# The Convenience Yield Channel of Monetary Policy and International Stock Prices*

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**Abstract**

Krishnamurthy and Lustig (2019) propose a convenience yield channel of monetary policy, whereby Federal Reserve decisions affect global financial variables via their influence on the convenience yield of dollar-denominated safe assets. We document that the convenience yield channel contributes to the spillover of Fed policy to international stock markets. Following a surprise monetary tightening, the convenience yield differential between US Treasuries and equivalent foreign government bonds grows. A monetary policy-induced increase in the convenience yield differential, in turn, results in a decline in international stock indexes. This decline cannot be explained by movements in interest rates or exchange rates but instead seems likely to be driven by a higher equity risk premium. While policy-induced *changes* in convenience yield differentials contribute to international spillovers of Fed policy, a wider differential (in *levels*) can help to insulate foreign markets from the cumulative impact of Fed policy decisions.

**Keywords:** Monetary Policy, International Spillovers, Convenience Yields

**JEL Codes:** E58, F30, G15

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# 1 Introduction

We investigate how the convenience yield on dollar-denominated safe assets contributes to the spillover of US monetary policy to international stock markets. The post-2008 literature on the global financial cycle has documented co-movement across a variety of international financial variables since the onset of financial globalization in the 1990s. The economic pain associated with the troughs of financial cycles is well documented (Reinhart and Rogoff, 2009), hence the importance of gaining a better understanding of this international financial co-movement.

The literature has identified US monetary policy (Miranda-Agrippino and Rey, 2020) and global safe asset scarcity (Caballero, Farhi, and Gourinchas, 2017) as two important factors underlying the global financial cycle. Miranda-Agrippino and Rey (2020), among other works, show that spillovers of US monetary policy are a key driver of co-movement in international financial variables. Further, Caballero, Farhi, and Gourinchas (2017) suggest that global scarcity of dollar-denominated safe assets can increase global financial interdependence. The convenience yield channel of monetary policy (Krishnamurthy and Lustig, 2019; Jiang, Krishnamurthy, and Lustig, 2020) combines these perspectives by proposing an explicit role for dollar-denominated safe assets in contributing to international spillovers of Federal Reserve policy.

The convenience yield is the yield that investors are willing to forgo (relative to an alternative security with equivalent cash flows) in order to hold an asset for its safety and liquidity characteristics. It, therefore, serves as a measure of the global scarcity of dollar-denominated safe assets, since investors will be willing to forgo a larger return when safe dollar assets are in shorter supply. Krishnamurthy and Lustig (2019) and Jiang, Krishnamurthy and Lustig (2020) argue that Federal Reserve monetary policy decisions can impact the expected supply of dollar-denominated safe assets, and thus influence its convenience yield, which in turn can cause ripple effects through the international financial system. Indeed, Krishnamurthy and Lustig (2019) document that an unanticipated Federal Reserve monetary tightening increases the convenience yield on US Treasuries and results in an appreciation of the US dollar against foreign currencies. Notably, this result holds even controlling for

contemporaneous movements in interest rates.

We extend the empirical framework of Krishnamurthy and Lustig (2019) to investigate whether the convenience yield channel influences the global financial system beyond foreign exchange markets. In particular, we focus on whether the channel can help to explain spillovers of US monetary policy to international stock markets. Using a measure of the convenience yield differential between US Treasuries and equivalent foreign government bonds from Du, Im, and Schreger (2018), we implement a two-stage estimation strategy to determine whether monetary policy-induced changes in convenience yield differentials impact stock prices in 10 advanced economies. We also analyze whether there are heterogeneous effects of US monetary shocks on foreign stock markets conditional on the level of the convenience yield differential between US Treasuries and the home country's government bonds.

Our results document three findings. First, consistent with Krishnamurthy and Lustig (2019), we find that contractionary US monetary shocks lead to an increase in convenience yield differentials. This supports the notion that an unanticipated tightening of policy reduces the expected supply of dollar-denominated safe assets. Second, a monetary-induced increase in convenience yield differentials leads to a decline in international stock returns. Combined, these two results indicate that the convenience yield channel is not only relevant for explaining the influence of US monetary policy on dollar exchange rates, but that it contributes to spillovers to international financial markets more broadly. Notably, these results hold when controlling for contemporaneous movements in interest rates and exchange rates. In investigating why an increase in convenience yield differentials lowers international stock returns, we provide evidence that the negative relationship is driven by heightened risk aversion and an increase in the equity risk premium. Lastly, we find that countries with wider convenience yield differentials (relative to Treasuries) are better insulated from cumulative spillovers of US monetary policy.

A significant body of literature has analyzed spillovers of Federal Reserve policy to the global financial system. Studies such as Anaya, Hachula, and Offermanns (2017), Bhattarai, Chatterjee, and Park (2015), Bowman, Londono, and Sapriza (2015), Neely (2015), and Bauer and Neely (2014) document the influence of the Fed's Quantitative Easing (QE) programs on international financial markets. The impact of conventional US monetary policy

has been investigated by Albagli, Ceballos, Claro, and Romero (2019), Gilchrist, Yue, and Zakrajšek (2019), Hausman and Wongswan (2011), Ehrmann and Fratzscher (2009), and Maćkowiak (2007) across a range of advanced and emerging economies. Lakdawala, Moreland, and Schaffer (2021) show that international markets react meaningfully not only to conventional US monetary shocks, but also to monetary policy uncertainty shocks. These studies consistently report that unanticipated tightening (loosening) of US monetary policy lowers (raises) stock prices, increases (decreases) bond yields, and appreciates (depreciates) the dollar exchange rate, although there is substantial heterogeneity across countries. This study further advances the literature by investigating whether the convenience yield channel contributes to spillovers to international stock indexes.

This paper also relates to the literature on safe assets and their convenience yields. Krishnamurthy and Vissing-Jorgensen (2012) demonstrate that US Treasuries are on average 73 basis points (bp) lower due to their liquidity and safety. Greenwood, Hanson, and Stein (2015) estimate a 40bp average convenience yield on one-week T-bills. Du, Im, & Schreger (2018) quantify the US Treasury Premium, i.e., the convenience yield differential between Treasuries and equivalent foreign government bonds, and document a secular decline in the Premium at medium to long maturities. Krishnamurthy and Lustig (2019) use a similar measure to analyze the relationship between dollar-denominated safe assets, the dollar exchange rate, and US monetary policy. Importantly, they establish evidence for the convenience yield channel investigated in this paper. Jiang, Krishnamurthy, and Lustig (2020) construct a model of the global financial cycle which incorporates the convenience yield channel and emphasizes the importance of global demand for safe dollar assets.

Using an alternative methodology, Diamond and Van Tassel (2022) offer a somewhat different perspective, arguing that convenience yields correlate with the level of domestic interest rates and are not particularly large for the US. For a panel of 40 countries Habib, Stracca, & Venditti (2020) find that past behavior as a safe asset, quality of institutions, and size of the debt market significantly predict a government bond's safe asset status. Caballero, Farhi, and Gourinchas (2017) offer an overview of the macroeconomic implications of the global safe asset shortage, while Caballero, Farhi, and Gourinchas (2021) show that safe asset scarcity can exacerbate global imbalances at the zero lower bound. Our results

contribute to this literature by further documenting how safe dollar asset dynamics contribute to international spillovers of US monetary policy.

The rest of the paper is organized as follows. Section 2 introduces our data on convenience yield differentials, US monetary policy shocks, and international stock indexes. Section 3 presents our baseline results and investigates the underlying mechanisms. Section 4 discusses policy implications and concludes.

