A Model of U.S. Monetary Policy and the Global Financial Cycle*

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Abstract

We propose a general equilibrium model in which U.S. monetary policy affects global risk premia by revaluing the wealth of currency-mismatched intermediaries. Assuming their portfolios are mean-variance efficient, intermediaries must be short the dollar. A U.S. tightening thus erodes intermediaries' net worth and raises the global price of risk. We discipline this mechanism to rationalize the effects of U.S. monetary policy on international asset prices, and we study its real implications. In a future with higher dollar interest rates, as due to lower foreign demand for dollar-denominated assets, intermediaries' dollar funding and U.S. monetary policy spillovers are dampened.

JEL codes: E44, E52, F31, G15

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1 Introduction

Over the past decade, a growing body of evidence has documented that changes in U.S. monetary policy have large effects on risky asset prices in the rest of the world. The resulting "global financial cycle", with U.S. monetary policy at its center, has attracted an enormous amount of academic and policy attention. Yet important questions remain: what makes U.S. monetary policy special? What are the associated macroeconomic spillovers? How might changes in the economic environment affect these spillovers in the future? In this paper, we offer answers to these questions through the lens of a general equilibrium model that can capture the observed effects of U.S. monetary policy on global risk pricing.

We augment a canonical New Keynesian open economy model with global intermediaries who facilitate international capital flows and price assets around the world. The key mechanism is that when intermediaries are short the dollar, a U.S. monetary policy tightening that appreciates the dollar thus erodes intermediaries' net worth and raises the global price of risk. Consistent with this mechanism, the exchange rate and global bond yield effects of identified U.S. monetary surprises line up with average excess currency and bond returns in the data. Furthermore, observed asset prices imply that intermediaries must indeed be short the dollar on average, assuming their portfolios are mean-variance efficient. We estimate their required leverage in non-dollar currencies to rationalize the observed effects of U.S. monetary policy shocks on the cross-section of international asset prices, and we quantify the implications for global economic activity. We then consider the possibility that dollar interest rates may rise in the future. In such an environment, intermediaries take smaller funding positions in dollars and U.S. monetary policy has smaller spillovers through risk premia in the rest of the world. The dynamics of asset prices in 2025 are consistent with a fall in foreign demand for dollar-denominated assets, and may be one reason why dollar interest rates are higher in the future than they have been in the past.

We study a multi-country New Keynesian open economy environment with global intermediaries facilitating international capital flows. Households in each country supply labor used to produce differentiated final goods sold globally. Firms adjust prices in each destination market subject to adjustment costs, so monetary policy is non-neutral. Monetary policy is characterized by standard policy rules in each country, with an additive shock in the U.S. that is of primary interest. The key

distinction relative to workhorse New Keynesian models is in the structure of financial markets. Households can only trade a local currency one-period bond freely, and face adjustment costs in trading all other assets. Global intermediaries are a subset of agents that can trade all assets freely and enforce no arbitrage. They maximize mean-variance preferences over wealth in the next period, and their effective risk aversion is declining in current wealth. We solve this model using a perturbation approach in which risk premia do not disappear, are time-varying, and affect allocations to first-order. We focus on trade in one-period bonds and geometrically decaying consols, so the relevant risk premia are currency and bond risk premia.

The propagation of a U.S. monetary policy shock in this model differs from standard New Keynesian models because it affects global risk pricing. We can analytically characterize the relevant mechanisms by focusing on the effects on exchange rates in the useful limiting case of fully sticky prices. Absent any change in risk pricing, a U.S. monetary tightening appreciates the dollar versus all foreign currencies. There are two channels through which risk pricing can then change. First, if intermediaries are long foreign currencies entering the period, the dollar appreciation erodes their wealth and raises their price of bearing risk. This channel predicts that currencies offering high unconditional average excess returns ("risky" currencies) will depreciate by more. Second, if households' intertemporal elasticity of substitution (IES) differs from one, the U.S. tightening induces capital flows from households, which changes the quantity of exchange rate risk absorbed by intermediaries — the "portfolio balance" mechanism. If in particular there are capital inflows to the U.S. because households' IES is below one, this channel predicts that currencies whose dollar exchange rate covaries more with the average dollar exchange rate should depreciate by less. The model makes similar predictions for the effect of a U.S. tightening on global consol prices, which will reflect both a change in the price and quantity of risk. Anticipating our empirical finding that the portfolio balance mechanism does not well explain the observed asset price responses to U.S. monetary surprises, we focus on the first channel operating through intermediary wealth and the price of risk.

Observed international asset prices imply that intermediaries must indeed be long non-dollar currencies, assuming that their portfolios are mean-variance efficient. Under mean-variance efficiency, the first and second moments of asset prices are sufficient to characterize the signs and relative size of intermediaries' positions in each non-dollar currency. Intermediaries' risk aversion only pins down the overall lever-

age of their portfolio, not the sign of their non-dollar positions. Using interest rates and exchange rates for the nine other "G10" economies besides the U.S. and for 15 emerging markets over 1991-2024, we characterize the implied composition of mean-variance efficient portfolios. Focusing on trade in three-month and ten-year bonds, we find that a mean-variance efficient investor would be short G10 currencies, long emerging market currencies, and net long all non-dollar currencies in our sample. This conclusion holds in the case of an investor with unitary risk aversion, and in which the base currency of the investor is thus irrelevant for his portfolio.

The response of international asset prices to identified U.S. monetary surprises both validates and disciplines the model mechanism operating through the price of risk. Using high-frequency data, we first document that a surprise U.S. tightening is indeed associated with a larger depreciation among currencies paying high unconditional average excess returns ("risky" currencies), and a larger increase in yields among long-term bonds that pay high unconditional average excess returns ("risky" bonds). This cross-sectional relationship allows us to identify the risk aversion of intermediaries, which governs intermediaries' leverage in non-dollar bonds and thus their wealth revaluation upon a U.S. tightening. Our estimated risk aversion implies that non-dollar positions are roughly 30 times intermediaries' average wealth. We also demonstrate that in the data, a surprise Euro area policy tightening has effects on international asset prices that are more weakly related to average excess returns. The model rationalizes this (completely untargeted) feature of the data, owing to the dominant role of dollar funding on intermediary balance sheets.

We then use the model to study how the risk premium spillovers of U.S. monetary policy affect real activity, and how this depends on policy responses, in the rest of the world. The heterogeneous effects on exchange rates are mirrored in heterogeneous spillovers: emerging markets (which pay high interest rates) experience larger inflation, a larger increase in policy rates, and a larger reduction in consumption than other G10 economies (which pay low interest rates). In other words, the effects of U.S. monetary policy on risk pricing induces a relative "sudden stop" in high interest rate economies. Consistent with prior research on sudden stops, such economies can mitigate the reduction in consumption by employing a modified policy response that permits the local currency to depreciate by more, or by selling dollar bonds through foreign exchange intervention. A distinction relative to prior work is that the change in risk premia is endogenous in our model: while we have not yet conducted a formal

normative analysis, we expect that this will imply distinct gains from policy coordination than in previous models with exogenous risk premium shocks. In particular, countries do not internalize the cumulative effects of their policy actions on the broad dollar exchange rate and, in turn, the risk-bearing capacity of intermediaries.

Looking forward, the model implies that a future with higher dollar interest rates would feature dampened U.S. monetary policy spillovers through risk premia. Given a higher dollar interest rate and keeping all second moments unchanged, the mean-variance efficient portfolio features a smaller long position in non-dollar currencies. Quantitatively, a $0.5pp$ higher dollar interest rate (modeled as arising from lower U.S. household patience) reduces intermediaries' portfolio share in non-dollar bonds from roughly 30 times their wealth to 10 times their wealth. This counterfactual environment thus dampens the effect of U.S. monetary policy on emerging markets, given the smaller revaluation of intermediary wealth. The dampened effects on risk pricing are reflected in dampened real spillovers: in response to a U.S. tightening, these economies experience smaller domestic inflation and a smaller economic contraction.

Lower foreign demand for dollar-denominated assets may be one reason dollar interest rates may rise in the future. Our final analysis using the model departs from our maintained focus on U.S. monetary shocks and instead characterizes shocks to the position of non-U.S. households in dollar-denominated bonds. A negative innovation simultaneously implies a weaker dollar and higher dollar interest rate relative to foreign interest rates. We discipline the price impact of flows in the model using the evidence from quantitative easing (QE) announcements, and find that a reduction in foreign demand for dollar-denominated assets by roughly 5% of annual U.S. GDP can account for the dynamics of asset prices post "liberation day". This is only a fraction of the foreign-owned dollar bond portfolio from the national accounts. The more persistent is the reduction in dollar demand, the lower is the required reduction to rationalize the same asset price data. In this sense, a persistent rotation away from dollar-denominated assets in the rest of the world seems a plausible reason why U.S. interest rates may be higher in the future than they have been in the past.

Related literature Our analysis connects to a large body of empirical work documenting that U.S. monetary policy surprises have significant effects on risky asset prices in global financial markets. Researchers have demonstrated this in the context of a common global factor in these prices (e.g., Rey (2015) and Miranda-Agrippino

and Rey (2020)) as well as for individual asset classes, such as global equities (e.g., Boehm and Kroner (2025)), fixed income (e.g., Albagli, Ceballos, Claro, and Romero (2019), Gilchrist, Yue, and Zakrajsek (2019), and Kalemli-Ozcan (2020)), and currencies (e.g., Mueller, Tahbaz-Salehi, and Vedolin (2017)). Using portfolio data, Loualiche, Pecora, Somogyi, and Ward (2026) document that investment funds and global banks rebalance toward riskier currencies in response to a U.S. monetary easing. We contribute to this literature by providing an equilibrium account of the global risk premium effects of U.S. monetary policy, in which currency mismatch generates a link between the dollar exchange rate and the global price of risk.

Our focus on wealth revaluation arising from dollar movements builds on a literature studying balance sheet effects in open economies. The partial equilibrium models of Bruno and Shin (2015), Miranda-Agrippino and Rey (2020), and Jiang, Krishnamurthy, and Lustig (2024) also emphasize balance sheet effects as a key aspect of what makes U.S. monetary policy special. We embed this feature into a general equilibrium New Keynesian setting and trace out the implications for global risk pricing and economic activity. Prior work in the financial accelerator tradition has also studied balance sheet effects in open economy New Keynesian models (e.g., Aghion, Bacchetta, and Banerjee (2007), Gertler, Gilchrist, and Natalucci (2007), and Aoki, Benigno, and Kiyotaki (2021)). Georgiadis, Mueller, and Schumann (2023) and Akinci and Queralto (2024) develop models in this tradition focused on the global spillovers from U.S. monetary policy. A key difference in our model is that imperfect substitutability across assets arises from risk, rather than intermediation frictions. The distinction matters — for instance, together with our focus on the cross-section of countries, it allows us to argue that the spillovers from U.S. monetary shocks are more consistent with a change in the price of risk than with portfolio balance effects.

We conclude that a dollar appreciation erodes intermediary net worth based on an analysis of mean-variance efficient portfolios. Our approach complements an emerging asset pricing literature using mean-variance efficient portfolios to shed light on the sources of currency returns (Chernov, Dahlquist, and Lochstoer (2023, 2025)). Our result that intermediaries will be dollar funded because the return on dollar bonds is low relative to its risk complements CIP-based measures of dollar convenience (Jiang, Krishnamurthy, and Lustig (2021), Du, Keerati, and Schreger (2025)). Directly measuring intermediary exposures in the data is made difficult by trading in derivative contracts, and by the fact that it requires an initial (and typically untested) assump-

tion about exactly who the intermediaries are. That said, we believe our approach can be fruitfully combined with a growing literature estimating international portfolios using granular data.[1] Future work could compare the efficient portfolio to actual data on holdings to shed light on the identity of intermediaries that price the cross-section of exchange rates and international yield curves.

Our model builds on recent work in international finance studying risk premia and capital flows in segmented markets. We synthesize the perspectives of Gabaix and Maggiori (2015), Itskhoki and Mukhin (2021), and Kekre and Lenel (2024a) on the one hand, and Gourinchas, Ray, and Vayanos (2024) and Greenwood, Hanson, Stein, and Sunderam (2023) on the other. Like the first set of papers, we study a general equilibrium model in which global arbitrageurs bear currency risk; like the second set of papers, arbitrageurs trade multiple risky assets, with risk premia across assets being jointly determined and consistent with no arbitrage. A key distinction relative to all of these papers is that the risk-bearing capacity of intermediaries is endogenous, owing to the endogenous evolution of their wealth. This is at the core of our explanation for why U.S. monetary policy affects the global price of risk.[2]

Our paper finally relates to a literature on the risk premium effects of monetary policy in the closed economy context. The model is an open economy counterpart to frameworks we have previously developed in which monetary shocks revalue the wealth of heterogeneous agents in equity and fixed income markets (Kekre and Lenel (2022) and Kekre, Lenel, and Mainardi (2025)). Other explanations for the risk premium effects of monetary policy are that monetary shocks affect consumption relative to habit (Pflueger and Rinaldi (2022)), change the quantity of risk on the balance sheets of agents who price risky assets (Hanson and Stein (2015) and Hanson, Lucca, and Wright (2021)), or communicate news about the policy rule and thereby future asset price comovements (Bianchi, Lettau, and Ludvigson (2021), Bauer, Pflueger, and Sunderam (2024), and Bianchi, Ludvigson, and Ma (2024)). While these mechanisms are all complementary, the wealth revaluation channel naturally explains why U.S. monetary policy generates disproportionate risk premium spillovers in the open economy context, owing to the dollar's dominant role as a funding currency.

[1] See, for instance, Maggiori, Neiman, and Schreger (2020), Koijen and Yogo (2022), Du, Fontana, Jakubik, Koijen, and Shin (2023), Hacioglu-Hoke, Ostry, Rey, Rousset Planat, Stavrakeva, and Tang (2024), Rey and Stavrakeva (2024), and Dao, Gourinchas, and Itskhoki (2025), among others.

[2] In this sense, our model also harkens back to the earlier work of Alvarez, Atkeson, and Kehoe (2002, 2009) studying monetary policy, exchange rates, and risk premia in segmented markets.

Outline In section 2 we outline our proposed model. In section 3 we analytically characterize the effects of U.S. monetary shocks in this environment. In section 4 we study mean-variance efficient portfolios and the effects of U.S. monetary shocks on international asset prices in the data. In section 5 we quantify the model using this evidence, and in section 6 we consider a potential future with higher dollar interest rates. Finally, in section 7 we conclude.

2 Model

We first outline a multi-country New Keynesian model with global intermediaries who facilitate international capital flows and price the cross-section of assets.

2.1 Environment

We study an environment with $n > 1$ countries. We index the U.S. as country 1, and we refer to its unit of account (currency) as the dollar.

Households There are measure ζ_j households in each country j, with the normalization $\zeta_1 = 1$. The representative household in j has time separable preferences over consumption $c_{j,t}$ and labor supply $\ell_{j,t}$ with flow utility

$$u(c_{j,t}) = \frac{c_{j,t}^{1-1/\psi} - 1}{1 - 1/\psi} - \bar{\varphi}\frac{\ell_{j,t}^{1+1/\varphi}}{1 + 1/\varphi},$$

given an elasticity of intertemporal substitution ψ, Frisch elasticity of labor supply φ, disutility of labor supply controlled by $\bar{\varphi}$, and discount factor β_j. Consumption is a CES aggregator over bundles of differentiated goods from each country

$$c_{j,t} = \left(\sum_{k=1}^{n} \eta_{jk}^{\frac{1}{\sigma}} \left(c_{jk,t}\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}},$$

where σ denotes the elasticity of substitution across domestic goods and imports, and η_{jk} controls the household's preference for goods originating in k. The consumption of goods produced in k is in turn a symmetric CES aggregator over a unit mass of

varieties

$$c_{jk,t} = \left(\int_0^1 c_{jk,t}(s)^{\frac{\varepsilon-1}{\varepsilon}} ds \right)^{\frac{\varepsilon}{\varepsilon-1}},$$

with elasticity of substitution ε.

Relative to a standard open economy New Keynesian model à la Gali and Monacelli (2005), the key distinction in the present environment is the structure of asset markets. Households only trade one-period bonds and geometrically decaying consols in each currency.[3] A one-period bond in currency k pays $1 + i_{k,t}$ at $t+1$. The consol in currency k trades at price $P^{\delta}_{k,t}$ at date t, pays a coupon of one at $t+1$, and decays at rate δ (which thus controls its duration). We assume that household j can trade its local currency one-period bond frictionlessly, but holds exogenous positions in its local currency consol and all foreign bonds

$$\begin{aligned} B^{\delta}_{jj} &= P_{j,t}\bar{b}^{\delta}_{jj}, \\ B_{jk} &= P_{k,t}\bar{b}_{jk}, \ \ \forall k \neq j, \\ B^{\delta}_{jk} &= P_{k,t}\bar{b}^{\delta}_{jk}, \ \ \forall k \neq j, \end{aligned}$$

where $B_{jk,t}$ is the value of its position in the one-period bond in currency k, B^{δ}_{jk} is the value of its position in the consol in currency k, and $P_{k,t}$ is k's consumer price index. We can relax the assumption of exogenous positions in these bonds to assume that the household trades them subject to adjustment costs, without changing any of our main results.

The representative household enters the period with $A_{j,t}$ in financial wealth and receives a wage $W_{j,t}$ in units of local currency. It also receives lump-sum transfers $T_{j,t}$ and profits of local firms $\Pi_{j,t}$, and U.S. households receive net transfers from intermediaries $\Pi_{m,t} - \xi P_{1,t}\omega_m$, all of which are described further below. Taken together, the resource constraint of household j is

$$\sum_{k=1}^{n} \int_0^1 P_{jk,t}(s) c_{jk,t}(s) ds + E_{j,t} \sum_{k=1}^{n} E^{-1}_{k,t} \left(B_{jk,t} + B^{\delta}_{jk,t} \right) = W_{j,t}\ell_{j,t} + T_{j,t} + \Pi_{j,t} + 1\{j=1\} \left(\Pi_{m,t} - \xi P_{1,t}\omega_m \right) + A_{j,t},$$

[3]The effects of monetary policy on risk pricing would be evident with trade only in one-period bonds. But we allow for trade in consols as well, anticipating that we will jointly seek to confront the model against data on exchange rates and yield curves.

where $P_{jk,t}(s)$ is the price of variety s produced in k and sold in j, and $E_{j,t}$ is the nominal exchange rate (j's currency per dollar).[4] Financial wealth evolves according to

$$A_{j,t+1} = E_{j,t+1} \sum_{k=1}^{n} E_{k,t+1}^{-1} \left((1 + i_{k,t}) B_{jk,t} + \left(\frac{1 + \delta P_{k,t+1}^{\delta}}{P_{k,t}^{\delta}} \right) B_{jk,t}^{\delta} \right).$$

Firms A unit mass of monopolistically competitive firms in j hire labor and produce differentiated varieties which are then sold globally. Firm $s \in [0, 1]$ faces Rotemberg (1982) adjustment costs when setting prices in each destination market,[5]

$$\frac{P_{kj,t} y_{kj,t} \chi_p}{2} \left(\frac{P_{kj,t}(s)}{P_{kj,t-1}(s)} - 1 \right)^2,$$

where χ_p controls the magnitude of price adjustment costs, $P_{kj,t}(s)$ is the firm's price in destination k, and $P_{kj,t}$ and $y_{kj,t}$ are aggregates that the firm takes as given. We assume local currency pricing (LCP) so that exchange rate pass-through is incomplete, as in the data, and we leave the analysis of alternatives (such as dollar pricing) for future work. The firm's local currency profits from global sales are thus

$$\Pi_{j,t}(s) = \sum_{k=1}^{n} \left[E_{j,t} E_{k,t}^{-1} \left[P_{kj,t}(s) y_{kj,t}(s) - \frac{P_{kj,t} y_{kj,t} \chi_p}{2} \left(\frac{P_{kj,t}(s)}{P_{kj,t-1}(s)} - 1 \right)^2 \right] - W_{j,t} \ell_{kj,t}(s) \right],$$

where $y_{kj,t}(s)$ is the quantity sold in destination k and $\ell_{kj,t}(s)$ is the labor demanded for sales in destination k. The firm internalizes its residual demand implied by household optimization across varieties

$$y_{kj,t}(s) = \left(\frac{P_{kj,t}(s)}{P_{kj,t}} \right)^{-\varepsilon} y_{kj,t},$$

where

$$P_{kj,t} = \left(\int_0^1 P_{kj,t}(s)^{1-\varepsilon} ds \right)^{\frac{1}{1-\varepsilon}}.$$

Finally, the firm uses a linear technology, so that

$$y_{kj,t}(s) = \ell_{kj,t}(s).$$

[4] Hence, we have $E_{1,t} = 1$.

[5] We assume for simplicity these are paid to the government and rebated lump-sum, so they do not affect aggregate resources.

In the usual way, the firm's vector of prior period prices are state variables in the firm's problem, and it makes optimal price setting decisions in each market using household j's stochastic discount factor.

Global intermediaries A unit mass of global intermediaries freely trade in all bonds and facilitate international capital flows. The representative intermediary operating at date t has wealth $W_{m,t}$ (denominated in dollars) and trades in bonds to satisfy the budget constraint

$$\sum_{j=1}^{n} E_{j,t}^{-1} \left(B_{mj,t} + B_{mj,t}^{\delta} \right) = W_{m,t},$$

where $B_{mj,t}$ and $B_{mj,t}^{\delta}$ are the value of its position in currency j's bonds and consols, respectively. The profits earned by this representative intermediary in the next period are

$$\Pi_{m,t+1} = \sum_{j=1}^{n} E_{j,t+1}^{-1} \left((1 + i_{j,t}) B_{mj,t} + \left(\frac{1 + \delta P_{j,t+1}^{\delta}}{P_{j,t}^{\delta}} \right) B_{mj,t}^{\delta} \right).$$

A fraction ξ of intermediaries exit at the start of the next period and rebate their profits to U.S. households. These are replaced by new intermediaries endowed with $P_{1,t+1}\omega_m$ dollars from U.S. households, so that the wealth of the representative intermediary evolves according to

$$W_{m,t+1} = \xi P_{1,t+1}\omega_m + (1 - \xi)\Pi_{m,t+1}.$$

When making their portfolio choice decisions, we assume that the representative intermediary maximizes the myopic mean-variance objective

$$E_t \Pi_{m,t+1} - \frac{\gamma}{W_{m,t}} Var_t \Pi_{m,t+1},$$

where γ controls the risk aversion of intermediaries. Crucially, their effective risk aversion is declining in their aggregate resources on hand $W_{m,t}$. This objective delivers approximately the same portfolio choice conditions as (myopic) CRRA utility with coefficient of relative risk aversion γ. It can also be interpreted as capturing balance sheet constraints on intermediaries that depend on the variance of investment payoffs, and where the tightness of the constraint is rising in $\gamma/W_{m,t}$.

Policy Let us define consumer price inflation in each country as

$$\pi_{j,t} = \log P_{j,t}/P_{j,t-1},$$

where the consumer price indices are

$$P_{j,t} = \left(\sum_{k=1}^{n} \eta_{jk} P_{jk,t}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}.$$

We assume that monetary policy in each economy follows a Taylor (1993) rule with inertia and subject to a transitory shock

$$\log(1+i_{j,t}) = \log(1+i_j) + \rho_i \left(\log(1+i_{j,t-1}) - \log(1+i_j) \right) + (1-\rho_i)\phi_\pi \pi_{j,t} + \nu_{ij,t},$$

where $\nu_{ij,t}$ follows an AR(1) process with persistence ρ_{ij}. The U.S. monetary shock, $\nu_{i1,t}$, is our main stochastic disturbance of interest. We later consider richer policy responses by foreign central banks, including through exchange rate interventions. Finally, we assume that the fiscal authority rebates the price adjustment costs back to households using

$$T_{j,t} = \sum_{k=1}^{n} E_{j,t} E_{k,t}^{-1} \frac{P_{kj,t} y_{kj,t} \chi_p}{2} \left(\frac{P_{kj,t}}{P_{kj,t-1}} - 1 \right)^2,$$

where we use that all firms in j will, in equilibrium, choose symmetric prices in each destination market k.

