Can Time-Varying Currency Risk Hedging Explain Exchange Rates?

Leonie Bräuer and Harald Hau

University of Geneva and SFI

12^{th} Workshop on Exchange Rates at BIS, 2022

Motivation: Liao Zhang (2021)

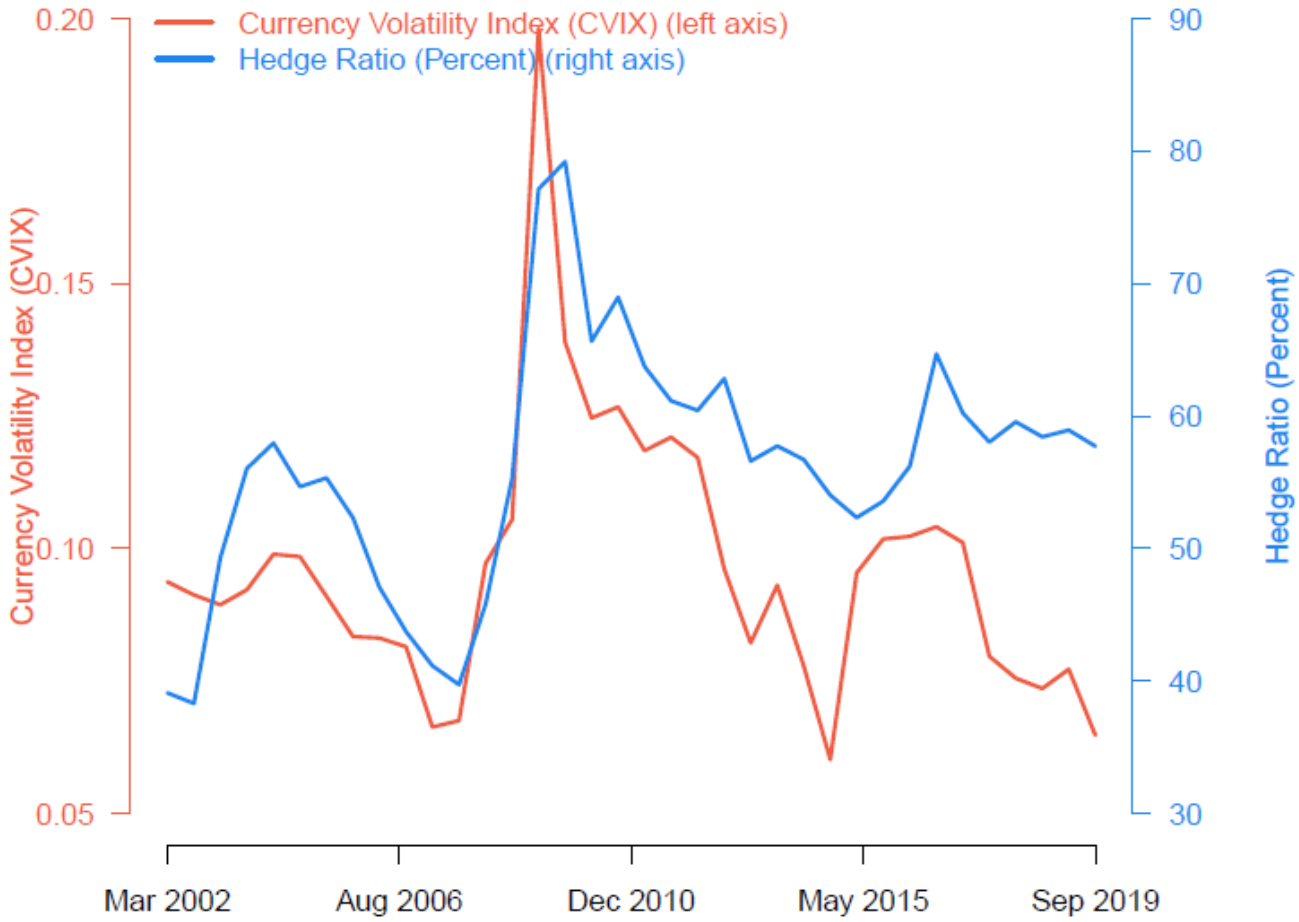


Figure 1: Currency volatility index (left axis) and hedge ratios of nine Japanese insurers (right axis). Source: Liao and Zhang (2021).

Motivation: Increasingly negative US Net Bond Positions

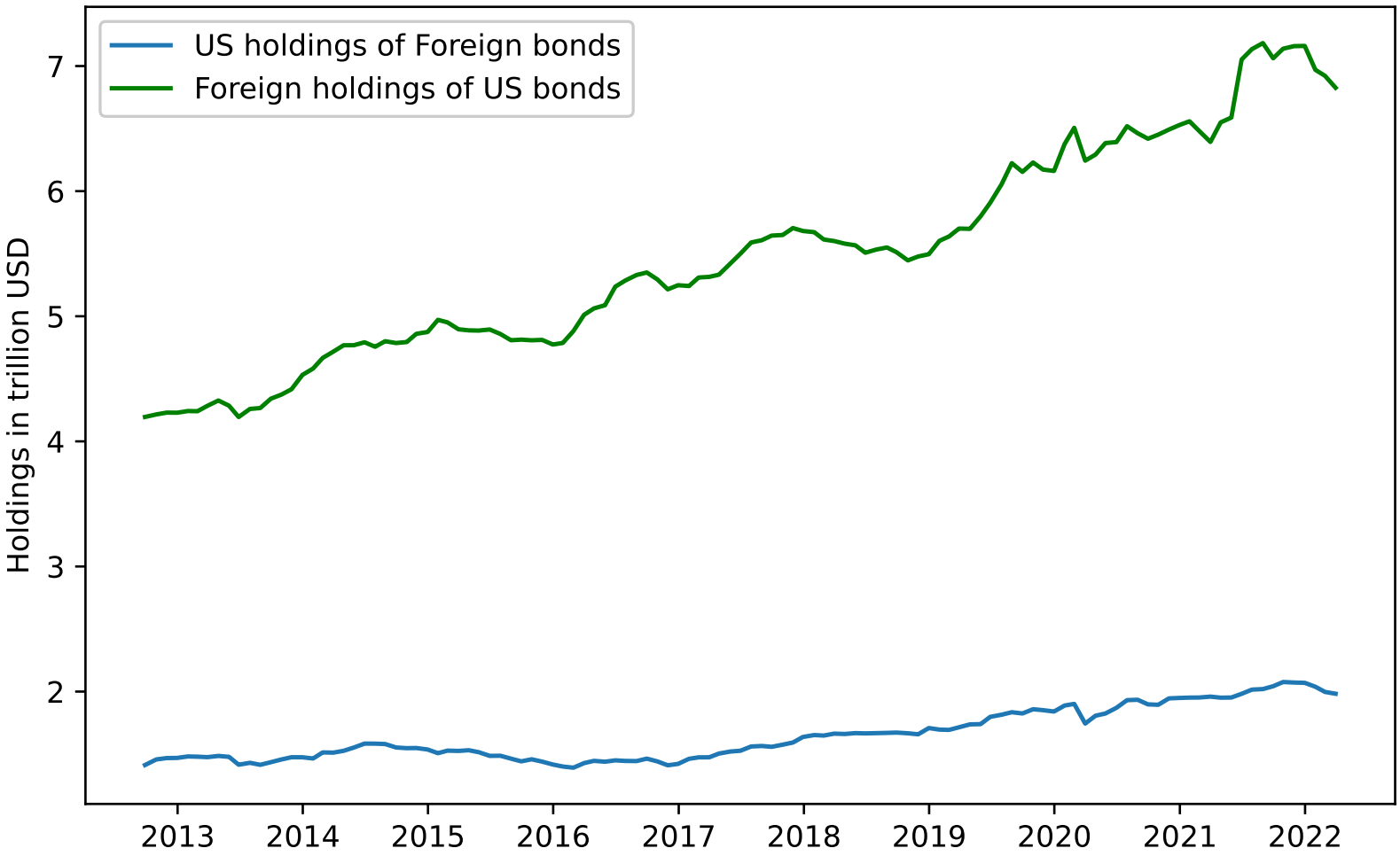


Figure 2: Bond holdings of US and foreign residents. Foreign countries are a sample of 7 countries used in our paper. Source: US Treasury TIC.