# 2 Data

The key variable in our empirical analysis is our measure of the convenience yield, which gauges the relative scarcity of a safe asset. An asset's convenience yield is the amount of yield or return that investors are willing to forgo due to the security's safety and liquidity characteristics. For instance, a convenience yield on the 10-year Treasury of 30bp would indicate that investors are willing to give up 30bp of return to hold the Treasury instead of an otherwise equivalent security (i.e., equivalent cash flows and no default risk) specifically due to the Treasury's safety and liquidity. Therefore, the magnitude of the convenience yield can provide a gauge of the safe asset's scarcity – the more scarce the asset is relative to demand, the higher the convenience yield will be.

Du, Im, and Schreger (2018) construct a measure of the convenience yield differential ($CYD$) between US Treasuries and equivalent foreign government bonds. For instance, consider a convenience yield on the 10-year Treasury and the convenience yield on the 10-year UK Gilt. The convenience yields represent the degree to which both securities are valued for their safety and liquidity. A higher convenience yield on the Treasury relative to the Gilt would indicate that the Treasury is more highly valued by investors for its safe asset characteristics. In our empirical analysis, our primary variable of interest is going to be the convenience yield differential between 2-year US Treasuries and equivalent 2-year government bonds for 10 other advanced economies. An increase in this variable will therefore represent an increase in the value investors attach to the safety and liquidity of Treasuries relative to the domestic safe assets in the 10 other countries.

It is not straightforward to measure convenience yields, however. Du, Im, and Schreger

(2018) show that under minimal assumptions (no default risk and frictionless international financial markets) convenience yield differentials are equivalent to deviations from covered interest parity (CIP). If CIP holds then the difference between two countries' risk-free rates should equal the forward foreign exchange swap rate. If CIP doesn't hold, and a higher dollar-denominated return can be earned on, say, a 2-year UK Gilt swapped into dollars than on a 2-year Treasury, the higher dollar-denominated return that investors are willing to give up in order to hold the Treasury can be attributed to the additional safety provided by holding the Treasury directly.

The measure, specifically, is:

$$CYD_{i,n,t} = y^{Govt}_{i,n,t} - \rho_{i,n,t} - y^{Govt}_{USD,n,t} \tag{1}$$

where $y^{Govt}_{i,n,t}$ is country $i$'s $n$-year domestic currency government bond yield, $\rho_{i,n,t}$ is the $n$-year market-implied forward premium for hedging currency $i$ against the U.S. dollar, and $y^{Govt}_{USD,n,t}$ is the $n$-year US Treasury yield (denominated in dollars).

We use monetary policy shocks at both the daily and monthly frequencies from Jarocinski and Karadi (2020). Jarocinski and Karadi (2020) start with the first principal component of the changes in the current month and three-month ahead fed funds futures contracts and two, three, and four-quarters ahead three-month eurodollar futures in a narrow window (10 minutes before to 20 minutes after) around the Federal Open Market Committee (FOMC) announcements.[1] They then strip out potential central bank information effects using two approaches. The first approach produces the "poor man's sign restrictions" shock, which is the first principal component shock on FOMC announcement days when the S&P 500 response in a narrow window around the announcement is of the opposite sign of the first principal component. The second approach produces the 'median rotation" shock, which strips out information effects by identifying separate structural monetary policy shocks and central bank information shocks in a sign restriction vector autoregression (VAR) model. We use the median rotation shock as our baseline measure, however, in the appendix, we reproduce all results using the first principal component and poor man shocks as alternatives.

[1]This is essentially the same measure as the "policy news" shock from Nakamura and Steinnson (2018).

Table 1: Summary statistics

| *Daily frequency* | Mean | Median | Std Dev | Min | Max | Obsv. |
|---|---|---|---|---|---|---|
| **Monetary policy shocks** | | | | | | |
| Median rotation | 0.001 | 0.004 | 0.059 | -0.348 | 0.138 | 158 |
| First principal component | 0.003 | 0.014 | 0.060 | -0.302 | 0.166 | 158 |
| Poor man's | 0.003 | 0.000 | 0.055 | -0.302 | 0.166 | 158 |
| **Variables of interest** | | | | | | |
| Convenience yield differential (level) | 11.264 | 12.240 | 29.345 | -93.800 | 156.870 | 1,504 |
| Convenience yield differential (change) | -0.524 | -0.360 | 4.516 | -24.645 | 21.780 | 1,469 |
| Stock index return | 0.084 | 0.075 | 1.356 | -5.268 | 9.494 | 1,572 |
| **Control variables** | | | | | | |
| Exchange rate (return) | 0.038 | 0.009 | 0.825 | -4.692 | 3.823 | 1,580 |
| Domestic long rate (change) | -0.003 | -0.004 | 0.058 | -0.404 | 0.351 | 1,580 |
| Domestic short rate (change) | -0.003 | 0.000 | 0.046 | -0.549 | 0.517 | 1,580 |
| US long rate (change) | -0.003 | -0.008 | 0.090 | -0.505 | 0.263 | 1,580 |
| US short rate (change) | -0.016 | 0.000 | 0.060 | -0.421 | 0.110 | 1,580 |
| *Monthly frequency* | Mean | Median | Std Dev | Min | Max | Obsv. |
| **Monetary policy shocks** | | | | | | |
| Median rotation | 0.001 | 0.000 | 0.047 | -0.304 | 0.138 | 233 |
| First principal component | 0.002 | 0.000 | 0.051 | -0.302 | 0.166 | 233 |
| Poor man's | 0.002 | 0.000 | 0.045 | -0.302 | 0.166 | 233 |
| **Variables of interest** | | | | | | |
| Convenience yield differential (level) | 12.119 | 12.618 | 29.283 | -91.367 | 152.65 | 2,318 |
| Convenience yield differential (change) | -0.147 | -0.091 | 8.277 | -61.809 | 74.975 | 2,306 |
| Stock index return | 0.302 | 0.696 | 4.794 | -24.936 | 22.442 | 2,330 |
| **Control variables** | | | | | | |
| Exchange rate | 97.835 | 98.605 | 12.035 | 69.105 | 132.44 | 2,330 |
| Domestic long rate | 3.117 | 3.190 | 1.856 | -0.543 | 7.480 | 2,330 |
| Domestic short rate | 2.329 | 1.960 | 2.203 | -1.150 | 8.910 | 2,330 |
| US long rate | 3.480 | 3.420 | 1.220 | 1.500 | 6.660 | 2,330 |
| US short rate | 1.982 | 1.230 | 1.952 | 0.110 | 6.730 | 2,330 |
| Industrial production | 101.893 | 101.880 | 11.130 | 62.784 | 133.840 | 2,330 |
| Consume price index | 96.681 | 98.795 | 10.125 | 64.627 | 120.315 | 2,330 |
| Bilateral trade balance | -1435.9 | -389.7 | 2335.1 | -9883.0 | 2741.2 | 2,330 |

We have data on stock index returns for 10 advanced economies at the daily and monthly frequencies. The daily data comes from Bloomberg and the monthly data comes from MSCI. Estimation at the daily level offers greater precision, as identification only requires that confounding events do not systematically occur on FOMC announcement days. Estimation at the monthly level, on the other hand, offers less precise identification but provides a broader perspective on the persistence of the effects. The results are consistent across both frequencies, with the primary difference being slightly larger estimates in magnitude at the monthly level.

Our sample period runs from January 2000 to May 2019 and covers ten advanced economies: Australia, Canada, Denmark, Germany, Japan, New Zealand, Norway, Sweden, Switzerland, and the UK. Our two-stage estimation aims to test whether the convenience yield channel contributes to US monetary policy spillovers to these international stock markets, so our estimation will control for other channels that spillovers could potentially operate through: short and long-term US interest rates, short and long-term domestic interest rates, and the domestic currency USD exchange rate. In the monthly estimation, we also include the domestic country's log of industrial production, log of the consumer price index, and the bilateral trade balance with the US. Summary statistics for all variables used in the empirical analysis are presented in Table 1, and variable definitions and sources are in Appendix Tables A1 and A2.

