The Impact of Monetary Policy on the Specialness of U.S. Treasuries

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Abstract

I estimate the causal effect of monetary policy on the specialness of U.S. Treasuries. I quantify this specialness using the U.S. Treasury Premium, which is the difference in the convenience yield of U.S. Treasuries and that of government bonds of other developed countries measured as the deviation from covered interest parity between government bond yields. I find that: (i) monetary tightening by the Federal Reserve increases the specialness of U.S. Treasuries primarily by increasing the convenience yield of U.S. Treasuries, (ii) after the Global Financial Crisis (GFC), such an action also decreases the convenience yield of government bonds of other developed countries, (iii) the magnitude of the impact varies across the term structure, especially after the GFC, (iv) U.S. and foreign monetary policy shocks have asymmetric impacts on the specialness of U.S. Treasuries, and (v) the impact is generally larger relative to the government bonds of commodity countries, especially after the GFC, and less so relative to those of safe-haven currency countries. These results provide evidence for the unique ability of the Federal Reserve to affect the specialness of U.S. Treasuries by altering the supply of dollar safe assets.

Keywords: Convenience Yield, Covered Interest Parity, Safe Assets, U.S. Treasury Premium.

1 Introduction

Investors value the liquidity and safety of government bonds, especially those of U.S. Treasuries. They are willing to pay a "convenience yield" by accepting a lower investment return to hold these bonds over alternative investments with a similar risk profile. Krishnamurthy and Vissing-Jorgensen (2012) quantify the convenience yield of U.S. Treasuries and provide evidence for the specialness of U.S. Treasuries relative to other safe dollar assets. When U.S. Treasuries carry a higher convenience yield relative to government bonds of other countries, it further highlights the special role of U.S. Treasuries in the global financial markets. To quantify the specialness of U.S. Treasuries, Du et al. (2018b) introduce a measure called the "U.S. Treasury Premium," which captures the difference in the convenience yield of U.S. Treasuries and that of government bonds

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of other developed countries in terms of the deviation from covered interest parity (CIP) between government bond yields. This paper examines what drives the specialness of U.S. Treasuries as quantified by the U.S. Treasury Premium.

Understanding drivers of the U.S. Treasury Premium is important because this measure reflects the relative funding cost advantage in the U.S. dollar for the U.S. government. A positive premium implies that the U.S. government can borrow in the U.S. dollar more cheaply than the government of another country. Furthermore, movement in the U.S. Treasury Premium also has implications for asset prices. Krishnamurthy and Lustig (2019) suggest that shifts in demand and supply of dollar safe assets affect the U.S. Treasury Premium, which in turn drives variation in the dollar exchange rate, bond yields, and other global financial variables. Jiang et al. (2018) also propose a theory that links a widening of the U.S. Treasury Premium to an immediate appreciation and a subsequent depreciation of the U.S. dollar. In a related paper, Jiang et al. (2019) propose a model to show that U.S. monetary policy has an outsized impact on the world economy—a phenomenon that is described as the "global financial cycle" by Rey (2015)—through its impact on the supply of dollar safe assets and thereby the dollar safe assets' premium. Understanding what drives the U.S. Treasury Premium hence carries market and policy implications.

In this paper, I focus on one specific driver: the monetary policy of central banks. I use a high-frequency identification strategy to observe how the U.S. Treasury Premium for the G10 countries responds to monetary policy shocks around scheduled policy meetings of the Federal Reserve and the European Central Bank (ECB). This approach is similarly used by Nakamura and Steinsson (2018), Gürkaynak et al. (2005), Cochrane and Piazzesi (2002), and Kuttner (2001), and it addresses potential endogeneity between movement in the U.S. Treasury Premium and monetary policy actions. My measure of monetary policy shocks is captured by the first principal component of unexpected changes in interest rates over a narrow window surrounding each scheduled policy announcement. My baseline analysis of the impact of U.S. monetary policy shocks on the U.S. Treasury Premium uses unexpected changes in interest rates with maturities up to one year, similar to Nakamura and Steinsson (2018). I also construct an alternative measure of U.S. policy shocks by extending the maturities of the interest rates that I use to construct this measure up to ten years. This is to capture the fact that monetary policy can affect the long end of the term structure of interest rates, a fact which has become especially relevant after the Global Financial Crisis (GFC) given wider adoptions of unconventional monetary policy tools—such as forward guidance and Quantitative Easing (QE)—by central banks in advanced countries. I construct a similar measure to capture policy shocks by the ECB using unexpected changes in interest rates with maturities up to ten years based on data availability. These maturities match those in my alternative measure of U.S. policy shocks for comparability.

Using this measure, I quantify the impact of monetary policy on the U.S. Treasury Premium and its components. I decompose the U.S. Treasury Premium into three primary components: the U.S. swap spread, the foreign swap spread, and the cross-currency basis. The swap spread captures the difference between the benchmark interest rate swap rate and the treasury yield and provides a

proxy for the convenience yield of the government bonds of that country. The cross-currency basis reflects the cost to interchange the benchmark interest rate in one currency into another. With this decomposition, the U.S. Treasury Premium equals the difference between the U.S. and the foreign swap spreads, less the cross-currency basis. This decomposition allows me to observe the channel through which monetary policy affects the U.S. Treasury Premium. Using a sample of the G10 countries—Australia, Canada, Denmark, Germany, Japan, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom—from 2000 to 2019, my study reveals the following key results:[1]

First, a tightening monetary policy by the Federal Reserve increases the specialness of U.S. Treasuries. Specifically, a policy action that would increase the one-year U.S Treasury yield by 100 basis points would increase the U.S. Treasury Premium by 31 to 50 basis points across the term structure on average for the G10 countries. This result arises because the risk-free rates and the government bond yields respond differently to monetary policy. In particular, a tightening action by the Federal Reserve would cause the U.S. Treasury yields to rise but the U.S. benchmark rates to rise even more, thereby increasing the convenience yield of U.S. Treasuries. Such a policy action would also induce foreign government bond yields and foreign benchmark rates to rise, albeit by smaller magnitudes. These results are robust to how I measure monetary policy shocks and to potential background noise in such measurement.

Second, the magnitude and channel of the impact vary across the term structure and periods. Before the GFC, the impact of a U.S. monetary policy shock on the U.S. Treasury Premium is relatively uniform, ranging from 30 to 46 basis points across the term structure. This arises almost entirely through the increase in the U.S. convenience yield, with minimal changes in the foreign convenience yield and the cross-currency basis. After the GFC, a similar action would still raise the premium overall, but the impact is stronger at shorter horizons than at longer ones. In particular, it would increase the one-year U.S. Treasury Premium by 80 basis points but the ten-year premium by only 20 basis points. Furthermore, such an action in the post-crisis period would also decrease the convenience yield of foreign government bonds, as reflected by the negative impact on the foreign swap spreads. The magnitude of the impact on the U.S. and the foreign interest rates is also much larger in the post-crisis subsample, except at the three-month horizon where the interest rates are more anchored. Finally, a tightening action by the Federal Reserve after the GFC would also induce the U.S. dollar shortage, as reflected by the negative impact on the cross-currency basis rates.