Research Questions

1. What drives the **net hedging demand** of funds in forward markets?
2. Do time-varying hedging demands influence the **short-run dynamics** of the **forward and spot rate**? What about **long-run dynamics** of the exchange rate?
3. What overall **variation of the monthly dollar exchange rate** can this hedging demand account for?

Findings

1. Uncertainty, NIP in bonds and their interaction are significant drivers of hedging pressure.

2. Strong explanatory power of hedging pressure changes for exchange rates at daily, weekly, monthly, and quarterly frequency.

3. Contemporaneous components of hedging pressure account for **23%** of all exchange rate variation.

Related Literature

- **FX Nihilism:** Exchange rate disconnect puzzle (Meese and Rogoff (1983); Rogoff (1996); Froot and Rogoff (1995); Frankel and Rose (1995); Rogoff (1996); Obstfeld and Rogoff (2000))
- **Inelastic Currency Supply by Banks:** International capital flows (in bonds or EQty) impact exchange rates (Froot and Ramadorai (2005); Gabaix and Maggiori (2015); Hau and Rey (2006); Camanho, Hau, and Rey (2022); Koijen and Yogo (2020); Adrian and Xie (2020); Lilley et al. (2022))
- **Microstructure Explanations:** FX order flow depends on order submission strategies (Evans and Lyons (2002); Ranaldo and Somogyi (2021); Cenedese, Della Corte, and Wang (2021); Syrstad and Viswanath-Natraj (2022))
- **USD Currency Dominance:** US dollar as a special currency in the international financial system (Gourinchas and Rey (2007); Stein (2018); Jiang, Krishnamurthy, and Lustig (2021))

Data

- Outstanding interest in FX derivatives from CLS

$$\text{HP}_{c,t} = \frac{\textit{Dollar Short Positions}^{\textit{Fund}}_{c,t} - \textit{Dollar Long Positions}^{\textit{Fund}}_{c,t}}{\frac{1}{4}\sum_{i=0,1,2,3} \textit{Outstanding Interest}^{\textit{Market}}_{c,t-i}} \times 100$$

- International bond holdings from U.S. Treasury (TIC)

$$\text{NIP}_{c,t} = \frac{\textit{Foreign Positions in US Bonds}_{c,t} - \textit{US Positions in Foreign Bonds}_{c,t}}{\textit{Foreign Positions in US Bonds}_{c,t} + \textit{US Positions in Foreign Bonds}_{c,t}} \times 100$$

- FX prices, government yields and VIX from Bloomberg

Sample: seven most liquid currencies (EUR, GBP, JPY, CHF, CAD, AUD and NZD) against USD over the period **09/2012 until 03/2022**.

Hedging Pressure and NIP

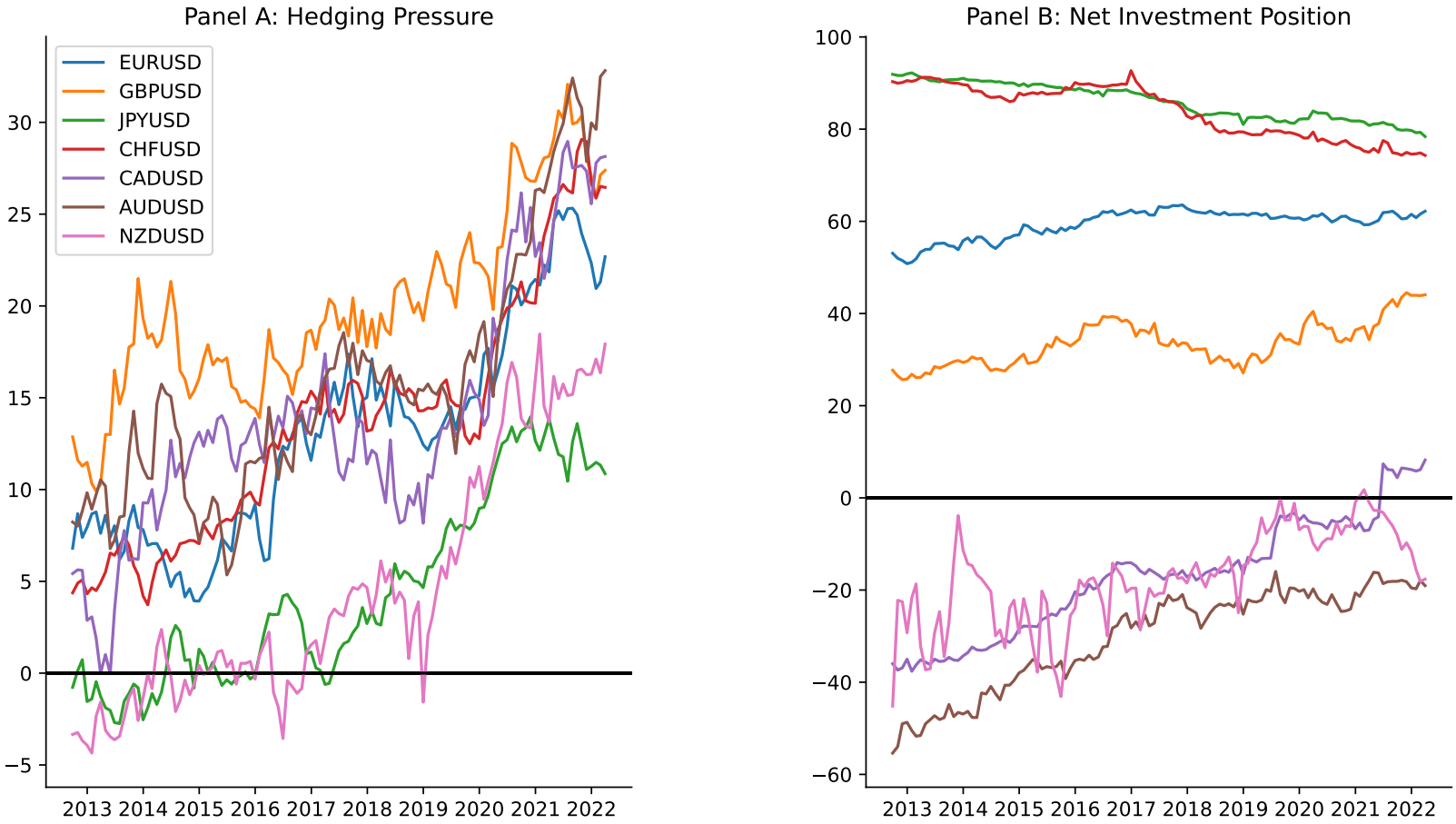


Figure 3: We plot hedging pressure (Panel A), and net investment positions (Panel B).