Market clearing The environment is closed with standard market clearing conditions in labor, goods, and bonds. The model can admit many more driving forces than the monetary policy shocks which will be our focus, such as to household tastes, technologies, and demands for foreign bonds or consols. As we further describe in the next section, our solution of the equilibrium will sidestep having to take a stand on all these driving forces or their stochastic properties.

2.2 Equilibrium and solution

The equilibrium admits a recursive representation in the real value of net foreign assets $a_{j,t} \equiv A_{j,t}/P_{j,t}$ for $j > 1$, the real wealth of intermediaries $w_{m,t} \equiv W_{m,t}/P_{1,t}$, the lagged real relative prices of goods relative to the consumption bundles $p_{jk,t-1} \equiv P_{jk,t-1}/P_{j,t-1}$, the lagged real exchange rates $q_{j,t-1} \equiv E_{j,t-1}P_{1,t-1}/P_{j,t-1}$, and the lagged nominal exchange rates $E_{j,t-1}$, as well as all exogenous state variables. Appendix A lists the full equilibrium conditions of the model.

We build on Itskhoki and Mukhin (2021), Borovicka, Hansen, and Sargent (2023), and Kekre and Lenel (2024a) in studying a first-order approximation of the equilibrium around a steady-state in which risk premia do not disappear. In particular, letting σ denote the perturbation parameter scaling the volatility of all innovations to exogenous state variables, we assume that the risk aversion of intermediaries is itself a function of this perturbation parameter, and that

$$\gamma(\sigma)\sigma^2 \to \Gamma$$

as $\sigma \to 0$. Under this assumption, and defining the excess returns to the one-period bond in currency j

$$ex_{j,t+1} \equiv \frac{E_{j,t}}{E_{j,t+1}}(1 + i_{j,t}) - (1 + i_{1,t})$$

and consol in currency j

$$ex^{\delta}_{j,t+1} \equiv \frac{E_{j,t}}{E_{j,t+1}}\frac{1 + \delta P^{\delta}_{j,t+1}}{P^{\delta}_{j,t}} - (1 + i_{1,t}),$$

appendix A demonstrates that as $\sigma \to 0$ intermediaries' optimal choice of one-period bonds in currency j becomes

$$ex_j = \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1})q_k^{-1}b_{mk} + \sum_{k=1}^{n} Cov(ex_{j,+1}, ex^{\delta}_{k,+1})q_k^{-1}b^{\delta}_{mk}\right], \quad (1)$$

where $w_{m,t} \equiv W_{m,t}/P_{1,t}$, $b_{mk,t} \equiv B_{mk,t}/P_{k,t}$, and $b^{\delta}_{mk,t} \equiv B^{\delta}_{mk,t}/P_{k,t}$. That is, in steady-state, intermediaries' required excess return on one-period bonds in currency j must compensate them for the associated risk, where this risk depends on the covariance of the trade with all other trades and the intermediaries' positions. To first order around steady-state, appendix A demonstrates that this same optimality condition

becomes

$$E_t\hat{ex}_{j,t+1} = -ex_j\hat{w}_{m,t} + \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1})q_k^{-1}\left(-b_{mk}\hat{q}_{k,t} + \hat{b}_{mk,t}\right) + \sum_{k=1}^{n} Cov(ex_{j,+1}, ex^{\delta}_{k,+1})q_k^{-1}\left(-b^{\delta}_{mk}\hat{q}_{k,t} + \hat{b}^{\delta}_{mk,t}\right)\right],$$

where $\hat{x}_t \equiv \log x_t - \log x$ except for variables which can be negative (such as excess returns and bond positions), in which case $\hat{x}_t \equiv x_t - x$. Analogous results hold for ex^{δ}_j and $E_t\hat{ex}^{\delta}_{j,t+1}$ for all j. In this way, currency and bond risk premia are time-varying even using a first-order approximation.

In equilibrium, the covariances of excess returns evaluated around steady-state need to be consistent with the first-order dynamics of the model. These covariances depend on all of the potential driving forces in the model. But crucially, these covariances are "sufficient statistics" for the presence and effects of other shocks on the propagation of U.S. monetary shocks up to first order. Hence, we will treat them as parameters of the model disciplined directly by the data, avoiding the complexity of taking a stand on all the driving forces and their stochastic properties. The implicit assumption we are making is that that there is some set of driving forces in this model which can rationalize the observed covariances of currency and bond excess returns. In previous work, we have explored the driving forces which rationalize the observed comovements of exchange rates (Kekre and Lenel (2024a,b)), and in ongoing work we are exploring the determinants of international bond returns.

3 Analytics of U.S. monetary policy transmission

We now analytically characterize the effects of a U.S. monetary policy shock in this environment. We focus on the impact effects on exchange rates and long-term bond prices given our focus on equilibrium risk pricing. If intermediaries hold foreign currency assets financed in dollars, a dollar appreciation induced by tighter U.S. monetary policy erodes their net worth and raises the global price of risk. Household capital flows induced by U.S. monetary policy shock also change the risk exposures on intermediary balance sheets, affecting asset prices through portfolio balance.

3.1 Effects of U.S. monetary shock on exchange rates

We first characterize the effect of the U.S. monetary shock $d\nu_{1,t}$ on the full set of bilateral dollar exchange rates.

We provide this result in the simplifying case of fully sticky prices ($\chi_p \to \infty$). While exchange rates have no expenditure switching role in this limiting case, they still jointly equilibrate goods and financial markets: they affect country budget constraints via the local currency value of foreign sales, and they affect the relative attractiveness of bonds denominated in different countries. We also assume zero consol positions $\{b^{\delta}_{jk}\}$, which simplifies the portfolio of intermediaries to be in one-period bonds alone. This does not prevent us from describing how a U.S. monetary shock affects consol prices, which we do in the next section. Finally, we assume no interest rate inertia ($\rho_i = 0$) and that the steady-state excess returns $\{ex_j, ex^{\delta}_j\}$, one-period bond positions $\{b_{jk}\}$, and effective risk aversion Γ/w_m are small. These assumptions simplify the mathematics without affecting the key economics.

We obtain:

Proposition 1. *Assume $\chi_p \to \infty$, zero $\{b^{\delta}_{jk}\}$ and ρ_i, and small $\{ex_j, ex^{\delta}_j, b_{jk}\}$ and Γ/w_m. Then given a U.S. monetary shock $d\nu_{i1,t}$,*

$$\begin{aligned}\hat{E}_{j,t} = \hat{q}_{j,t} = \Bigg(& \left[\beta^{-1} - \rho_{i1}\right]^{-1} \left[1 + (\beta^{-1} - 1)(1 - \rho_{i1})^{-1}\psi\right] \\ & + \left[\beta^{-1} - \rho_{i1}\right]^{-1} \left[1 + (\beta^{-1} - 1)(1 - \rho_{i1})^{-1}\psi\right] \beta \frac{1-\xi}{\xi} \frac{\sum_{k=2} q_k^{-1} b_{mk}}{w_m} ex_j \\ & - \left[\beta^{-1} - \rho_{i1}\right]^{-2} \left[\beta^{-1} - 1\right]^{-1} [1 - \psi] \frac{\Gamma}{w_m} Cov\left(ex_{j,+1}, \sum_{k=2}^{n} \eta_{1k} ex_{k,+1}\right)\Bigg) d\nu_{i1,t}. \quad (2)\end{aligned}$$

The first line of (2) describes the response of exchange rates in the absence of any change in equilibrium risk pricing. It implies that a U.S. monetary tightening causes a depreciation of all foreign currencies. The foreign depreciation is rising in the persistence of the U.S. tightening ρ_{i1}, and becomes arbitrarily large as the discount factor β and persistence ρ_{i1} approach one, reflecting the logic of Engel and West (2005). The foreign depreciation is also rising in households' intertemporal elasticity of substitution ψ, reflecting that U.S. consumption falls by more upon a U.S. monetary tightening, and thus the required depreciation to restore the local currency value of exports to the U.S. and equilibrate goods markets must rise. Relatedly, the foreign

depreciation is symmetric across all economies regardless of their trade linkages. This reflects that, while economies that sell more to the U.S. experience a larger decline in revenues following the reduction in U.S. demand, they also experience a larger increase in revenues following a local currency depreciation versus the dollar.

The second line of (2) describes the effect on exchange rates arising from a revaluation in intermediary wealth and thus a change in risk pricing — our key mechanism of interest. When intermediaries hold foreign currency exposure $\sum_{k=2} q_k^{-1} b_{mk}$, the dollar appreciation induced by a U.S. monetary tightening will reduce their wealth and thus raise their effective risk aversion. As a result, "risky" currencies ($ex_j > 0$) will further depreciate relative to the benchmark described in the prior paragraph: these exchange rates further depreciate on impact so that they can deliver a higher expected appreciation, and thus higher excess return, going forward. Symmetrically, "safe" currencies ($ex_j < 0$) appreciate relative to the benchmark without a change in risk pricing. The key statistic governing the strength of this channel is

$$\frac{1-\xi}{\xi} \frac{\sum_{k=2} q_k^{-1} b_{mk}}{w_m},$$

which is rising in the leverage of intermediaries in foreign currency assets, $\frac{\sum_{k=2} q_k^{-1} b_{mk}}{w_m}$, and the persistence of their wealth, $1-\xi$. The former governs the initial wealth revaluation from a dollar appreciation, while the latter governs how persistently currency risk premia are affected, and thus how much exchange rates must move on impact.

The third line of (2) clarifies that risk premia in this model are also affected by capital flows that change the quantity of risk intermediaries are exposed to — the "portfolio balance" mechanism. The U.S. monetary tightening induces cross-border capital flows in equilibrium. For $\psi < 1$, the U.S. experiences capital inflows, while for $\psi > 1$, foreign economies experience capital inflows. In the first case, this means that intermediaries are less exposed to foreign currencies. If excess returns on currency j covary positively with the trade-weighted average of excess returns (higher $Cov\left(ex_{j,+1}, \sum_{k=2}^{n} \eta_{1k} ex_{k,+1}\right)$), j's currency risk premium is diminished, and its exchange rate appreciates relative to the benchmark without a change in risk pricing. Note that $Cov\left(ex_{j,+1}, \sum_{k=2}^{n} \eta_{1k} ex_{k,+1}\right)$ can equivalently be interpreted as the covariance of j's dollar exchange rate with the trade-weighted average of dollar exchange rates — what the asset pricing literature describes as the "dollar beta" of currency j (Verdelhan (2018)). Interestingly, dollar betas are the relevant measure of

risk exposures to capital flows in/out of the U.S. in intermediated financial markets.

3.2 Effects of U.S. monetary shock on consol prices

We now characterize the effect of the U.S. monetary shock on consol prices.

Under our simplifying assumption that household positions are fixed in consols, the presence of consols only affects the allocation by affecting intermediaries' risk pricing, and thus willingness to intermediate capital flows in one-period bonds. But when household consol positions are in particular zero — as assumed in this section alone — even this effect is absent, and the pricing of consols does not affect the rest of the allocation. Nonetheless, it is useful to still characterize the response of consol prices to a U.S. monetary shock, both to underscore that these responses also reflect a change in the price and quantity of risk, and to clarify what aspects of cross-country heterogeneity govern these channels in the case of long-term bonds.

We obtain:

Proposition 2. *Assume the same parametric conditions as in Proposition 1. Then given a U.S. monetary shock $d\nu_{i1,t}$,*

$$\begin{aligned}\hat{P}^{\delta}_{j,t} = \Bigg(& - \left[1-\delta\beta\rho_{i1}\right]^{-1} 1\{j=1\} \\ & - \left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[1+(\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right]\frac{1-\xi}{1-\delta(1-\xi)}\frac{\sum_{k=2} q_k^{-1} b_{mk}}{w_m}\left(ex^{\delta}_j - ex_j\right) \\ & + \left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[\beta^{-1}-\delta\rho_{i1}\right]^{-1}\left[1-\psi\right]\frac{\Gamma}{w_m} Cov\left(ex^{\delta}_{j,+1} - ex_{j,+1}, \sum_{k=2}^{n}\eta_{1k} ex_{k,+1}\right)\Bigg) d\nu_{i1,t}. \end{aligned} \tag{3}$$

The first line of (3) describes the response of consol prices in the absence of any change in risk pricing. It implies that the U.S. consol price falls upon the U.S. tightening according to the expectations hypothesis, with a bigger fall in the price the higher is δ (which controls duration), discount factor β, and persistence ρ_{i1}. With fully sticky prices, foreign consol prices are unaffected in the absence of any change in risk pricing, because the expected path of foreign interest rates is unchanged.

The second line of (3) describes the response of consol prices to a revaluation in intermediary wealth and thus a change in their price of bearing risk. The key insight

here is that it is the average "local currency bond carry" return,

$$ex_j^\delta - ex_j = \frac{1 + \delta P_j^\delta}{P_j^\delta} - (1 + i_j),$$

which governs the response of consol j's price to a change in the price of risk. This is the excess return to a strategy of borrowing a unit of currency j using j's one-period bond and investing in j's consol. Intuitively, holding consols in currency j exposes intermediaries to two sources of risk: the risk that currency j depreciates, and the risk that j's consol price falls. A change in the intermediary's willingness to bear the former risk will be reflected in the exchange rate, while it is only a change in the intermediary's willingness to bear the latter risk that is reflected in the consol price. The latter depends in turn on how risky it is to hold j's consol abstracting from exchange rate risk, summarized by the average local currency bond carry return. Hence, in currencies with a steeper yield curve, a reduction in intermediary wealth would reduce long-term bond prices by more.

Away from the case of zero consol positions, the change in consol prices would feed back to affect intermediary wealth and thus their price of bearing risk. For small consol positions, small average excess returns, and small Γ/w_m, only the revaluation in wealth driven by the expectations hypothesis would matter. In particular, if intermediaries are long dollar consols, their wealth would fall upon a U.S. tightening through a distinct channel than intermediaries' currency mismatch.[6] We focus on the currency mismatch channel in this paper because the duration channel is not specific to U.S. monetary policy: as we will later describe, the data implies that intermediaries have positive positions in long-term bonds in many currencies.

Finally, the third line of (3) describes the response of consol prices to capital flows in one-period bonds. As described in the last subsection, for $\psi < 1$, the U.S. experiences capital inflows and intermediaries are less exposed to foreign currencies. If j's local currency bond carry covaries positively with the average excess return on foreign currencies, then j's bond risk premium is diminished, and its consol price rises. It is again the covariance with the local currency bond carry return that is relevant because this isolates the risk in the consol price alone.

[6] In a closed economy, the revaluation of intermediary wealth through duration is the focus of Kekre et al. (2025).

Taking stock A U.S. monetary tightening affects global risk pricing via a change in intermediaries' wealth and via the cross-border capital flows induced by the shock. The strength of the first mechanism relies on the composition of intermediary portfolios, and the relative importance of these mechanisms is in principle evident from the cross-section of asset price responses to identified U.S. monetary surprises. In the next section, we examine these features of the data.

4 Empirical analysis

In the data, the observed first and second moments of currency returns imply that mean-variance efficient investors are indeed net long foreign currencies, particularly emerging markets, and short the dollar. The cross-section of exchange rate and global yield curve responses to identified U.S. monetary shocks is consistent with an increase in the price of risk following a U.S. tightening, as due to lower intermediary wealth.

4.1 Mean-variance efficient portfolios

The first and second moments of currency returns pin down intermediaries' portfolios, up to leverage. This follows from the fact that intermediaries' steady-state portfolios solve a standard Markowitz (1952) problem. Letting $\boldsymbol{ex}$ denote the column vector of $\{ex_j, ex_j^\delta\}$, $\boldsymbol{C}$ denote the covariance matrix of $\{Cov\left(ex_{j,+1}, ex_{k,+1}\right), Cov\left(ex_{j,+1}, ex_{k,+1}^\delta\right), Cov\left(ex_{j,+1}^\delta, ex_{k,+1}^\delta\right)\}$, and $(\boldsymbol{q}^{-1}\boldsymbol{b}_m)$ denote the column vector of $\{q_j^{-1}b_{mj}, q_j^{-1}b_{mj}^\delta\}$, we can express the solution, (1) and the analog for ex_j^δ, as

$$\frac{1}{w_m}(\boldsymbol{q}^{-1}\boldsymbol{b}_m) = \frac{1}{\Gamma}\boldsymbol{C}^{-1}\boldsymbol{ex}, \tag{4}$$

assuming $\boldsymbol{C}$ is invertible. It follows that the expected excess returns $\boldsymbol{ex}$ and (conditional) covariance matrix of excess returns $\boldsymbol{C}$ together govern the sign and relative size of intermediaries' positions in non-dollar currencies, while risk aversion Γ governs the overall leverage in these non-dollar currencies.[7] In this subsection, we thus estimate the first and second moments of currency returns in the data, and characterize the implied mean-variance efficient portfolios up to overall leverage.

[7] In equilibrium, of course, these positions and excess returns must be consistent with the optimizing behavior of households and market clearing.

We collect daily data on yield curves and exchange rates for nine advanced economies (which together with the U.S. are referred to as the "G10") and 15 emerging markets (EMs). The G10 economies besides the U.S. are Australia (AUD), Canada (CAD), Euro area (EUR), Japan (JPY), Norway (NOK), New Zealand (NZD), Sweden (SEK), Switzerland (CHF), and the U.K. (GBP). The emerging markets are Brazil (BRL), Chile (CLP), Colombia (COP), Hungary (HUF), India (INR), Indonesia (IDR), Israel (ILS), Mexico (MXN), Malaysia (MYR), Peru (PEN), Philippines (PHP), Poland (PLN), South Africa (ZAR), South Korea (KRW), and Thailand (THB). For each currency, we collect three-month and ten-year yields as well as dollar exchange rates from Bloomberg from April 1991 through February 2024.[8,9] We use government bond yields as our baseline measure of yields, but explore the consequences of using IBOR-based yields for the G10 economies as well. Since Bloomberg reports government par yields, we bootstrap zero coupon yields using this data.[10]

The first panel of Table 1 reports the first and second moments of annualized excess returns using this data. We focus on three groups of currencies of particular interest: the Swiss franc, euro, and Japanese yen; all other G10 currencies besides the U.S.; and all emerging markets. Using three-month interest rates, the first row reports that Swiss franc, euro, and yen interest rates have been on average lower than the U.S. interest rate; other G10 interest rates have been slightly higher than the U.S. interest rate; and emerging market interest rates have been considerably higher than the U.S. interest rate. The second row reports similar patterns using excess currency returns, which add the realized appreciation of the foreign currency to the interest rate differential from the prior row. The third row reports the daily standard deviation of log exchange rates, annualized.[11] We see that exchange rate movements have undone some but not all of the carry returns from interest rate differentials, and

[8]We choose this sample period because a consistent set of Bloomberg tickers for government bond yields are available over it, and it broadly overlaps with the period over which the U.S. monetary surprises studied in the next section are available. Using new tickers, we study the behavior of yields and exchange rates around "liberation day" in 2025 in section 6.

[9]For many emerging markets, we start the sample period later to avoid including periods of pegs or "falling freely" exchange rates, following the classification of Ilzetzki, Reinhart, and Rogoff (2019, 2022). Appendix C describes the start date of all yields and exchange rates used in the analysis.

[10]We assume that all countries pay coupons semiannually except for Germany, Norway, Sweden, Switzerland, and Poland, which we assume pay annually, based on our understanding of typical practice for sovereign bonds in each country.

[11]We compute this statistic for each currency and then construct the simple average within each group. Dividing the second row by the third row yields an estimate of the Sharpe ratio on funding a foreign currency position in dollars for three months.

First and second moments of excess currency returns				
	CHF, EUR, JPY	Other non-U.S. G10	EM	
Average 3m interest rate diff. (ann.)	-1.4%	0.9%	3.9%	
Average 3m excess return (ann.)	-0.5%	0.9%	2.5%	
Daily s.d. of log exchange rate (ann.)	10.1%	11.0%	10.8%	
Mean-variance efficient portfolio shares				
	CHF, EUR, JPY	Other non-U.S. G10	EM	Sum
$\Gamma = 1$	-1.9	-2.4	8.8	4.5
$\Gamma = 1$, JPY-based investor	-1.9	-2.4	8.8	4.5
$\Gamma = 0.1$	-19.1	-24.2	88.0	44.6
$\Gamma = 0.1$, JPY-based investor	-28.1	-24.2	88.0	35.6
$\Gamma = 1$, G10 IBOR yields	-2.9	-0.4	5.7	2.4
$\Gamma = 1$, no 10-year bonds	-0.6	-2.9	9.2	5.7
$\Gamma = 1$, 2008-2024	-3.6	-2.2	9.5	3.7
$\Gamma = 1$, 0.5*pp* higher dollar interest rate	-2.8	-2.7	6.4	0.9

Table 1: moments of excess returns and mean-variance efficient portfolios

Notes: first panel reports averages of first and second moments computed for each currency.

emerging market currencies have had the highest Sharpe ratio on funding a foreign currency position in dollars for three months.

We use this historical data to construct estimates of $\boldsymbol{ex}$ and $\boldsymbol{C}$. We estimate $\{ex_j\}$ by computing average quarterly excess returns for each currency, running a cross-sectional regression of these on the average three-month interest rate differential versus the dollar, and finally using the fitted values as our estimates. We estimate $\{ex_j^\delta\}$ by computing average quarterly excess returns on ten-year bonds in each currency financed by the three-month dollar bond,[12] running a cross-sectional regression

[12] We estimate the quarterly return on a ten-year bond purchased at quarter t and sold at quarter $t+1$ assuming that the yield on a bond with maturity nine years and nine months at time $t+1$ is the same as the yield on a bond with maturity ten years at that same time.

of these on the average yield differential between ten-year bonds in that currency and the three-month dollar interest rate, and using the fitted values as our estimates. We use these fitted values from cross-sectional regressions to reduce the noise in our estimates of excess returns; appendix C demonstrates that the average interest rate differentials and yield curve slopes do a very good job explaining the cross-section of average excess returns. We finally estimate $\boldsymbol{C}$ by computing covariances of log daily changes in exchange rates and log daily changes in ten-year bond prices.[13]

The second panel of Table 1 reports the implied mean-variance efficient portfolio shares. The portfolio shares in each currency include three-month and ten-year bonds. The holding period is assumed to be one quarter, so that the three-month bonds are "one-period" instruments.[14]

The first row reports that, with $\Gamma = 1$, a mean-variance efficient investor over the sample period has been on average short G10 currencies, long emerging market currencies, and net long all non-dollar currencies. Quantitatively, the investor would borrow 3.5 times their wealth in dollars; borrow 1.9 times their wealth in Swiss franc, euros, and yen; borrow an additional 2.4 times their wealth in other G10 currencies; and invest 8.8 times their wealth in emerging markets. In total, the investor would hold a leveraged position of 4.5 of their wealth in non-dollar currencies. While it is not reported in the table, we also note that the investor would hold a position of 1.2 times their wealth in the ten-year dollar bond. As described in the last section, this means that in response to a U.S. tightening which erodes the value of long-term dollar bonds, such an investor would take additional balance sheet losses.

The case with unitary risk aversion is useful because, following Solnik (1974) and Sercu (1980), in this case the mean-variance efficient portfolio is invariant to the base currency of the investor.[15] The second row makes this clear by characterizing

[13]We use the subsample beginning in July 1998 to estimate the covariance matrix. While we still compute pairwise covariances to deal with the fact that we do not have a balanced panel, starting in July 1998 means that we have a balanced panel for the G10 economies at least, helping to ensure the resulting covariance matrix is positive semi-definite.

[14] We make this assumption because three months is the shortest tenor for government bond yields consistently available from Bloomberg across countries. When we study our quantitative model in the next section, we will calibrate it to a weekly frequency which we view as a more appropriate frequency at which active market participants make trading decisions. We will assume the annualized yield on a bond with maturity one week is identical to that on a bond with three months in the data.