Next, in contrast to actions by the Federal Reserve, actions by a foreign central bank—in this paper, the ECB—have limited impact on the specialness of U.S. Treasuries. In particular, when the ECB tightens its monetary policy, it has minimal impact on the U.S. Treasury Premium for Germany and other G10 countries. Although such a policy shock would increase German Bund yields and German benchmark rates, their impacts offset each other, resulting in a minimal net

[1]Strictly speaking, the Danish krone (DKK) is not among the ten most liquid currency based on trading volume and turnover. However, market participants still often refer to the DKK as a G10 or a G11 currency.

impact on the convenience yield of German Bunds. The shock would also induce movements in the government bond yields and benchmark rates of other G10 countries, including the United States. However, such movements again offset each other, leaving minimal net impacts on those countries' convenience yields and therefore the U.S. Treasury Premium. One exception to the aforementioned results is at the one-year maturity, where a tightening action by the ECB would decrease the one-year U.S. Treasury Premium. Nevertheless, the impact on each component of the premium is only weakly significant at that horizon. Additionally, a tightening action by the ECB would also cause a shortage of the euro and other currencies relative to the U.S. dollar.

Finally, there is heterogeneity of results across countries and periods. Variations in the results were slight before the GFC but became substantial thereafter. In particular, after the GFC, the impacts of a U.S. monetary policy shock on the U.S. Treasury Premium are more pronounced for commodity countries and less so for safe-haven currency countries. Despite these variations, the pattern of the impact remains consistent across countries—a tightening action by the Federal Reserve would induce a uniform increase in the U.S. Treasury Premium across the term structure before the GFC, but the term structure of the impact became downward sloping thereafter. The cross-country results also point to the potential role of the Swiss government bonds as the next preferred safe asset alternative to U.S. Treasuries, as evidenced by the relatively muted impact of U.S. monetary policy actions on the U.S. Treasury Premium for Switzerland.

The above results suggest that the Federal Reserve holds the unique ability to affect the specialness of U.S. Treasuries relative to government bonds of other developed countries. One potential explanation is that the Federal Reserve can change the supply of dollar safe assets, while foreign central banks cannot. By tightening the money supply, the Federal Reserve reduces the supply of dollar safe assets and hence increases the specialness of U.S. Treasuries. This supports the theoretical model proposed by Jiang et al. (2019), which argues that the convenience yield of dollar bonds is downward sloping in quantity. Moreover, these results also imply a segmentation of safe assets by maturity, whereby a supply shock at a particular point in the term structure induces a larger impact on the specialness of U.S. Treasuries at such maturity. In light of these findings, the fact that the specialness of U.S. Treasuries at long maturities has been declining, or even turned negative recently, is intriguing when one considers the fact that the Federal Reserve has been effectively neutral on its monetary policy after the GFC based on my monetary policy measure. This implies that other factors must have caused long-dated U.S. Treasuries to lose their specialness.[2]

This paper is the first to explore empirically the causal link between monetary policies of both the U.S. and foreign central banks and the specialness of U.S. Treasuries. Using the U.S. Treasury Premium as a measure of this specialness, the paper quantifies the impact of monetary policy on the term structure of the U.S. Treasury Premium and its components. It also provides evidence for the asymmetry of U.S. versus foreign central banks' actions on the specialness of U.S. Treasuries

[2]For instance, Augustin et al. (Forthcoming) suggest that sovereign risks potentially contribute to the negative interest rate swaps post the GFC.

and explores the heterogeneity of this impact relative to the government bonds of other developed economies.

1.1 Related Literature

The specialness of U.S. Treasuries and government bond convenience yields were studied in important papers by Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016), Greenwood et al. (2015). In particular, Krishnamurthy and Vissing-Jorgensen (2012) were the first to document the presence of convenience yields in U.S. Treasuries and provide evidence for their specialness. Du et al. (2018b) take this concept to an international context and propose the U.S. Treasury Premium measure to analyze the specialness of U.S. Treasuries relative to government bonds of other developed countries.[3] The U.S. Treasury Premium measure is also related to CIP deviations, of which several papers have looked at its causes and consequences. Specifically, Du et al. (2018a) document large, persistent, and systematic patterns of CIP deviations, especially for forward contracts that appear on banks' balance sheets at the end of the quarter, pointing to a causal effect of banking regulation on asset prices. Avdjiev et al. (2019) also document a triangular relationship between a stronger dollar, larger deviations from CIP, and contractions of cross-border bank lending in dollars.

The specialness of U.S. Treasuries is also related to the "Exorbitant Privilege" and the role of the United States as the preferred supplier of safe assets, subjects which were studied by Gourinchas and Rey (2007), Gourinchas et al. (2010), and He et al. (2019). This strand of literature is also related to several papers that document safe asset shortage and its consequences, such as Bernanke et al. (2011), Greenwood and Vayanos (2014), Krishnamurthy and Vissing-Jorgensen (2015), and Gopinath and Stein (Forthcoming). Note that since the U.S. Treasury Premium measures the yield differential between government bonds in the U.S. dollar, it precludes currency risk premia. There is another strand of literature that instead focuses on the special role of the U.S. dollar, such as Maggiori (2017), Farhi and Maggiori (2017), and Maggiori et al. (Forthcoming).

Recently, there also emerge several papers that examine how changes in the relative government bond convenience yields can affect asset prices. Jiang et al. (2018) develop a theory to show that an increase in foreign investors' demand for dollar safe assets increases the U.S Treasury Premium—called "the U.S. Treasury basis" in their paper—which causes the dollar to appreciate, thereby lowering foreign investors' expected return from owning dollar safe assets.[4] Jiang et al. (2019) extend this model and propose the "convenience yield channel of monetary policy" whereby U.S. monetary policy has an outsized impact on the world economy because it alters the supply of dollar assets and the relative convenience yield of U.S. Treasuries. Krishnamurthy and Lustig (2019) also show that shifts in the demand and supply of dollar safe assets can affect the relative convenience

[3] Du and Schreger (2016) also construct the "local currency credit spreads" in a similar fashion for emering countries and use them to measure credit risks of local currency sovereign bonds.

[4] Note that this explanation for the movement of the U.S. dollar is different from the forward premium puzzle (Hansen and Hodrick (1980), Fama (1984), Engel (2014), Engel (2016)), the dollar carry trade (Lustig et al. (2011), Hassan and Mano (2014)) and the US fiscal cycle (Jiang (Forthcoming)).

yield of U.S. Treasuries and drive variation in the dollar exchange rate, bond yields, and other global financial variables. While these papers focus on how changes in the relative convenience yield of U.S. Treasuries affect asset prices, my paper focuses on analyzing monetary policy as a driver of this relative convenience yield itself.

The remaining of this paper proceeds as follows. Section 2 provides an overview of the U.S. Treasury Premium as a measure of the specialness of U.S. Treasuries. Section 3 and 4 describes the construction of my monetary policy measure and my empirical strategy. Section 5 and 6 study the impact of the U.S. and foreign monetary policies on the U.S. Treasury Premium, respectively. Section 7 explores cross-country heterogeneity. Section 8 proposes a potential explanation for the observed empirics, and Section 9 concludes.