Determinants of Hedging Pressure

$$\Delta HP_{c,t} = \alpha_c + \beta_1 \Delta NIP_{c,t} + \beta_2 \Delta VIX_t + \beta_3 \Delta(NIP_{c,t} \times VIX_t) + \beta_4 ECT_{c,t-1} + \epsilon_{c,t},$$

where

- $\Delta HP_{c,t}$ are changes in the monthly (net) hedging pressure
- $\Delta NIP_{c,t}$ are changes in the US foreign net bond position
- ΔVIX_t are changes in the Chicago Board Options Exchange's Volatility Index
- $ECT_{c,t-1}$ denotes the error correction term.

Determinants of Hedging Pressure

Dep. variables:	$HP_{c,t}$			$\Delta HP_{c,t}$	
	(1)	(2)	(3)	(4)	(5)
$NIP_{c,t}$	0.3237***		0.2702***		
	(0.1240)		(0.1008)		
VIX_t		0.3653***	0.2466***		
		(0.0827)	(0.0903)		
$NIP_{c,t} \times VIX_t$			0.2078***		
			(0.0538)		
$\Delta NIP_{c,t}$				−0.0081	−0.0191
				(0.0185)	(0.0186)
ΔVIX_t					−0.0394***
					(0.0118)
$\Delta(NIP_{c,t} \times VIX_t)$					0.0603***
					(0.0132)
Error correction term					
$HP_{c,t-1} - \hat{\beta}_1 NIP_{c,t-1} - \hat{\beta}_2 VIX_{t-1} - \hat{\beta}_3 (NIP_{c,t-1} \times VIX_{t-1})$				−0.0321***	−0.0297***
				(0.0119)	(0.0634)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.1821	0.1622	0.3088	0.0173	0.0397
Observations	805	805	805	798	798

Determinants of Hedging Pressure

Dep. variables:	$HP_{c,t}$			$\Delta HP_{c,t}$	
	(1)	(2)	(3)	(4)	(5)
$NIP_{c,t}$	0.3237***		0.2702***		
	(0.1240)		(0.1008)		
VIX_t		0.3653***	0.2466***		
		(0.0827)	(0.0903)		
$NIP_{c,t} \times VIX_t$			0.2078***		
			(0.0538)		
$\Delta NIP_{c,t}$				−0.0081	−0.0191
				(0.0185)	(0.0186)
ΔVIX_t					−0.0394***
					(0.0118)
$\Delta(NIP_{c,t} \times VIX_t)$					
Error correction term $HP_{c,t-1} - \hat{\beta}_1 NIP_{c,t-1} - \hat{\beta}_2 VIX_{t-1} - \hat{\beta}_3 (NIP_{c,t-1} \times VIX_{t-1})$					
Currency FEs	Yes	Yes	Yes		
Adjusted R^2	0.1821	0.1622	0.3088	0.0173	0.0397
Observations	805	805	805	798	798

Residuals from level regression are stationary:

$$HP^{EQ} = \beta_1 NIP^{EQ} - \beta_2 VIX^{EQ} - \beta_3 (NIP \times VIX)^{EQ}$$

Determinants of Hedging Pressure

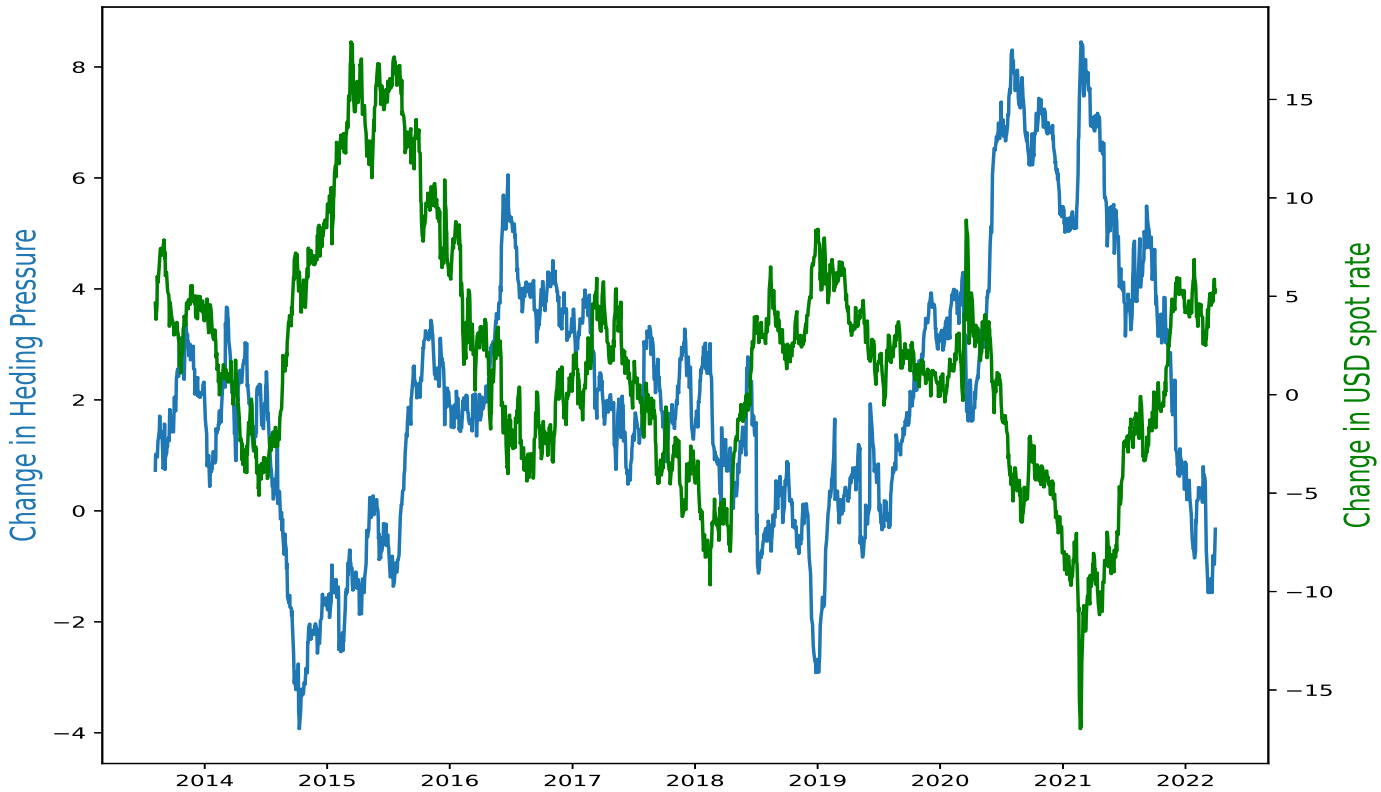
Dep. variables:	$HP_{c,t}$			$\Delta HP_{c,t}$	
	(1)	(2)	(3)	(4)	(5)
$NIP_{c,t}$	0.3237***		0.2702***		
	(0.1240)		(0.1008)		
VIX_t		0.3653***	0.2466***		
		(0.0827)	(0.0903)		
$NIP_{c,t} \times VIX_t$			0.2078***		
			(0.0538)		
$\Delta NIP_{c,t}$				−0.0081	−0.0191
				(0.0185)	(0.0186)
ΔVIX_t					−0.0394***
					(0.0118)
$\Delta(NIP_{c,t} \times VIX_t)$					0.0603***
					(0.0132)
Error correction term					
$HP_{c,t-1} - \hat{\beta}_1 NIP_{c,t-1} - \hat{\beta}_2 VIX_{t-1} - \hat{\beta}_3 (NIP_{c,t-1} \times VIX_{t-1})$				−0.0321***	−0.0297***
				(0.0119)	(0.0634)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.1821	0.1622	0.3088	0.0173	0.0397
Observations	805	805	805	798	798