[15]We conjecture that this is also closely related to the result in Coeurdacier and Gourinchas (2016) that a log investor does not have a real exchange rate hedging motive.

the efficient portfolio of an investor that cares about payoffs in yen. The portfolio is unchanged from the case of a dollar-based investor. Loosely, the fact that the efficient portfolio features a large funding position in dollars regardless of the investor's base currency reflects that the dollar interest rate is low relative to its risk. We will later describe how the relatively small funding position of the representative intermediary in non-dollar "safe" currencies allows us to explain why U.S. monetary policy has larger effects on risk pricing than monetary policy abroad.

Away from unitary risk aversion, the base currency also matters. For Γ lower than one in particular, the dollar-based investor leverages his portfolio by further borrowing in one-period dollar bonds, as demonstrated in the third row. By contrast, a yen-based investor would leverage his portfolio by borrowing more in one-period yen bonds, as demonstrated in the fourth row. We anticipate that in an extension of our model with intermediaries caring about payoffs in each possible base currency, these considerations would shape the risk-sharing among intermediaries (as in Black (1990)). Our assumption that the representative intermediary cares about payoffs in dollars is effectively an assumption that the risk aversion of dollar-based intermediaries is much lower than that of other intermediaries.

The next three rows of Table 1 demonstrate that the investor's large funding position in dollars is robust to several features of the underlying data. Returning to assume $\Gamma = 1$, we first use IBOR-based yields rather than government bond yields for the G10 economies, which may be more appropriate if private investors cannot take large short positions in G10 government bonds at the prevailing yields. Relative to the first or second rows, we see that the investor still takes a meaningful short position in dollars. This illustrates that it is the dollar interest rate, not just the U.S. Treasury bill rate, that is low relative to its risk. We next drop ten-year bonds from the menu of assets available to the investor or focus on the second half of our sample period alone to investigate stability over time. In both cases, we find that the investor still takes similar currency exposure as in the baseline case, holding a leveraged position in emerging market currencies funded largely in dollars.

The last row of Table 1 finally contemplates a counterfactual world in which the U.S. dollar interest rate is higher relative to all other interest rates. In particular, we reduce each entry of $\boldsymbol{ex}$ by $0.5pp$ (annualized), we keep the covariances in $\boldsymbol{C}$ unchanged, and we continue to assume $\Gamma = 1$. Relative to the first or second rows, the portfolio share in non-dollar bonds now meaningfully falls. This counterfactual

scenario is of interest when contemplating the consequences of a potential rise in dollar interest rates in the future, as driven by a shift of households away from dollar-denominated assets. We will return to it in section 6.

4.2 U.S. monetary surprises and global asset prices

We now estimate the cross-section of exchange rate and global yield curve responses to identified U.S. monetary shocks. This evidence is useful both in discriminating between channels of transmission to risk premia, and in disciplining the quantitative model in the next section.

In the data, we follow Bauer and Swanson (2023) in measuring surprises to U.S. nominal interest rates. This is the first principal component of 30-minute changes in the nearest four quarterly Eurodollar contracts around U.S. monetary policy announcements.[16] We project two-day changes in global yields and exchange rates on the two-day change in the two-year dollar yield around FOMC announcements, instrumented by the intraday monetary surprise. Two-day changes are computed as the closing asset price on the day after the U.S. monetary announcement, less the closing asset price on the day before the announcement. We use an instrumental variables design only to ease interpretation: our estimates correspond to the effect of a $1pp$ increase in the two-year dollar yield induced by the monetary surprise.

Figure 1 suggests that an increase in the price of risk, as due to lower intermediary wealth, drives the response of exchange rates and global yield curves to a U.S. monetary tightening. In the first row, we compare the exchange rate responses to our estimated average excess currency returns, ex_j. In the second row, we compare the 10-year yield responses to our estimated average excess local currency bond carry returns, $ex_j^\delta - ex_j$.[17] Consistent with the wealth revaluation channel described in Propositions 1 and 2, it is indeed the case that currencies earning higher average

[16] We use the version of this measure orthogonalized with respect to macro news released prior to the monetary announcement. Bauer and Swanson (2023) argue that monetary surprises are predictable by this news because markets are learning about the central bank's policy response to this news from monetary announcements. They argue that orthogonalizing the monetary surprise is not needed to study the high-frequency response of asset prices, but we still do so to sharpen interpretation and compare to the model: it suggests that the asset price effects we estimate are not driven by learning about the policy rule, but are driven by surprise innovations around the rule.

[17] Similar results are obtained replacing the 10-year yield with five-year ahead, five-year forward rates, validating our interpretation that the response of 10-year yields is driven by a change in global term premia.

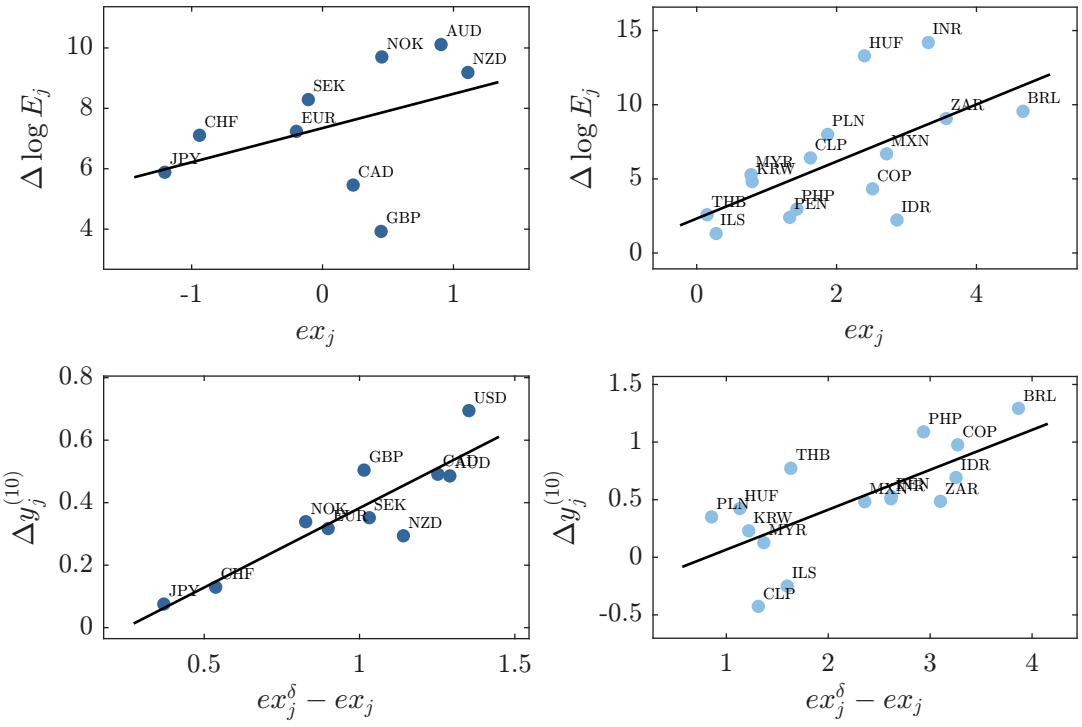


Figure 1: asset price responses to U.S. monetary tightening in data

Notes: response to U.S. monetary tightening estimated in data using Bauer and Swanson (2023) measure of monetary surprises and two-day changes in asset prices around surprises. Responses reported for surprise that raises two-year dollar yield by 1*pp*.

excess returns depreciate by more, and long-dated yields for currencies with higher average excess bond carry returns returns rise by more, upon a U.S. tightening. This pattern in exchange rate responses for G10 economies echoes Mueller et al. (2017); to our knowledge, this pattern in exchange rate responses for emerging markets, and these patterns in global yield curve responses for both the G10 and emerging market economies, are novel.

Appendix C demonstrates that it is difficult to explain the response of these asset prices to a U.S. monetary tightening through the portfolio balance mechanism. As demonstrated in Propositions 1 and 2, the portfolio balance channel would imply that currencies (long-term bond prices) that covary more with the trade-weighted average currency carry trade return should depreciate by less (fall by less) following a U.S. tightening, assuming capital inflows to the U.S. This prediction does not hold in the

data. For instance, currencies with a higher dollar beta depreciate by *more*.[18,19]

A similar challenge faces portfolio balance effects arising from other potential capital flows on impact of a U.S. tightening. For instance, one could generalize our model to assume that foreigners' desired position in dollar-denominated bonds $\bar{b}_{j1}$ for $j > 1$ rises with the U.S. nominal interest rate. In that case, intermediaries would hold fewer dollar-denominated and more foreign-denominated assets on impact of a U.S. tightening, so that the portfolio balance channel would imply that currencies (long-term bond prices) that covary more with the average currency carry trade return should depreciate by more (fall by more) following a U.S. tightening. This is consistent with the response of currencies and emerging market bonds, but not G10 bonds.

Taken together, we conclude that the international asset price responses to a U.S. monetary tightening suggest a dominant role for a higher global price of risk.[20]

5 Quantification

We now discipline the model to rationalize the high-frequency effects of U.S. monetary policy on the cross-section of international asset prices, and we use it to understand what makes U.S. monetary policy special. We then use the model to study how the risk premium spillovers of U.S. monetary policy affect real activity, and how this depends on policy responses, in the rest of the world.

5.1 Model parameterization

We solve the model at a weekly frequency. We set parameters in three steps.

We first set a number of parameters without solving the model, summarized in Table 2. We set households' elasticity of intertemporal substitution ψ to 0.5, the

[18] If a U.S. tightening instead implies capital outflows from the U.S., then the predictions of portfolio balance would hold for currencies and emerging market bonds, but still not for G10 bonds.

[19] This approach of comparing asset price responses against (conditional) covariances of asset returns builds on the approach in Bauer and Neely (2014). Our analysis contrasts the portfolio balance channel with one operating through the price of risk, and is focused on interest rate surprises (though, as described in the next footnote, we also study quantitative tightening in appendix C).

[20] This result is sharpened by contrast with the asset price responses to U.S. quantitative tightening. Appendix C reports the global responses of exchange rates and bond yields using Swanson (2021)'s measure of news about large-scale asset purchases. It demonstrates that these responses *are* consistent with spillovers through portfolio balance. This both validates the substitution elasticities across assets implied by mean-variance optimization, and sharpens the finding that interest rate policy spills over through a distinct mechanism.

	Description	Value
ψ	elast. of intertemporal subs.	0.5
σ	trade elasticity	1.5
φ	Frisch elasticity	1
ϵ	elast. of subs. across varieties	11
χ_p	price adj. cost	41,600
ϕ_π	interest rate coeff. on CPI inflation	1.5
ρ_i	interest rate inertia	$0.4^{1/52}$
δ	consol decay	$1-(52\times 10)^{-1}$
$Cov(ex_{j,+1}, ex_{k,+1})$	conditional cov. of carry returns	see text

Table 2: baseline parameters set without solving model

Notes: model is solved at a weekly frequency.

trade elasticity σ to 1.5, and the Frisch elasticity of labor supply φ to 1, all standard values in the literature.[21] We set the elasticity of substitution across product varieties ϵ to 11 and the price adjustment cost χ_p to $41,600$; together, these imply a Calvo (1983)-equivalent frequency of price adjustment around five quarters. We set the monetary policy coefficient on inflation to the standard value $\phi_\pi = 1.5$, and we set interest rate inertia ρ_i to 0.4 annualized, which we assume for simplicity are identical everywhere. We assume that $\delta = 1-(52\times 10)^{-1}$ so that the duration of consols is approximately 10 years. Finally, we set the conditional covariance of excess returns to exactly match our baseline estimates of the covariance matrix $\boldsymbol{C}$ described in the prior subsection. As previously noted, it is only through this covariance matrix that the presence and stochastic properties of other shocks affect the propagation of a U.S. monetary policy shock. Our implicit assumption is thus that there exists a set of shocks in this environment that can rationalize the estimated $\boldsymbol{C}$.

The second set of parameters are calibrated after solving the model, but without reference to U.S. monetary surprises. These are reported in the first panel of Table 3, and all calibrated to targets estimated over the 1991 Q2 – 2024 Q1 period.[22] We

[21] See, for instance, Barsky, Juster, Kimball, and Shapiro (1997), Backus, Kehoe, and Kydland (1994), and Chetty, Guren, Manoli, and Weber (2011), respectively.

[22] We solve the model for all G10 economies used in our empirical analysis, the nine largest emerging markets from the 15 used in our empirical analysis, and a "rest of world", bringing it to 20 countries. Appendix D describes how we set parameters for the "rest of world".

	Description	Moments	Targets
ζ_j	populations	$\zeta_j q_j^{-1} c_j / c_1$	relative consumption
β_j	discount factors	i_1, ex_j	dollar rate, excess returns
$\bar{b}_{1j}^{\delta}$	consol demand	ex_j^{δ}	excess returns
η_{jk}	trade shares	$P_{jk}c_{jk}/(P_j c_j)$	expend. shares by origin
Γ	intermediary risk aversion	resp. to U.S. monetary surprise (see text)	
ξ	intermediary exit rate	resp. to U.S. monetary surprise (see text)	
$\rho_{\nu i 1}$	persist. U.S. MP shock	resp. to U.S. monetary surprise (see text)	
ω_m	intermediary endowment	resp. to U.S. QE surprise (see text)	

Table 3: baseline parameters set by solving model

Notes: data moments estimated over 1991 Q2 – 2024 Q1. Disutility of labor $\bar{\varphi}$ and Taylor rule intercepts i_j are set to normalize $\ell_1 = 1$ and $\pi_j = 0$. For simplicity $\{\bar{b}_{1j} = 0\}$ and $\{\bar{b}_{jk} = 0, \bar{b}_{jk}^{\delta} = 0\}$ for $j > 1$.

set the populations ζ_j to target average consumption relative to the U.S. as reported in the IMF national accounts. We set the discount factors β_j and consol holdings of U.S. households $\bar{b}_{1j}^{\delta}$ to target the expected excess returns $\boldsymbol{ex}$ estimated in the prior subsection, as well as the average three-month dollar interest rate from Bloomberg.[23] We assume for simplicity that U.S. households' positions in foreign one-period bonds $\{\bar{b}_{1j}\}$ as well as non-U.S. households' positions in foreign bonds and consols $\{\bar{b}_{jk}, \bar{b}_{jk}^{\delta}\}$ (for $j > 1$) are all zero. Taken together, these assumptions on households' positions in foreign bonds and consols allow us to match the average bond currency carry returns in each currency, while implying zero net foreign assets in each country.[24] We finally set the trade shares η_{jk} to target expenditure shares using the IMF's Direction of Trade Statistics (DOTS) and national accounts data. Appendix D reports the value of each of these parameters in our baseline calibration, as well as the model's success in matching the targeted moments closely.

The remaining parameters are calibrated after solving the model, and targeting the high-frequency asset price responses to U.S. policy surprises. These are intermediary risk aversion Γ, the exit rate of intermediaries ξ, the persistence of the monetary

[23] As described in footnote 14, we assume the annualized yield on a bond with maturity one week in the model is identical to that on a bond with three months in the data.

[24] We anticipate later refining the calibration of these parameters so that the model is consistent with average net foreign assets and the average share of dollar-denominated net foreign assets documented by Allen and Juvenal (2024).

shock $\rho_{\nu i1}$, and the initial endowment of intermediaries ω_m.

We discipline the first three parameters to match the high-frequency evidence from U.S. interest rate surprises studied in the last section. Since the model matches observed average excess returns and conditional covariances of excess returns in the data, intermediaries' portfolio is already pinned down up to leverage, as argued in section 4.1 — their risk aversion Γ is the only remaining degree of freedom we have to pin down their portfolio, as it governs their leverage. Consistent with Propositions 1 and 2, intermediaries' leverage, ξ, and $\rho_{\nu i1}$ shape the asset price responses to U.S. monetary surprises, and can thus be identified by them.

Formally, we use the generalized method of moments (GMM) to choose these parameters to minimize the squared deviation of exchange rate, two-year yield, and 10-year yield responses between data and model,[25] simulating the U.S. monetary surprise as a positive innovation to $\nu_{i1,t}$ which raises the two-year dollar yield by $1pp$ as in the data. We use identical weights on all moments, and target moments for the G10 economies alone, given that emerging markets may have richer policy reactions functions than the inflation targeting rule we have assumed (we return to this below).

Conditional on these parameters, we then discipline intermediaries' initial endowment ω_m to match the response of U.S. yields to quantitative easing (QE) announcements. Intuitively, conditional on Γ, intermediaries' steady-state wealth governs the price impact of a dollar change in their bond positions, and is thus well-suited to match evidence from QE. Roughly matching the Federal Reserve's purchase of 10-year equivalent bonds in QE1, we simulate a positive U.S. household consol demand shock ($\Delta\bar{b}^{\delta}_{11,t}$) that is 6.5% of annual U.S. GDP, and with half-life of roughly three years.[26] We discipline ω_m to match a $1.05pp$ decline in the 10-year dollar yield on impact of the shock.[27] We return to discuss the implications of the calibrated ω_m in section 6, when we discuss asset price dynamics around "liberation day".

Figure 2 demonstrates that the model is quite successful in matching the asset

[25] We obtain two-year yields in the model by pricing consols with duration of two years, even though intermediaries only have non-zero positions in the consols with duration 10 years.

[26] Gagnon, Raskin, Remache, and Sack (2011) report purchases of 10-year equivalents of \$850bn between December 2008 and March 2010. To adjust for the fact that the resulting price impact may have been larger than in non-crisis times, we round this upwards to \$1tn. Relative to annual GDP of roughly \$15tn, this is approximately 6.5%. We discuss how our results are affected by the assumed half-life (about which there is considerable uncertainty) in section 6.

[27] This is the cumulative change in 10-year dollar yield on 11/25/2008, 12/1/2008, 12/16/2008, 1/28/2009, and 3/18/2009, the first five U.S. QE "event days" widely studied in the literature. We cumulate the change in yields from the day after the event, relative to the day before the event.

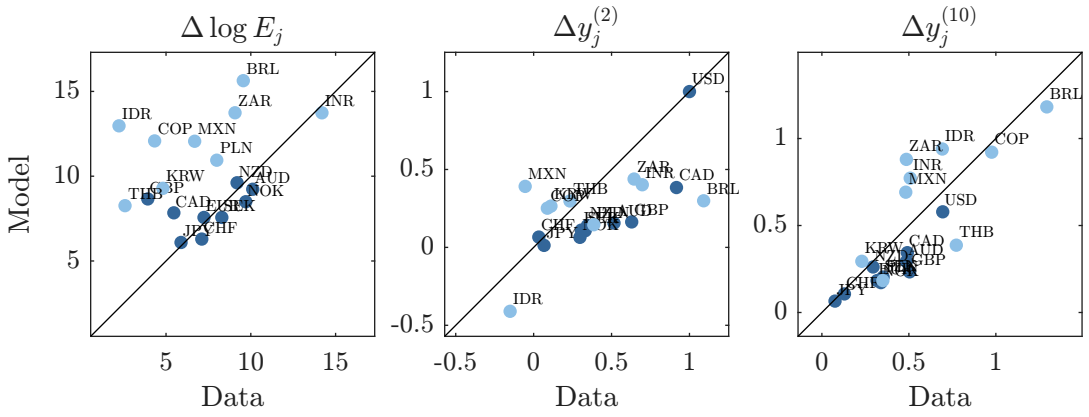


Figure 2: asset price responses to U.S. monetary tightening in model vs. data

Notes: both model and data responses reported for surprise that raises two-year dollar yield by 1*pp*.

price responses to U.S. interest rate surprises in the data. While these moments are targeted for the G10 economies, the success for these economies is still notable given that the estimation is substantially overidentified (only three parameters are being chosen to match 29 moments). The model is even fairly successful for emerging markets, which were not at all used in the GMM. The discrepancies that do appear for emerging markets may reflect two forces. First, many of these economies likely engage in exchange rate intervention to prevent their exchange rate from depreciating without relying on an increase in policy rates, consistent with the arguments in Albagli et al. (2019) and Albagli, Ceballos, Claro, and Romero (2024). Indeed, one could use Figure 2 to quantify how much such economies must engage in exchange rate intervention to rationalize their observed exchange rate responses to U.S. monetary shocks. Second, it may be that we are especially mismeasuring the true currency and bond term premia for these economies, which control their exposure to a change in risk pricing.

Figure 3 depicts how Γ, governing intermediaries' leverage and thus revaluation of wealth upon a dollar appreciation, is identified. The estimated Γ implies that intermediaries' leverage in non-dollar bonds

$$\frac{\sum_{k=2} q_k^{-1} b_{mk}}{w_m} \approx 32.$$

Consistent with Propositions 1 and 2, at a higher value of Γ and thus lower leverage, the model would imply a much smaller depreciation for currencies offering high

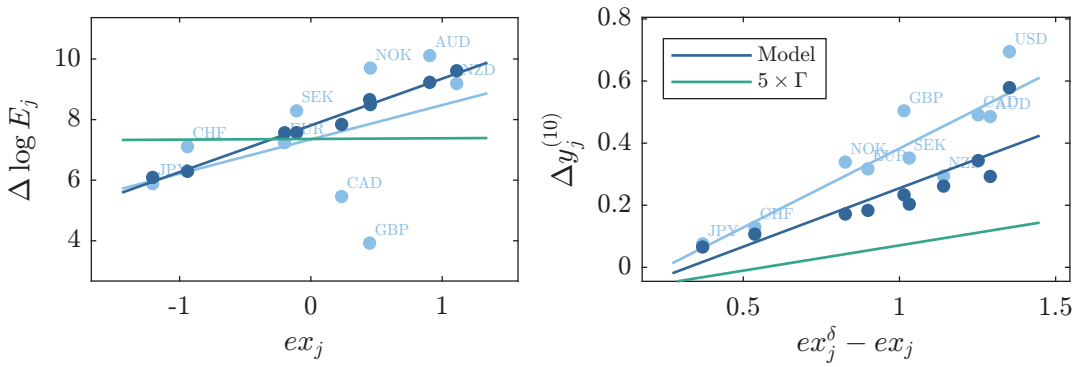


Figure 3: identification of intermediary leverage

Notes: both model and data responses reported for surprise that raises two-year dollar yield by 1*pp*.

average excess returns, and smaller increase in yields for bonds offering high average local currency excess returns, counterfactual to the data. Appendix D demonstrates how ξ, governing intermediaries' persistence of wealth, is similarly identified by these cross-sectional patterns. We estimate $\xi = 0.026$, so that the half-life of intermediary wealth is roughly two quarters.

5.2 The specialness of U.S. monetary policy

We can use our model to understand what makes U.S. monetary policy special.

We first demonstrate the specialness of U.S. monetary policy in the data. Figure 4 compares the high-frequency responses of exchange rates to Federal Reserve surprises versus European Central Bank (ECB) surprises. We focus on Euro area surprises because it is an economy of comparable size to the U.S. We measure ECB monetary surprises using the "forward guidance" surprise measure from Altavilla, Brugnolini, Gurkaynak, Motto, and Ragusa (2019).[28] In both panels, we consider a surprise that raises the two-year domestic yield by 1*pp*. By comparison to the responses to Federal

[28]That paper provides several measures of Euro area monetary surprises extracted from the intraday response of asset prices around ECB monetary announcements. One, called the "timing factor", concerns the near-term path of monetary policy (explaining most variation in OIS rates around the monetary announcement with maturity less than or equal to one year). The second, a "forward guidance factor", concerns the longer-term path of monetary policy (explaining most variation in OIS rates around the monetary announcement with maturity between two and five years). We focus for concreteness on the second measure, constructed from the event window that encapsulates both the press release and press conference, but similar results hold for the first measure. The surprises begin in January 1999 and we study all such surprises through December 2019, for comparability with the sample of Federal Reserve surprises studied in the last section.