2 The U.S. Treasury Premium

2.1 Definition

Du et al. (2018b) define the n-year U.S. Treasury Premium for country i at time t, $\Phi_{i,n,t}$, as the deviation from CIP between the U.S. Treasury yield and the government bond yield of country i:

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

where $y^{Govt}_{i,n,t}$ denotes the n-year government bond yield of country i at time t, and $\rho_{i,n,t}$ denotes the n-year market-implied forward premium for hedging currency i against the U.S. dollar.

This measure captures the difference in the convenience yield of U.S. Treasuries and that of government bonds of country i. To see this, let $\lambda_{i,n,t+1}$ denote the convenience yield of n-year government bond of country i realized at time $t+1$ and $y^{rf}_{i,n,t}$ denote the n-year risk-free rate in country i at time t. Assuming no default risks on these government bonds, I can express the n-year government bond yield of country i at time t, $y^{Govt}_{i,n,t}$, as:[5]

$$y^{Govt}_{i,n,t} = y^{rf}_{i,n,t} - \lambda_{i,n,t+1} \tag{2}$$

[5]One can think of the convenience yield as the foregone return for the expected convenience benefit of the government bond under the risk neutral measure, that is:

$$\lambda_{i,n,t+1} \equiv \log \mathbb{E}_{i,t}(1 + \Lambda_{i,n,t+1})$$

where $\lambda_{i,n,t+1}$ denotes the convenience yield and $\Lambda_{i,n,t+1}$ denotes the convenience benefit of n-year government bond of country i, both realized at time $t+1$. One can express the price of n-year government bond in country i at time t, $P^{Govt}_{i,n,t}$, as:

$$P^{Govt}_{i,n,t} = \exp(-y^{rf}_{i,n,t})\mathbb{E}_{i,t}[(1 + \Lambda_{i,n,t+1})],$$

where $\mathbb{E}_{i,t}$ refers to the risk-neutral expectation in country i at time t. Therefore, the n-year government bond yield of country i at time t, $y^{Govt}_{i,n,t} = -\log\left(P^{Govt}_{i,n,t}\right)$, is simply:

$$y^{Govt}_{i,n,t} = y^{rf}_{i,n,t} - \log \mathbb{E}_{i,t}(1 + \Lambda_{i,n,t+1}) = y^{rf}_{i,n,t} - \lambda_{i,n,t+1}$$

I can also also expressed the relationship between risk-free rates across countries as:

$$y^{rf}_{i,n,t} = y^{rf}_{USD,n,t} + \rho_{i,n,t} + \tau_{i,n,t} \tag{3}$$

where $\tau_{i,n,t}$ denotes the deviaion from CIP for the risk-free rates, capturing the FX swap market frictions.[6] Substituting Eq. (2) and (3) into Eq. (1) and rearrange, I get:

$$\Phi_{i,n,t} = \left(y^{rf}_{i,n,t} - \lambda_{i,n,t+1}\right) - \left(y^{rf}_{i,n,t} - y^{rf}_{USD,n,t} - \tau_{i,n,t}\right) - \left(y^{rf}_{USD,n,t} - \lambda_{USD,n,t+1}\right) \tag{4}$$

$$= \lambda_{USD,n,t+1} - \lambda_{i,n,t+1} + \tau_{i,n,t} \tag{5}$$

which states that the CIP deviation between U.S. Treasury yields and government bond yields of country i captures the difference in the convenience yield of U.S. Treasuries and that of government bonds of country i, plus the swap market friction.

2.2 Data and Measurement

Daily data for the U.S. Treasury Premium and its components from 2000 to 2019 is made available by Du et al. (2018b).[7] Government bond yields are based on Bloomberg Fair Value (BFV) curves, which are fitted par yield curves based on secondary market bond prices. For the forward premium at short maturity ($n < 1$), Du et al. (2018b) use the market-implied forward premium from the forward and spot exchange rates:

$$\rho_{i,n,t} = \frac{1}{n}\left[\log(F_{i,t,t+n}) - \log(S_{i,t})\right] \tag{6}$$

where $F_{i,t,t+n}$ denotes the n-year outright forward rate and $S_{i,t}$ is the spot exchange rate, both measured in terms of units of currency i per dollar. For longer maturities, the liquidity of outright forward contracts is poor. Instead, they use a combination of interest rate swaps and cross-currency basis swap, expressed as:

$$\rho_{i,n,t} = irs_{i,n,t} + bs_{i,n,t} - irs_{USD,n,t} \tag{7}$$

where $irs_{i,n,t}$ denotes the n-year interest rate swap rate that exchanges fixed cash flows in currency i into the floating interbank benchmark rate in the same currency, and $bs_{i,n,t}$ denotes the n-year cross-currency basis swap rate that exchanges the floating interbank benchmark rate in currency i into the floating interbank benchmark rate in the U.S. dollar, which is U.S. LIBOR. This combination of swap transactions effectively converts fixed cash flows in currency i into fixed cash flows in the U.S. dollar.

[6] See, for example, Feldhütter and Lando (2008) and Klinger and Sundaresan (2019), which study frictions in the interest rate and FX swap markets.

[7] See https://sites.google.com/view/jschreger/CIP or https://sites.google.com/site/wenxindu/data/govt-cip.

Using Eq. (1) and (7), I can decompose the U.S. Treasury Premium as:

$$\Phi_{i,n,t} = \left(irs_{USD,n,t} - y^{Govt}_{USD,n,t}\right) - \left(irs_{i,n,t} - y^{Govt}_{i,n,t}\right) - bs_{i,n,t} \tag{8}$$

$$= ss_{USD,n,t} - ss_{i,n,t} - bs_{i,n,t} \tag{9}$$

where $ss_{i,n,t} \equiv irs_{i,n,t} - y^{Govt}_{i,n,t}$ denotes the n-year swap spread in currency i. Since academic literature often use interest rate swap rates as proxies for risk-free rates, $y^{rf}_{i,n,t} \approx irs_{i,n,t}$, the swap spread, $ss_{i,n,t}$, serves as a proxy for the convenience yield of the government bond of country i.[8] Comparing Eq. (9) to Eq. (5), I also get that:

$$\tau_{i,n,t} \approx -bs_{i,n,t} \tag{10}$$

which suggests that the swap market mispricing is approximately equal to the negative of the cross-currency basis swap rate.

2.3 Summary Statistics

Table (1) reports the average U.S. Treasury Premium and its components for the G10 countries by tenor. Based on the full sample (2000-2019), the U.S. Treasury Premium is positive and statistically significant. The average U.S. Treasury Premium is higher at short than at long maturities, with the value ranging from 2 basis points at the ten-year maturity to 22 basis points at the three-month maturity.

[Table 1 about here.]

Splitting the sample into the pre-GFC (2000-2007) versus the post-GFC (2008-2019) periods reveals how the term structure of the U.S. Treasury Premium has changed over time. Before the crisis, the average U.S. Treasury Premium, the average U.S. swap spreads, and the average foreign swap spreads were all positive with a slightly upward-sloping term structure except at the three-month horizon. There were little frictions in the FX swap market before the crisis, as evidenced by minimal cross-currency basis rates. After the crisis, the term structure of the U.S. Treasury Premium has become inverted with the seven-year premium and beyond even having turned negative. This arises as the U.S. swap spreads at long maturities have declined while those at short maturities remain the same. Cross-currency bases also have turned significantly negative, meaning that market participants are willing to pay the cross-currency basis rates on top of U.S. LIBOR to receive the interbank benchmark rates in the other currency.[9] Market participants view this as a sign of the U.S. dollar shortage.