Determinants of Hedging Pressure

Dep. variables:	$HP_{c,t}$			$\Delta HP_{c,t}$	
	(1)	(2)	(3)	(4)	(5)
$NIP_{c,t}$	0.3237^{***}		0.2702^{***}		
	(0.1240)		(0.1008)		
VIX_t		0.3653^{***}	0.2466^{***}		
		(0.0827)	(0.0903)		
$NIP_{c,t} \times VIX_t$			0.2078^{***}		
			(0.0538)		
$\Delta NIP_{c,t}$				-0.0081	-0.0191
				(0.0185)	(0.0186)
ΔVIX_t					-0.0394^{***}
					(0.0118)
$\Delta(NIP_{c,t} \times VIX_t)$					0.0603^{***}
					(0.0132)
Error correction term					
$HP_{c,t-1} - \hat{\beta}_1 NIP_{c,t-1} - \hat{\beta}_2 VIX_{t-1} - \hat{\beta}_3 (NIP_{c,t-1} \times VIX_{t-1})$				-0.0321^{***}	-0.0297^{***}
				(0.0119)	(0.0634)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.1821	0.1622	0.3088	0.0173	0.0397
Observations	805	805	805	798	798

$$\Delta HP_{c,t} = \widehat{\Delta HP_{c,t}}^{\Delta VIX} + \widehat{\Delta HP_{c,t}}^{\Delta(NIP \times VIX)} + \widehat{\Delta HP_{c,t}}^{ECT} + \Delta HP_{c,t}^{Residual}$$

Hedging Pressure and the Dollar Exchange Rate



$$corr(\Delta s_t, \Delta HP_t) = -\mathbf{0.66}$$

Figure 4: Annual change in the hedging pressure emanating from forward contracts of funds and the annual change in the (log) US dollar spot exchange rates. Both measures are computed as the cross-sectional average over all G7 currencies.

Explaining Exchange Rates

$$\Delta s_{c,t} = \alpha_c + \gamma_t + \beta_1 \Delta HP_{c,t} + \beta_2 \Delta (y^*_{c,t} - y^{\$}_{c,t}) + \beta_3 \Delta Basis_{c,t} + \beta_4 ECT_{c,t-1} + \epsilon_{c,t}$$

where

- $\Delta s_{c,t}$ are monthly log spot rate changes denoted as foreign currency per USD
- $\Delta HP_{c,t}$ are changes in (net) hedging pressure
- $\Delta(y^*_{c,t} - y^{\$}_{c,t})$ are monthly changes in the spread of the two-year foreign treasury yield minus the two-year US treasury yield
- $\Delta Basis_{c,t}$ are monthly changes in the treasury basis[1]
- $ECT_{c,t-1}$ denotes the error correction term

[1] Where $Basis_{c,t} = y^{\$}_{c,t} - y^*_{c,t} + (f_{c,t} - s_{c,t})$, see Du, Im, and Schreger (2018) and Jiang, Krishnamurthy, and Lustig (2021).

Explaining Exchange Rates

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	-0.5198^{***}	-0.5078^{***}	-0.4507^{***}	-0.3148^{***}	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}_{c,t}^{\Delta VIX}$					-3.4851^{***}
					(1.1299)
$\widehat{\Delta HP}_{c,t}^{\Delta(NIP \times VIX)}$					-4.0312^{***}
					(1.4498)
$\widehat{\Delta HP}_{c,t}^{ECT}$					3.3710^{***}
					(1.1719)
$\Delta HP_{c,t}^{Residual}$					-0.4302^{***}
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		-0.0363^{**}	-0.0362^{**}	-0.0622^{***}	-0.0435^{***}
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		-0.0023	-0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			-0.0669^{***}	-0.0722^{***}	-0.0753^{***}
			(0.0179)	(0.0172)	(0.0185)
Currency FEs Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

Explaining Exchange Rates

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}^{\Delta VIX}_{c,t}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}^{\Delta(NIP\times VIX)}_{c,t}$					−4.0312***
					(1.4498)
$\widehat{\Delta HP}^{ECT}_{c,t}$					3.3710***
					(1.1719)
$\Delta HP^{Residual}_{c,t}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
m Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

A one S.D. increase in ΔHP depreciates spot rate by 0.63%.

Explaining Exchange Rates

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	-0.5198^{***}	-0.5078^{***}	-0.4507^{***}	-0.3148^{***}	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}^{\Delta VIX}_{c,t}$					-3.4851^{***}
					(1.1299)
$\widehat{\Delta HP}^{\Delta(NIP \times VIX)}_{c,t}$					$m12^{***}$
					(1.4498)
$\widehat{\Delta HP}^{ECT}_{c,t}$					3.3710^{***}
					(1.1719)
$\Delta HP^{Residual}_{c,t}$					-0.4302^{***}
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		-0.0363^{**}	-0.0362^{**}	-0.0622^{***}	-0.0435^{***}
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		-0.0023	-0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			-0.0669^{***}	-0.0722^{***}	-0.0753^{***}
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

$\Delta HP_{c,t}$ still significant with Time FEs.

Explaining Exchange Rates

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}^{\Delta VIX}_{c,t}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}^{\Delta(NIP\times VIX)}_{c,t}$					$m12^{***}$
					(1.4498)
$\widehat{\Delta HP}^{ECT}_{c,t}$					3.3710***
					(1.1719)
$\Delta HP^{Residual}_{c,t}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

ECT is highly significant.

$$s^{EQ} = \beta_1 HP^{EQ} - \beta_2(y^* - y^{\$})^{EQ}$$

Decomposing Hedging Pressure

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}_{c,t}^{\Delta VIX}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}_{c,t}^{\Delta(NIP \times VIX)}$					−4.0312***
					(1.4498)
$\widehat{\Delta HP}_{c,t}^{ECT}$					3.3710***
					(1.1719)
$\Delta HP_{c,t}^{Residual}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

where $\Delta HP_{c,t} = \widehat{\Delta HP}_{c,t}^{\Delta VIX} + \widehat{\Delta HP}_{c,t}^{\Delta(NIP \times VIX)} + \widehat{\Delta HP}_{c,t}^{ECT} + \Delta HP_{c,t}^{Residual}$

A one S.D. increase in $\widehat{\Delta HP}_{c,t}^{\Delta VIX}$ depreciates spot rate by 0.76%.

Decomposing Hedging Pressure

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}_{c,t}^{\Delta VIX}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}_{c,t}^{\Delta(NIP\times VIX)}$					−4.0312***
					(1.4498)
$\widehat{\Delta HP}_{c,t}^{ECT}$					3.3710***
					(1.1719)
$\Delta HP_{c,t}^{Residual}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

where $\Delta HP_{c,t} = \widehat{\Delta HP}_{c,t}^{\Delta VIX} + \widehat{\Delta HP}_{c,t}^{\Delta(NIP\times VIX)} + \widehat{\Delta HP}_{c,t}^{ECT} + \Delta HP_{c,t}^{Residual}$

Long-run EQlibrium between *NIP* (bond flows into US) and *HP* appreciate the spot.