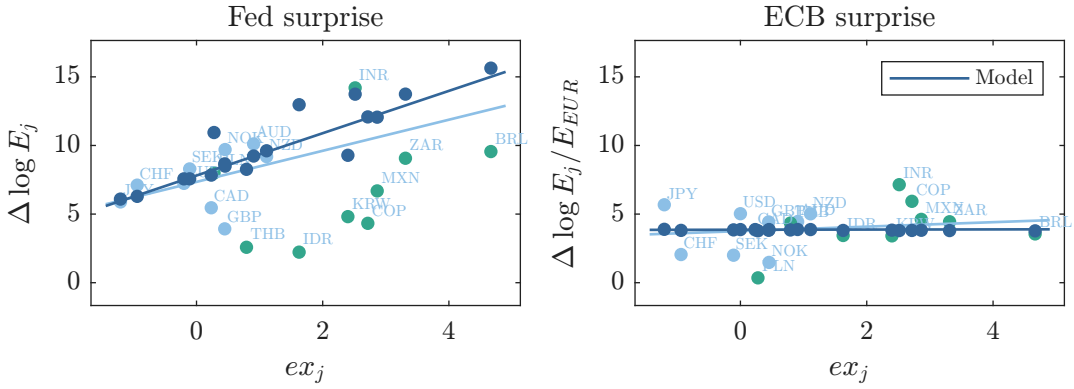


Figure 4: asset price responses to U.S. vs. Euro area monetary tightening

Notes: both model and data responses reported for surprise that raises two-year dollar yield by $1pp$ (left panel), and two-year euro yield by $1pp$ (right panel). The response to Euro area monetary tightening estimated in data using Altavilla et al. (2019) "forward guidance" measure of monetary surprises and two-day changes in asset prices around surprises.

Reserve surprises in the first panel, we see that the exchange rate effects of ECB surprises are much more weakly related to average excess returns. Through the lens of Proposition 1, this is consistent with weaker effects of the ECB surprise on global risk pricing. While other researchers have compared spillovers induced by the Federal Reserve and other central banks (e.g., Gerko and Rey (2017) and Ca'Zorzi, Dedola, Georgiadis, Jarocinski, Stracca, and Strasser (2023)), to our knowledge this evidence leveraging the cross-section of international asset price responses is novel.

Figure 4 then demonstrates that our model generates precisely such an asymmetry between U.S. and Euro area monetary surprises. We keep all parameters fixed from our simulation of a U.S. monetary surprise in the last section, except that we estimate the persistence of a Euro area monetary surprise $\rho_{i,EUR}$ to match the average exchange rate response relative to the euro. We see that as in the data (and completely untargeted), the model generates an essentially non-existent relationship between the exchange rate responses to a Euro area surprise and average excess currency returns, unlike in the case of a U.S. monetary surprise.[29] This follows from the fact that intermediaries fund only a small fraction of their portfolio in euros, as described in the discussion of Table 1: while a euro appreciation thus erodes their

[29]The model still does generate heterogeneity in exchange rate responses to a Euro area surprise, largely explained by trade relationships with the Euro area. For instance, Switzerland and the Scandinavian currencies depreciate by less, and the U.S dollar depreciates by more, in response to a Euro area tightening, as in the data.

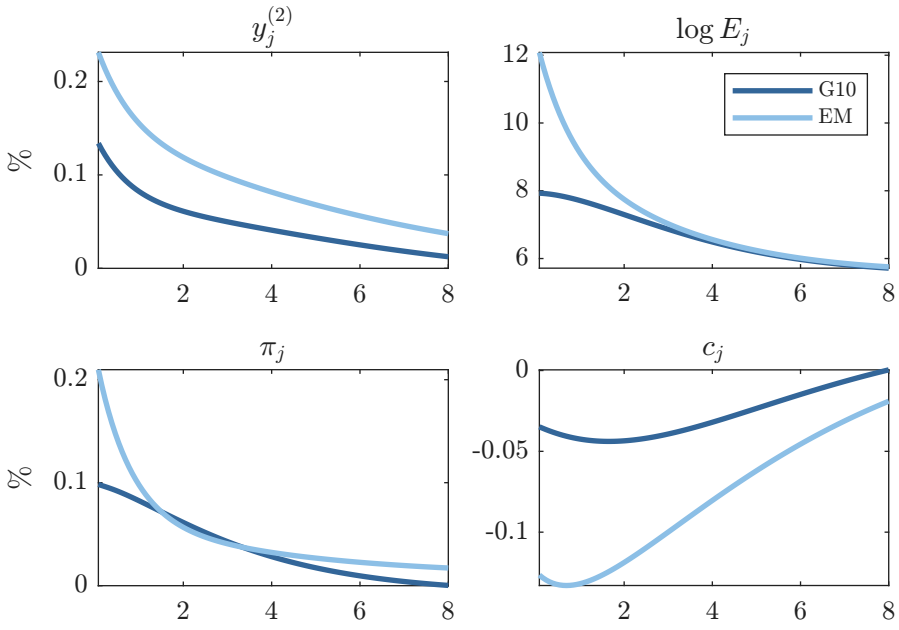


Figure 5: impulse responses to U.S. monetary tightening

Notes: responses reported for same $\nu_{i1,t}$ innovation depicted in Figure 2. x-axis denotes quarters since the shock.

wealth, the wealth revaluation is an order of magnitude smaller than in response to a dollar appreciation. The dollar's dominant role as a funding currency is thus essential for the disproportionate effects of U.S. monetary policy on financial markets.

5.3 Broader effects of risk premium spillovers

Having studied these high-frequency asset price responses, we now consider the broader implications for the global transmission of U.S. monetary policy.

Figure 5 depicts impulse responses to the same U.S. monetary policy shock simulated in the prior subsections. We contrast simple averages of impulse responses for the other G10 economies against those for emerging markets.

A U.S. monetary tightening is accompanied by an endogenous policy tightening in the rest of the world. It has a larger effect on inflation in emerging markets than other G10 economies, consistent with the exchange rate responses in Figure 2 and the associated effects on import prices. The policy rate and thus short-dated yields rise by more in emerging markets, and these economies suffer a larger decline in

consumption.[30] These simulations thus demonstrate that the effects of U.S. monetary policy on global risk pricing have first-order implications for real transmission in the rest of the world.

We can also use the model to ask how the response to a U.S. tightening can shape domestic outcomes. The literature on sudden stops in New Keynesian models (e.g., Schmitt-Grohe and Uribe (2012), Farhi and Werning (2012, 2014), Bianchi and Lorenzoni (2022), and Corsetti, Dedola, and Leduc (2023)) has emphasized that economies facing a higher external risk premium face a trade-off between domestic inflation induced by the exchange rate depreciation and a domestic contraction, and that tools besides monetary policy can be helpful in managing this trade-off. Figures 6 and 7 demonstrate these ideas in our model. Focusing on Brazil as a representative emerging market, we consider two counterfactual policy responses to the U.S. tightening than is assumed in our baseline model.[31]

Figure 6 adds a term targeting the (real) exchange rate to Brazil's monetary policy rule,

$$\begin{aligned}\log(1+i_{BRL,t}) = \log(1+i_{BRL}) &+ \rho_i \left(\log(1+i_{BRL,t-1}) - \log(1+i_{BRL})\right) \\ &+ (1-\rho_i)\left(\phi_\pi \pi_{BRL,t} + \phi_{q,BRL}\left(\log q_{BRL,t} - \log q_{BRL}\right)\right).\end{aligned}$$

With a positive value $\phi_{q,BRL}$, Brazil experiences a smaller depreciation and smaller inflation (in fact, deflation), but at the cost of a more severe decline in consumption. Interestingly, quantitatively, the effect on the nominal exchange rate is minimal, while that on inflation is more meaningful, owing to the decline in domestic demand.

Figure 7 considers the possibility that Brazil can engage in exchange rate intervention. We model this as the Brazilian government selling one-period dollar bonds and buying one-period Brazilian bonds. Since Brazil is Ricardian with respect to the local currency bonds (because households can freely trade them), this amounts to the Brazilian government selling one-period dollar bonds — lowering $\bar{b}_{BRL1}$ — on behalf

[30] Hence, the model at least qualitatively generates the heterogeneous dynamic responses to U.S. monetary surprises between emerging market and advanced economies documented in Mendoza-Fernandez and Pelin (2025).

[31] In both cases, we are keeping the covariance matrix of excess returns $\boldsymbol{C}$ unchanged. Hence, this should be thought of as a "one-off" change in the reaction to a U.S. tightening that does not change anticipated future comovements. Itskhoki and Mukhin (2023) emphasize how the policy rule affects these second moments and thereby risk pricing.

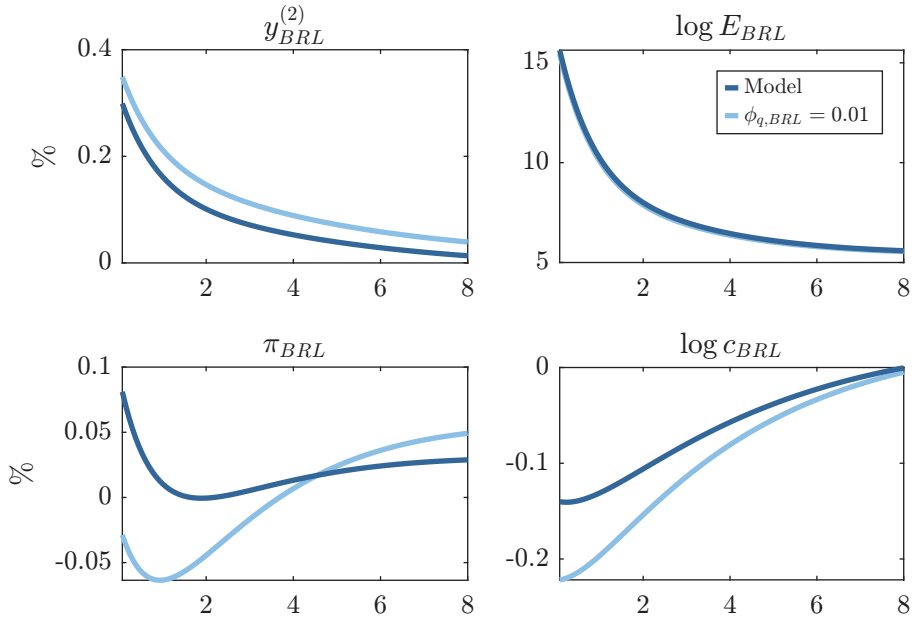


Figure 6: effects of alternative monetary policy response to U.S. monetary tightening

Notes: responses reported for same $\nu_{i1,t}$ innovation depicted in Figure 2. x-axis denotes quarters since the shock.

of local households. We thus consider a rule

$$\bar{b}_{BRL1,t} = -(\phi_{fxi,BRL}/52)\left(\log q_{BRL,t} - \log q_{BRL}\right).$$

With a positive value $\phi_{fxi,BRL}$, the government sells dollar bonds on behalf of local households, who then seek to smooth consumption by buying local currency bonds. With fewer such bonds on the balance sheet of intermediaries, Figure 7 demonstrates that the local currency risk premium is dampened, resulting in both dampened inflation and a dampened decline in consumption.

Relative to previous models studying exogenous risk premium shocks, a key novelty in the present environment is that the sudden stop affecting Brazil is endogenized in a multi-country setting. In particular, the depreciation of emerging market currencies like Brazil plays a key role in driving the increase in risk pricing to begin with, owing to the leverage of intermediaries in these currencies. While a formal normative analysis is outside the scope of the present paper, we conjecture that the gains from policy coordination will be different in the present environment than previous models

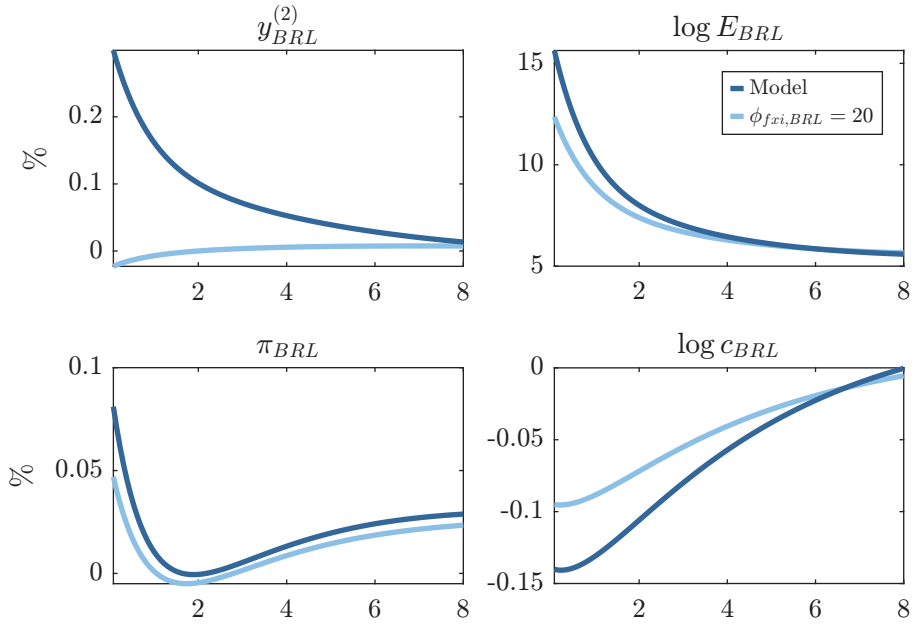


Figure 7: effects of FX intervention in response to U.S. monetary tightening

Notes: responses reported for same $\nu_{i1,t}$ innovation depicted in Figure 2. x-axis denotes quarters since the shock.

of small open economies facing exogenous risk premium shocks. This is because countries will not internalize the cumulative effects of their policy actions on the broad dollar exchange rate and, in turn, the risk-bearing capacity of global intermediaries.[32]

6 A future with higher dollar interest rates

We now use the model to study a potential future with higher dollar interest rates. With smaller resulting leverage of intermediaries in non-dollar bonds, such an environment would feature dampened effects of U.S. monetary policy on global risk premia. Higher dollar interest rates may arise in part from foreigners reducing their

[32]This is distinct from the role for policy coordination recently emphasized in Fontanier (2025). In that paper, intermediaries are not subject to currency risk, but emerging market firms who borrow in dollar-denominated debt are. From a global perspective, that paper argues that countries excessively tighten their policy rate in response to an external risk premium shock, because they do not internalize that the associated capital inflows and increase in dollar borrowing costs affects other countries. By contrast, we anticipate that in our model, countries may *insufficiently* tighten their policy rate in response to an external risk premium shock, because they do not internalize that the resulting dollar depreciation would mitigate the risk premium shock to begin with.

willingness to hold dollar exposure, consistent with asset prices since "liberation day".

6.1 Effects of higher dollar interest rates

We first explore how a higher average level of dollar interest rates would affect the transmission of U.S. monetary policy.

A higher steady-state dollar interest rate arises in the model via more impatience of U.S. households (lower β_1). It would also arise from lower foreign demand for dollar-denominated assets (lower $\bar{b}_{j1}$ for any j), provided we modify the model to make U.S. households unwilling to perfectly elastically supply such assets at the prevailing interest rate.[33] Under a similar condition, increased issuance of dollar-denominated debt by governments would also cause an increase in the dollar interest rate.

Here we consider a decrease in β_1 that raises the steady-state dollar interest rate by $0.5pp$ (annualized). Consistent with the discussion of the last row of Table 1, intermediaries take smaller equilibrium positions in emerging market currencies. Quantitatively, keeping all other economic primitives fixed, intermediaries' leverage in non-dollar bonds falls from its value of 32 in the baseline model, to 12 here.

The implications for U.S. monetary policy transmission reflect a smaller revaluation of intermediary wealth due to dampened currency mismatch. The first row of Figure 8 compares the asset price responses to a U.S. monetary tightening in this counterfactual environment versus the baseline model (from Figure 2). Following a U.S. monetary tightening in this counterfactual environment, the exchange rate depreciation of currencies paying high excess returns is dampened, as is the increase in bond yields of currencies with high excess bond carry returns.

These heterogeneous effects on U.S. monetary policy transmission to asset prices are in turn reflected in the real spillovers from U.S. tightening. The second row of Figure 8 compares the impulse responses to a U.S. tightening on outcomes in Brazil in the baseline model, versus this counterfactual environment. Brazil experiences smaller domestic inflation, a smaller increase in near-dated yields, and a smaller decline in consumption, consistent with a dampened effective risk premium shock. In this way, the model implies that a future with higher dollar interest rates will feature dampened

[33] This could be achieved by an adjustment cost in the dollar bond position of U.S. households. Note that this is a statement about steady-state — in response to shocks to foreign dollar demand, U.S. households will not elastically accommodate them because they wish to smooth consumption, so such shocks will affect allocations. We study such shocks in the next subsection.

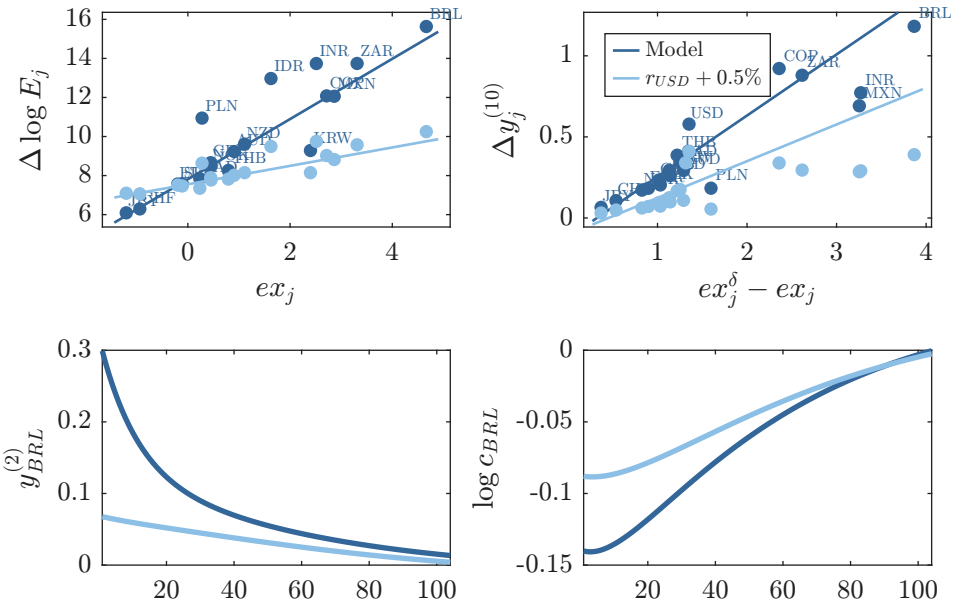


Figure 8: responses to U.S. monetary tightening with 0.5*pp* higher U.S. interest rate

Notes: responses reported for same $\nu_{i1,t}$ innovation in Figure 2.

U.S. monetary spillovers through risk pricing, particularly among emerging markets.

6.2 Has dollar demand fallen through 2025?

As noted in the prior subsection, one reason why dollar interest rates may rise is that the demand for dollar-denominated bonds falls. In this final analysis, we use our model to shed light on the potential dynamics of such demand in 2025.[34]

We extend our model so that foreign demand for one-period dollar bonds and dollar consols is now stochastic:

$$\bar{b}_{j1,t} = \bar{b}_{j1} + \nu_{\bar{b},t}, \quad \forall j > 1,$$
$$\bar{b}^{\delta}_{j1,t} = \bar{b}^{\delta}_{j1} + \nu_{\bar{b}^{\delta},t}, \quad \forall j > 1,$$

[34]This analysis complements recent models of the dollar depreciation in 2025. Hassan, Mertens, Wang, and Zhang (2025) propose a model in which the risk premium on dollar bonds rises because trade barriers dampen the dollar appreciation in bad times. Closer to our model, Itskhoki and Mukhin (2025) argue that an erosion of the dollar convenience yield is needed to explain the dollar depreciation in 2025, and Jiang, Krishnamurthy, Lustig, and Richmond (2025) quantify the steady-state consequences of a permanent loss in U.S. seignorage revenues. Our analysis differs from both papers because we quantify the effects of an erosion of foreign dollar demand in a dynamic model, disciplined by the price impact of flows.

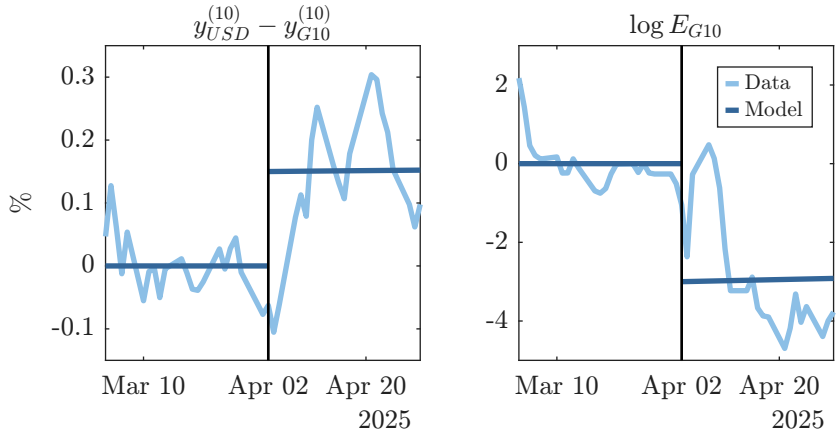


Figure 9: yield differential and exchange rates around "liberation day"

Notes: panels depict simple average across all G10 economies relative to the U.S. Yield differential in data refers to zero coupon government bond yields (as throughout the paper), though appendix D depicts these dynamics using 10-year OIS differentials. Model depicts effects of innovations to $\nu_{\bar{b},t}$ and $\nu_{\bar{b}^\delta,t}$ calibrated to match increase in U.S. 10-year yields by $0.15pp$ relative to other G10 yields, and dollar depreciation of $3pp$ relative to other G10 currencies.

where $\nu_{\bar{b},t}$ and $\nu_{\bar{b}^\delta,t}$ follow AR(1) processes with common persistence $\rho_{\bar{b}} = \rho_{\bar{b}^\delta}$. We assume a common innovation to demand for dollar-denominated assets across all foreign economies for simplicity. Appendix D depicts impulse responses to $\nu_{\bar{b},t}$ and $\nu_{\bar{b}^\delta,t}$. Both shocks imply a weaker dollar and higher dollar interest rate relative to foreign interest rates, a robust prediction of any shock that raises the dollar risk premium (Kekre and Lenel (2024a)). The shock for one-period bonds has a relatively larger effect on the exchange rate, while the shock for consols has a relatively larger effect on the long-term yield differential (driven by the dollar term premium).

Taken together, negative innovations to foreign demand for short- and long-dated dollar bonds can account for the dynamics of yield curves and the dollar exchange rate around "liberation day" in 2025. Figure 9 demonstrates that, around April 2, 2025, long-dated U.S. yields rose by roughly $0.15pp$ relative to other G10 yields, while the dollar depreciated by roughly $3pp$.[35] We can match these targets in the model using a negative innovation to $\nu_{\bar{b},t}$ equal to 3.0% of annual U.S. output, and a simultaneous

[35]Appendix D zooms out to plot the yield differential and against the dollar/G10 exchange rate through 2025. It demonstrates that the gap between the yield differential and dollar exchange rate that opened up around "liberation day" has not fully reversed. It also demonstrates that the dynamics of the yield differential around "liberation day" is evident using 10-year OIS rates, consistent with a declining demand for dollar assets, not just Treasuries.

		$\rho_{\bar{b}}, \rho_{\bar{b}^\delta}$			
$w_m/(52y_1)$	half-life QE1	$0.85^{1/52}$	$0.90^{1/52}$	$0.95^{1/52}$	$0.9999^{1/52}$
0.1%	$\approx$ 1 yr	-2.3%	-2.1%	-1.9%	-1.7%
0.2%	$\approx$ 2 yr	-3.1%	-2.7%	-2.4%	-2.1%
0.3%	$\approx$ 3 yr	-4.5%	-3.9%	-3.3%	-2.8%
0.8%	$\approx$ 170 yrs	-9.6%	-8.0%	-6.4%	-5.1%

Table 4: required $(d\nu_{\bar{b},t} + d\nu_{\bar{b}^\delta,t})/(52y_1)$ to match data around "liberation day"

Notes: each cell reports $d\nu_{\bar{b},t} + d\nu_{\bar{b}^\delta,t}$ relative to annual U.S. output calibrated to match $0.15pp$ increase in 10-year dollar yields relative to other G10 yields, and $3pp$ dollar depreciation relative to other G10 currencies, as observed around "liberation day". Rows vary intermediary endowment ω_m and thus intermediaries' steady-state wealth to annual output reported in first column. Second column reports half-life of QE1 which would rationalize this calibration of ω_m to match the price impact of QE1. Remaining columns vary persistence of innovation to foreign demand for dollar-denominated assets, $\rho_{\bar{b}}$ and $\rho_{\bar{b}^\delta}$ (assumed identical). Appendix D reports $d\nu_{\bar{b},t}$ and $d\nu_{\bar{b}^\delta,t}$ separately.

negative innovation to $\nu_{\bar{b}^\delta,t}$ equal to 0.3% of annual U.S. output, given persistence $\rho_{\bar{b}} = \rho_{\bar{b}^\delta} = 0.95$ (a half-life of roughly three years.)