[8] Duffie and Huang (1996) show that the credit risk component of the benchmark interest rate swap is less than 2 basis points. Du et al. (2018b) also calculate the U.S. Treasury Premium using alternative measures of risk-free rate—specifically the Overnight Index Swap (OIS) interest rate and the interest rate of a near risk-free agency KfW, which is a German development bank fully backed by the German government—and their findings are robust to the choice of the risk-free rate.

[9] Non-zero cross-currency basis is an anomaly that emerges after the GFC. See Klinger and Sundaresan (2019) and Jermann (2020), for example.

Figure (1) plots the time series of the average U.S. Treasury Premium for the G10 countries by tenor, which shows that the U.S. Treasury Premium has been declining at long maturities and that the premium spikes during the GFC as investors sought the safety and liquidity of U.S. Treasuries. There is also cross-country heterogeneity of the measure which is discussed in Appendix A.

[Figure 1 about here.]

3 Monetary Policy Measure

I use tick-by-tick data on interest rates to construct my measure of monetary policy shocks. Specifically, my monetary policy measure is captured by the first principal component of changes in interest rates at different maturities during a narrow window around each scheduled monetary policy announcement. My baseline measure of U.S. monetary policy shocks uses the change over a 30-minute window around each scheduled FOMC announcement—from 10 minutes before to 20 minutes after it—of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. This measure is similar to the one used by Nakamura and Steinsson (2018) and equivalent to the "path factor" considered by Gürkaynak et al. (2005).[10] I extend this measure through 2017 using the dataset that Refet Gürkaynak kindly shared with me.

I also construct an alternative measure of U.S. monetary policy shocks using interest rates that extend further in maturity. Specifically, I use the change over the same 30-minute window around each scheduled FOMC announcement of the following seven interest rates: the expected Fed funds rate at the one-month horizon, the expected three-month eurodollar interest rates at horizons of one, two, four, and eight quarters, and the U.S. Treasury yields at five- and ten-year maturities. This allows me to capture the impact of monetary policy that aims to affect interest rates at the long-end of the term structure, such as forward guidance and QE. As the next section will show, my results on the impact of U.S. monetary policy shocks on the U.S. Treasury Premium are robust to the choices of interest rates that I use to construct the measure of monetary policy shocks.

For monetary policy actions by the ECB, I use the change over a 135-minute window around each scheduled policy announcement—from approximately 15 minutes before the announcement of the policy decision to approximately 15 minutes after the conclusion of the press conference—of the following seven interest rates: the euro Overnight Index Swap (OIS) rates at horizons of one month and one, two, four, and eight quarters, and the German Bund yields at five- and ten-year maturities. I use a 135-minute window to ensure that my measure of ECB monetary policy shocks captures similar information as that captured by my measure of U.S. monetary policy shocks.[11] I

[10] While Gürkaynak et al. (2005) argue the need to use two factors to capture both the "target" and the "path" of interest rates, I focus on using only one factor for simplicity, similarly to Nakamura and Steinsson (2018).

[11] Monetary policy announcements by the ECB proceed in two separate steps. On the day of a policy meeting, at 13:45 Central European Time (CET) the ECB issues a brief press release providing the policy decision without any narratives. Then at 14:30 CET until approximately 15:30 CET, the ECB President reads a prepared *Introductory*

choose these interest rates based on data availability, and I match the tenors of the interest rates that I use to construct this measure to those that I use to construct the alternative measure of U.S. monetary policy shocks to enable comparability. The data to construct this measure is made available by Altavilla et al. (2019), and it covers policy announcements by the ECB from 2000 to 2019. Appendix B provides more details on the construction of these monetary policy measures.

4 Empirical Strategy

With these measures of monetary policy shocks, I can observe the impact of the shocks on the U.S. Treasury Premium and its components by regressing:

$$\Delta s_t = \alpha + \gamma i_t + \epsilon_t \tag{11}$$

where t is the time indicator for each policy announcement, Δs_t is the change in the variable of interest—the U.S. Treasury Premium and its components—and i_t is my measure of monetary policy shocks. The parameter of interest is γ, which captures the impact of monetary policy shocks on the U.S. Treasury Premium and its components. For the change in the variable of interest, Δs_t, I focus on the two-day change, which is calculated as the change in the level from the day before the policy announcement to the day after the policy announcement. I choose a two-day window—rather than a one-day window as in some event studies—to allow for the time zone difference of government bond markets globally. For instance, at the time of a U.S. monetary policy announcement, the government bond markets in Australia, Japan, and New Zealand are already close for the day. Using a one-day window will fail to capture the reactions in these markets.

With this regression, I make two identifying assumptions: (i) the change of the interest rates that I use to construct my measure of monetary policy shocks during the narrow window around each policy announcement is primarily in response to the policy announcement, and (ii) all information that is public at the beginning of these announcement windows is already incorporated into financial markets. These assumptions preclude any spurious variation in my measure of monetary policy shocks and therefore allow me to identify the impact of monetary policy on the U.S. Treasury Premium. In the pooled regressions in Section 5 and Section 6, I include a country fixed effect to account for cross-country heterogeneity. I also cluster standard errors by date of the policy announcement to account for the fact that my regressors share a common component across countries, namely the U.S. components of the U.S. Treasury Premium calculation. Standard errors are adjusted for potential heteroskedasticity.

Note that when employing this empirical strategy using my alternative measure of U.S. monetary policy or my measure of ECB monetary policy, one potential concern arises from the fact that the calculation of the change in the U.S. Treasury Premium and my measure of monetary

Statement (IS) to provide the rationale behind the decision, followed by a question-and-answer session. Before December 2014, the press releases only include decisions on policy rates, but between January 2015 and January 2016, the press releases also include announcements of other measures. See Altavilla et al. (2019) for more details on monetary policy announcements by the ECB.

policy shocks both include changes in government bond yields. Specifically, my alternative measure of U.S. monetary policy shocks and the U.S. Treasury Premium are both calculated using U.S. Treasury yields, and my measure of monetary policy shocks by the ECB and the U.S. Treasury Premium for Germany are both calculated using German Bund yields. The fact that both the regressors and regressands share a common component may hence bias my results. This concern is partially mitigated by the fact that changes in government bond yields that are used to calculate the regressors and the regressands are based on different time frames: two-day window for the regressor and 30-minute or 135-minute windows for the regressand. More importantly, since this confounding factor will bias the results against my findings, any results that remain would have been stronger without this bias. Specifically, the bias will *attenuate* the coefficient of interest in the regression of the U.S. Treasury Premium on U.S. monetary policy shocks, while it will *accentuate* the results in the regression of the U.S. Treasury Premium on monetary policy shocks by the ECB. Since I will show in subsequent sections that U.S. monetary policy has a significant impact on the U.S. Treasury Premium, while monetary policy by the ECB does not, this bias helps strengthen my findings. Finally, I also run the same analysis using adjusted monetary policy measures that are calculated by excluding government bond yields, and my results remain consistent.