Decomposing Hedging Pressure

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}_{c,t}^{\Delta VIX}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}_{c,t}^{\Delta(NIP\times VIX)}$					−4.0312***
					(1.4498)
$\widehat{\Delta HP}_{c,t}^{ECT}$					3.3710***
					(1.1719)
$\Delta HP_{c,t}^{Residual}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

where $\Delta HP_{c,t} = \widehat{\Delta HP}_{c,t}^{\Delta VIX} + \widehat{\Delta HP}_{c,t}^{\Delta(NIP\times VIX)} + \widehat{\Delta HP}_{c,t}^{ECT} + \Delta HP_{c,t}^{Residual}$

Short-run dynamics

Long-run dynamics

Decomposing Hedging Pressure

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$				
	(1)	(2)	(3)	(4)	(5)
$\Delta HP_{c,t}$	−0.5198***	−0.5078***	−0.4507***	−0.3148***	
	(0.1799)	(0.1691)	(0.1592)	(0.0784)	
$\widehat{\Delta HP}_{c,t}^{\Delta VIX}$					−3.4851***
					(1.1299)
$\widehat{\Delta HP}_{c,t}^{\Delta(NIP \times VIX)}$					−4.0312***
					(1.4498)
$\widehat{\Delta HP}_{c,t}^{ECT}$					3.3710***
					(1.1719)
$\Delta HP_{c,t}^{Residual}$					−0.4302***
					(0.1474)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$		−0.0363**	−0.0362**	−0.0622***	−0.0435***
		(0.0151)	(0.0153)	(0.0117)	(0.0118)
$\Delta Basis_{c,t}$		−0.0023	−0.0027	0.0068	0.0101
		(0.0129)	(0.0140)	(0.0240)	(0.0138)
Error Correction Term					
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$			−0.0669***	−0.0722***	−0.0753***
			(0.0179)	(0.0172)	(0.0185)
Currency FEs	Yes	Yes	Yes	Yes	Yes
Time FEs	No	No	No	Yes	No
Adjusted R^2	0.0696	0.1134	0.1479	0.1809	0.2306
Observations	798	714	714	714	714

where $\Delta HP_{c,t} = \widehat{\Delta HP}_{c,t}^{\Delta VIX} + \widehat{\Delta HP}_{c,t}^{\Delta(NIP \times VIX)} + \widehat{\Delta HP}_{c,t}^{ECT} + \Delta HP_{c,t}^{Residual}$

Contemporaneous components of *HP* account for 23% of spot rate variations.

Conclusion

Long-run dynamics in the last decade:

1. more and more bond flows into the US: $NIP \uparrow$
2. funds accumulate dollar short positions in the forward market: $HP \uparrow$
3. appreciation of the dollar: $s \uparrow$

➡ Existence of a long-run equilibrium relationship: $s \propto HP \propto NIP$.

Short-run dynamics along long-run trends:

1. more hedging demand depreciates dollar rates $s \downarrow$ and $f \downarrow$
2. volatility shocks $VIX \uparrow$: demand increases and supply contracts: stronger effect $s \downarrow\downarrow$ and $f \downarrow\downarrow$

➡ Time-varying hedging demand is a driver of short-run dollar changes.

References I

[1] Tobias Adrian and Peichu Xie. "The Non-US Bank Demand for US Dollar Assets". In: *International Monetary Fund Working Paper* (2020).

[2] Nelson Camanho, Harald Hau, and Helene Rey. "Global portfolio rebalancing under the microscope". In: *Review of Financial Studies, forthcoming* (2022).

[3] Gino Cenedese, Pasquale Della Corte, and Tianyu Wang. "Currency mispricing and dealer balance sheets". In: *The Journal of Finance* 76.6 (2021), pp. 2763–2803.

[4] Wenxin Du, Joanne Im, and Jesse Schreger. "The us treasury premium". In: *Journal of International Economics* 112 (2018), pp. 167–181.

[5] Martin DD Evans and Richard K Lyons. "Order flow and exchange rate dynamics". In: *Journal of political economy* 110.1 (2002), pp. 170–180.

[6] Jeffrey A Frankel and Andrew K Rose. "Empirical research on nominal exchange rates". In: *Handbook of international economics* 3 (1995), pp. 1689–1729.

[7] Kenneth A Froot and Tarun Ramadorai. "Currency returns, intrinsic value, and institutional-investor flows". In: *The Journal of Finance* 60.3 (2005), pp. 1535–1566.

[8] Kenneth A Froot and Kenneth Rogoff. "Perspectives on PPP and long-run real exchange rates". In: *Handbook of international economics* 3 (1995), pp. 1647–1688.

[9] Xavier Gabaix and Matteo Maggiori. "International liquidity and exchange rate dynamics". In: *The Quarterly Journal of Economics* 130.3 (2015), pp. 1369–1420.

References II

[10] Pierre-Olivier Gourinchas and Helene Rey. "International financial adjustment". In: *Journal of political economy* 115.4 (2007), pp. 665–703.

[11] Harald Hau and Helene Rey. "Exchange rates, equity prices, and capital flows". In: *The Review of Financial Studies* 19.1 (2006), pp. 273–317.

[12] Zhengyang Jiang, Arvind Krishnamurthy, and Hanno Lustig. "Foreign safe asset demand and the dollar exchange rate". In: *The Journal of Finance* 76.3 (2021), pp. 1049–1089.

[13] Ralph SJ Koijen and Motohiro Yogo. *Exchange rates and asset prices in a global demand system*. Tech. rep. National Bureau of Economic Research, 2020.

[14] Gordon Liao and Tony Zhang. "The hedging channel of exchange rate determination". In: *International finance discussion paper 1283* (2021).

[15] Andrew Lilley et al. "Exchange rate reconnect". In: *Review of Economics and Statistics* 104.4 (2022), pp. 845–855.

[16] Maurice Obstfeld and Kenneth Rogoff. "The six major puzzles in international macroeconomics: is there a common cause?" In: *NBER macroeconomics annual* 15 (2000), pp. 339–390.

[17] Angelo Ranaldo and Fabricius Somogyi. "Asymmetric information risk in FX markets". In: *Journal of Financial Economics* 140.2 (2021), pp. 391–411.

References III

[18] Kenneth Rogoff. "The purchasing power parity puzzle". In: *Journal of Economic literature* 34.2 (1996), pp. 647–668.

[19] Jeremy C Stein. "Banking, Trade, and the Making of a Dominant Currency". In: *NBER Working Paper* 24485 (2018).

[20] Olav Syrstad and Ganesh Viswanath-Natraj. "Price-setting in the foreign exchange swap market: Evidence from order flow". In: *Journal of Financial Economics* 146.1 (2022), pp. 119–142.