The magnitude of the required innovation depends on the price impact of flows in the model. Table 4 summarizes the required total innovation $d\nu_{\bar{b},t} + d\nu_{\bar{b}^\delta,t}$ to match the same data as in Figure 9 as we vary (along the rows) intermediaries' steady-state wealth relative to annual U.S. GDP, $w_m/(4y_1)$.[36] Holding all other parameters fixed, at a higher value of intermediary wealth, the same dollar flow absorbed by intermediaries will change required excess returns by less. Our baseline calibration assumes $w_m/(4y_1) = 0.3\%$, which was chosen to match the price impact of QE1 in the model assuming a particular persistence of the QE1 shock. Had we assumed a QE1 shock with half-life of only one year, we would have required $w_m/(4y_1) = 0.1\%$ to match the same QE1 evidence, implying that a given outflow from dollar-denominated assets has much larger impact. Thus, continuing to assume $\rho_{\bar{b}} = \rho_{\bar{b}^\delta} = 0.95$, we would only need to assume a decline in foreign demand for dollar-denominated assets of 1.9% of annual U.S. output to match the same "liberation day" data.

The magnitude of the required innovation also depends on the assumed persistence of the foreign outflow from dollar-denominated bonds. Fixing the row of Table 4, the columns depict the required $d\nu_{\bar{b},t} + d\nu_{\bar{b}^\delta,t}$ to match the data in Figure 9 as we vary

[36]The underlying parameter here is the endowment of new intermediaries, ω_m, but we focus on the resulting steady-state wealth of intermediaries relative to annual U.S. GDP for ease of interpretation.

the persistences $\rho_{\bar{b}}, \rho_{\bar{b}^\delta}$. The key message is that as persistence rises, the required innovation $d\nu_{\bar{b},t} + d\nu_{\bar{b}^\delta,t}$ falls. This reflects that a more persistent decline in dollar demand by foreigners implies a more persistent rise in the risk premium on dollar-denominated assets required by intermediaries, and asset prices are forward-looking.

We conclude that, disciplined by the price impact of QE, a plausible flow out of dollar-denominated assets can account for asset price dynamics around "liberation day". Indeed, the required decline in foreigners' position is relatively small compared to the foreign-owned Treasury portfolio (debt of U.S. residents, assets in the U.S.) of roughly 25% (50%, 200%) of annual U.S. GDP.[37] The role of persistence also clarifies that no sales by foreigners need to be realized in the near term to generate large asset price reactions. Even if foreign portfolios gradually adjust away from dollar-denominated assets, we should expect price impact on the news of future rebalancing.

7 Conclusion

This paper has proposed a general equilibrium model of U.S. monetary policy spillovers through changes in risk premia in global financial markets. In an otherwise standard multi-country New Keynesian environment, capital flows are facilitated by global intermediaries that price the cross section of assets. If intermediaries are short the dollar and long foreign currencies, tighter U.S. monetary policy erodes intermediaries' net worth and raises the global price of risk. We conclude from observed asset prices that intermediary portfolios must indeed have this structure, assuming they are mean-variance efficient. Consistent with an increase in the price of risk, the high-frequency responses to a U.S. tightening line up with average excess returns. We quantify intermediaries' leverage to rationalize this evidence, and we assess the implications for global economic activity. In a potential future with higher dollar interest rates, the model implies that intermediaries will be less currency-mismatched and the spillovers of U.S. monetary policy through risk pricing will be dampened. A decline in foreign demand for dollar-denominated assets may be one reason dollar interest rates will rise, and such a shift appears consistent with asset price dynamics in 2025.

We see two natural directions to extend the analysis in this paper, both of which could take advantage of the tractable linearized framework we propose. First, we have focused on the transmission of U.S. monetary policy, given its central role in

[37] These calculations are based on Bureau of Economic Analysis data for Q1 2025.

discussions of a "global financial cycle." But the mechanisms we emphasize would also apply to any driving force that appreciates the dollar (such as a decline in U.S. output), which would endogenously raise risk premia in our model.[38] Future work could study many such shocks in this model and estimate their relative importance in explaining the comovements between the dollar and global risk pricing.[39] Second, our model can be used to study normative questions. We have conjectured that because the price of risk depends on the broad dollar exchange rate, it may imply novel gains from policy coordination in responding to spillovers induced by U.S. monetary policy (or other shocks). We leave the analysis of these questions to future work.

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[38] While the transmission from the dollar exchange rate to risk pricing is the focus of the present paper, it is also the case that an exogenous shock to intermediary risk aversion would appreciate the dollar owing to intermediaries' dollar funding, as emphasized in Kekre and Lenel (2024a).

[39] For a description of these comovements see, for instance, Obstfeld and Zhou (2023).

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Appendix for Online Publication

A Equilibrium

In this appendix we outline the equilibrium conditions pertaining to the model described in section 2 and the first-order approximation studied throughout the paper.

A.1 Equilibrium conditions

In addition to the variables defined in the main text, let us define

$$\begin{aligned} w_{j,t} &\equiv W_{j,t}/P_{j,t}, \\ \pi_{kj,t} &\equiv \log P_{kj,t}/P_{kj,t-1}, \\ b_{jk,t} &\equiv B_{jk,t}/P_{k,t}, \\ b^{\delta}_{jk,t} &\equiv B^{\delta}_{jk,t}/P_{k,t}. \end{aligned}$$

The optimality conditions of the representative households in each country are:

$$1 = E_t \beta_j \left(\frac{c_{j,t+1}}{c_{j,t}} \right)^{-1/\psi} \exp(-\pi_{j,t+1})(1 + i_{j,t}), \ \ \forall j, \tag{5}$$

$$b_{jk,t} = \bar{b}_{jk}, \ \ \forall j, k \neq j, \tag{6}$$

$$b^{\delta}_{jk,t} = \bar{b}^{\delta}_{jk}, \ \ \forall j, k, \tag{7}$$

$$\bar{\varphi} \ell_{j,t}^{1/\varphi} c_{j,t}^{1/\psi} = w_{j,t}, \ \ \forall j, \tag{8}$$

$$c_{jk,t} = \eta_{jk} \left(p_{jk,t} \right)^{-\sigma} c_{j,t}, \ \ \forall j, k. \tag{9}$$

The resource constraints and evolution of net foreign assets of all countries besides the U.S., which also makes use of firms' profits, goods market clearing, and the equilibrium lump-sum transfers, are:

$$c_{j,t} + \sum_{k=1}^{n} q_{j,t} q_{k,t}^{-1} \left(b_{jk,t} + b^{\delta}_{jk,t} \right) = \zeta_j^{-1} q_{j,t} \sum_{k=1}^{n} \zeta_k q_{k,t}^{-1} p_{kj,t} c_{kj,t} + a_{j,t}, \ \ \forall j > 1, \tag{10}$$

$$a_{j,t+1} = \sum_{k=1}^{n} \exp(\Delta \log q_{j,t+1} - \Delta \log q_{k,t+1} - \pi_{k,t+1}) \times$$

$$\left((1+i_{k,t})q_{j,t}q_{k,t}^{-1}b_{jk,t}+\left(\frac{1+\delta P_{k,t+1}^{\delta}}{P_{k,t}^{\delta}}\right)q_{j,t}q_{k,t}^{-1}b_{jk,t}^{\delta}\right),\ \ \forall j>1. \tag{11}$$

The optimal price-setting conditions of firms in each origin and destination market, which also makes use of the symmetry of firms from each origin as well as goods market clearing, are:

$$\begin{aligned}(\exp(\pi_{kj,t})-1)\exp(\pi_{kj,t}) &= \frac{\varepsilon-1}{\chi_p}\left[\frac{\varepsilon}{\varepsilon-1}\frac{w_{j,t}}{q_{j,t}q_{k,t}^{-1}p_{kj,t}}-1\right]\\ &+E_t\beta\left(\frac{c_{j,t+1}}{c_{j,t}}\right)^{-1/\psi}\exp(\Delta\log q_{j,t+1}-\Delta\log q_{k,t+1})\frac{p_{kj,t+1}c_{kj,t+1}}{p_{kj,t}c_{kj,t}}\times\\ &(\exp(\pi_{kj,t+1})-1)\exp(\pi_{kj,t+1}),\ \ \forall j,k.\end{aligned} \tag{12}$$

The definition of excess returns, optimality conditions of intermediaries, and resource constraints of intermediaries are:

$$ex_{j,t+1}=\frac{E_{j,t}}{E_{j,t+1}}(1+i_{j,t})-(1+i_{1,t}),\ \ \forall j>1, \tag{13}$$

$$ex_{j,t+1}^{\delta}\equiv\frac{E_{j,t}}{E_{j,t+1}}\frac{1+\delta P_{j,t+1}^{\delta}}{P_{j,t}^{\delta}}-(1+i_{1,t}),\ \ \forall j, \tag{14}$$

$$\begin{aligned}E_tex_{j,t+1} &= \frac{\gamma}{w_{m,t}}\left[\sum_{k=2}^{n}Cov_t\left(ex_{j,t+1},ex_{k,t+1}\right)q_{k,t}^{-1}b_{mk,t}\right.\\ &\left.+\sum_{k=1}^{n}Cov_t\left(ex_{j,t+1},ex_{k,t+1}^{\delta}\right)q_{k,t}^{-1}b_{mk,t}^{\delta}\right],\ \ \forall j>1,\end{aligned} \tag{15}$$

$$\begin{aligned}E_tex_{j,t+1}^{\delta} &= \frac{\gamma}{w_{m,t}}\left[\sum_{k=2}^{n}Cov_t\left(ex_{j,t+1}^{\delta},ex_{k,t+1}\right)q_{k,t}^{-1}b_{mk,t}\right.\\ &\left.+\sum_{k=1}^{n}Cov_t\left(ex_{j,t+1}^{\delta},ex_{k,t+1}^{\delta}\right)q_{k,t}^{-1}b_{mk,t}^{\delta}\right],\ \ \forall j,\end{aligned} \tag{16}$$

$$\sum_{j=1}^{n}q_{j,t}^{-1}\left[b_{mj,t}+b_{mj,t}^{\delta}\right]=w_{m,t}, \tag{17}$$

$$\begin{aligned}w_{m,t+1} &= \xi\omega_m+(1-\xi)\exp(-\pi_{1,t+1})\left[(1+i_{1,t})w_{m,t}\right.\\ &\left.+\sum_{j=2}^{n}ex_{j,t+1}q_{j,t}^{-1}b_{mj,t}+\sum_{j=1}^{n}ex_{j,t+1}^{\delta}q_{j,t}^{-1}b_{mj,t}^{\delta}\right].\end{aligned} \tag{18}$$

The definitions of CPIs and mapping between prices are:

$$1 = \left(\sum_{k=1}^{n} \eta_{jk} \left(p_{jk,t} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \ \ \forall j, \tag{19}$$

$$\pi_{kj,t} = \Delta \log p_{kj,t} + \pi_{k,t}, \ \ \forall j, k, \tag{20}$$

$$\Delta \log q_{j,t} = \Delta \log E_{j,t} + \pi_{1,t} - \pi_{j,t}, \ \ \forall j > 1. \tag{21}$$

The market clearing conditions, also making use of firms' technologies, are:

$$\sum_{k=1}^{n} \zeta_k c_{kj,t} = \zeta_j \ell_{j,t}, \ \ \forall j, \tag{22}$$

$$\sum_{k=1}^{n} \zeta_k b_{kj,t} + b_{mj,t} = 0, \ \ \forall j, \tag{23}$$

$$\sum_{k=1}^{n} \zeta_k b^{\delta}_{kj,t} + b^{\delta}_{mj,t} = 0, \ \ \forall j. \tag{24}$$

The specification of policy is finally:

$$\log(1 + i_{j,t}) = \log(1 + i_j) + \rho_i \left(\log(1 + i_{j,t-1}) - \log(1 + i_j) \right) + \phi_\pi \pi_{j,t} + \nu_{ij,t}, \ \ \forall j. \tag{25}$$

By Walras' Law, we have that the U.S. aggregate resource constraint

$$c_{1,t} + \sum_{k=1}^{n} q_{k,t}^{-1} \left(b_{1k,t} + b_{mk,t} + b^{\delta}_{mk,t} + b^{\delta}_{1k,t} \right) = \sum_{k=1}^{n} \zeta_k q_{k,t}^{-1} p_{k1,t} c_{k1,t}$$
$$+ \sum_{k=1}^{n} q_{k,t}^{-1} \exp(-\pi_{k,t}) \left((1 + i_{k,t-1})(b_{1k,t-1} + b_{mk,t-1}) + \left(\frac{1 + \delta P^{\delta}_{k,t}}{P^{\delta}_{k,t-1}} \right) \left(b^{\delta}_{1k,t-1} + b^{\delta}_{mk,t-1} \right) \right)$$

is satisfied as well.

(5)-(25) define a dynamical system of $5n^2 + 13n - 3$ equations in $5n^2 + 13n - 3$ unknowns

$$\{\{\{c_{jk,t}, b_{jk,t}, b^{\delta}_{jk,t}, p_{jk,t}, \pi_{jk,t}\}, c_{j,t}, \ell_{j,t}, b_{mj,t}, b^{\delta}_{mj,t}, w_{j,t}, \pi_{j,t}, i_{j,t}, P^{\delta}_{j,t}, ex^{\delta}_{j,t+1}\},$$
$$\{q_{j,t}, E_{j,t}, ex_{j,t+1}, a_{j,t+1}\}_{j>1}, w_{m,t+1}\},$$

given the endogenous state variables $\{\{p_{jk,t-1}\}, \{q_{j,t-1}, E_{j,t-1}, a_{j,t}\}_{j>1}, w_{m,t}\}$, exogenous state variables $\{\nu_{ij,t}\}$ and any other driving forces which can be added to the model, and evolution of exogenous state variables.

A.2 First-order approximation with risk premia

We now characterize the first-order approximation studied in the paper. Since the approximation for all equilibrium conditions except arbitrageurs' portfolio choice (15)-(16) is standard, we focus on the latter. The approach and exposition closely follows that in Kekre and Lenel (2024a), which in turn follows Itskhoki and Mukhin (2021) and Borovicka et al. (2023).

Let us collect the state variables of the model in a vector $\boldsymbol{\theta}_t$, and let us scale the volatility of all innovations by the perturbation parameter σ. We will approximate the equilibrium around the point of approximation $\sigma \to 0$ and $\boldsymbol{\theta}_t = \boldsymbol{\theta}$.

Around that point, the first-order evolution of state variables is given by

$$\boldsymbol{\theta}_{t+1} = \boldsymbol{\theta} + \boldsymbol{\Delta}_\theta^\theta (\boldsymbol{\theta}_t - \boldsymbol{\theta}) + \boldsymbol{\Delta}_\epsilon^\theta \sigma \boldsymbol{\epsilon}_{t+1},$$

where $\boldsymbol{\Delta}_\theta^\theta$ is a matrix of coefficients on lagged state variables, $\boldsymbol{\Delta}_\epsilon^\theta$ is a matrix of coefficients on innovations to driving forces, and $\boldsymbol{\epsilon}_{t+1}$ is a vector of these innovations. We ignore coefficients on the perturbation parameter σ anticipating that these will be zero around the point of approximation. Similarly, a first-order approximation for $\log q_{k,t}$, $b_{mk,t}$, $b^\delta_{mk,t}$, $\log w_{m,t}$, $ex_{j,t+1}$, and $ex^\delta_{j,t+1}$ around the point of approximation is given by

$$\begin{aligned}
\log q_{k,t} &= \log q_k + \boldsymbol{\delta}_\theta^{q_k} (\boldsymbol{\theta}_t - \boldsymbol{\theta}), \\
b_{mk,t} &= b_{mk} + \boldsymbol{\delta}_\theta^{b_{mk}} (\boldsymbol{\theta}_t - \boldsymbol{\theta}), \\
b^\delta_{mk,t} &= b^\delta_{mk} + \boldsymbol{\delta}_\theta^{b^\delta_{mk}} (\boldsymbol{\theta}_t - \boldsymbol{\theta}), \\
\log w_{m,t} &= \log w_m + \boldsymbol{\delta}_\theta^{w_m} (\boldsymbol{\theta}_t - \boldsymbol{\theta}), \\
ex_{j,t+1} &= ex_j + \boldsymbol{\delta}_\theta^{ex_j} (\boldsymbol{\theta}_t - \boldsymbol{\theta}) + \boldsymbol{\delta}_\epsilon^{ex_j} \sigma \boldsymbol{\epsilon}_{t+1}, \\
ex^\delta_{j,t+1} &= ex^\delta_j + \boldsymbol{\delta}_\theta^{ex^\delta_j} (\boldsymbol{\theta}_t - \boldsymbol{\theta}) + \boldsymbol{\delta}_\epsilon^{ex^\delta_j} \sigma \boldsymbol{\epsilon}_{t+1},
\end{aligned}$$

where $\boldsymbol{\delta}_\theta^x$ is a row vector of coefficients on the state variables and $\boldsymbol{\delta}_\epsilon^{ex_j}$, $\boldsymbol{\delta}_\epsilon^{ex^\delta_j}$ are row vectors of coefficients on innovations.

By the property of lognormally distributed variables, we have that

$$\begin{aligned} &Cov_t\left(ex_j + \boldsymbol{\delta}_\theta^{ex_j}(\boldsymbol{\theta}_t - \boldsymbol{\theta}) + \boldsymbol{\delta}_\epsilon^{ex_j}\sigma\boldsymbol{\epsilon}_{t+1}, ex_k + \boldsymbol{\delta}_\theta^{ex_k}(\boldsymbol{\theta}_t - \boldsymbol{\theta}) + \boldsymbol{\delta}_\epsilon^{ex_k}\sigma\boldsymbol{\epsilon}_{t+1}\right), \\ &\quad = \boldsymbol{\delta}_\epsilon^{ex_j}\Sigma^2\left(\boldsymbol{\delta}_\epsilon^{ex_k}\right)'\sigma^2, \\ &\quad \equiv Cov(ex_{j,+1}, ex_{k,+1})\sigma^2, \end{aligned}$$

where Σ is the covariance matrix of the innovations, scaled appropriately by σ^2. An analogous argument holds for $Cov_t\left(ex_{j,t+1}, ex^\delta_{k,t+1}\right)$ and $Cov_t\left(ex^\delta_{j,t+1}, ex^\delta_{k,t+1}\right)$. Thus, substituting the first-order approximations for all variables into (15) yields

$$\begin{aligned} &ex_j + \boldsymbol{\delta}_\theta^{ex_j}(\boldsymbol{\theta}_t - \boldsymbol{\theta}) \\ &= \frac{a(\sigma)\sigma^2}{w_m + \boldsymbol{\delta}_\theta^{w_m}(\boldsymbol{\theta}_t - \boldsymbol{\theta})}\left[\sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1})\exp\left(-\log q_k - \boldsymbol{\delta}_\theta^{q_k}(\boldsymbol{\theta}_t - \boldsymbol{\theta})\right)\left(b_{mk} + \boldsymbol{\delta}_\theta^{b_{mk}}(\boldsymbol{\theta}_t - \boldsymbol{\theta})\right)\right. \\ &\qquad \left. + \sum_{k=1}^{n} Cov(ex_{j,+1}, ex^\delta_{k,+1})\exp\left(-\log q_k - \boldsymbol{\delta}_\theta^{q_k}(\boldsymbol{\theta}_t - \boldsymbol{\theta})\right)\left(b^\delta_{mk} + \boldsymbol{\delta}_\theta^{b^\delta_{mk}}(\boldsymbol{\theta}_t - \boldsymbol{\theta})\right)\right]. \end{aligned}$$

Hence, at the point of approximation, under the assumption $\gamma(\sigma)\sigma^2 \to \Gamma$ as $\sigma \to 0$, we have that

$$ex_j = \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1})q_k^{-1}b_{mk} + \sum_{k=1}^{n} Cov(ex_{j,+1}, ex^\delta_{k,+1})q_k^{-1}b^\delta_{mk}\right].$$

Differentiating the above condition with respect to each state variable and evaluating at the point of approximation, the coefficients will solve

$$\begin{aligned} E_t\hat{ex}_{j,t+1} = -ex_j\hat{w}_{m,t} + \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1})\left(-q_k^{-1}b_{mk}\hat{q}_{k,t} + q_k^{-1}\hat{b}_{mk,t}\right)\right. \\ \left. + \sum_{k=1}^{n} Cov(ex_{j,+1}, ex^\delta_{k,+1})\left(-q_k^{-1}b^\delta_{mk}\hat{q}_{k,t} + q_k^{-1}\hat{b}^\delta_{mk,t}\right)\right]. \end{aligned}$$

It is straightforward to show that a similar argument applies for consol pricing (16). At the point of approximation,

$$ex_j = \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex^\delta_{j,+1}, ex_{k,+1})q_k^{-1}b_{mk} + \sum_{k=1}^{n} Cov(ex^\delta_{j,+1}, ex^\delta_{k,+1})q_k^{-1}b^\delta_{mk}\right],$$

and to first order around the point of approximation,

$$E_t\hat{ex}^{\delta}_{j,t+1} = -ex^{\delta}_j\hat{w}_{m,t} + \frac{\Gamma}{w_m}\left[\sum_{k=2}^{n} Cov(ex^{\delta}_{j,+1}, ex_{k,+1})\left(-q_k^{-1}b_{mk}\hat{q}_{k,t} + q_k^{-1}\hat{b}_{mk,t}\right)\right.$$
$$\left. + \sum_{k=1}^{n} Cov(ex^{\delta}_{j,+1}, ex^{\delta}_{k,+1})\left(-q_k^{-1}b^{\delta}_{mk}\hat{q}_{k,t} + q_k^{-1}\hat{b}^{\delta}_{mk,t}\right)\right].$$

B Proofs of analytical results

In this appendix we provide proofs of our analytical results in section 3.

B.1 Proposition 1

Proof. We first characterize the first-order approximation of the equilibrium (5)-(25) around an arbitrary steady-state, but already using that $\chi_p \to 0$, which implies

$$\hat{p}_{jk,t} = 0,$$
$$\pi_{jk,t} = 0,$$
$$\hat{q}_{j,t} = \hat{E}_{j,t}.$$

We also use that, since households' positions in foreign one-period bonds and consols are exogenous and fixed,

$$\hat{b}_{jk,t} = 0, \ \ \forall j, k \neq j,$$
$$\hat{b}^{\delta}_{jk,t} = 0, \ \ \forall j, k.$$

We finally also use that there is no interest rate inertia ($\rho_i = 0$).

The optimality conditions of the representative households in each country are:

$$0 = -\frac{1}{\psi}E_t\Delta\hat{c}_{j,t+1} + \hat{i}_{j,t}, \ \ \forall j,$$
$$\hat{c}_{jk,t} = \hat{c}_{j,t}, \ \ \forall j, k.$$

The labor-leisure condition is only relevant to characterize the behavior of real wages, which are not of interest, so we ignore it.