# 3 Results

## 3.1 The Convenience Yield Channel and International Stock Prices

In investigating how US monetary policy impacts convenience yields, and how monetary-induced changes in convenience yield differentials impact international stock markets, we use a two-stage approach. In the first stage, given by equation 2, we estimate the impact of a US monetary policy shock on the change in the convenience yield differential between country

$i$'s 2-year government bond and the 2-year US Treasury:

$$\Delta CYD_{i,t} = \alpha_i + \beta_1 mps_t + \Phi X_t + \Gamma Z_{i,t} + \epsilon_{i,t} \tag{2}$$

where $\Delta CYD_{i,t}$ is the change in convenience yield differential for country $i$ at time (day or month) $t$, $mps_t$ is the US monetary policy shock at time $t$, $X_t$ contains the US short (3-month) and long rate (10-year) at time $t$, and $Z_{i,t}$ contains country $i$'s short rate, long rate, and exchange rate with USD at time $t$. A significant coefficient on $mps$ ($\beta_1$) would indicate that US monetary shocks influence convenience yield differentials between Treasuries and equivalent foreign bonds.

The goal of our two-stage approach is to investigate whether changes in convenience yields are a channel through which US monetary policy can spillover to international stock markets. This implies a need to control for all other potential channels through which US monetary policy spillovers could operate. Accordingly, we control for US short and long rates, country $i$'s short and long rates, and country $i$'s exchange rate against the dollar. For the monthly estimation we also add macroeconomic controls including country $i$'s IP, CPI, and bilateral trade balance with the US.

Panel (a) of Table 2 shows the results from the daily estimation. Observe that the coefficient on the monetary policy shock grows in magnitude and becomes more precisely estimated as control variables are added. Our preferred specification with the full set of controls in column (6) indicates that a 100bp contractionary US monetary shock leads to a roughly 15bp increase in the convenience yield differential. Or, in other words, a 100bp contractionary US monetary shock results in global investors being willing to forgo an additional 15bp of dollar-denominated return in order to hold a 2-year Treasury instead of an equivalent 2-year government bond (plus currency swap) from one of the 10 other advanced economies.[2] This indicates an increase in global safe dollar asset scarcity, relative to other "safe" government securities, in response to a US monetary shock.

[2]This is consistent with Table 12 of Krishnamurthy and Lustig (2019), which reports a similar widening of convenience yield differentials following a US monetary policy shock. Our estimation differs in that we employ a panel of convenience yield differentials instead of taking the average across countries, we focus on the differential at the 2-year maturity rather than the 3-month, and we employ a much longer sample period ending in 2019 rather than 2008.

Table 2: Monetary policy and convenience yields

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock | 8.59* | 8.50* | 9.72** | 12.10*** | 13.17*** | 14.79*** |
| | (4.15) | (4.05) | (3.83) | (3.43) | (3.43) | (3.39) |
| Exchange Rate | | 2.60 | 6.15 | 2.27 | 7.17 | 22.71 |
| | | (20.58) | (21.66) | (21.47) | (21.57) | (20.85) |
| Domestic Short Rate | | | -12.50 | -7.95 | -7.95 | -7.85 |
| | | | (7.44) | (4.78) | (4.93) | (5.06) |
| Domestic Long Rate | | | | -12.21 | -12.38 | -5.35 |
| | | | | (8.43) | (8.35) | (6.72) |
| US Short Rate | | | | | -7.97*** | -6.29** |
| | | | | | (2.44) | (2.41) |
| US Long Rate | | | | | | -10.23*** |
| | | | | | | (2.62) |
| $N$ | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock | 19.53*** | 19.54*** | 19.52*** | 19.47*** | 19.58*** | 19.54*** |
| | (4.30) | (4.29) | (4.28) | (4.27) | (4.41) | (4.41) |
| Exchange Rate | | -1.58 | -0.93 | -0.75 | -0.61 | -1.16 |
| | | (1.46) | (1.82) | (1.83) | (1.70) | (1.60) |
| Domestic Short Rate | | | -0.16 | -0.26 | -0.30 | -0.08 |
| | | | (0.21) | (0.22) | (0.19) | (0.19) |
| Domestic Long Rate | | | | 0.32 | 0.36 | -0.26 |
| | | | | (0.27) | (0.30) | (0.21) |
| US Short Rate | | | | | 0.26 | 0.03 |
| | | | | | (0.56) | (0.55) |
| US Long Rate | | | | | | 1.22* |
| | | | | | | (0.55) |
| $N$ | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Turning to the monthly estimation in Panel (b), the coefficient on *mps* is more stable regardless of the controls included, with the preferred specification in column (6) suggesting that a 100bp contractionary US monetary shock results in a 19.5bp increase in convenience yield differentials. The larger magnitude here suggests that some of the response of the convenience yield differential to the US monetary policy decision may occur after the daily event window of our higher frequency estimation. In terms of sample construction, it should be noted that our daily estimation only includes days with an FOMC announcement whereas our monthly estimation includes all months from Jan 2000 to May 2019, where months without an FOMC announcement are set to zero.[3] We obtain very similar results using the alternative monetary shock measures in Appendix Tables A3 and A4.

The first stage results suggest there's a positive relationship between US monetary policy and convenience yield differentials. In the second stage, given by equation 3, we estimate how the monetary policy-induced change in convenience yield differentials from the first stage ($\Delta\widehat{CYD}$) impacts international stock returns. We are testing whether convenience yield fluctuations represent a channel through which US monetary policy can spillover to international stock markets, so we continue to control for the alternative channels through which US monetary policy may spillover to other countries' financial systems.

$$Stocks_{i,t} = \alpha_i + \beta_1 \Delta\widehat{CYD}_{i,t} + \Phi X_t + \Gamma Z_{i,t} + \epsilon_{i,t} \tag{3}$$

At the daily level, shown in Panel (a) of Table 3, the coefficient of interest on $\Delta\widehat{CYD}$ becomes more precisely estimated with the inclusion of additional control variables. The preferred specification in column (6) indicates that a one basis point monetary policy–induced increase in a country's convenience yield differential leads to a 0.34% decline in that country's major stock index. Or, in other words, when global investors are willing to forgo an additional basis point in dollar-denominated return to hold a Treasury rather than country $i$'s equivalent government bond, stock prices in country $i$ fall by 0.34%, even when controlling for simultaneous changes in interest and exchange rates. This indicates that the convenience yield channel does indeed contribute to spillovers of Federal Reserve policy to international

[3]We do not have interest rate data at the monthly frequency for a handful of countries early in the sample, so the number of observations drops a bit from columns (2) to (3).

markets.

Table 3: Convenience yield channel and stock prices

| | Outcome: Stock Index Returns | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.49* | -0.45* | -0.42** | -0.42** | -0.39** | -0.34** |
| | (0.25) | (0.22) | (0.18) | (0.15) | (0.13) | (0.11) |
| Exchange Rate | | -9.16 | -8.48 | -8.34 | -6.24 | -0.48 |
| | | (12.67) | (12.75) | (12.53) | (11.75) | (11.25) |
| Domestic Short Rate | | | -2.98 | -3.19 | -2.88 | -2.45 |
| | | | (3.87) | (1.81) | (1.70) | (1.41) |
| Domestic Long Rate | | | | 0.34 | 0.74 | 4.06 |
| | | | | (4.44) | (3.99) | (3.21) |
| US Short Rate | | | | | -3.53* | -2.50 |
| | | | | | (1.83) | (1.55) |
| US Long Rate | | | | | | -3.98** |
| | | | | | | (1.43) |
| $N$ | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| | Outcome: Stock Index Returns | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.94*** | -0.94*** | -0.91*** | -0.91*** | -0.94*** | -0.94*** |
| | (0.22) | (0.22) | (0.22) | (0.22) | (0.23) | (0.23) |
| Exchange Rate | | -2.48 | -0.75 | -0.43 | -1.02 | -1.65 |
| | | (1.50) | (2.06) | (1.99) | (1.97) | (1.78) |
| Domestic Short Rate | | | -0.53** | -0.71** | -0.54** | -0.29 |
| | | | (0.22) | (0.25) | (0.23) | (0.18) |
| Domestic Long Rate | | | | 0.57* | 0.41 | -0.29 |
| | | | | (0.27) | (0.29) | (0.34) |
| US Short Rate | | | | | -1.10* | -1.36** |
| | | | | | (0.58) | (0.58) |
| US Long Rate | | | | | | 1.37* |
| | | | | | | (0.68) |
| $N$ | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Turning to the monthly estimation, shown in Panel (b) of Table 3, we once again observe a more stable and somewhat elevated coefficient relative to the daily estimation, with column (6) indicating that a one basis point monetary policy-induced increase in a country's convenience yield differential leads to a 0.94% decline in the country's stock market. Estimation at both frequencies therefore consistently implies an active role for the convenience yield channel in transmitting US monetary policy abroad. Appendix Tables A5 and A6 show the second stage results are very similar when using the alternative monetary shock measures.