Appendix

Outstanding FX positions by Funds

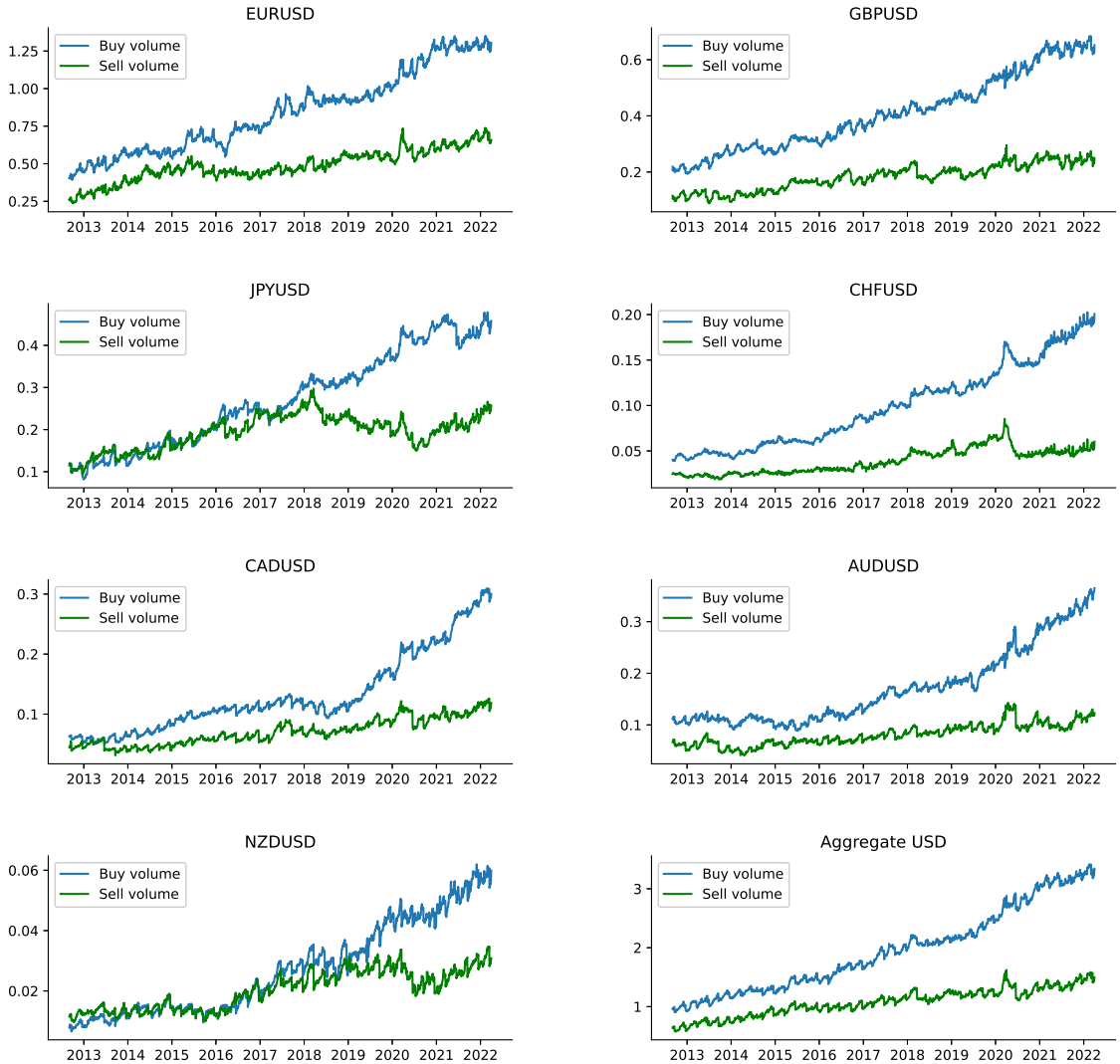


Figure 5: Buy and Sell volume of FX Forwards of Funds in trillion USD. Source: CLS.

Hedging Pressure by Market Participants

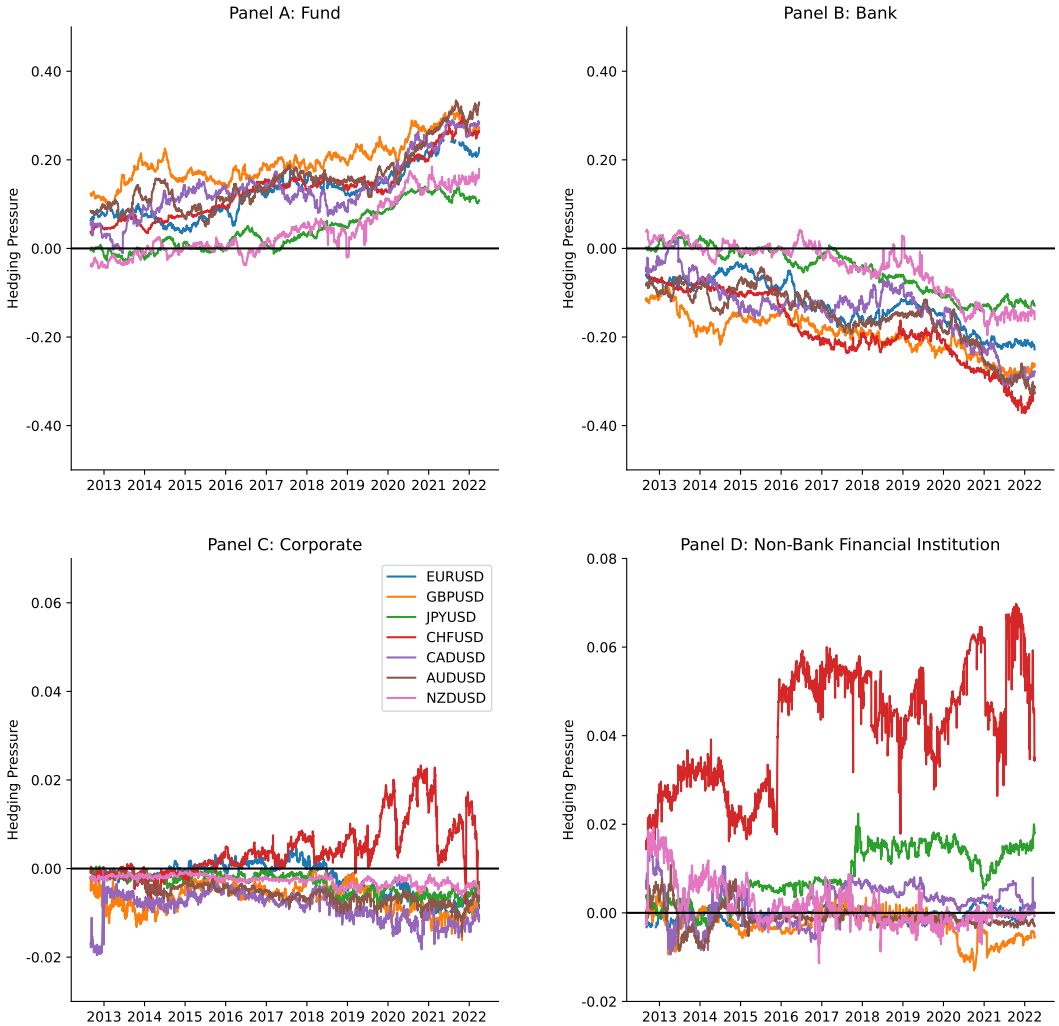


Figure 6: Hedging pressure by investor. Source: CLS.