5 Impact of U.S. Monetary Policy

Table (2) illustrates my main results. It reports the average impact of U.S. monetary policy actions on the U.S. Treasury Premium for the G10 countries using my baseline measure of U.S. monetary policy. The results are normalized such that they reflect the impact on the U.S. Treasury Premium and its components in response to a policy shock that would increase the one-year U.S. Treasury yield by 100 basis points. I only show the results at the one- and five-year tenors for brevity—see Appendix C for the results across the entire term structure. I also split the full sample (2000-2017) into the pre-GFC (2000-2007) and post-GFC (2008-2017) subsamples to illustrate the difference in the impacts across periods.

[Table 2 about here.]

5.1 Baseline Results

In the full sample, when the Federal Reserve tightens its monetary policy such that the one-year U.S. Treasury yield would increase by 100 basis points, the U.S. Treasury Premium would increase by 44 and 33 basis points on average for the G10 countries at the one- and the five-year tenors, respectively. The results across the entire term structure are similar with the impact ranging from 31 to 50 basis points—see Appendix C. Most of the impact comes from an increase in the U.S. swap spreads (43 and 33 basis points at the one- and five-year tenors, respectively), and the results are statistically significant at almost all maturities.

Decomposing the impact, one notices that a tightening action by the Federal Reserve would increase both the benchmark rates and the government bond yields of both the United States and

foreign countries. The impacts on the term structure of interest rates for both the U.S. and foreign treasury yields and benchmark interest rates have a slightly inverted U-shape.[12] The increase in the U.S. swap spreads (43 and 33 basis points) in response to a tightening policy action arises because the increase in U.S. LIBOR (143 and 154 basis points) exceeds the increase in U.S. Treasury yields (100 and 121 basis points).[13] In other words, upon tightening its monetary policy, the Federal Reserve exerts impacts on both the benchmark rates and U.S. Treasury yields with a stronger impact on the former. Concurrently, such an action would also cause foreign treasury yields to rise, albeit by a lesser extent (45 and 61 basis points). Foreign benchmark rates would also move by roughly the same magnitude (45 and 63 basis points), resulting in a minimal change in the foreign swap spreads (-2 and -1 basis points). Monetary policy tightening by the Federal Reserve also makes the foreign currencies depreciate relative to the U.S. dollar and reduces the forward premium, the latter of which simply reflects the difference in the impact of the policy action on the U.S. and on foreign benchmark rates.

5.2 Pre- vs. Post-GFC Results

Splitting the sample into the pre- and the post-GFC periods offers a view into how the impact on the term structure of the U.S. Treasury Premium has changed across periods. Before the crisis, the impact of a policy action by the Federal Reserve is relatively uniform across the term structure. Specifically, a tightening action that would increase the one-year U.S. Treasury yield by 100 basis points would raise the U.S. Treasury Premium by 34 and 30 basis points at the one- and five-year tenors, respectively. Virtually all of the impact comes from the increase in the U.S. swap spreads (39 and 36 basis points) as the increase in U.S. LIBOR (134 and 136 basis points) exceeds that of U.S. Treasury yields (95 and 100 basis points). Foreign benchmark rates and foreign treasury yields also increase but by much less (46 and 55 basis points for foreign benchmark rates; 42 and 48 basis points for foreign treasury yields), and their increases offset each other, leaving a minimal net impact on the foreign swap spreads (-3 to 7 basis points). The impact on the treasury yields and the benchmark rates also exhibits a slightly inverted U-shaped term structure as in the full sample. The movement in the cross-currency bases is muted (2 and 0 basis points), implying minimal frictions in the FX market.

After the crisis, a tightening action by the Federal Reserve still causes the U.S. Treasury Premium to increase but with a downward tilt in the term structure. Specifically, a tightening action that would increase the one-year U.S. Treasury yield by 100 basis points would increase the one-year U.S. Treasury Premium by 80 basis points but increase the five-year premium by only 42 basis points. These results arise primarily because the U.S. swap spreads at short horizons rise more than those at long horizons (54 and 23 basis points). Again, this arises as the increase in U.S. LIBOR (172 and 211 basis points) exceeds the increase in U.S. Treasury yields (118 and 189

[12] Nakamura and Steinsson (2018) similarly document that the impact of U.S. monetary policy shocks on U.S. Treasury yields also exhibits an inverted-U shape.

[13] For the remaining of this section and unless otherwise stated, two numbers in parentheses indicate the impact at the one-year and the five-year tenor, respectively.

basis points), particularly at short horizons. While a tightening action by the Federal Reserve has a minimal impact on the foreign swap spreads before the crisis, it causes the foreign swap spread to decline (-12 and -16 basis points) after the crisis as the increase in foreign treasury yields (54 and 106 basis points) exceeds the increase in foreign benchmark rates (42 and 90 basis points). Similar to the pre-crisis period, the term structures of the impact on the U.S. and foreign treasury yields and benchmark rates are still slightly hump-shaped. Such a tightening action also causes the cross-currency basis rates to decline, suggesting the U.S. dollar scarcity, although the results are not statistically significant (-14 and -4 basis points). An exception to the aforementioned results is at the three-month horizon, where the movements in the U.S. Treasury Premium, the U.S. swap spreads, the U.S. and foreign treasury yields, and the U.S. and foreign benchmark rates are much more muted, potentially as these rates are more anchored to the countries' policy rates.

5.3 Impulse Responses

Figure (2) plots the average impulse responses of the five-year U.S. Treasury Premium and its components to U.S. monetary policy shocks using local projections. I plot the impulse responses over ten days—from one to ten days after each policy announcement date—and the impacts at these dates are calculated relative to the date immediately before the policy announcement. I limit my projection horizon to only ten days after each monetary policy shock, taking into account the fact that a high-frequency identification approach often has low power, thereby preventing me from projecting the impact too far in the future. Recall also that my measure of monetary policy shocks is scaled such that it would induce a 100 basis point increase in the one-year U.S. Treasury yield in the full sample, and therefore the impulse responses are scaled as such. The graphs show that the impacts of monetary policy shocks on the U.S. Treasury Premium, the U.S. swap spreads, cross-currency bases, and the forward and spot exchange rates are all persistent, although they may not be statistically significant across all periods.

[Figure 2 about here.]

5.4 Robustness Tests

Two potential concerns emerge from the above analysis. First, my measure of monetary policy shocks might be confounded by other nonmonetary shocks. If this is the case, my first identifying assumption will be violated, and my measure of monetary policy shocks will be contaminated. This concern is partially mitigated by the fact that my measure of monetary policy shocks is calculated using changes of interest rates around narrow windows—30 minutes for U.S. monetary policy and 135 minutes for ECB monetary policy—thereby reducing potential interference. Furthermore, I use a heteroskedasticity-based estimation approach developed by Rigobon (2003) and Rigobon and Sack (2004) to assess the severity of this potential problem. The heteroskedasticity-based estimator allows for noise in interest rates that I use to construct my measure of monetary policy shocks by comparing the movement in interest rates during the event windows on FOMC announcement days

to such movement during similar windows on non-FOMC announcement days. My estimates using OLS regressions and those using a heteroskedasticity-based estimation approach are very similar, suggesting that the problem of background noise in interest rates is inconsequential.