The resource constraints and evolution of net foreign assets of all countries besides the U.S. are:

$$
\begin{aligned}
&c_j\hat{c}_{j,t} + \hat{b}_{jj,t} + \sum_{k=1}^{n} q_j q_k^{-1}(b_{jk} + b_{jk}^{\delta})\left(\hat{q}_{j,t} - \hat{q}_{k,t}\right) \\
&\quad = \zeta_j^{-1} q_j \sum_{k=1}^{n} \zeta_k q_k^{-1} p_{kj} c_{kj}\left(\hat{q}_{j,t} - \hat{q}_{k,t} + \hat{c}_{k,t}\right) + \hat{a}_{j,t}, \ \ \forall j > 1, \\
&\hat{a}_{j,t+1} = (1+i_j)\hat{b}_{jj,t} + \sum_{k=1}^{n}\Bigg[\left((1+i_k) q_j q_k^{-1} b_{jk} + \left(\frac{1+\delta P_k^{\delta}}{P_k^{\delta}}\right) q_j q_k^{-1} b_{jk}^{\delta}\right)\left(\hat{q}_{j,t+1} - \hat{q}_{k,t+1}\right) \\
&\quad + (1+i_k) q_j q_k^{-1} b_{jk}\hat{i}_{k,t} + \left(\frac{1+\delta P_k^{\delta}}{P_k^{\delta}}\right) q_j q_k^{-1} b_{jk}^{\delta}\left(\frac{\delta P_k^{\delta}}{1+\delta P_k^{\delta}}\hat{P}_{k,t+1}^{\delta} - \hat{P}_{k,t}^{\delta}\right)\Bigg], \ \ \forall j > 1.
\end{aligned}
$$

The definition of excess returns, optimality conditions of intermediaries, and resource constraints of intermediaries are:

$$
\begin{aligned}
&\hat{ex}_{j,t+1} = (1+i_j)\left(-\Delta\hat{q}_{j,t+1} + \hat{i}_{j,t}\right) - (1+i_1)\hat{i}_{1,t}, \ \ \forall j > 1, \\
&\hat{ex}_{j,t+1}^{\delta} = \left(\frac{1+\delta P_j^{\delta}}{P_j^{\delta}}\right)\left(-\Delta\hat{q}_{j,t+1} + \frac{\delta P_j^{\delta}}{1+\delta P_j^{\delta}}\hat{P}_{j,t+1}^{\delta} - \hat{P}_{j,t}^{\delta}\right) - (1+i_1)\hat{i}_{1,t}, \ \ \forall j, \\
&E_t\hat{ex}_{j,t+1} = -\frac{ex_j}{w_m}\hat{w}_{m,t} + \frac{\Gamma}{w_m}\Bigg[\sum_{k=2}^{n} Cov\left(ex_{j,+1}, ex_{k,+1}\right)\left(q_k^{-1}\hat{b}_{mk,t} - q_k^{-1} b_{mk}\hat{q}_{k,t}\right) \\
&\quad + \sum_{k=1}^{n} Cov\left(ex_{j,+1}, ex_{k,+1}^{\delta}\right)\left(q_k^{-1}\hat{b}_{mk,t}^{\delta} - q_k^{-1} b_{mk}^{\delta}\hat{q}_{k,t}\right)\Bigg], \ \ \forall j > 1, \\
&E_t\hat{ex}_{j,t+1}^{\delta} = -\frac{ex_j^{\delta}}{w_m}\hat{w}_{m,t} + \frac{\Gamma}{w_m}\Bigg[\sum_{k=2}^{n} Cov\left(ex_{j,+1}^{\delta}, ex_{k,+1}\right)\left(q_k^{-1}\hat{b}_{mk,t} - q_k^{-1} b_{mk}\hat{q}_{k,t}\right) \\
&\quad + \sum_{k=1}^{n} Cov\left(ex_{j,+1}^{\delta}, ex_{k,+1}^{\delta}\right)\left(q_k^{-1}\hat{b}_{mk,t}^{\delta} - q_k^{-1} b_{mk}^{\delta}\hat{q}_{k,t}\right)\Bigg], \ \ \forall j, \\
&\sum_{j=1}^{n} q_j^{-1}\left(\hat{b}_{mj,t} + \hat{b}_{mj,t}^{\delta} - \left(b_{mj} + b_{mj}^{\delta}\right)\hat{q}_{j,t}\right) = \hat{w}_{m,t}, \\
&\hat{w}_{m,t+1} = (1-\xi)\Bigg[(1+i_1) w_m \hat{i}_{1,t} + (1+i_1)\hat{w}_{m,t} \\
&\quad + \sum_{j=2}^{n} q_j^{-1}\left(b_{mj}\hat{ex}_{j,t+1} - ex_j b_{mj}\hat{q}_{j,t} + ex_j\hat{b}_{mj,t}\right)
\end{aligned}
$$

$$+\sum_{j=1}^{n} q_j^{-1}\left(b_{mj}^{\delta}\hat{ex}_{j,t+1}^{\delta} - ex_j^{\delta}b_{mj}^{\delta}\hat{q}_{j,t} + ex_j^{\delta}\hat{b}_{mj,t}^{\delta}\right)\Bigg].$$

The bond market clearing conditions are:

$$\sum_{k=1}^{n}\zeta_k\hat{b}_{kj,t} + \hat{b}_{mj,t} = 0, \ \ \forall j,$$
$$\sum_{k=1}^{n}\zeta_k\hat{b}_{kj,t}^{\delta} + \hat{b}_{mj,t}^{\delta} = 0, \ \ \forall j.$$

The goods market clearing condition is only relevant to characterize the implied behavior of labor, which is again not of interest, so we ignore it.

The specification of policy is finally:

$$\hat{i}_{j,t} = \nu_{ij,t}, \ \ \forall j.$$

As stated in the claim, we will now characterize the effects of a U.S. monetary shock $\nu_{i1,t}$ around a steady-state with small excess returns, small one-period bond positions, and zero consol positions. We first formalize what this condition means.

Suppose we parameterize primitives as:

$$\begin{aligned}
\bar{b}_{jk} &= \kappa\bar{\tilde{b}}_{jk}, \ \ \forall j, k \neq j,\\
\bar{b}_{jk}^{\delta} &= 0, \ \ \forall j, k,\\
\beta_j &= \beta + \kappa\left(\tilde{\beta}_j - \beta\right), \ \ \forall j,\\
\Gamma &= \tilde{\Gamma}\kappa^2,\\
\omega_m &= \tilde{\omega}_m\kappa^2,
\end{aligned}$$

for some $\kappa > 0$. Let us further define the "tilde" allocation

$$\begin{aligned}
\tilde{i}_1 &\equiv (i_1 - (\beta^{-1} - 1))/\kappa,\\
\tilde{ex}_j &\equiv ex_j/\kappa, \ \ \forall j > 1,\\
\tilde{ex}_j^{\delta} &\equiv ex_j^{\delta}/\kappa, \ \ \forall j,\\
\tilde{w}_m &\equiv w_m/\kappa^2,\\
\tilde{b}_{mj} &\equiv b_{mj}/\kappa, \ \ \forall j > 1,
\end{aligned}$$

$$\tilde{b}_{jk} \equiv b_{jk}/\kappa, \ \ \forall j, k \neq j.$$

Now in any steady-state with zero household consol positions and thus zero intermediary consol positions, the equilibrium conditions from appendix A imply that $\{\{i_j, ex_j^\delta, q_j^{-1} b_{mj}\}, w_m\}$ must solve

$$\begin{aligned}
&1 = \beta_j (1 + i_j), \ \ \forall j, \\
&i_j - i_1 = \frac{\Gamma}{w_m} \sum_{k=2}^{n} Cov\left(ex_{j,+1}, ex_{k,+1}\right) q_k^{-1} b_{mk}, \ \ \forall j > 1, \\
&ex_j^\delta = \frac{\Gamma}{w_m} \sum_{k=2}^{n} Cov\left(ex_{j,+1}^\delta, ex_{k,+1}\right) q_k^{-1} b_{mk}, \ \ \forall j, \\
&\sum_{j=1}^{n} q_j^{-1} b_{mj} = w_m, \\
&w_m = \xi \omega_m + (1 - \xi) \left[(1 + i_1) w_m + \sum_{j=2}^{n} (i_j - i_1) q_j^{-1} b_{mj} \right].
\end{aligned}$$

Then substituting in for the "tilde" allocation above and evaluating at the limit $\kappa \to 0$ implies that $\{\{\tilde{i}_j, \tilde{ex}_j^\delta, q_j^{-1} \tilde{b}_{mj}\}, \tilde{w}_m\}$ solve

$$\begin{aligned}
&0 = \beta^{-1} \left(\tilde{\beta}_j - \beta \right) + \beta \tilde{i}_1, \ \ \forall j, \\
&\tilde{ex}_j = \frac{\tilde{\Gamma}}{\tilde{w}_m} \sum_{k=2}^{n} Cov\left(ex_{j,+1}, ex_{k,+1}\right) q_k^{-1} \tilde{b}_{mk}, \ \ \forall j > 1, \\
&\tilde{ex}_j^\delta = \frac{\tilde{\Gamma}}{\tilde{w}_m} \sum_{k=2}^{n} Cov\left(ex_{j,+1}^\delta, ex_{k,+1}\right) q_k^{-1} \tilde{b}_{mk}, \ \ \forall j, \\
&\sum_{j=1}^{n} q_j^{-1} \tilde{b}_{mj} = 0, \\
&\tilde{w}_m = \xi \tilde{\omega}_m + (1 - \xi) \left[\beta^{-1} \tilde{w}_m + \sum_{j=2}^{n} \tilde{ex}_j q_j^{-1} \tilde{b}_{mj} \right].
\end{aligned}$$

This is a convenient limit because it means that as $\kappa \to 0$, all valuation effects in the household budget constraints vanish in the first-order approximation (since $b_{jk} \to 0$ for all j, k). At the same time, intermediaries' effective risk aversion Γ / w_m remains nonzero even in the limit, and the valuation effects of shocks on intermediary

balance sheets, and the resulting endogenous price of risk, also do not vanish. In particular, note that

$$\frac{ex_j q_j^{-1} b_{mj}}{w_m} \to \frac{\tilde{ex}_j q_j^{-1} \tilde{b}_{mj}}{\tilde{w}_m} \ \ \forall j,$$

which will not in general be zero.

We also make only for expositional simplicity the assumptions that

$$\sum_{k=1}^{n} \zeta_k \eta_{kj} = \zeta_j, \ \ \forall j,$$
$$\bar{\varphi} = \frac{\varepsilon - 1}{\varepsilon},$$

which implies that the limiting steady-state features:

$$c_j = 1, \ \ \forall j,$$
$$\ell_j = 1, \ \ \forall j,$$
$$c_{jk} = \eta_{jk}, \ \ \forall j, k,$$
$$p_{jk} = 1, \ \ \forall j, k,$$
$$q_j = 1, \ \ \forall j.$$

Given these assumptions on the steady-state, we can write the first-order system as follows. We do so in matrix notation for brevity. The local currency bond optimality conditions together with the monetary policy rules imply

$$\mathbf{0}_n = -\frac{1}{\psi} E_t \Delta \hat{\boldsymbol{c}}_{t+1} + \left(\mathbf{1}_n - \boldsymbol{J}'_{n-1} \mathbf{1}_{n-1} \right) \nu_{i1,t}, \tag{26}$$

where $\mathbf{0}_n$ is a $n \times 1$ vector of zeros; $\hat{\boldsymbol{c}}_t$ is a $n \times 1$ vector of $\hat{c}_{j,t}$; $\mathbf{1}_n$ is a $n \times 1$ vector of ones; and $\boldsymbol{J}_{n-1}$ is a $(n-1) \times n$ matrix of zeros in the first column, and $\boldsymbol{I}_{n-1}$ in the remaining columns

The non-U.S. resource constraints, together with the evolution of net worth and the assumption $\sum_{k=1}^{n} \zeta_k \eta_{kj} = \zeta_j$, imply

$$\boldsymbol{J}_{n-1} \hat{\boldsymbol{c}}_t + \beta \hat{\boldsymbol{a}}_t = \hat{\boldsymbol{q}}_t - \boldsymbol{J}_{n-1} \boldsymbol{\zeta}^{-1} (\boldsymbol{\zeta} \boldsymbol{\eta})' \boldsymbol{J}'_{n-1} \hat{\boldsymbol{q}}_t + \boldsymbol{J}_{n-1} \boldsymbol{\zeta}^{-1} (\boldsymbol{\zeta} \boldsymbol{\eta})' \hat{\boldsymbol{c}}_t + \hat{\boldsymbol{a}}_{t-1}, \tag{27}$$

where $\hat{\boldsymbol{a}}_t$ is a $(n-1) \times 1$ vector of $\hat{a}_{j,t}$; $\hat{\boldsymbol{q}}_t$ is a $(n-1) \times 1$ vector of $\hat{q}_{j,t}$; $\boldsymbol{\zeta}$ is a $n \times n$ matrix

of ζ_j on the diagonals, and zero on off-diagonals; and $\boldsymbol{\eta}$ is a $n \times n$ matrix of η_{jk}. Note that we have changed the timing convention for $\hat{a}_{j,t}$ given the absence of valuation effects on the household budget constraints around the assumed steady-state.

The definition of excess returns, together with the monetary policy rules, implies

$$\hat{\boldsymbol{ex}}_{t+1} = \beta^{-1}\left(-\Delta\hat{\boldsymbol{q}}_{t+1} - \mathbf{1}_{n-1}\nu_{i1,t}\right). \tag{28}$$

The intermediary optimality conditions for one-period bonds are

$$E_t\hat{\boldsymbol{ex}}_{t+1} = -\boldsymbol{ex}\frac{1}{w_m}\hat{w}_{m,t} - \beta\frac{\Gamma}{w_m}\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\hat{\boldsymbol{a}}_t, \tag{29}$$

where $\boldsymbol{C}$ is a $(n-1)\times(n-1)$ matrix of $Cov\left(ex_{j,+1}, ex_{k,+1}\right)$ (in an abuse of the notation for $\boldsymbol{C}$ used in the main text, which includes covariances with consol bond returns).

Finally, the evolution of intermediary net worth is

$$\hat{w}_{m,t+1} = (1-\xi)\left[\beta^{-1}\hat{w}_{m,t} + \boldsymbol{b}'_m\hat{\boldsymbol{ex}}_{t+1} - \boldsymbol{ex}'\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\hat{\boldsymbol{a}}_t\right], \tag{30}$$

where $\boldsymbol{ex}$ is a $(n-1)\times 1$ vector of ex_j; and $\boldsymbol{b}_m$ is a $(n-1)\times 1$ vector of b_{mj} for $j > 1$. Note here that we have eliminated terms of order κ^2 from the evolution of $\hat{w}_{m,t+1}$, but retained terms of order κ, as these will be relevant for risk pricing.[40]

Then, (26)-(30) is a linear system of expectational difference equations in $\{\hat{\boldsymbol{c}}_t, \hat{\boldsymbol{q}}_t, \hat{\boldsymbol{a}}_t, \hat{w}_{m,t+1}, \hat{\boldsymbol{ex}}_{t+1}\}$, given the state variables $\{\hat{\boldsymbol{a}}_{t-1}, \hat{w}_{m,t}, \nu_{i1,t}\}$ and the evolution of the exogenous state variable $\nu_{i1,t}$. We conjecture a solution of the form

$$\begin{aligned}
\hat{\boldsymbol{c}}_t &= \boldsymbol{\Delta}^c_a\hat{\boldsymbol{a}}_{t-1} + \boldsymbol{\delta}^c_w\hat{w}_{m,t} + \boldsymbol{\delta}^c_\nu\nu_{i1,t},\\
\hat{\boldsymbol{q}}_t &= \boldsymbol{\Delta}^q_a\hat{\boldsymbol{a}}_{t-1} + \boldsymbol{\delta}^q_w\hat{w}_{m,t} + \boldsymbol{\delta}^q_\nu\nu_{i1,t},\\
\hat{\boldsymbol{a}}_t &= \boldsymbol{\Delta}^a_a\hat{\boldsymbol{a}}_{t-1} + \boldsymbol{\delta}^a_w\hat{w}_{m,t} + \boldsymbol{\delta}^a_\nu\nu_{i1,t},\\
\hat{w}_{m,t+1} &= \boldsymbol{\delta}^{Ew}_a\hat{\boldsymbol{a}}_{t-1} + \delta^{Ew}_w\hat{w}_{m,t} + \delta^{Ew}_\nu\nu_{i1,t} + \delta^w_\epsilon\epsilon_{\nu 1,t+1},\\
\hat{\boldsymbol{ex}}_{t+1} &= \boldsymbol{\Delta}^{Eex}_a\hat{\boldsymbol{ex}}_{t-1} + \boldsymbol{\delta}^{Eex}_w\hat{w}_{m,t} + \boldsymbol{\delta}^{Eex}_\nu\nu_{i1,t} + \boldsymbol{\delta}^{ex}_\epsilon\epsilon_{\nu 1,t+1},
\end{aligned}$$

where $\boldsymbol{\Delta}^{\cdot}_{\cdot}$, $\boldsymbol{\delta}^{\cdot}_{\cdot}$, and $\delta^{\cdot}_{\cdot}$ are matrices, vectors, and scalars of coefficients, respectively. We use the method of undetermined coefficients to characterize the solution.

Our main object of interest in the proposition is the impact effect of $\epsilon_{\nu 1,t}$ on

[40] This in turn is because they are multiplied by $\boldsymbol{ex}\frac{1}{w_m}$, which is of order κ^{-1}, in (29).

exchange rates. This is given by

$$\boldsymbol{\delta}_w^q \delta_\epsilon^w + \boldsymbol{\delta}_\nu^q.$$

By (27), we have that

$$\hat{\boldsymbol{q}}_t = \boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\hat{\boldsymbol{c}}_t + \beta\hat{\boldsymbol{a}}_t - \hat{\boldsymbol{a}}_{t-1}\right]$$

where

$$\boldsymbol{Q}_{n-1} \equiv \left(\boldsymbol{I}_{n-1} - \boldsymbol{J}_{n-1}\boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\boldsymbol{J}'_{n-1}\right)^{-1},$$

assuming the expression in parenthesis is invertible. It follows that

$$\begin{aligned}\boldsymbol{\delta}_w^q &= \boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_w^c + \beta\boldsymbol{\delta}_w^a\right],\\ \boldsymbol{\delta}_\nu^q &= \boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_\nu^c + \beta\boldsymbol{\delta}_\nu^a\right].\end{aligned}$$

We thus characterize $\{\boldsymbol{\delta}_w^c, \boldsymbol{\delta}_w^a, \delta_\epsilon^w, \boldsymbol{\delta}_\nu^c, \boldsymbol{\delta}_\nu^a\}$ before combining them using the above formulas.

$\boldsymbol{\delta}_w^c$ Using the method of undetermined coefficients, we can show

$$\boldsymbol{\delta}_w^c = \mathbf{0}_n,$$

a $n \times 1$ vector of zeros. Intuitively, with fully sticky prices and central banks which target inflation, changes in intermediary wealth and thus risk pricing do not affect the consumption decisions of households, which are pinned down by the path of monetary policy alone.

$\boldsymbol{\delta}_w^a$ Using the method of undetermined coefficients, we can show that $\boldsymbol{\delta}_w^a$ implicitly solves

$$\begin{aligned}&\left[\left(1-\beta(1-\xi)\left[\left(\beta^{-1} - \boldsymbol{w}'\boldsymbol{e}\boldsymbol{x}\frac{1}{w_m}\right) - \left(\boldsymbol{e}\boldsymbol{x}' + \beta\frac{\Gamma}{w_m}\boldsymbol{w}'\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\boldsymbol{\delta}_w^a\right]\right)\boldsymbol{I}_{n-1}\right.\\ &\quad\left. + \beta\left(\boldsymbol{I}_{n-1} - \boldsymbol{\Delta}_a^a\right) + \beta^2\frac{\Gamma}{w_m}\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{X}_{n-1}\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\right]\boldsymbol{\delta}_w^a = -\beta\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{X}_{n-1}\boldsymbol{e}\boldsymbol{x}\frac{1}{w_m}, \quad (31)\end{aligned}$$

where

$$\boldsymbol{X}_{n-1} \equiv \left(\boldsymbol{I}_{n-1} + \beta^2\frac{\bar{\Gamma}}{\tilde{w}_m}\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\boldsymbol{\chi}_b^{-1}\right)^{-1}.$$

We can also show that $\boldsymbol{\Delta}_a^a$ implicitly solves

$$\begin{aligned}&\left(\beta\boldsymbol{\Delta}_a^a - \boldsymbol{I}_{n-1}\right)\left(\boldsymbol{\Delta}_a^a - \boldsymbol{I}_{n-1}\right)\\&= \left[\beta(1-\xi)\boldsymbol{\delta}_w^a\left(\boldsymbol{e}\boldsymbol{x}' + \beta\frac{\Gamma}{w_m}\boldsymbol{w}'\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1} + \beta^2\frac{\Gamma}{w_m}\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{X}_{n-1}\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\right]\boldsymbol{\Delta}_a^a.\end{aligned} \tag{32}$$

As is evident, in general we cannot solve (31) and (32) in closed form. However, we can characterize them in closed form in a limiting case, and we can approximate them away from that case, as we further describe below.

$\boldsymbol{\delta}_\epsilon^w$ Using the method of undetermined coefficients, we can show

$$\begin{aligned}\delta_\epsilon^w = -\left(1 + (1-\xi)\boldsymbol{b}'_m\beta^{-1}\boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_w^c + \beta\boldsymbol{\delta}_w^a\right]\right)^{-1}\times\\ (1-\xi)\boldsymbol{b}'_m\beta^{-1}\boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_\nu^c + \beta\boldsymbol{\delta}_\nu^a\right].\end{aligned}$$

$\boldsymbol{\delta}_\nu^c$ Using the method of undetermined coefficients, we can show

$$\boldsymbol{\delta}_\nu^c = -(1-\rho_{i1})^{-1}\psi\left(\boldsymbol{1}_n - \boldsymbol{J}'_{n-1}\boldsymbol{1}_{n-1}\right).$$

That is, a U.S. monetary tightening lowers U.S. consumption and leaves consumption in the rest of the world unchanged. This is again a consequence of fully sticky prices and central banks which target inflation.