US Bond Holdings of NBFI in the Euro Area

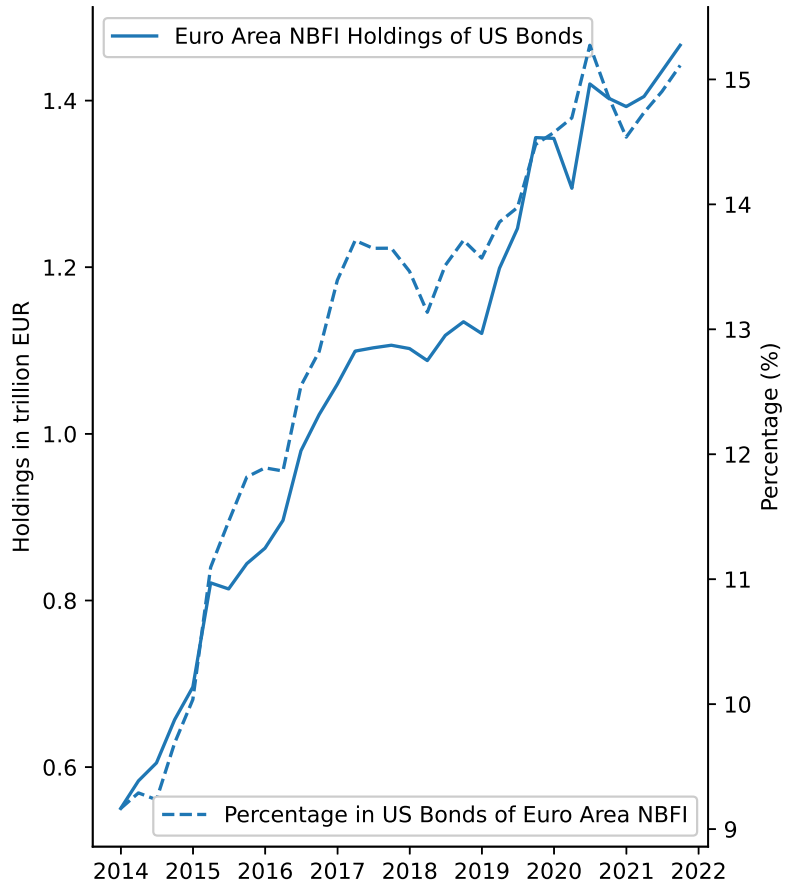


Figure 7: We plot bond holdings in trillion EUR (left axis), and percentage of US bonds in the overall bond portfolio (right axis and dashed line). Source: ECB.

International Bond Holdings

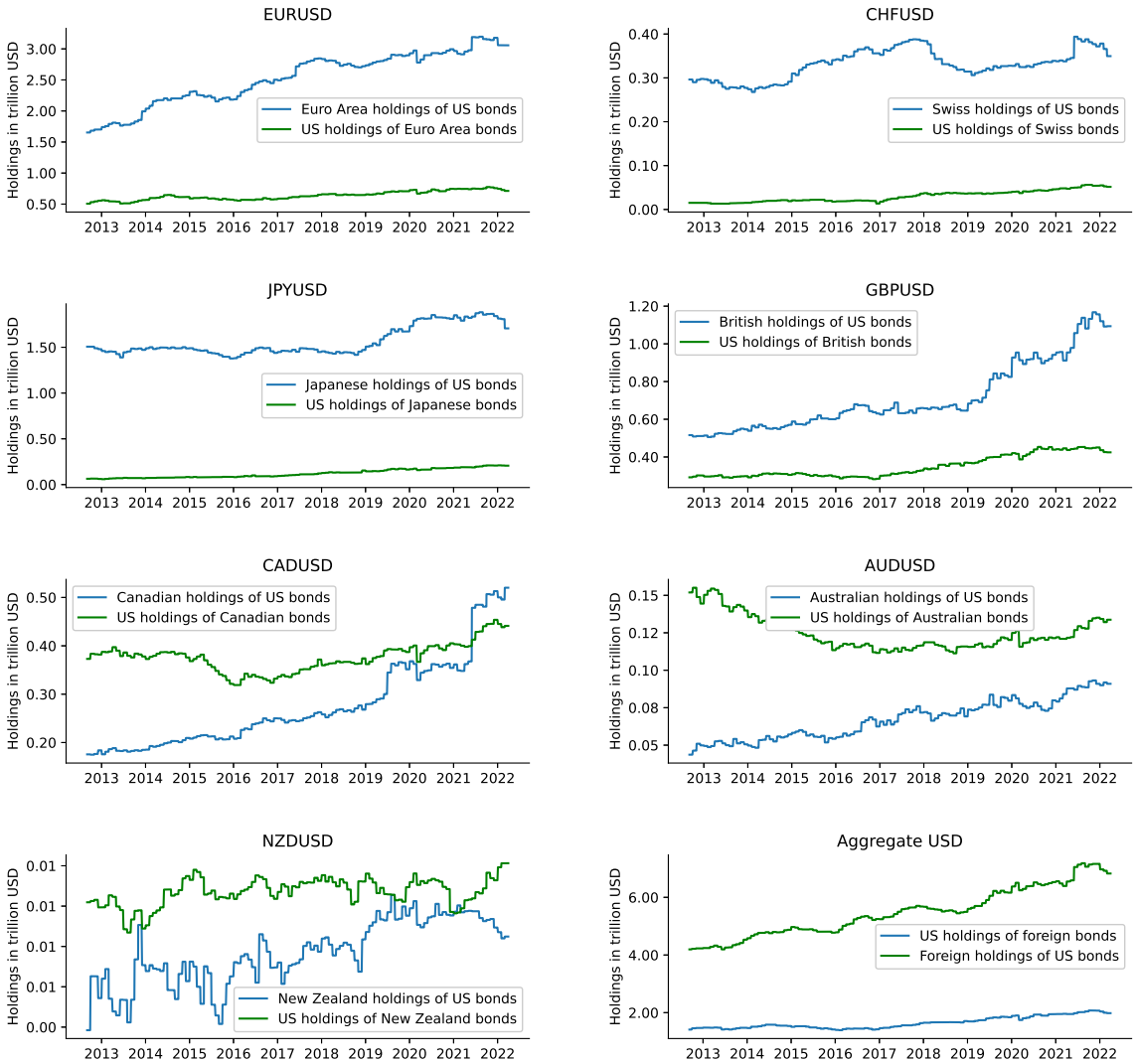


Figure 8: Buy and Sell volume of FX Forwards of Funds in trillion USD. Source: CLS.