Another concern is that my measure of monetary policy shocks may not properly capture policy actions, especially in the post-crisis period. This arises from the fact that my measure of monetary policy shocks is calculated using the change in interest rates up to one year in maturity, while some unconventional monetary policy tools that have become widely used after the GFC aim to affect interest rates at longer horizons. To assess the severity of this concern, I re-estimate the results using my alternative measure of monetary policy shocks, which is constructed using the change over the same 30-minute window around each scheduled FOMC announcement of the interest rates that extend up to ten years in maturity. Including the interest rates at longer horizons allows me to capture the effect of monetary policy that targets interest rates at the long end of the term structure. Although the point estimates differ slightly, key results remain the same: a tightening action by the Federal Reserve increases the U.S. Treasury Premium across the term structure, and the impact arises primarily through the increase in the U.S. swap spreads. This suggests that my results are robust to how I measure monetary policy shocks.

Appendix C.2 provides detailed analyses for both robustness tests.

5.5 Discussion of Results

A couple of key takeaways emerge from the above results. First, when the Federal Reserve tightens its monetary policy, it increases the specialness of U.S. Treasuries, as reflected by the increase in the U.S. Treasury Premium. This arises from the increase in the convenience yield of U.S. Treasuries, with minimal change in the convenience yield of foreign government bonds especially before the GFC, as captured by changes in the U.S. and foreign swap spreads, respectively. These results occur because the U.S. and foreign interest rates respond differently to U.S. monetary policy shocks. When the Federal Reserve tightens its monetary policy, U.S. Treasury yields increase, but U.S. risk-free rates increase by even more, while foreign treasury yields and foreign benchmark rates increase roughly equally and also by smaller magnitudes.

To address why the specialness of U.S. Treasuries at short and long horizons responds to U.S. monetary policy shocks differently before versus after the GFC, one potential explanation is that the types of monetary policy tools pursued by the Federal Reserve have changed since the crisis. Before the crisis, the Federal Reserve implemented its policy by changing the Fed funds rate, while after the crisis, it has been utilizing a broader array of monetary policy tools, including quantitative easing and forward guidance. The Federal Reserve has also changed its communication practice since the crisis. These tools aim to affect not only the current short-term interest rates but also the expectation of future short-term interest rates and therefore the long-term interest rates. The change in the nature of monetary policy actions may hence induce different impacts on the benchmark rates, the government bonds yields, and consequently the U.S. Treasury Premium before versus after the crisis. Another potential explanation is that the specialness of U.S. Treasuries may

simply respond differently to the same monetary policy action during the pre- versus post-crisis period. To address this question, one needs a more refined measure of monetary policy shocks that can capture changes in policy strategies and practices of the Federal Reserve.

6 Is the Federal Reserve Special?

Next, I analyze whether the ability to affect the specialness of U.S. Treasuries is unique to the Federal Reserve. Specifically, I observe whether monetary policy actions by a foreign central bank would reciprocally affect the U.S. Treasury Premium. I focus on policy actions by the ECB given its importance in the global economy and data availability. The results below show that the Federal Reserve indeed holds a unique ability to affect the specialness of U.S. Treasuries and confirm the special role of U.S. Treasuries themselves.

6.1 Can the ECB affect the Specialness of U.S. Treasuries relative to German Bunds?

First, I observe whether monetary policy actions by the ECB would affect the U.S. Treasury Premium for Germany. If U.S. Treasuries are no different than German Bunds in the global financial markets and the ECB holds a similar power as the Federal Reserve to affect the specialness of its country's government bonds, one would expect a monetary policy action by the ECB to have the opposite impact on the U.S. Treasury Premium for Germany when compared to the results from an action by the Federal Reserve. This is because, through its policy actions, the ECB can alter the supply of German Bunds and thereby affect their convenience yield and consequently the U.S. Treasury Premium for Germany. However, this is *not* the case, which implies the special role of U.S. Treasuries and the unique ability of the Federal Reserve to affect this specialness.

Table (3) compares side-by-side the impacts of monetary policy actions by the Federal Reserve versus the ECB on the U.S. Treasury Premium for Germany. I only include the results at the one-, five-, and ten-year maturities for brevity—Appendix D provides the full results. For comparability, this analysis uses my alternative measure of U.S. monetary policy shocks and my measure of ECB monetary policy shocks, since both measures are calculated based on the change during policy announcement windows of interest rates with matching maturities. Both policy measures are also scaled such that their impacts on the one-year U.S. Treasury yield and the one-year German Bund yield, respectively, are 100 basis points.

While a tightening action by the Federal Reserve would increase the U.S. Treasury Premium through its positive impact on the U.S. swap spreads, a tightening action by the ECB has a minimal impact on the U.S. Treasury Premium for Germany. The impacts of a policy shock by the ECB on the U.S and German swap spreads and on the cross-currency basis rates for euro are also muted. Specifically, while a tightening action by the Federal Reserve would increase the U.S. Treasury Premium for Germany by 30 to 49 basis points across these maturities, a similar action by the ECB would affect the U.S. Treasury Premium for Germany by only -11 to 12 basis points. In

addition, only the result at the ten-year maturity is statistically significant, but the magnitude of the impact is relatively small.

[Table 3 about here.]

Observing the impact on the components of the U.S. Treasury Premium provides further details on the mechanism. Similar to the results in the previous section, a tightening action by the Federal Reserve would increase the U.S. Treasury Premium (30 to 49 basis points) through its positive impact on the U.S. swap spreads (33 to 44 basis points) as the increase in U.S. LIBOR (144 to 208 basis points) exceeds the increase in U.S. Treasury yields (100 to 171 basis points). Such an action would also increase German Bund yields (64 to 96 basis points) and the German benchmark rates (61 to 93 basis points) by roughly equally, resulting in a minimal change in the German swap spreads (-3 to 4 basis points). On the other hand, a tightening monetary policy by the ECB has muted impacts on the U.S. Treasury Premium (-11 to 12 basis points), the U.S. swap spreads (-8 to 3 basis points), and the German swap spreads (-13 to -4 basis points). The muted impact of the policy shock on the German swap spreads emerges as the increase in German Bund yields (51 to 100 basis points) offset the increase in the German benchmark rates (39 to 96 basis points). A tightening action by the ECB would also induce a small increase in U.S. Treasury yields (12 to 17 basis points) that almost perfectly offsets a small increase in U.S. LIBOR (9 to 20 basis points). Interestingly, a tightening policy action by the ECB would also induce a small but statistically significant increase in the cross-currency basis (3 to 7 basis points), signaling the euro shortage.

6.2 Can the ECB affect the Specialness of U.S. Treasuries relative to the Government Bonds of Other Countries?

Next, I analyze whether monetary policy actions by the ECB can affect the U.S. Treasury Premium of other G10 countries. If the U.S. Treasuries are special relative to government bonds of other countries, one would expect policy shocks by the ECB to have minimal impact on the U.S. Treasury Premium for other G10 countries since policy actions by the ECB affect the supply of neither U.S. Treasuries nor the government bonds of other G10 countries.