### 3.1.1 Robustness (pre-crisis sample)

Krishnamurthy and Lustig (2019) note that while a tightening (loosening) of conventional monetary policy should decrease (increase) the expected supply of safe dollar assets, resulting in an increase (decrease) in convenience yield differentials, the effect may run opposite for unconventional monetary policy. Quantitative Easing programs by the Federal Reserve involve the large-scale purchase of dollar-denominated safe assets, thus reducing their expected supply for the global financial system, whereas Quantitative Tightening has the opposite effect. Therefore, one would expect a tightening (loosening) of unconventional monetary policy to decrease (increase) convenience yield differentials.

Since our monetary shock measures are constructed from short-term interest rate future contracts, they should primarily capture changes in conventional policy.[4] However, to ensure that our estimates are not distorted by the presence of unconventional policy following the Global Financial Crisis (GFC), we re-estimate equations 2 and 3 for a pre-crisis sample of 2000-2008.

Table 4 presents first stage results and Table 5 presents second stage results. In both cases, we obtain similar results to the full sample estimation. Contractionary monetary shocks significantly widen convenience yield differentials, while monetary policy-induced increases in convenience yield differentials lead to a significant decline in international stock prices. We can therefore conclude that the presence of unconventional policy from 2008 on is unlikely to be biasing the full sample results in Tables 2 and 3.

[4]In contrast, Swanson (2021) constructs a Large Scale Asset Purchase (LSAP) shock measure using longer-term maturities.

Table 4: Monetary policy and convenience yields (pre-crisis sample)

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock | 10.88** | 13.82** | 14.55** | 15.03*** | 16.52*** | 11.33** |
| | (4.00) | (4.36) | (4.56) | (4.56) | (4.08) | (3.88) |
| Exchange Rate | | -84.49* | -80.98* | -79.00* | -70.86* | -59.22 |
| | | (37.61) | (37.62) | (37.95) | (37.69) | (38.98) |
| Domestic Short Rate | | | -8.95 | -1.60 | -1.02 | 1.37 |
| | | | (10.72) | (5.81) | (6.13) | (5.73) |
| Domestic Long Rate | | | | -15.99 | -15.59 | -5.24 |
| | | | | (10.16) | (10.17) | (7.18) |
| US Short Rate | | | | | -5.85* | -3.00 |
| | | | | | (3.01) | (3.58) |
| US Long Rate | | | | | | -19.50*** |
| | | | | | | (4.97) |
| *N* | 588 | 588 | 588 | 588 | 588 | 588 |

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock | 10.95** | 10.60** | 9.78** | 9.63** | 9.52* | 9.39* |
| | (3.82) | (3.83) | (4.03) | (3.97) | (4.69) | (4.82) |
| Exchange Rate | | -7.57** | -6.93** | -5.69 | -5.79 | -5.30 |
| | | (2.86) | (2.72) | (3.15) | (3.32) | (3.20) |
| Domestic Short Rate | | | -0.14 | -0.53** | -0.51** | -0.61* |
| | | | (0.17) | (0.17) | (0.23) | (0.32) |
| Domestic Long Rate | | | | 1.21* | 1.19* | 1.44 |
| | | | | (0.61) | (0.63) | (1.13) |
| US Short Rate | | | | | -0.05 | 0.03 |
| | | | | | (0.40) | (0.36) |
| US Long Rate | | | | | | -0.35 |
| | | | | | | (0.88) |
| *N* | 944 | 944 | 917 | 917 | 917 | 917 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table 5: Convenience yield channel and stock prices (pre-crisis sample)

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.55** | -0.45** | -0.44** | -0.44** | -0.49*** | -0.76** |
| | (0.23) | (0.16) | (0.16) | (0.15) | (0.14) | (0.27) |
| Exchange Rate | | -31.23 | -30.25 | -29.90 | -37.68 | -46.57 |
| | | (22.93) | (22.45) | (22.06) | (23.45) | (34.12) |
| Domestic Short Rate | | | -1.19 | -0.66 | -1.04 | 0.89 |
| | | | (4.97) | (2.72) | (3.07) | (4.49) |
| Domestic Long Rate | | | | -1.09 | -2.02 | 2.72 |
| | | | | (6.35) | (6.78) | (7.51) |
| US Short Rate | | | | | 2.81 | 3.67 |
| | | | | | (2.29) | (3.28) |
| US Long Rate | | | | | | -17.10** |
| | | | | | | (6.56) |
| *N* | 588 | 588 | 588 | 588 | 588 | 588 |

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -1.88** | -1.95** | -2.08** | -2.11** | -2.25* | -2.28* |
| | (0.63) | (0.69) | (0.83) | (0.85) | (1.11) | (1.17) |
| Exchange Rate | | -17.04* | -13.14 | -10.91 | -12.90 | -11.94 |
| | | (8.21) | (9.01) | (8.61) | (11.41) | (10.46) |
| Domestic Short Rate | | | -0.96* | -1.74** | -1.60** | -1.84* |
| | | | (0.50) | (0.69) | (0.63) | (0.96) |
| Domestic Long Rate | | | | 2.40 | 2.29 | 2.93 |
| | | | | (1.68) | (1.68) | (3.05) |
| US Short Rate | | | | | -0.65 | -0.44 |
| | | | | | (1.13) | (1.01) |
| US Long Rate | | | | | | -0.84 |
| | | | | | | (2.02) |
| *N* | 944 | 944 | 917 | 917 | 917 | 917 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

## 3.2 Convenience Yields and the Equity Risk Premium

Our baseline results control for the primary alternative channels through which US monetary policy might affect international stock markets: interest rates and exchange rates. The fact that a policy-induced increase in convenience yield differentials lowers stock returns independent of these channels raises the question: why does an expected decrease in the supply of safe dollar assets (as proxied for by a wider differential) reduce stock prices?

In a risk neutral world, a stock's price should equal the present value of expected future cash flows discounted at the risk free rate. More realistically, in a risk averse world, investors will discount expected cash flows at a higher rate which reflects the fact that future cash flows are not perceived to be riskless. The difference between the rate that expected cash flows are actually discounted at and the risk free rate is the equity risk premium. The premium rises as investors demand a greater reward for taking on risk, which in turn reduces the present value of future cash flows and lowers stock prices.

A decline in stock prices can therefore be caused by an increase in the risk free rate, a downward revision in expected future cash flows, or an increase in the equity risk premium. Our empirical analysis controls for US and domestic short rates, which rules out changes in risk free rates driving the observed decline in stock returns. While we cannot entirely rule out that the decline is driven by downward revisions to expected cash flows, this possibility seems unlikely for two reasons.