$\boldsymbol{\delta}_\nu^a$ Using the method of undetermined coefficients, we can show

$$\begin{aligned}\boldsymbol{\delta}_\nu^a = \Bigg[(1-\beta\rho_{i1})\boldsymbol{I}_{n-1} + \beta\left(\boldsymbol{I}_{n-1} - \boldsymbol{\Delta}_a^a\right) + \beta(1-\xi)\boldsymbol{\delta}_w^a\left(\boldsymbol{e}\boldsymbol{x}' + \beta\frac{\Gamma}{w_m}\boldsymbol{w}'\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\\ + \beta^2\frac{\Gamma}{w_m}\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{X}_{n-1}\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}\Bigg]^{-1}(1-\psi)\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{1}_{n-1}.\end{aligned} \tag{33}$$

Combining these We can finally combine the above results to obtain the impact effect of a U.S. monetary tightening on exchange rates

$$\boldsymbol{\delta}_w^q\delta_\epsilon^w + \boldsymbol{\delta}_\nu^q,$$

again using

$$\boldsymbol{\delta}_w^q = \boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_w^c + \beta\boldsymbol{\delta}_w^a\right],$$
$$\boldsymbol{\delta}_\nu^q = \boldsymbol{Q}_{n-1}\left[\boldsymbol{J}_{n-1}\left(\boldsymbol{I}_n - \boldsymbol{\zeta}^{-1}(\boldsymbol{\zeta}\boldsymbol{\eta})'\right)\boldsymbol{\delta}_\nu^c + \beta\boldsymbol{\delta}_\nu^a\right].$$

Since we cannot in general obtain a closed form for $\boldsymbol{\delta}_w^a$ and $\boldsymbol{\delta}_\nu^a$, it will be convenient to approximate these solutions to first order in $\boldsymbol{ex}$ and Γ/w_m around the point with $\boldsymbol{ex} \to 0$ and $\Gamma/w_m \to 0$. At that point of approximation, it is straightforward to show that the unique stable solution to (31)-(33) is

$$\lim_{\boldsymbol{ex},\Gamma\to 0} \boldsymbol{\Delta}_a^a = \boldsymbol{I}_{n-1},$$
$$\lim_{\boldsymbol{ex},\Gamma\to 0} \boldsymbol{\delta}_w^a = \boldsymbol{0}_{n-1},$$
$$\lim_{\boldsymbol{ex},\Gamma\to 0} \boldsymbol{\delta}_\nu^a = (1-\beta\rho_{i1})^{-1}(1-\psi)\boldsymbol{Q}_{n-1}^{-1}\boldsymbol{1}_{n-1}.$$

That is, in this limit net foreign assets follow a unit root, and respond to U.S. monetary shocks depending on households' intertemporal elasticity of substitution ψ as described in the main text. It follows that

$$\lim_{\boldsymbol{ex},\Gamma\to 0}\left[\boldsymbol{\delta}_w^q\delta_\epsilon^w + \boldsymbol{\delta}_\nu^q\right] = \left[\beta^{-1} - \rho_{i1}\right]^{-1}\left[1 + (\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right]\boldsymbol{1}_{n-1}.$$

We can then differentiate (31)-(33) with respect to $\boldsymbol{ex}$ and evaluate at the point of approximation, and we obtain

$$\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\Delta}_a^a}{d\boldsymbol{ex}} = \boldsymbol{0}_{(n-1)\times(n-1)},$$
$$\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\delta}_w^a}{d\boldsymbol{ex}} = -\frac{1}{\xi}\beta\boldsymbol{Q}_{n-1}^{-1}\frac{1}{w_m},$$
$$\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\delta}_\nu^a}{d\boldsymbol{ex}} = \boldsymbol{0}_{(n-1)\times(n-1)}.$$

Using as well that

$$\lim_{\boldsymbol{ex},\Gamma\to 0}\delta_\epsilon^w = -(1-\xi)\left(\sum_{k=2}^{n} b_{mk}\right)\beta^{-1}\left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[1+(\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right],$$

it follows that

$$\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\left[\boldsymbol{\delta}_w^q \delta_\epsilon^w + \boldsymbol{\delta}_\nu^q\right]}{d\boldsymbol{ex}} = \frac{1-\xi}{\xi}\beta \frac{\sum_{k=2}^n b_{mk}}{w_m} \left[\beta^{-1} - \rho_{i1}\right]^{-1} \left[1 + (\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right] \boldsymbol{I}_{n-1}.$$

Finally, we can differentiate (31)-(33) with respect to Γ/w_m and evaluate at the point of approximation, and we obtain

$$\begin{aligned}
\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\Delta}_a^a}{d[\Gamma/w_m]} &= -(1-\beta)^{-1}\beta^2 \boldsymbol{Q}_{n-1}^{-1} \boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1}, \\
\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\delta}_w^a}{d[\Gamma/w_m]} &= \mathbf{0}_{n-1}, \\
\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\boldsymbol{\delta}_\nu^a}{d[\Gamma/w_m]} &= -(\beta^{-1}-\rho_{i1})^{-2}(1-\beta)^{-1} \boldsymbol{Q}_{n-1}^{-1} \boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi),
\end{aligned}$$

where $\boldsymbol{\eta}_1$ is the $1 \times n$ vector of $\{\eta_{1k}\}$, the expenditure shares of U.S. households on goods from all origins. It follows that

$$\lim_{\boldsymbol{ex},\Gamma\to 0} \frac{d\left[\boldsymbol{\delta}_w^q \delta_\epsilon^w + \boldsymbol{\delta}_\nu^q\right]}{d[\Gamma/w_m]} = -(\beta^{-1}-\rho_{i1})^{-2}(1-\beta)^{-1}\beta \boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi).$$

Combining these results, we obtain that to first order in $\boldsymbol{ex}$ and Γ/w_m,

$$\begin{aligned}
\boldsymbol{\delta}_w^q \delta_\epsilon^w + \boldsymbol{\delta}_\nu^q = &\left[\beta^{-1} - \rho_{i1}\right]^{-1} \left[1 + (\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right] \mathbf{1}_{n-1} \\
&+ \frac{1-\xi}{\xi}\beta \frac{\sum_{k=2}^n b_{mk}}{w_m} \left[\beta^{-1} - \rho_{i1}\right]^{-1} \left[1 + (\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right] \boldsymbol{ex} \\
&- (\beta^{-1}-\rho_{i1})^{-2}(1-\beta)^{-1}\beta \frac{\Gamma}{w_m} \boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi).
\end{aligned}$$

Noting that

$$\boldsymbol{C}\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1 = \begin{bmatrix} Cov\left(ex_{2,+1}, \sum_{k=2}^n \eta_{1k} ex_{k,+1}\right) \\ \vdots \\ Cov\left(ex_{n,+1}, \sum_{k=2}^n \eta_{1k} ex_{k,+1}\right) \end{bmatrix},$$

we obtain the claimed result in the proposition. □

B.2 Proposition 2

Proof. The intermediary optimality conditions for consols can be written in vector notation as

$$E_t \hat{\boldsymbol{ex}}^{\delta}_{t+1} = -\boldsymbol{ex}^{\delta} \frac{1}{w_m} \hat{w}_{m,t} - \beta \frac{\Gamma}{w_m} \boldsymbol{C}^{\delta} \boldsymbol{J}_{n-1} \boldsymbol{\zeta} \boldsymbol{J}'_{n-1} \hat{\boldsymbol{a}}_t.$$

where $\hat{\boldsymbol{ex}}^{\delta}_t$ is a $n \times 1$ vector of $\hat{ex}^{\delta}_{j,t}$; and $\boldsymbol{C}^{\delta}$ is a $n \times (n-1)$ matrix of $Cov\left(ex^{\delta}_{j,+1}, ex_{k,+1}\right)$.

And the definition of excess consol returns, together with the monetary policy rules, implies

$$\hat{\boldsymbol{ex}}^{\delta}_{t+1} = -\beta^{-1} \boldsymbol{J}'_{n-1} \Delta \hat{\boldsymbol{q}}_{t+1} + \delta \hat{\boldsymbol{P}}^{\delta}_{t+1} - \beta^{-1} \hat{\boldsymbol{P}}^{\delta}_{t} - \beta^{-1} \mathbf{1}_n \nu_{i1,t}.$$

Using the definition of excess currency returns, this can be equivalently written

$$\hat{\boldsymbol{ex}}^{\delta}_{t+1} = \boldsymbol{J}'_{n-1} \hat{\boldsymbol{ex}}_{t+1} + \delta \hat{\boldsymbol{P}}^{\delta}_{t+1} - \beta^{-1} \hat{\boldsymbol{P}}^{\delta}_{t} - \beta^{-1} \left(\mathbf{1}_n - \boldsymbol{J}'_{n-1} \mathbf{1}_{n-1}\right) \nu_{i1,t}.$$

Combining these results and using (29) yields

$$\begin{aligned} &\delta E_t \hat{\boldsymbol{P}}^{\delta}_{t+1} - \beta^{-1} \hat{\boldsymbol{P}}^{\delta}_{t} - \beta^{-1} \left(\mathbf{1}_n - \boldsymbol{J}'_{n-1} \mathbf{1}_{n-1}\right) \nu_{1,t} \\ &\qquad = -\left(\boldsymbol{ex}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{ex}\right) \frac{1}{w_m} \hat{w}_{m,t} - \beta \frac{\Gamma}{w_m} \left(\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{C}\right) \boldsymbol{J}_{n-1} \boldsymbol{\zeta} \boldsymbol{J}'_{n-1} \hat{\boldsymbol{a}}_t. \end{aligned}$$

It is already evident that it is the average local currency bond carry trade returns $\boldsymbol{ex}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{ex}$, and covariances with these returns $\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{C}$, which will govern the response of consol prices to a change in risk pricing. Defining a solution of the form

$$\hat{\boldsymbol{P}}^{\delta}_{t} = \boldsymbol{\Delta}^{P^{\delta}}_{a} \hat{\boldsymbol{a}}_{t-1} + \boldsymbol{\delta}^{P^{\delta}}_{w} \hat{w}_{m,t} + \boldsymbol{\delta}^{P^{\delta}}_{\nu} \nu_{i1,t},$$

the method of undetermined coefficients implies

$$\begin{aligned} \boldsymbol{\Delta}^{P^{\delta}}_{a} &= \left[\delta \boldsymbol{\delta}^{P^{\delta}}_{w} \boldsymbol{\delta}^{Ew}_{a} + \beta \frac{\Gamma}{w_m} \left(\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{C}\right) \boldsymbol{J}_{n-1} \boldsymbol{\zeta} \boldsymbol{J}'_{n-1} \boldsymbol{\Delta}^{a}_{a}\right] \left(\beta^{-1} \boldsymbol{I}_{n-1} - \delta \boldsymbol{\Delta}^{a}_{a}\right)^{-1}, \\ \boldsymbol{\delta}^{P^{\delta}}_{w} &= \left[\delta \boldsymbol{\Delta}^{P^{\delta}}_{a} \boldsymbol{\delta}^{a}_{w} + \left(\boldsymbol{ex}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{ex}\right) \frac{1}{w_m} + \beta \frac{\Gamma}{w_m} \left(\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{C}\right) \boldsymbol{J}_{n-1} \boldsymbol{\zeta} \boldsymbol{J}'_{n-1} \boldsymbol{\delta}^{a}_{w}\right] \left(\beta^{-1} - \delta \delta^{Ew}_{w}\right)^{-1}, \\ \boldsymbol{\delta}^{P^{\delta}}_{\nu} &= \left[\delta \left(\boldsymbol{\Delta}^{P^{\delta}}_{a} \boldsymbol{\delta}^{a}_{\nu} + \boldsymbol{\delta}^{P^{\delta}}_{w} \delta^{Ew}_{\nu}\right) - \beta^{-1} \left(\mathbf{1}_n - \boldsymbol{J}'_{n-1} \mathbf{1}_{n-1}\right) + \beta \frac{\Gamma}{w_m} \left(\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1} \boldsymbol{C}\right) \boldsymbol{J}_{n-1} \boldsymbol{\zeta} \boldsymbol{J}'_{n-1} \boldsymbol{\delta}^{a}_{\nu}\right] \times \\ &\quad \left(\beta^{-1} - \delta \rho_{i1}\right)^{-1}. \end{aligned}$$

The impact effect of a U.S. monetary tightening on consol prices is then

$$\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta}.$$

We again approximate this vector to first order in $\boldsymbol{ex}$, $\boldsymbol{ex}^\delta$ and Γ/w_m around the point with $\boldsymbol{ex} \to 0$, $\boldsymbol{ex}^\delta \to 0$, and $\Gamma/w_m \to 0$. At that point of approximation, and using the results derived in the proof of Proposition 1, we have that

$$\begin{aligned}
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \boldsymbol{\Delta}_a^{P^\delta} &= \mathbf{0}_{n\times(n-1)},\\
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \boldsymbol{\delta}_w^{P^\delta} &= \mathbf{0}_n,\\
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \boldsymbol{\delta}_\nu^{P^\delta} &= -\left(1-\beta\delta\rho_{i1}\right)^{-1}\left(\mathbf{1}_n - \boldsymbol{J}'_{n-1}\mathbf{1}_{n-1}\right).
\end{aligned}$$

It follows that

$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0}\left[\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta}\right] = -\left(1-\beta\delta\rho_{i1}\right)^{-1}\left(\mathbf{1}_n - \boldsymbol{J}'_{n-1}\mathbf{1}_{n-1}\right).$$

Moreover,

$$\begin{aligned}
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\Delta}_a^{P^\delta}}{dex_j} &= \mathbf{0}_{n\times(n-1)},\ \ \forall j,\\
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_w^{P^\delta}}{d\boldsymbol{ex}} &= -\frac{1}{w_m}\beta\left(1-\delta(1-\xi)\right)^{-1}\boldsymbol{J}'_{n-1},\\
\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_\nu^{P^\delta}}{d\boldsymbol{ex}} &= \mathbf{0}_{n\times(n-1)}.
\end{aligned}$$

Further using the expression for $\lim_{\boldsymbol{ex},\Gamma\to 0}\delta_\epsilon^w$ in the proof of Proposition 1, it follows that

$$\begin{aligned}
&\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\left[\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta}\right]}{d\boldsymbol{ex}}\\
&= \left(1-\delta(1-\xi)\right)^{-1}(1-\xi)\left(\frac{\sum_{k=2}^n b_{mk}}{w_m}\right)\left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[1+(\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right]\boldsymbol{J}'_{n-1}.
\end{aligned}$$

Similarly,

$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\Delta}_a^{P^\delta}}{dex_j^\delta} = \mathbf{0}_{n\times(n-1)}, \quad \forall j,$$
$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_w^{P^\delta}}{d\boldsymbol{ex}^\delta} = \frac{1}{w_m}\beta\left(1-\delta(1-\xi)\right)^{-1},$$
$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_\nu^{P^\delta}}{d\boldsymbol{ex}^\delta} = \mathbf{0}_{n\times n}.$$

It follows that

$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\left[\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta}\right]}{d\boldsymbol{ex}^\delta}$$
$$= -\left(1-\delta(1-\xi)\right)^{-1}(1-\xi)\left(\frac{\sum_{k=2}^n b_{mk}}{w_m}\right)\left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[1+(\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right].$$

Finally,

$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\Delta}_a^{P^\delta}}{d[\Gamma/w_m]} = (1-\beta\delta)^{-1}\left(\boldsymbol{C}^\delta - \boldsymbol{J}'_{n-1}\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\zeta}\boldsymbol{J}'_{n-1},$$
$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_w^{P^\delta}}{d[\Gamma/w_m]} = \mathbf{0}_n,$$
$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\boldsymbol{\delta}_\nu^{P^\delta}}{d[\Gamma/w_m]} = (\beta^{-1}-\rho_{i1})^{-1}\left(\beta^{-1}-\delta\rho_{i1}\right)^{-1}\left(\boldsymbol{C}^\delta - \boldsymbol{J}'_{n-1}\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi).$$

It follows that

$$\lim_{\boldsymbol{ex},\boldsymbol{ex}^\delta,\Gamma\to 0} \frac{d\left[\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta}\right]}{d[\Gamma/w_m]} = (\beta^{-1}-\rho_{i1})^{-1}\left(\beta^{-1}-\delta\rho_{i1}\right)^{-1}\left(\boldsymbol{C}^\delta - \boldsymbol{J}'_{n-1}\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi).$$

Combining these results, we obtain that to first order in $\boldsymbol{ex}$, $\boldsymbol{ex}^\delta$, and Γ/w_m,

$$\boldsymbol{\delta}_w^{P^\delta}\delta_\epsilon^w + \boldsymbol{\delta}_\nu^{P^\delta} = -\left(1-\beta\delta\rho_{i1}\right)^{-1}\left(\mathbf{1}_n - \boldsymbol{J}'_{n-1}\mathbf{1}_{n-1}\right)$$
$$-(1-\delta(1-\xi))^{-1}(1-\xi)\left(\frac{\sum_{k=2}^n b_{mk}}{w_m}\right)\left[\beta^{-1}-\rho_{i1}\right]^{-1}\left[1+(\beta^{-1}-1)(1-\rho_{i1})^{-1}\psi\right]\left(\boldsymbol{ex}^\delta - \boldsymbol{J}'_{n-1}\boldsymbol{ex}\right)$$
$$+(\beta^{-1}-\rho_{i1})^{-1}\left(\beta^{-1}-\delta\rho_{i1}\right)^{-1}\frac{\Gamma}{w_m}\left(\boldsymbol{C}^\delta - \boldsymbol{J}'_{n-1}\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1(1-\psi).$$

Noting that

$$\mathbf{1}_n - \boldsymbol{J}'_{n-1}\mathbf{1}_{n-1} = \begin{bmatrix} 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

and again noting that

$$\left(\boldsymbol{C}^{\delta} - \boldsymbol{J}'_{n-1}\boldsymbol{C}\right)\boldsymbol{J}_{n-1}\boldsymbol{\eta}'_1 = \begin{bmatrix} Cov\left(ex^{\delta}_{1,+1}, \sum_{k=2}^{n}\eta_{1k}ex_{k,+1}\right) \\ Cov\left(ex^{\delta}_{2,+1} - ex_{2,+1}, \sum_{k=2}^{n}\eta_{1k}ex_{k,+1}\right) \\ \vdots \\ Cov\left(ex^{\delta}_{n,+1} - ex_{n,+1}, \sum_{k=2}^{n}\eta_{1k}ex_{k,+1}\right) \end{bmatrix},$$

we obtain the claimed result in the proposition. □

C Additional empirical results

In this appendix we provide additional results accompanying those in section 4.

C.1 Sample periods

Table 5 summarizes the starting months for three-month yields, ten-year yields, and exchange rates used in the empirical analysis. For the G10 economies, the start dates are determined by the latest of April 1991 (when U.S. Treasury yields become available from Bloomberg) and the date the relevant ticker from Bloomberg becomes available. For the emerging markets, the start dates are in some cases pushed further forward to avoid periods of hard pegs, crawling pegs, or "freely falling" exchange rates as classified by Ilzetzki et al. (2019, 2022). We make this choice because such exchange rate arrangements are not well captured by our model, and to avoid these periods from exerting substantial influence on our estimated comovements.

C.2 Estimating expected excess returns

As described in the main text, we estimate excess currency returns $\{ex_j\}$ by computing average quarterly excess returns for each currency, running a cross-sectional regression of these on the average three-month interest rate differential versus the

	Government yields		IBOR yields		
	3m	10y	3m	10y	Exchange rate
AUD	Apr-91	Apr-91	Apr-91	Apr-91	Apr-91
CAD	Jun-91	Jun-91	Dec-91	Apr-91	Apr-91
CHF	Feb-94	Feb-94	Apr-91	Apr-91	Apr-91
EUR	Oct-91	Oct-91	Dec-98	Jan-99	Apr-91
GBP	Apr-91	Apr-91	Apr-91	Apr-91	Apr-91
JPY	Sep-92	Sep-92	Apr-91	Apr-91	Apr-91
NOK	Jul-98	Jul-98	Apr-91	Oct-93	Apr-91
NZD	Mar-92	Mar-92	Oct-95	Mar-96	Apr-91
SEK	Feb-94	Feb-94	Apr-91	Apr-91	Apr-91
USD	Apr-91	Apr-91	Apr-91	Apr-91	
BRL*	Mar-07	Mar-07			Oct-99
CLP	Oct-05	Oct-05			Apr-91
COP	Aug-03	Oct-04			Aug-92
HUF*	Feb-99	Feb-99			Feb-99
IDR*	Feb-03	Jul-03			Jun-99
ILS	Mar-05	Mar-05			Apr-91
INR*	Apr-09	Apr-09			Apr-09
KRW*	Aug-99	Oct-00			Aug-98
MXN*	Sep-02	Feb-03			May-96
MYR*	Aug-05	Aug-05			Aug-05
PEN*	Feb-06	Feb-06			Feb-03
PHP*	Dec-00	Dec-00			Feb-98
PLN*	Apr-98	May-99			Jul-93
THB*	Jun-99	Jun-99			Mar-98
ZAR*	Apr-95	Apr-95			Apr-95

Table 5: starting months for yields and exchange rates used in empirical analysis

Notes: IBOR yields only used in robustness for G10 economies, as described in main text. * denotes emerging markets for which the start dates are pushed forward from the first date of Bloomberg ticker availability to avoid periods of hard pegs, crawling pegs, or "freely falling" exchange rates as classified by Ilzetzki et al. (2019, 2022).

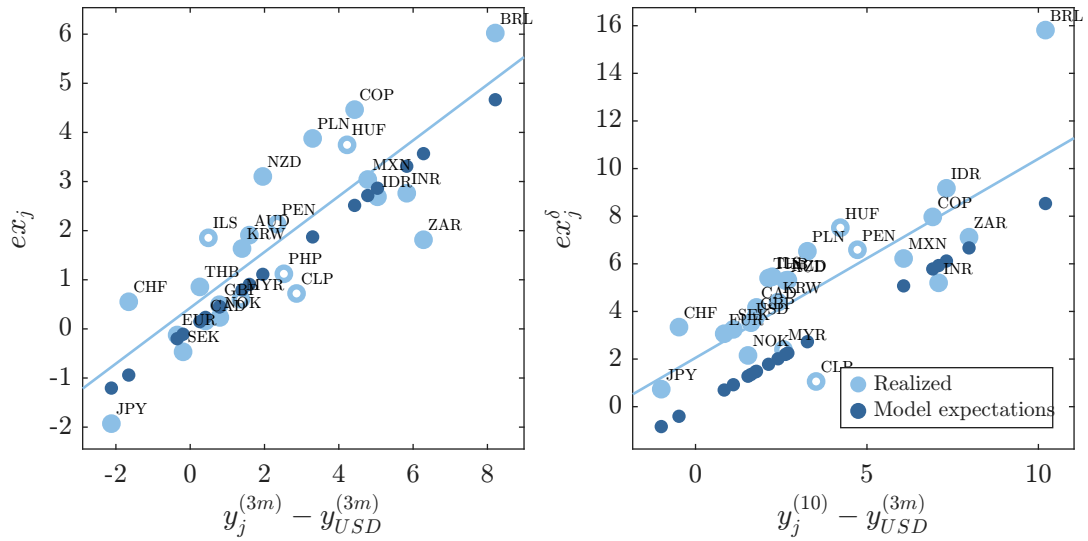


Figure 10: average realized excess returns vs. estimates of expected excess returns

Notes: all excess returns are annualized. Expectations estimated by running a cross-sectional regression on realized values in each panel and computing fitted values, dropping the constant. Emerging markets depicted with open circles are the smallest six and thus excluded from the quantitative model for computational reasons.

dollar, and finally using the fitted values as our estimates. We similarly estimate $\{ex_j^\delta\}$ by computing average quarterly excess returns on ten-year bonds in each currency financed by the three-month dollar bond, running a cross-sectional regression of these on the average yield differential between ten-year bonds in that currency and the three-month dollar interest rate, and using the fitted values as our estimates. We use gross returns (not log returns) throughout, consistent with the theory.

We use the fitted values from cross-sectional regressions to reduce the noise in our estimates of excess returns. We do not include the constant from these cross-sectional regressions in our fitted values. This is motivated by our view that the secular dollar appreciation and decline in global interest rates over our sample period may have been unexpected ex-ante.

Figure 10 compares average realized excess returns on currencies and long-term bonds against our estimates of expected excess returns. There are two messages. First, average interest rate differentials and yield curve slopes indeed do a very good job explaining the cross-section of average excess returns.[41] Second, eliminating the

[41]For currencies in particular, this echoes a central message of Hassan and Mano (2019).

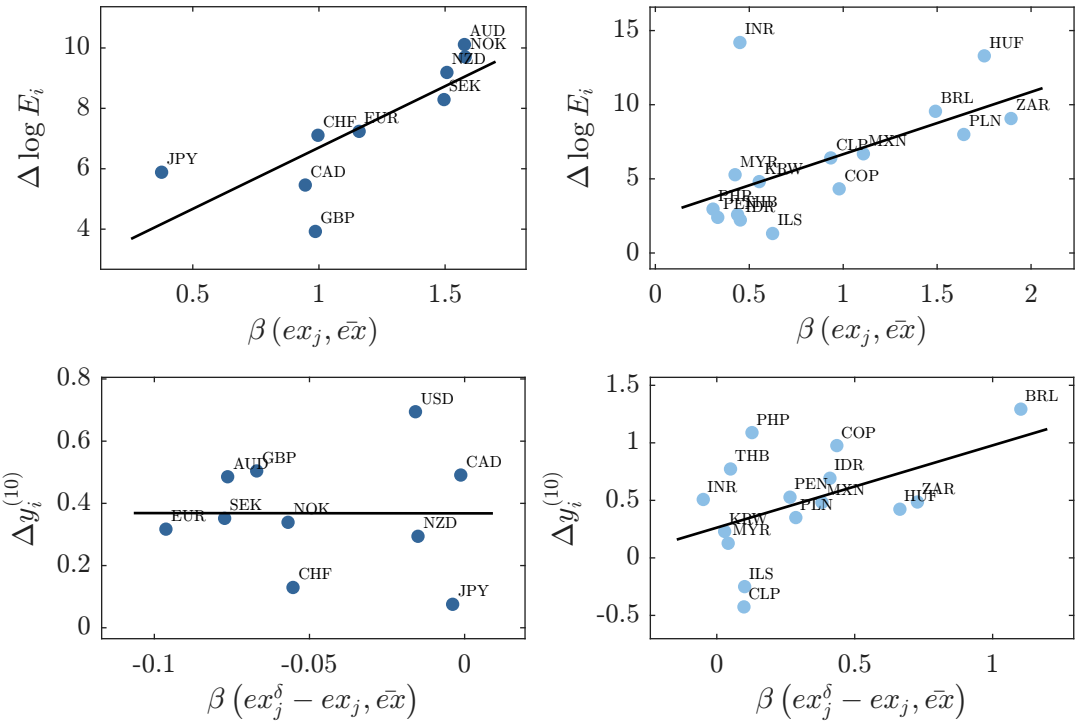


Figure 11: asset price responses to U.S. monetary tightening in data

Notes: response to U.S. monetary tightening estimated in data using Bauer and Swanson (2023) measure of monetary surprises and two-day changes in asset prices around surprises. Responses reported for surprise that raises two-year dollar yield by 1*pp*. $\beta(y,x) \equiv Cov(y,x)/Var(x)$, and $\bar{ex}$ denotes the simple average of currency carry returns.

constant from the cross-sectional regressions when constructing expected returns is a conservative assumption, because it means that we generally estimate lower expected excess returns. It has a small quantitative effect for currencies, but is more meaningful for long-term bond returns given the large decline in global interest rates in sample.