Table (4) compares side-by-side the impact of monetary policy actions by the Federal Reserve and the ECB on the U.S. Treasury Premium for the other G10 countries besides Germany. Again, I only show the results at the one-, five-, and ten-year maturities for brevity. The results show that the average response of the U.S. Treasury Premium to a policy action by the ECB is more muted when compared to the response to an action by the Federal Reserve. While a policy shock by the Federal Reserve that would induce a 100 basis point increase in the one-year U.S. Treasury yield would increase the U.S. Treasury Premium for the other G10 countries by 36 to 55 basis points on average, a similar policy shock by the ECB would only induce a 4 to 30 basis point increase in the premium across the term structure; in fact, the impact at other tenors are even weaker—see Appendix D for the full results. One exception is at the one-year horizon where the impact is a

negative 40 basis points on the U.S. Treasury Premium with a negative impact on the U.S. swap spread.

[Table 4 about here.]

Notice that a policy action by the ECB also has smaller impacts on U.S. Treasury yields, U.S. LIBOR, and the U.S. swap spreads compared to an action by the Federal Reserve. In contrast, it has larger impacts on the foreign treasury yields and the foreign benchmark rates when compared to an action by the Federal Reserve. These impacts largely offset each other, resulting in a minimal impact on the foreign swap spreads. There are exceptions at the three-month, seven-year, and ten-year horizons where the impacts on the foreign swap spreads are statistically significant, but the net impacts on the U.S. Treasury Premium at these horizons are still small in magnitude. Also, when the ECB tightens its monetary policy, the other G10 currencies appreciate relative to the U.S. dollar whereas when the Federal Reserve tightens, the other G10 currencies depreciate.

The above results confirm the specialness of the U.S. Treasuries and suggests that the Federal Reserve holds a unique ability to affect this specialness. When the Federal Reserve tightens its policy, the specialness of U.S. Treasuries increases through the rise in the U.S. convenience yield. A tightening action by a foreign central bank—in this case, the ECB—does not have the same effect. One potential explanation is that investors have a preference for U.S. Treasuries and dollar safe assets, and only the Federal Reserve has the ability to alter their supply and affect the convenience yield of U.S. Treasuries. Neverthless, two findings remain intriguing. The first is the fact that the ECB has limited ability to affect the convenience yield of German Bunds. Since the ECB can affect the supply of euro-denominated safe assets, one would expect the ECB's action to affect German swap spreads, but the results prove otherwise. This leaves open the question of what drives foreign convenience yield. Another intriguing finding is the fact that when the ECB tightens its monetary policy, the currencies of other G10 countries appreciate relative to the U.S. dollar, implying that these other currencies appreciate versus the U.S. dollar along with the euro.

7 Cross-Country Heterogeneity

In this section, I study the heterogeneity of results across countries. Using my baseline measure of monetary policy shocks, Table (5) shows the impact of monetary policy actions by the Federal Reserve on the U.S. Treasury Premium by tenor and country. I only display results for the one- and five-year horizons for conciseness, and I split the full sample into the pre- and post-GFC subsamples to illustrate the difference in the impacts across periods as in the main analysis. The results for the entire term structure are also available in Appendix E. In the full sample, when the Federal Reserve tightens its monetary policy, it increases the U.S. Treasury Premium for all the G10 countries and across all tenors, but the magnitude of the impact varies. For instance, a U.S. monetary policy shock that would increase the one-year U.S. Treasury yield by 100 basis points would increase the five-year U.S. Treasury Premium by 36 basis points for Japan but by only 13 basis points for Switzerland.

[Table 5 about here.]

Splitting the sample into the pre- versus post-crisis periods also reveals how the impacts differ across periods. Before the crisis, a tightening action by the Federal Reserve would generally induce a parallel upward shift in the term structure of the U.S. Treasury Premium for most G10 countries, except for a couple of observations at the three-month tenor. The magnitude of the impact varies slightly across countries. For instance, a tightening action that would induce a 100 basis point increase in the one-year U.S. Treasury yield would raise the five-year U.S. Treasury Premium by 9 basis points for Australia and 38 basis points for Japan, with the results for other countries lying between. These results are also statistically significant for almost all the G10 countries at almost every tenor.

After the crisis, the results diverge materially across countries. Post the GFC, a tightening action by the Federal Reserve would still increase the U.S. Treasury Premium for most countries, except for Switzerland where the impact is muted. The action would also induce a downward tilt in the term structure of the U.S. Treasury Premium for most countries. The magnitude of the impact varies across countries and is particularly pronounced for Australia but subdued for Switzerland. Specifically, a tightening action by the Federal Reserve with a 100 basis point impact on the one-year U.S. Treasury yield would induce a 71 to 135 basis point increase in the U.S. Treasury Premium for Australia but only a -8 to 50 basis point change for Switzerland; in fact, the results for Switzerland also are not statistically significant at any tenor. Figure (3) plots the impact of a tightening monetary policy shock on the U.S. Treasury Premium by country and tenor for the pre- and post-GFC periods. The figure similarly illustrates the flat and the downward-sloping term structures of the impact for the pre- and post-GFC periods, respectively.

[Figure 3 about here.]

Table (6) reports the impact of U.S. monetary policy shocks on the five-year U.S. Treasury Premium and its components by currency for the pre- and post-GFC periods. Before the crisis, the impact varies slightly across countries as mentioned previously. Since the impact of a policy action on the U.S. swap spreads is the same across countries (28 basis points), its variation comes primarily from different effects on the foreign swap spreads. The impacts on the foreign swap spreads range from a decline of 9 basis points for Sweden to an increase of 12 basis points for Australia.[14] Note that although the difference in the impact on the foreign swap spreads is relatively small, the impacts on the foreign treasury yields and the foreign benchmark rates vary substantially across countries. For instance, a tightening action by the Federal Reserve that would raise the one-year U.S. Treasury yield by 100 basis points would raise the Japanese government bond yield and the Japanese benchmark rate by 17 and 13 basis points, respectively, while these numbers are 112 and 124 basis points for Australia. The impact on the cross-currency basis rates is also minimal for the pre-crisis period.

[14]Note that in this analysis, I only include announcement dates where the U.S. Treasury Premium measure is observable for all countries to ensure comparability.

[Table 6 about here.]

After the GFC, the impact varies substantially across countries, ranging from an increase of 5 basis points for Switzerland to an increase of 76 basis points for Australia. Again, the variation comes primarily from the difference in the impacts on the foreign swap spreads, ranging from -51 basis points for Australia to +15 basis points for Switzerland. Different impacts on the cross-currency basis rates also contribute partially to the results. The impacts on the foreign treasury yields and the foreign benchmark rates also vary substantially across countries. Notice that for the post-crisis period, a tightening action by the Federal Reserve reduces the swap spreads for most countries, except for Switzerland. The results for the post-crisis periods are consistent with what one may expect from a dollar carry trade. When the Federal Reserve tightens its monetary policy, investors reduce their investment in the government bonds of countries with high interest rates—such as Australia—thereby reducing the swap spreads of those countries. They also increase their short positions in the government bonds of countries with low interest rates—such as Switzerland—thereby widening the swap spreads for Switzerland. Note also that the impacts on U.S. Treasury yields and U.S. LIBOR are larger for the post-crisis period (166 and 186 basis points, respectively) than the pre-crisis period (108 and 136 basis points, respectively), even though the net impacts on the U.S. swap spreads are roughly the same across periods (28 and 22 basis points for the pre- and post-crisis periods, respectively).