First, the primary mechanisms through which US monetary policy might influence the expected cash flows of foreign corporations are interest rates and the USD exchange rate, which our analysis controls for. Second, while Caballero, Farhi, and Gourinchas (2017, 2021) argue that an increased scarcity of safe assets can push global output below its potential, this "tipping point" is only reached when safe interest rates reach their effective lower bound (ELB). Such a mechanism could therefore have been relevant when safe interest rates in the US were at their ELB: following a policy-induced decrease in the supply of safe dollar assets, investors may have become more pessimistic about the state of the global economy and, correspondingly, more pessimistic about future cash flows. Interest rates on safe dollar assets did not reach the ELB until late 2008, however, and the previous analysis from Section 3.1.1 shows that our results hold prior to this period. Such a mechanism is therefore unlikely

to be the primary cause of the convenience yield channel's impact on international stock returns. This leaves the equity risk premium as the most likely candidate.

The equity risk premium is the price attached to risk. Accordingly, many factors can play a role in influencing it (Damodaran, 2020). In the context of safe dollar asset scarcity, one key determinant is risk aversion. When global investors become more risk averse, they will naturally require a higher price for taking on risk in equity markets. Under the convenience yield channel, a surprise tightening of US monetary policy decreases the expected future supply of safe dollar assets, thereby raising the convenience yield on those assets. A higher convenience yield represents a higher opportunity cost (larger amount of forgone yield) for holding a safe asset. Accordingly, if investors anticipate greater difficulty and higher costs in acquiring safe dollar assets in the future, they may become more averse to holding risky assets today. Such an increase in risk aversion can correspondingly increase the premium investors require to hold stocks.

We investigate the relationship between convenience yield differentials and risk aversion by estimating the following equation for all available trading days from January 1997 to May 2019:[5]

$$\Delta RA_t = \alpha_i + \beta_1 \Delta CYD_{i,t} + \Phi X_t + \Gamma Z_{i,t} + \epsilon_{i,t} \tag{4}$$

where $\Delta RA_t$ is the change in market risk aversion at time $t$, $CYD_{i,t}$ is the change in convenience yield differential for country $i$ at time $t$, and $X_t$ and $Z_{i,t}$ contain the same control variables as the earlier estimation. Our measures of market risk aversion are estimates of the variance risk premium from Bekaert, Hoerova, and Lo Duca (2013) and Bekaert and Hoerova (2014).[6]

[5]Daily data begins at various points between 1997-2000 for the 10 advanced economies. Estimation at the monthly frequency begins in February 2000 due to availability of control variables.

[6]The daily measure is from Bekaert and Hoerova (2014) and the monthly is from Bekaert, Hoerova, and Lo Duca (2013).

Table 6: Convenience yields and risk aversion

| | Outcome: Δ Risk Aversion | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | 0.25*** | 0.27*** | 0.26*** | 0.24*** | 0.24*** | 0.19*** |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Exchange Rate | | 40.75 | 35.31 | 27.89 | 27.75 | 36.45 |
| | | (35.24) | (35.21) | (33.59) | (33.46) | (31.60) |
| Domestic Short Rate | | | -13.52*** | -8.58*** | -8.07*** | -9.04*** |
| | | | (2.24) | (2.14) | (2.20) | (2.36) |
| Domestic Long Rate | | | | -15.62*** | -15.11*** | 0.25 |
| | | | | (3.67) | (3.66) | (2.72) |
| US Short Rate | | | | | -8.11*** | -1.45 |
| | | | | | (1.07) | (0.81) |
| US Long Rate | | | | | | -31.10*** |
| | | | | | | (0.83) |
| *N* | 50586 | 46735 | 46735 | 46735 | 46735 | 46735 |

| | Outcome: Δ Risk Aversion | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | 0.07** | 0.07** | 0.07** | 0.07** | 0.07** | 0.07** |
| | (0.03) | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) |
| Exchange Rate | | -0.66 | -2.23* | -2.47* | -1.07 | -1.73 |
| | | (0.67) | (1.20) | (1.15) | (1.00) | (1.02) |
| Domestic Short Rate | | | 0.77*** | 0.90*** | 0.48** | 0.75*** |
| | | | (0.22) | (0.23) | (0.17) | (0.21) |
| Domestic Long Rate | | | | -0.41* | 0.00 | -0.74** |
| | | | | (0.19) | (0.19) | (0.30) |
| US Short Rate | | | | | 2.69*** | 2.42*** |
| | | | | | (0.26) | (0.29) |
| US Long Rate | | | | | | 1.46*** |
| | | | | | | (0.21) |
| *N* | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

If an expected increase in the scarcity of safe dollar assets raises investor risk aversion, the result could be an increase in the equity risk premium and a resulting decrease in stock prices. If this is indeed the mechanism producing our baseline results in Table 3, we would expect to observe a positive relationship between convenience yield differentials and risk aversion. Estimates in Table 6 confirm this is the case, as the $\beta_1$ coefficient is positive and statistically significant in all columns of Panels (a) and (b).[7] The results indicate that risk aversion in the stock market is higher when the gap between safe dollar asset convenience yields and foreign equivalents widens. This points to heightened risk aversion and a larger equity risk premium as the most likely explanation for the convenience yield channel's negative impact on international stock prices.

## 3.3 Convenience Yields and Cumulative Spillover Effects

The results from our two-stage estimation indicate that one of the ways that US monetary policy can impact other countries' stock markets is through changes in the relative scarcity of safe dollar assets. This is just one channel through which US monetary policy spillovers can operate, however, as spillovers can also be transmitted through interest rate dynamics and exchange rate fluctuations.

Having documented that a widening of convenience yield differentials has a negative direct impact on international stock markets, we next want to examine whether a country's *level* of convenience yield differential versus Treasuries influences overall, or cumulative, US monetary policy spillovers. We can do this, as displayed in equation 5, by interacting a country's level of convenience yield differential from the period just prior to a US monetary policy decision, with the US monetary policy shock.

$$Stocks_{i,t} = \alpha_i + \beta_1 mps_t + \beta_2 CYD_{i,t-1} + \beta_3 mps_t * CYD_{i,t-1} + \Phi X_t + \Gamma Z_{i,t} + \epsilon_{i,t} \quad (5)$$

In this specification, we'd expect a negative $\beta_1$: contractionary US monetary shocks result in stock market declines (while expansionary US shocks result in rises). The coefficient of interest is $\beta_3$, where a significant coefficient would indicate meaningful heterogeneity in

[7] Risk aversion is in monthly percentages squared.

countries' overall stock market responses to US monetary policy based on the convenience yield differential between their domestic government bonds and US Treasuries.

As expected, the coefficient on *mps* in Panel (a) of Table 7 is negative and significant: a 100bp contractionary shock results in a roughly 6% decline in international stock indexes. The interaction coefficient, $\beta_3$, is positive and significant, suggesting that countries with convenience yield differentials one standard deviation above average experience a 1.65 percentage point smaller drop in stock returns following a contractionary monetary shock.[8] Or, in other words, having a one standard deviation above average convenience yield differential relative to US Treasuries reduces the overall spillover effects of US monetary policy by roughly 25%. Similar results can be observed using the alternative monetary shock measures in Panel (a) of Appendix Tables A7 and A8. All three tables show a positive and significant interaction coefficient, suggesting that higher levels of convenience yield differentials can insulate international stock markets from cumulative spillovers of US monetary policy.

Results from the monthly estimation in Panel (b) of Table 7 show an even larger decline in response to a contractionary shock. While the interaction coefficient remains positive, it is somewhat smaller in magnitude than in the daily estimation and is no longer statistically significant. Panel (b) in Tables A7 and A8 tell a slightly more nuanced story. Results using the poor man's shock (Table A8) also show a positive but imprecisely estimated interaction coefficient. Estimates using the first principal shock (Table A7), however, produce a positive and statistically significant $\beta_3$ coefficient. Overall, while the precision of the estimates decreases at the monthly frequency, the qualitative pattern is consistent with the daily estimation, suggesting that higher convenience yield differentials dampen overall spillover effects.

[8] $CYD_{i,t-1}$ has been normalized to have zero mean and unit standard deviation.