Summary Statistics

	Obs.	Mean	S.D.	Median	P25	P75	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Level variables								
$s_{c,t}$	805	70.37	164.35	15.51	−11.43	34.09	−53.68	482.15
$f_{c,t}$	805	70.28	164.29	16.14	−11.67	34.20	−53.61	482.03
$(y^*_{c,t} - y^{\$}_{c,t})$	805	−0.40	1.32	−0.35	−1.08	0.15	−3.60	2.92
$Basis_{c,t}$	721	−5.24	27.99	1.31	−24.97	13.48	−88.77	60.01
$HP_{c,t}$	805	12.20	8.13	12.77	6.19	16.83	−4.35	32.82
$NIP_{c,t}$	805	28.27	47.02	33.36	−18.15	78.76	−55.38	92.70
VIX_t	805	17.58	6.76	15.87	13.41	19.20	9.51	53.54
$NIP_{c,t} \times VIX_t$	805	5.05	8.78	4.96	−2.78	11.91	−10.98	44.95
Monthly differences								
$\Delta s_{c,t}$	798	0.19	2.46	0.17	−1.33	1.79	−7.74	9.13
$\Delta f_{c,t}$	798	0.19	2.46	0.16	−1.32	1.77	−7.98	9.04
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$	798	−1.61	15.44	−1.70	−9.78	4.92	−91.12	91.10
$\Delta Basis_{c,t}$	714	−0.03	6.28	0.10	−3.87	3.81	−28.50	27.69
$\Delta HP_{c,t}$	798	0.17	1.25	0.16	−0.59	0.92	−5.47	5.31
$\Delta NIP_{c,t}$	798	0.13	2.40	−0.00	−0.53	0.66	−13.48	22.96
ΔVIX_t	798	0.04	5.55	−0.09	−2.74	2.15	−19.39	21.27
$\Delta(NIP_{c,t} \times VIX_t)$	798	0.03	3.00	0.02	−0.86	0.98	−16.43	17.49
Fitted values								
$\widehat{\Delta HP}^{\Delta VIX}_{c,t}$	798	−0.00	0.22	0.00	−0.08	0.11	−0.84	0.76
$\widehat{\Delta HP}^{\Delta(NIP \times VIX)}_{c,t}$	798	0.00	0.18	0.00	−0.05	0.06	−0.99	1.05
$\widehat{\Delta HP}^{ECT}_{c,t}$	798	0.00	0.15	0.01	−0.09	0.10	−0.56	0.42
$\Delta HP^{Residual}_{c,t}$	798	0.16	1.22	0.14	−0.57	0.90	−5.18	5.62

Explaining Exchange Rates at Different Frequencies

Dep. variable:	Spot Rate Changes, $\Delta s_{c,t}$			
	Daily	Weekly	Monthly	Quarterly
	(1)	(2)	(3)	(4)
$\Delta HP_{c,t}$	-0.2368^{***}	-0.3293^{***}	-0.2969^{***}	-0.3812^{***}
	(0.0765)	(0.1101)	(0.0853)	(0.1450)
$\Delta HP_{c,t-1}$	0.0160	-0.0210	-0.0218	0.0481
	(0.0170)	(0.0439)	(0.0619)	(0.0443)
$\Delta(y^*_{c,t} - y^{\$}_{c,t})$	-0.0412^{***}	-0.0046	-0.0620^{***}	-0.0231
	(0.0139)	(0.0040)	(0.0119)	(0.0242)
$\Delta(y^*_{c,t-1} - y^{\$}_{c,t-1})$	-0.0035	0.0170	0.0016	-0.0081^{**}
	(0.0026)	(0.0047)	(0.0094)	(0.0040)
$\Delta Basis_{c,t}$	-0.0217^{**}	-1.1768	0.0067	0.0189
	(0.0093)	(1.2467)	(0.0243)	(0.0324)
Error correction term				
$s_{c,t-1} - \hat{\beta}_1 HP_{c,t-1} - \hat{\beta}_2(y^*_{c,t-1} - y^{\$}_{c,t-1})$	-0.0040^{***}	-0.0171^{***}	-0.0721^{***}	0.0024
	(0.0013)	(0.0043)	(0.0175)	(0.0126)
Currency FEs	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes
Adjusted R^2	0.0741	0.0505	0.1760	0.0691
Observations	12595	3072	707	2163

Forecasting the EURUSD Exchange Rate

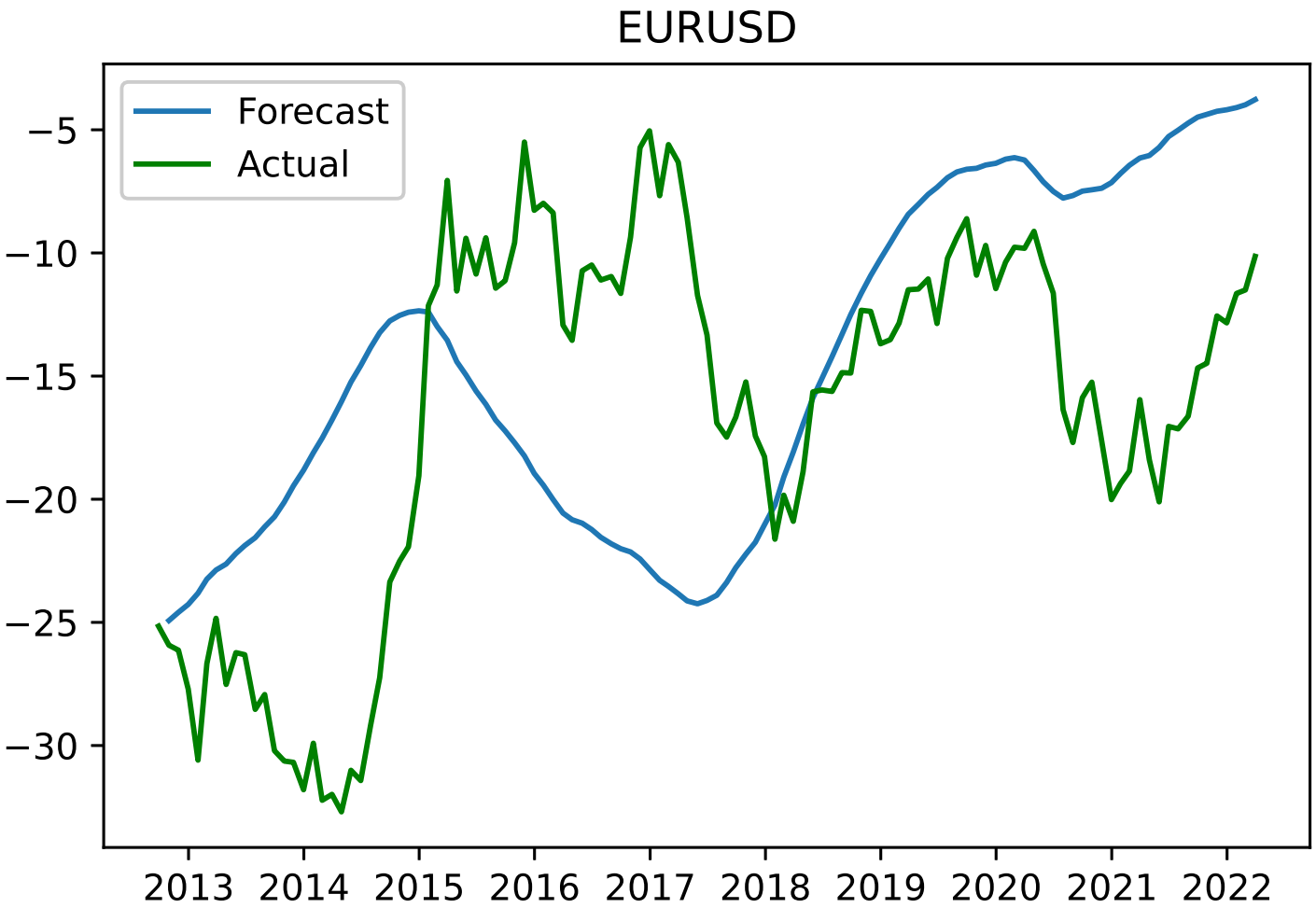


Figure 9: Dynamic forecast based on error correction model. Specifically, the next month's spot rate is calculated as $s_{t+1} = s_t + \widehat{\alpha}(s_t - \widehat{\beta_1} HP_t - \widehat{\beta_2}(y_t^* - y_t^{\$}))$.