C.3 Evidence against portfolio balance

Figure 11 depicts the same responses of international asset prices to U.S. monetary shocks as in Figure 1, but plots these against covariances of currency and local currency bond carry returns with the (simple) average of currency carry returns that are long foreign currencies, and short the dollar. As demonstrated in Proposition 1, assuming U.S. capital inflows upon a monetary tightening, the portfolio balance channel would imply that currencies with a bigger such covariance should depreciate

by less, and the yield on long-dated bonds with a bigger such covariance should rise by less. These predictions clearly do not hold in the data for emerging market bonds,[42] nor for either set of currencies. If a U.S. monetary tightening instead implies capital outflows from the U.S., then the response of currencies and emerging market bonds would be consistent with the portfolio balance mechanism. However, the response of G10 bonds would not, as these are essentially unrelated to covariances of local currency bond carry returns with the currency carry trade.

As noted in the main text, this evidence also is inconsistent with a portfolio balance channel whereby foreigners' desired position in dollar-denominated bonds $\bar{b}_{j1}$ for $j > 1$ rises with the U.S. nominal interest rate.

C.4 Global effects of quantitative tightening

The results of the last subsection suggest that the portfolio balance mechanism does not explain well the asset price responses to U.S. interest rate surprises. Here we study surprises to large-scale asset purchases (LSAP) and demonstrate that the spillovers *are* well explained by the portfolio balance mechanism. This both validates the asset substitution elasticities implied by mean-variance optimization, and sharpens our finding that interest rate policy spills over through a distinct mechanism.

We measure LSAP surprises using Swanson (2021)'s LSAP factor using the high-frequency response of long yields in tight intraday windows around Federal Reserve announcements. We project two-day changes in global yields and exchange rates on two-day changes in the U.S. 10-year yield, instrumented with the intraday Swanson (2021) LSAP surprise. Figure 12 depicts the estimated effects corresponding to a $1pp$ increase in the U.S. 10-year yield, and plots them against covariances with the U.S. bond carry return. Figure 13 depicts the same effects against average excess currency and local currency bond carry returns.

The responses to LSAP surprises are consistent with the portfolio balance mechanism. In response to more long-term dollar bonds on intermediary balance sheets, the portfolio balance mechanism predicts that currencies with a higher covariance with the U.S. bond carry trade should depreciate by more, and long-term bond prices with

[42]Combining the pictures for G10 bonds and EM bonds further undercuts the portfolio balance prediction, since EM bond returns have a higher covariance with the average currency carry trade than G10 bonds, but EM bond yields also rise by more upon a U.S. tightening. The higher covariance of EM bond returns with the average currency carry trade echoes points made in Kekre and Lenel (2024a) and De Leo, Keller, Simoncelli, Villamizar-Villegas, and Williams (2025).

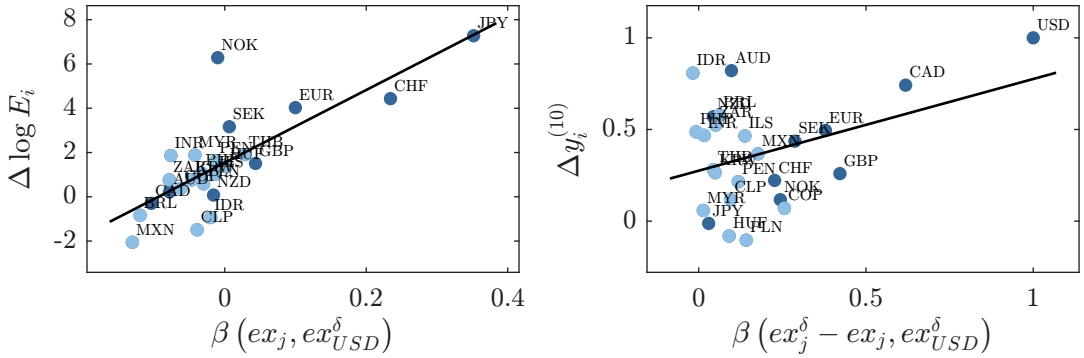


Figure 12: asset price responses to U.S. quantitative tightening in data

Notes: response to U.S. quantitative tightening estimated in data using Swanson (2021) intraday LSAP factor and two-day changes in asset prices around surprises. Responses reported for surprise that raises 10-year yield in U.S. by 1*pp*. $\beta(y,x) \equiv Cov(y,x)/Var(x)$.

a higher covariance with the U.S. bond carry trade should fall by more (and thus long yields should rise by more). Figure 12 demonstrates that this is broadly what we see. The exchange rate responses are particularly striking because currencies with a higher covariance with the U.S. bond carry trade tend to pay *lower* excess returns on average. Thus, a higher price of risk, as in the case of an interest rate surprise, would generate the *opposite* patterns in exchange rate responses than what we see in Figure 13.

An interpretation is that, while U.S. quantitative tightening revalues downward the wealth of intermediaries like an U.S. interest rate hike (both due to the stronger dollar and lower long-term dollar bond prices), the main effects on global risk premia following U.S. quantitative tightening operate through the portfolio balance mechanism. In response to interest rate policy, the latter effects are instead much weaker.

D Additional quantitative results

In this appendix we provide additional results accompanying those in sections 5-6.

D.1 Baseline calibration

The main text described the overall calibration strategy for parameters disciplined after solving the model, as summarized in Table 3. Here we provide detail on all of

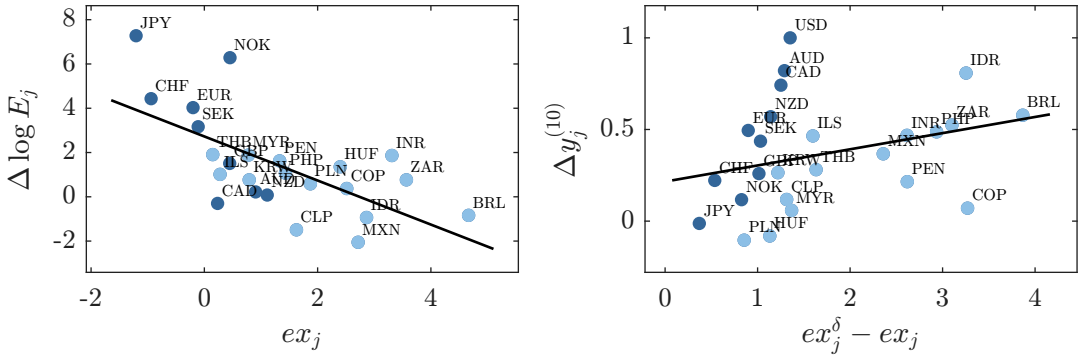


Figure 13: asset price responses to U.S. quantitative tightening in data

Notes: response to U.S. quantitative tightening estimated in data using Swanson (2021) intraday LSAP factor and two-day changes in asset prices around surprises. Responses reported for surprise that raises 10-year yield in U.S. by 1*pp*.

these calibrated parameter values and, where relevant, the associated model moments.

The model features the U.S., nine other G10 economies, nine emerging markets, and one "rest of world" (ROW) which is a residual ensuring market clearing given the targets for all other economies.

Table 6 provides the population parameters in each economy, which are targeted to match relative consumption from the IMF International Financial Statistics. The ROW has population such that world consumption is 3.5 times U.S. consumption.

Table 7 provides the discount factors in each economy and consol positions of U.S. households, which are targeted to match the one-month dollar interest rate and excess returns estimated using Bloomberg data, as described in section 5. We set β_{ROW} so that the average β_j globally is the same as that in the U.S., and $\bar{b}^{\delta}_{1ROW} = 0$ for simplicity.

Finally, Table 8 provides the taste parameters governing trade shares, which are targeted to match expenditure shares by origin from the IMF International Financial Statistics and Direction of Trade Statistics. For brevity we focus in this table on taste parameters for imports from and exports to the U.S., though there is an entire matrix of such parameters corresponding to all origins and destinations. We set the ROW's taste parameters so that

$$\sum_{j=1}^{n} \zeta_j \eta_{jk} = \zeta_k,$$

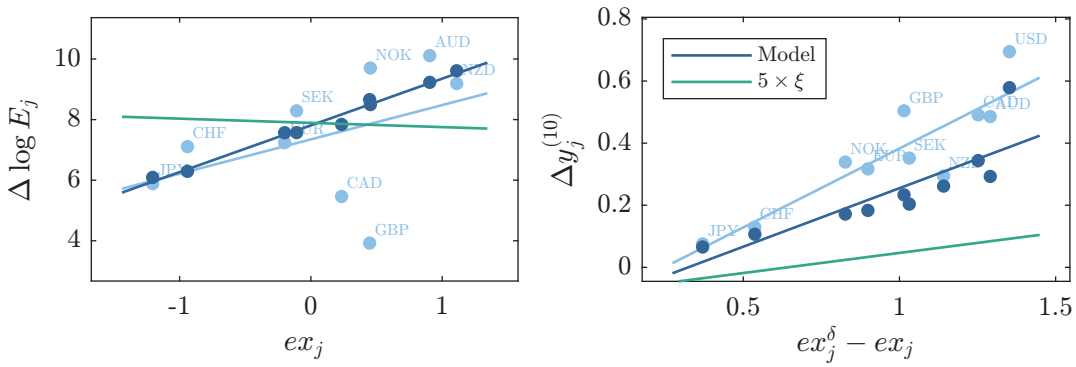


Figure 14: identification of intermediary exit rate

Notes: both model and data responses reported for surprise that raises two-year dollar yield by 1*pp*.

for all k, which implies (together with the above parameters) that all real exchange rates are one in steady-state.

D.2 Identification of ξ

We estimate $\xi = 0.026$, implying a half-life of intermediaries that is roughly two quarters. Figure 14 demonstrates that, like intermediary risk aversion Γ, this parameter allows the model to match the cross-section of asset price responses for the G10 economies and how they line up with unconditional average excess returns. Consistent with Propositions 1 and 2, at a higher value of ξ and thus lower persistence of intermediary wealth, the model would imply a much smaller depreciation for currencies offering high average excess returns and smaller increase in yields for bonds offering high average local currency excess returns. Comparing these propositions, we can also see that ξ is identified from intermediary leverage by the relative response of long yields versus exchange rates, provided that $\delta < 1$.

D.3 Foreign demand for dollar-denominated assets

Finally, we provide more detail on our analysis of shocks to foreign demand for dollar-denominated assets in section 6.

Figure 15 depicts the effects of negative innovations to $\nu_{\bar{b},t}$ and $\nu_{\bar{b}^{\delta},t}$ on the U.S. nominal interest rate, slope of the U.S. yield curve, U.S./G10 10-year yield differential, and U.S./G10 dollar exchange rate (where the last two variables are simple averages

		$\zeta_j q_j^{-1} c_j / c_1$	
Country	ζ_j	Target	Achieved
USD	1	normalization	
AUD	0.05	0.05	0.05
CAD	0.08	0.08	0.08
CHF	0.03	0.03	0.03
EUR	0.66	0.66	0.66
GBP	0.17	0.17	0.17
JPY	0.34	0.34	0.34
NOK	0.02	0.02	0.02
NZD	0.01	0.01	0.01
SEK	0.02	0.02	0.02
BRL	0.09	0.09	0.09
IDR	0.04	0.04	0.04
INR	0.09	0.09	0.09
KRW	0.06	0.06	0.06
MXN	0.07	0.07	0.07
PLN	0.02	0.02	0.02
ZAR	0.02	0.02	0.02
THB	0.02	0.02	0.02
COP	0.02	0.02	0.02
ROW	0.70	0.70	0.70

Table 6: baseline ζ_j parameters

Notes: data targets estimated over 1991 Q2 – 2024 Q1.

		$\imath_j$			$52\log((1+\delta P_j)/P_j)$	
Country	β_j^{52}	Target	Achieved	$\bar{b}_{1j}^{\delta}/(52\cdot y_1)$	Target	Achieved
USD	0.9901	1.00%	1.00%	9.27%	2.35%	2.35%
AUD	0.9811	1.90%	1.90%	1.40%	3.20%	3.19%
CAD	0.9877	1.23%	1.23%	4.53%	2.49%	2.49%
CHF	0.9994	0.06%	0.06%	0.65%	0.60%	0.60%
EUR	0.9920	0.80%	0.80%	0.08%	1.70%	1.70%
GBP	0.9856	1.45%	1.45%	-0.18%	2.46%	2.46%
JPY	1.0021	-0.21%	-0.21%	2.11%	0.16%	0.16%
NOK	0.9856	1.45%	1.45%	0.32%	2.28%	2.28%
NZD	0.9791	2.11%	2.11%	0.07%	3.25%	3.25%
SEK	0.9911	0.89%	0.89%	3.90%	1.92%	1.92%
BRL	0.9450	5.66%	5.66%	-2.32%	9.53%	9.52%
IDR	0.9621	3.86%	3.86%	-2.45%	7.12%	7.11%
INR	0.9578	4.31%	4.31%	-8.36%	6.93%	6.92%
KRW	0.9822	1.79%	1.79%	4.24%	3.01%	3.01%
MXN	0.9635	3.71%	3.71%	-0.30%	6.07%	6.07%
PLN	0.9717	2.87%	2.87%	-2.10%	3.73%	3.73%
ZAR	0.9554	4.57%	4.57%	-0.80%	7.67%	7.66%
THB	0.9886	1.15%	1.15%	6.57%	2.78%	2.78%
COP	0.9655	3.51%	3.51%	0.37%	6.78%	6.78%
ROW	1.0018	-0.18%	-0.18%	0.00%	1.00%	1.00%

Table 7: baseline β_j and $\bar{b}_{1j}^{\delta}$ parameters

Notes: data targets estimated over 1991 Q2 – 2024 Q1. Note that for all $j > 1$, we obtain the targeted i_j as $i_1 + ex_j$, where ex_j is estimated as described in section 5. We obtain the targeted $(1+\delta P_j)/P_j$ as $i_j + (ex_j^{\delta} - ex_j)$, where $ex_j^{\delta} - ex_j$ is estimated as described in section 5.

		$P_{j1}c_{j1}/(P_jc_j)$			$P_{1j}c_{1j}/(P_1c_1)$	
Country	η_{j1}	Target	Achieved	η_{1j}	Target	Achieved
USD	87.35%	87.35%	87.35%	87.35%	87.35%	87.35%
AUD	2.93%	2.93%	2.93%	0.06%	0.06%	0.06%
CAD	23.13%	23.13%	23.13%	2.19%	2.19%	2.19%
CHF	4.30%	4.30%	4.30%	0.15%	0.15%	0.15%
EUR	1.87%	1.87%	1.87%	1.86%	1.86%	1.86%
GBP	2.50%	2.50%	2.50%	0.41%	0.41%	0.41%
JPY	1.70%	1.70%	1.70%	1.03%	1.03%	1.03%
NOK	1.61%	1.61%	1.61%	0.04%	0.04%	0.04%
NZD	3.34%	3.34%	3.34%	0.02%	0.02%	0.02%
SEK	1.44%	1.44%	1.44%	0.08%	0.08%	0.08%
BRL	2.71%	2.71%	2.71%	0.16%	0.16%	0.16%
IDR	1.24%	1.24%	1.24%	0.09%	0.09%	0.09%
INR	1.25%	1.25%	1.25%	0.17%	0.17%	0.17%
KRW	4.57%	4.57%	4.57%	0.36%	0.36%	0.36%
MXN	18.62%	18.62%	18.62%	1.65%	1.65%	1.65%
PLN	0.63%	0.63%	0.63%	0.02%	0.02%	0.02%
ZAR	1.60%	1.60%	1.60%	0.04%	0.04%	0.04%
THB	4.14%	4.14%	4.14%	0.14%	0.14%	0.14%
COP	6.04%	6.04%	6.04%	0.08%	0.08%	0.08%
ROW	8.66%	8.66%	8.66%	4.09%	4.09%	4.09%

Table 8: baseline η_{j1} and η_{1j} parameters

Notes: data targets estimated over 1991 Q2 – 2024 Q1.

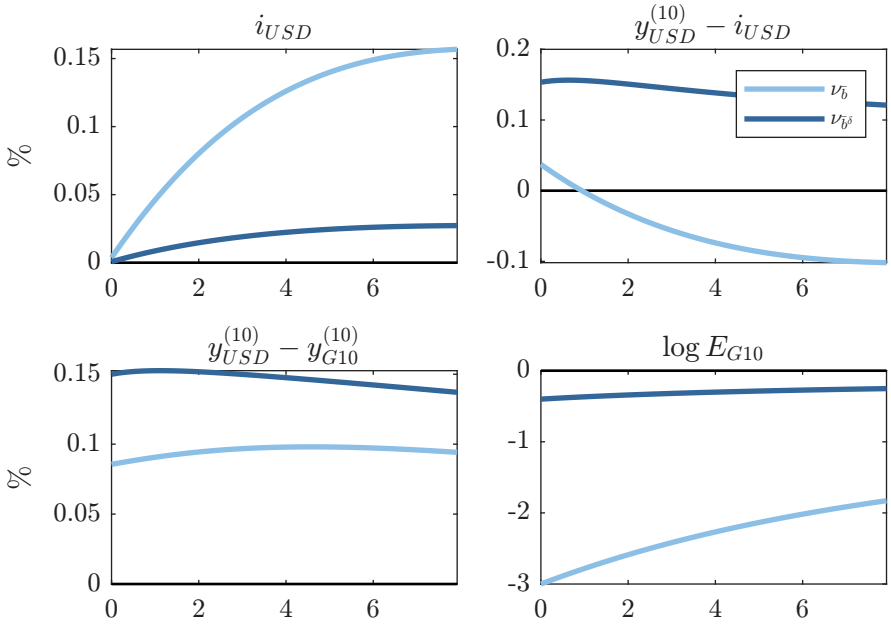


Figure 15: impulse responses to negative shock to foreign demand for dollar bonds

Notes: responses reported for negative $\nu_{\bar{b},t}$ innovation with persistence $\rho_{\bar{b}} = 0.95^{1/52}$ and scaled to induce $3pp$ dollar depreciation vs. G10 currencies, and negative $\nu_{\bar{b}^\delta,t}$ innovation with persistence $\rho_{\bar{b}^\delta} = 0.95^{1/52}$ and scaled to induce $0.15pp$ increase in 10-year dollar yield vs. G10 currencies. x-axis denotes quarters since the shock.

across the other G10 economies). A decline in foreign demand for one-period dollar bonds is like an increase in the "dollar risk premium", implying a dollar depreciation and increase in dollar yields relative to foreign yields. However, because the shock is transitory, the expectations hypothesis implies that the U.S. yield curve inverts (soon after the initial shock), and there is a limited effect on the 10-year dollar/G10 yield differential. By contrast, a decline in foreign demand for dollar consols steepens the U.S. yield curve because intermediaries must hold more dollar consols, generating an increase in the dollar term premium. Relatedly, it has a larger effect on the 10-year yield differential. However, it has a more limited effect on the dollar exchange rate, reflecting the small (positive) covariance between excess returns on long-term dollar bonds and excess returns to foreign currencies in the data. In this way, the combination of a decline in foreign demand for dollar-denominated assets at *both* short and long maturities can account for the dollar depreciation and increase in dollar long yields observed around "liberation day".

Table 9 reports separately the required innovations to $\nu_{\bar{b},t}$ and $\nu_{\bar{b}^\delta,t}$ to match the

		$\rho_{\bar{b}}, \rho_{\bar{b}^\delta}$			
$w_m/(52y_1)$	half-life QE1	$0.85^{1/52}$	$0.90^{1/52}$	$0.95^{1/52}$	$0.9999^{1/52}$
0.1%	$\approx$ 1 yr	-2.0%,-0.3%	-1.9%,-0.2%	-1.7%,-0.2%	-1.5%,-0.2%
0.2%	$\approx$ 2 yrs	-2.7%,-0.4%	-2.4%,-0.3%	-2.2%,-0.2%	-1.9%,-0.2%
0.3%	$\approx$ 3 yrs	-4.0%,-0.5%	-3.5%,-0.4%	-3.0%,-0.3%	-2.5%,-0.3%
0.8%	$\approx$ 170 yrs	-8.5%,-1.1%	-7.2%,-0.8%	-5.8%,-0.7%	-4.2%,-0.8%

Table 9: required $d\nu_{\bar{b},t}/(52y_1), d\nu_{\bar{b}^\delta,t}/(52y_1)$ to match data around "liberation day"

Notes: first value in each cell reports $d\nu_{\bar{b},t}/(52y_1)$ and second value reports $d\nu_{\bar{b}^\delta,t}/(52y_1)$. Sum is as reported in Table 4 in main text.

data around "liberation day". The comparative statics with respect to intermediaries' wealth and thus the price impact of flows, and the persistence of each innovation, are as described in the main text.

Finally, Figure 16 zooms out from the event study depicted in the main text (Figure 9) to depict the dynamics of the 10-year yield differential and dollar/G10 exchange rate through 2025. There are two messages. First, the gap between the yield differential and dollar exchange rate that opened up around "liberation day" had not fully reversed even six months later. Second, the dynamics of the yield differential around "liberation day" is similar using 10-year OIS rates, consistent with a declining demand for all dollar assets, not just Treasuries.

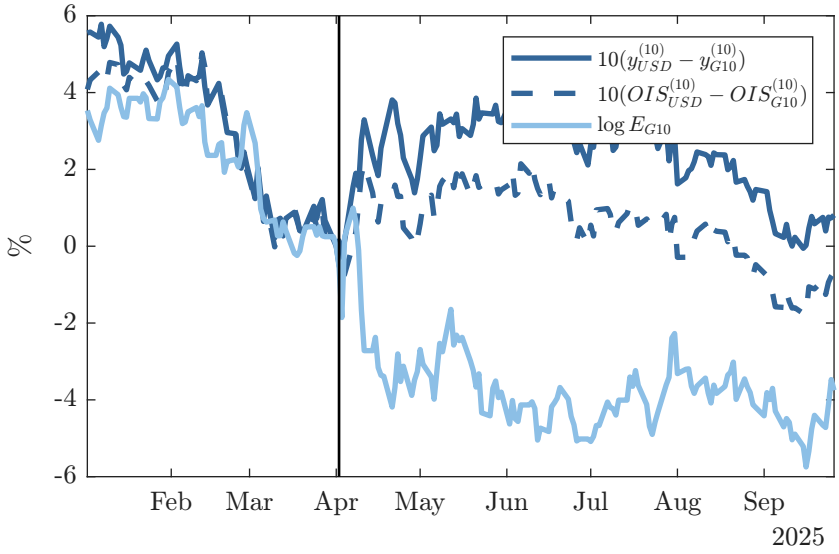


Figure 16: yield differential and exchange rates through 2025

Notes: all series depict simple average across all G10 economies relative to the U.S. $y_j^{(10)}$ refers to government bond yields (as throughout the paper), and $ois_j^{(10)}$ refers to 10-year OIS rate based on SOFR in the U.S. and equivalents in other economies.