Table 7: Convenience yield differential and cumulative policy spillovers

| Panel (a): Daily | Outcome: Stock Index Returns (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| MP Shock | -5.47*** | -5.23*** | -5.50*** | -6.61*** | -6.21*** | -6.20*** |
| | (1.17) | (1.24) | (1.26) | (1.38) | (1.35) | (1.35) |
| MP Shock*CY Differential$_{t-1}$ | 1.51* | 1.63** | 1.63** | 1.71** | 1.60** | 1.65** |
| | (0.73) | (0.70) | (0.69) | (0.66) | (0.63) | (0.62) |
| Convenience Yield Differential$_{t-1}$ | 0.08 | 0.05 | 0.05 | 0.06 | 0.05 | 0.05 |
| | (0.06) | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) |
| Exchange Rate | | -13.39 | -13.70 | -12.15 | -10.41 | -9.41 |
| | | (9.55) | (9.49) | (9.40) | (9.27) | (9.11) |
| Domestic Short Rate | | | 2.19* | -0.13 | -0.01 | -0.04 |
| | | | (1.09) | (0.78) | (0.75) | (0.76) |
| Domestic Long Rate | | | | 6.13*** | 6.05*** | 6.57*** |
| | | | | (1.37) | (1.39) | (1.46) |
| US Short Rate | | | | | -1.65** | -1.56** |
| | | | | | (0.67) | (0.69) |
| US Long Rate | | | | | | -0.74* |
| | | | | | | (0.39) |
| $N$ | 1564 | 1564 | 1564 | 1564 | 1564 | 1564 |

| Panel (b): Monthly | Outcome: Stock Index Returns (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| MP shock | -18.87*** | -18.90*** | -17.91*** | -17.91*** | -17.75*** | -18.02*** |
| | (3.04) | (3.09) | (2.74) | (2.74) | (2.65) | (2.72) |
| MP Shock*CY Differential$_{t-1}$ | 1.57 | 1.58 | 0.93 | 0.92 | 0.60 | 0.84 |
| | (2.49) | (2.53) | (2.53) | (2.49) | (2.40) | (2.39) |
| Convenience Yield Differential$_{t-1}$ | -0.44* | -0.43* | -0.46** | -0.46** | -0.48** | -0.57** |
| | (0.22) | (0.23) | (0.19) | (0.18) | (0.17) | (0.19) |
| Exchange Rate | | 0.20 | 2.71 | 2.69 | 3.42 | 3.38* |
| | | (1.13) | (1.65) | (1.61) | (1.88) | (1.71) |
| Domestic Short Rate | | | -0.83*** | -0.84*** | -1.02*** | -1.19*** |
| | | | (0.14) | (0.17) | (0.18) | (0.20) |
| Domestic Long Rate | | | | 0.02 | 0.04 | 0.44 |
| | | | | (0.14) | (0.15) | (0.25) |
| US Short Rate | | | | | 0.21* | 0.42*** |
| | | | | | (0.10) | (0.08) |
| US Long Rate | | | | | | -0.63** |
| | | | | | | (0.27) |
| $N$ | 2308 | 2308 | 2281 | 2281 | 2281 | 2281 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

# 4 Conclusion

We investigate whether dollar-denominated safe assets influence spillovers of US monetary policy to international stock markets by extending the empirical framework of Krishnamurthy and Lustig (2019), which provides evidence of US monetary policy affecting dollar exchange rates through a convenience yield channel. Under the convenience yield channel, Federal Reserve policy actions influence the expected supply of dollar-denominated safe assets, which in turn affects the convenience yield on such assets. Given the central role of safe dollar assets in the global financial system, fluctuations in their convenience yields can influence financial markets around the world. We provide the first evidence that the convenience yield channel impacts international financial variables beyond the dollar exchange rate.

Our findings reveal that an unanticipated tightening of US monetary policy widens convenience yield differentials between US Treasuries and equivalent foreign government bonds for a panel of 10 advanced economies. Such a policy-induced increase in convenience yield differentials results in a decrease in international stock returns, even when controlling for contemporaneous movements in interest rates and exchange rates. The decline in international stock returns appears to be primarily driven by a higher equity risk premium. These results underscore the importance of dollar-denominated safe assets in the global financial system, suggesting that their scarcity can contribute to the transmission of US monetary policy shocks abroad. Further analysis shows that the overall effects of US monetary shocks on international stock prices are heterogeneous across countries, with wider convenience yield differentials relative to Treasuries resulting in greater insulation from cumulative spillovers of US monetary policy.

There are policy implications for both the Federal Reserve's conduct of US monetary policy and for macroprudential policy around the globe. First, Federal Reserve policymakers should be conscious of how their monetary policy decisions may influence global investors' expectations about the supply of safe dollar assets. In particular, it may be strategic to downplay the extent to which contractionary policy works via the credit channel, as an expectation of tighter borrowing constraints would likely lead to larger and more destabilizing jumps in convenience yield differentials. For global policymakers, a lack of domestic safe

assets may have some advantages if larger convenience yield differentials vis-à-vis Treasuries help to insulate domestic financial markets from US spillovers. There are many openings for future work, particularly in extending this analysis to emerging economies.

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# Appendix

Table A1: Variable definitions

| *Daily frequency* | Definition | Source |
|---|---|---|
| **Monetary policy shocks** | | |
| Median rotation | Monetary policy shock purged of central bank information through combining high frequency identification and sign restrictions in Bayesian VAR (see Jarocinski & karadi, 2020 for details). | Jarocinski & Karadi (2020) |
| First principal component | First principal component of surprises calculated in 30 minute window around FOMC announcements in the current month and three-month fed funds futures and two-, three-, and four-quarters ahead three-month eurodollar futures. | Jarocinski & Karadi (2020) |
| Poor man's | First principal component on FOMC announcement days where the stock price surprise had the opposite sign of the first principal component. | Jarocinski & Karadi (2020) |
| **Variables of interest** | | |
| Convenience Yield Differential | Covered interest parity deviations between government bond yields in the United States and other countries. In basis points, measured daily. | Du, Im, & Schreger (2018) |
| $\Delta$ Convenience Yield Differential | Daily change in covered interest parity deviations. | Du, Im, & Schreger (2018) |
| Stock index return | One-day return on country-specific stock indexes, centered around FOMC announcements. | Bloomberg |
| **Control variables** | | |
| Exchange rate | One-day return on country-specific exchange rate with US dollar, centered around FOMC announcements. | Bloomberg |
| Domestic long rate | One-day change in country-specific long-term (ten year) government bond rates, centered around FOMC announcements. | Bloomberg |
| Domestic short rate | One-day change in country-specific short-term (three month) government bond rates, centered around FOMC announcements. | Bloomberg |
| US long rate | One-day change in US long-term (ten year) government bond rate, centered around FOMC announcements. | Bloomberg |
| US short rate | One-day change in US short-term (three month) government bond rate, centered around FOMC announcements. | Bloomberg |
| Risk Aversion | One-day change in the US variance risk premium. | Bekaert & Hoerova (2014) |

Table A2: Variable definitions (continued)

| *Monthly frequency* | Definition | Source |
|---|---|---|
| **Monetary policy shocks** | | |
| Median rotation | Daily measure aggregated to the monthly level. Months without a FOMC meeting are set to zero. | Jarocinski & Karadi (2020) |
| First principal component | Daily measure aggregated to the monthly level. Months without a FOMC meeting are set to zero. | Jarocinski & Karadi (2020) |
| Poor man's | Daily measure aggregated to the monthly level. Months without a FOMC meeting are set to zero. | Jarocinski & Karadi (2020) |
| **Variables of interest** | | |
| Convenience Yield Differential | Daily measure averaged over a month. | Du, Im, & Schreger (2018) |
| $\Delta$ Convenience Yield Differential | Change in monthly average CIP deviation | Du, Im, & Schreger (2018) |
| Stock index return | Monthly return on country-specific MSCI stock indexes. | MSCI |
| **Control variables** | | |
| Exchange rate | Monthly average of country-specific exchange rate with US dollar. | OECD |
| Domestic long rate | Monthly average of country-specific long-term (ten year) government bond rates. | OECD |
| Domestic short rate | Monthly average of country-specific short-term (three month) government bond rates. | OECD |
| US long rate | Monthly average of US long-term (ten year) government bond rate. | OECD |
| US short rate | Monthly average of US short-term (three month) government bond rate. | OECD |
| Industrial production | Country-specific index measuring output of industrial establishments. | OECD |
| Consume price index | Country-specific index measuring prices of a fixed set of consumer goods and services of constant quantity and characteristics, acquired, used or paid for by the reference population. | OECD |
| Bilateral trade balance | Difference between US exports to and imports from a country. Figures reported in millions of dollars on a nominal basis, then deflated with the US consumer price index. | US Census Bureau |
| Risk Aversion | Monthly change in the US variance risk premium. | Bekaert, Hoerova, & Lo Duca (2013) |

Table A3: Monetary policy and convenience yields

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock (First Principal) | 4.95 | 4.64 | 5.95 | 8.76** | 11.61*** | 15.14*** |
| | (4.58) | (4.54) | (3.90) | (2.72) | (2.90) | (2.80) |
| Exchange Rate | | 8.46 | 11.52 | 6.74 | 9.94 | 24.31 |
| | | (21.15) | (22.18) | (21.52) | (21.39) | (20.37) |
| Domestic Short Rate | | | -11.95 | -7.66 | -7.78 | -7.79 |
| | | | (7.07) | (4.46) | (4.56) | (4.59) |
| Domestic Long Rate | | | | -11.81 | -12.40 | -5.25 |
| | | | | (8.32) | (8.25) | (6.68) |
| US Short Rate | | | | | -9.55*** | -8.55*** |
| | | | | | (2.55) | (2.50) |
| US Long Rate | | | | | | -11.05*** |
| | | | | | | (2.54) |
| *N* | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock (First Principal) | 18.34*** | 18.36*** | 18.40*** | 18.32*** | 18.34*** | 17.90*** |
| | (3.86) | (3.86) | (3.85) | (3.84) | (3.86) | (3.92) |
| Exchange Rate | | -1.57 | -0.87 | -0.70 | -0.61 | -1.05 |
| | | (1.46) | (1.82) | (1.83) | (1.70) | (1.58) |
| Domestic Short Rate | | | -0.17 | -0.25 | -0.28 | -0.10 |
| | | | (0.22) | (0.23) | (0.20) | (0.20) |
| Domestic Long Rate | | | | 0.29 | 0.32 | -0.18 |
| | | | | (0.27) | (0.30) | (0.22) |
| US Short Rate | | | | | 0.18 | -0.01 |
| | | | | | (0.56) | (0.55) |
| US Long Rate | | | | | | 0.97 |
| | | | | | | (0.56) |
| *N* | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table A4: Monetary policy and convenience yields

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock (Poor Man) | 7.16 | 6.98 | 8.26* | 11.26*** | 12.31*** | 14.54*** |
| | (4.58) | (4.56) | (4.04) | (3.02) | (3.05) | (2.97) |
| Exchange Rate | | 4.43 | 7.61 | 2.47 | 6.97 | 21.58 |
| | | (21.42) | (22.51) | (21.93) | (21.99) | (21.14) |
| Domestic Short Rate | | | -12.14 | -7.66 | -7.64 | -7.54 |
| | | | (7.20) | (4.54) | (4.67) | (4.74) |
| Domestic Long Rate | | | | -12.17 | -12.35 | -5.38 |
| | | | | (8.28) | (8.21) | (6.65) |
| US Short Rate | | | | | -7.59** | -5.93** |
| | | | | | (2.44) | (2.43) |
| US Long Rate | | | | | | -10.35*** |
| | | | | | | (2.54) |
| *N* | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| Outcome: Δ Convenience Yield Differential | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP Shock (Poor Man) | 18.96*** | 18.98*** | 19.01*** | 18.95*** | 18.94*** | 18.60*** |
| | (3.81) | (3.81) | (3.80) | (3.80) | (3.76) | (3.79) |
| Exchange Rate | | -1.58 | -0.91 | -0.72 | -0.67 | -1.16 |
| | | (1.48) | (1.85) | (1.86) | (1.72) | (1.61) |
| Domestic Short Rate | | | -0.16 | -0.26 | -0.27 | -0.07 |
| | | | (0.22) | (0.23) | (0.20) | (0.20) |
| Domestic Long Rate | | | | 0.32 | 0.33 | -0.22 |
| | | | | (0.27) | (0.30) | (0.22) |
| US Short Rate | | | | | 0.10 | -0.10 |
| | | | | | (0.55) | (0.54) |
| US Long Rate | | | | | | 1.08* |
| | | | | | | (0.56) |
| *N* | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table A5: Convenience yield channel and stock prices

| Outcome: Stock Index Returns (Instrument: First Principal MP Shock) | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.73 | -0.69 | -0.58 | -0.55** | -0.42*** | -0.32*** |
| | (0.65) | (0.65) | (0.37) | (0.18) | (0.11) | (0.07) |
| Exchange Rate | | -5.17 | -5.03 | -5.76 | -5.35 | -1.42 |
| | | (17.41) | (15.96) | (13.82) | (11.83) | (10.86) |
| Domestic Short Rate | | | -4.78 | -4.05 | -3.12 | -2.30 |
| | | | (7.35) | (2.48) | (1.88) | (1.31) |
| Domestic Long Rate | | | | -0.87 | 0.40 | 4.13 |
| | | | | (6.02) | (4.42) | (3.11) |
| US Short Rate | | | | | -3.73* | -2.40 |
| | | | | | (1.79) | (1.42) |
| US Long Rate | | | | | | -3.78** |
| | | | | | | (1.19) |
| *N* | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| Outcome: Stock Index Returns (Instrument: First Principal Shock) | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.51*** | -0.50*** | -0.45*** | -0.45*** | -0.46*** | -0.48** |
| | (0.14) | (0.14) | (0.13) | (0.14) | (0.14) | (0.15) |
| Exchange Rate | | -1.82 | -0.31 | -0.08 | -0.69 | -1.07 |
| | | (1.01) | (1.39) | (1.30) | (1.30) | (1.22) |
| Domestic Short Rate | | | -0.49*** | -0.62*** | -0.44** | -0.29** |
| | | | (0.13) | (0.16) | (0.14) | (0.10) |
| Domestic Long Rate | | | | 0.41* | 0.23 | -0.18 |
| | | | | (0.19) | (0.19) | (0.25) |
| US Short Rate | | | | | -1.17*** | -1.32*** |
| | | | | | (0.36) | (0.36) |
| US Long Rate | | | | | | 0.81 |
| | | | | | | (0.50) |
| *N* | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table A6: Convenience yield channel and stock prices

| Outcome: Stock Index Returns (Instrument: Poor Man MP Shock) | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.60 | -0.56 | -0.50* | -0.49** | -0.44*** | -0.37*** |
| | (0.37) | (0.34) | (0.24) | (0.16) | (0.13) | (0.10) |
| Exchange Rate | | -7.46 | -6.81 | -6.99 | -4.79 | 0.73 |
| | | (14.39) | (14.24) | (13.38) | (12.42) | (11.60) |
| Domestic Short Rate | | | -3.85 | -3.64 | -3.26 | -2.64 |
| | | | (5.28) | (2.16) | (2.01) | (1.56) |
| Domestic Long Rate | | | | -0.29 | 0.19 | 3.97 |
| | | | | (5.09) | (4.53) | (3.41) |
| US Short Rate | | | | | -3.86* | -2.62 |
| | | | | | (1.92) | (1.57) |
| US Long Rate | | | | | | -4.25** |
| | | | | | | (1.55) |
| *N* | 1467 | 1467 | 1467 | 1467 | 1467 | 1467 |

| Outcome: Stock Index Returns (Instrument: Poor Man MP Shock) | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ Convenience Yield Differential | -0.64*** | -0.64*** | -0.58*** | -0.59*** | -0.58*** | -0.60*** |
| | (0.17) | (0.17) | (0.16) | (0.16) | (0.16) | (0.17) |
| Exchange Rate | | -2.02 | -0.44 | -0.18 | -0.77 | -1.22 |
| | | (1.13) | (1.57) | (1.48) | (1.45) | (1.33) |
| Domestic Short Rate | | | -0.50** | -0.64*** | -0.46** | -0.29** |
| | | | (0.16) | (0.18) | (0.16) | (0.12) |
| Domestic Long Rate | | | | 0.46* | 0.27 | -0.21 |
| | | | | (0.21) | (0.21) | (0.27) |
| US Short Rate | | | | | -1.15** | -1.33** |
| | | | | | (0.41) | (0.41) |
| US Long Rate | | | | | | 0.95 |
| | | | | | | (0.54) |
| *N* | 2306 | 2306 | 2279 | 2279 | 2279 | 2279 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table A7: Convenience yield differential and cumulative policy spillovers

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP shock (first principal) | -4.34*** | -4.04*** | -4.34*** | -5.68*** | -5.36*** | -5.28*** |
| | (0.79) | (0.73) | (0.84) | (1.00) | (1.14) | (1.12) |
| MP Shock*CY Differential$_{t-1}$ | 0.69* | 0.77* | 0.75* | 0.83** | 0.77* | 0.78* |
| | (0.36) | (0.38) | (0.38) | (0.35) | (0.35) | (0.36) |
| Convenience Yield Differential$_{t-1}$ | 0.04 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| Exchange Rate | | -12.09 | -12.27 | -10.00 | -9.67 | -9.13 |
| | | (10.16) | (10.05) | (9.91) | (9.96) | (9.75) |
| Domestic Short Rate | | | 2.23* | -0.07 | -0.05 | -0.07 |
| | | | (1.11) | (0.75) | (0.75) | (0.75) |
| Domestic Long Rate | | | | 6.29*** | 6.23*** | 6.52*** |
| | | | | (1.40) | (1.45) | (1.49) |
| US Short Rate | | | | | -0.59 | -0.57 |
| | | | | | (0.79) | (0.80) |
| US Long Rate | | | | | | -0.44 |
| | | | | | | (0.42) |
| $N$ | 1564 | 1564 | 1564 | 1564 | 1564 | 1564 |

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP shock (first principal) | -3.95*** | -3.96** | -4.90*** | -4.90*** | -5.17*** | -5.35*** |
| | (1.21) | (1.24) | (0.97) | (0.97) | (1.05) | (1.05) |
| MP Shock*CY Differential$_{t-1}$ | 2.24* | 2.25* | 2.10* | 2.10* | 2.00 | 2.23* |
| | (1.18) | (1.21) | (1.11) | (1.08) | (1.11) | (1.11) |
| Convenience Yield Differential$_{t-1}$ | -0.31 | -0.31 | -0.34* | -0.34* | -0.36* | -0.46** |
| | (0.21) | (0.22) | (0.18) | (0.17) | (0.17) | (0.19) |
| Exchange Rate | | 0.04 | 2.59 | 2.62 | 3.33 | 3.29* |
| | | (1.08) | (1.66) | (1.66) | (1.93) | (1.76) |
| Domestic Short Rate | | | -0.85*** | -0.84*** | -1.01*** | -1.19*** |
| | | | (0.14) | (0.17) | (0.19) | (0.21) |
| Domestic Long Rate | | | | -0.03 | -0.01 | 0.39 |
| | | | | (0.15) | (0.16) | (0.25) |
| US Short Rate | | | | | 0.20* | 0.41*** |
| | | | | | (0.10) | (0.07) |
| US Long Rate | | | | | | -0.63* |
| | | | | | | (0.29) |
| $N$ | 2308 | 2308 | 2281 | 2281 | 2281 | 2281 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.

Table A8: Convenience yield differential and cumulative policy spillovers

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (a): Daily | (1) | (2) | (3) | (4) | (5) | (6) |
| MP shock (poor man's) | -5.45*** | -5.11*** | -5.42*** | -6.94*** | -6.45*** | -6.42*** |
| | (1.01) | (1.03) | (1.10) | (1.34) | (1.38) | (1.37) |
| MP Shock*CY Differential$_{t-1}$ | 1.35** | 1.43** | 1.42** | 1.50*** | 1.37*** | 1.42*** |
| | (0.46) | (0.47) | (0.46) | (0.43) | (0.40) | (0.39) |
| Convenience Yield Differential$_{t-1}$ | 0.06 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| | (0.06) | (0.06) | (0.06) | (0.05) | (0.05) | (0.05) |
| Exchange Rate | | -12.39 | -12.60 | -10.26 | -9.10 | -8.24 |
| | | (10.03) | (9.95) | (9.82) | (9.75) | (9.55) |
| Domestic Short Rate | | | 2.20* | -0.13 | -0.05 | -0.07 |
| | | | (1.12) | (0.77) | (0.75) | (0.75) |
| Domestic Long Rate | | | | 6.35*** | 6.25*** | 6.72*** |
| | | | | (1.43) | (1.46) | (1.51) |
| US Short Rate | | | | | -1.30 | -1.23 |
| | | | | | (0.71) | (0.73) |
| US Long Rate | | | | | | -0.66 |
| | | | | | | (0.41) |
| $N$ | 1564 | 1564 | 1564 | 1564 | 1564 | 1564 |

| Outcome: Stock Index Returns | | | | | | |
|---|---|---|---|---|---|---|
| Panel (b): Monthly | (1) | (2) | (3) | (4) | (5) | (6) |
| MP shock (poor man's) | -8.39*** | -8.40*** | -8.75*** | -8.75*** | -8.84*** | -9.10*** |
| | (1.49) | (1.60) | (1.67) | (1.67) | (1.72) | (1.66) |
| MP Shock*CY Differential$_{t-1}$ | 1.10 | 1.11 | 0.81 | 0.81 | 0.60 | 0.84 |
| | (1.60) | (1.65) | (1.58) | (1.54) | (1.51) | (1.46) |
| Convenience Yield Differential$_{t-1}$ | -0.37 | -0.37 | -0.40* | -0.40* | -0.42** | -0.52** |
| | (0.21) | (0.23) | (0.18) | (0.18) | (0.17) | (0.19) |
| Exchange Rate | | 0.07 | 2.63 | 2.65 | 3.37 | 3.33* |
| | | (1.12) | (1.68) | (1.66) | (1.94) | (1.78) |
| Domestic Short Rate | | | -0.86*** | -0.85*** | -1.03*** | -1.20*** |
| | | | (0.14) | (0.17) | (0.19) | (0.21) |
| Domestic Long Rate | | | | -0.01 | 0.01 | 0.40 |
| | | | | (0.15) | (0.16) | (0.25) |
| US Short Rate | | | | | 0.21* | 0.42*** |
| | | | | | (0.10) | (0.08) |
| US Long Rate | | | | | | -0.62* |
| | | | | | | (0.28) |
| $N$ | 2308 | 2308 | 2281 | 2281 | 2281 | 2281 |

*Note:* In all specifications, we control for country and year fixed effects to account for any time-invariant differences across countries and year-specific shocks. Additionally, specifications in Panel (b) incorporate the log of industrial production, the log of the consumer price index, and the bilateral trade balance with the US as control variables to further account for potential confounding factors. For brevity, we omit the coefficients of these control variables in our reported results. Robust standard errors clustered by country are reported in parentheses. ***, **, and * indicate statistically significant coefficients at the one, five, and ten percent levels.