The above results suggest that monetary policy actions by the Federal Reserve affect the specialness of U.S. Treasuries relative to the government bonds of all other G10 countries. The magnitude of the impact varies across countries, especially after the GFC, but the pattern remains consistent. One exception is with respect to the Swiss government bonds whereby a policy action by the Federal Reserve has a minimal impact on the U.S. Treasury Premium for Switzerland. This perhaps suggests the role of the Swiss government bonds as the next preferred safe asset alternative to U.S. Treasuries in the post-GFC period.

8 Discussion

My empirical analysis yields a couple of key results that are worth re-highlighting: (i) a tightening action by the Federal Reserve increases the specialness of U.S. Treasuries primarily by increasing the convenience yield of U.S. Treasuries, (ii) after the GFC, such an action also decreases the convenience yield of government bonds of other developed countries, (iii) the magnitude of the impact varies across the term structure, especially after the GFC, (iv) U.S. and foreign monetary policy shocks have an asymmetric impact on the specialness of U.S. Treasuries, and (v) the magnitude of the impact of a policy shock on the relative convenience yield varies across countries.

The above results demonstrate the Federal Reserve's unique ability to affect the specialness of U.S. Treasuries. One potential explanation is that the specialness of U.S. Treasuries is driven by supply and demand of dollar safe assets, and the Federal Reserve can affect their supply. By tightening its monetary policy, the Federal Reserve reduces the supply of dollar safe assets and as

a consequence raises the convenience yield of U.S. Treasuries and the U.S. Treasury Premium.

The fact that the Federal Reserve's policy tools have changed after the GFC could also explain why a policy action affects the specialness of U.S. Treasuries differently across the term structure after the crisis. Before the GFC, the Federal Reserve implemented its monetary policy by changing the Fed funds rate and altering bank reserves. It also implicitly affected the forward path of interest rates—see Woodford (2012), for instance—thereby also changing the expected supply of long-term dollar safe assets. As a result, a tightening policy shock increases the specialness of U.S. Treasuries relatively uniformly across the term structure. After the crisis, however, the Federal Reserve has been utilizing a broader array of monetary policy tools, including quantitative easing and forward guidance. These tools affect the supply of dollar safe assets at different horizons differently. Consider a QE, for instance: tightening policy is corresponding to a slow down or termination of purchases of long-term U.S. Treasuries or MBS. This increases the supply of long-term dollar safe assets while decreases bank reserves on a relative basis. As a result, the convenience yield of short-duration U.S. Treasuries increases by more than that of the long-duration securities.

These results also provide evidence for the segmentation of the safe asset market and the specialness of U.S. Treasuries. The fact that the relative convenience yields of U.S. Treasuries at different tenors respond differently to varying supply shocks across maturities implies that investors do not perfectly substitute safe assets across maturities. In other words, maturity matters for safe asset investors. In addition, the asymmetric impact of a monetary policy shock on the U.S. versus foreign convenience yields further reconfirms the role of U.S. Treasuries as the preferred safe assets in the global financial markets. The fact that a tightening action by the Federal Reserve increases the U.S. convenience yield while leaving little impact on the foreign convenience yield suggests that investors do not seek to substitute U.S. Treasuries with foreign government bonds even as the price of safety and liquidity of U.S. Treasuries increases in response to a negative supply shock. In fact, a reduction in the supply of U.S. Treasuries may even shift the demand curve for foreign safe assets *inward*, resulting in a reduction in the convenience yield of foreign government bonds post the GFC. One exception is the Swiss government bonds, whereby the convenience yields of both U.S. Treasuries and the Swiss government bonds respond similarly to a tightening policy by the Federal Reserve. This unique attribute of the Swiss government bonds is potentially related to the safe-haven status of the Swiss franc, which leads us to another open question of to what extent the specialness of U.S. Treasuries reflects the specialness of the U.S. dollar.

9 Conclusion

This paper explores the impact of monetary policy on the specialness of U.S. Treasuries. Using the U.S. Treasury Premium—the difference in the convenience yield of U.S. Treasuries and that of government bonds of other G10 countries—to measure this specialness, I find that when the Federal Reserve tightens its monetary policy, the specialness of U.S. Treasuries increases on average versus government bonds of all other G10 countries. The impact on the term structure of the premium

differs before versus after the crisis, with a tightening policy inducing a parallel upward shift in the term structure before the crisis but it induces a downward tilt thereafter. The Federal Reserve can uniquely affect the specialness of U.S. Treasuries, presumably through its ability to alter the supply of dollar safe assets.

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Table 1: Average U.S. Treasury Premium and its components by tenor and period.

		3M	1Y	2Y	3Y	5Y	7Y	10Y
Full Sample:								
U.S. Treasury Premium	Mean	21.85***	13.34***	11.28***	11.52***	9.04***	4.06***	2.13
	SE	(1.05)	(0.98)	(1.05)	(1.15)	(1.25)	(1.31)	(1.46)
U.S. Swap Spread	Mean	36.33***	31.58***	33.67***	35.36***	33.66***	29.15***	27.15***
	SE	(1.28)	(0.72)	(0.81)	(0.91)	(0.99)	(1.01)	(1.16)
Foreign Swap Spread	Mean	29.14***	28.99***	31.77***	32.26***	32.39***	31.73***	31.53***
	SE	(1.03)	(0.88)	(0.83)	(0.79)	(0.80)	(0.84)	(0.92)
Cross-Currency Basis	Mean	-14.66***	-11.41***	-10.26***	-9.46***	-8.21***	-7.45***	-6.31***
	SE	(0.77)	(0.79)	(0.78)	(0.81)	(0.86)	(0.88)	(0.88)
	N	52,051	46,893	48,474	48,005	48,498	48,343	47,105
Pre-GFC:								
U.S. Treasury Premium	Mean	20.73***	9.26***	14.43***	17.73***	19.44***	17.30***	21.74***
	SE	(1.17)	(1.15)	(1.20)	(1.21)	(1.31)	(1.39)	(1.57)
U.S. Swap Spread	Mean	35.64***	34.94***	44.60***	49.69***	54.17***	52.54***	59.64***
	SE	(1.42)	(0.79)	(0.75)	(0.81)	(0.99)	(1.07)	(1.26)
Foreign Swap Spread	Mean	18.00***	24.85***	29.00***	30.56***	33.34***	34.15***	36.93***
	SE	(1.05)	(1.14)	(1.10)	(1.05)	(1.14)	(1.26)	(1.34)
Cross-Currency Basis	Mean	-3.04***	0.23	0.48*	0.64**	0.76**	0.57	0.27
	SE	(0.30)	(0.25)	(0.26)	(0.28)	(0.33)	(0.36)	(0.39)
	N	20,805	18,340	18,767	18,615	18,890	18,827	18,889
Post-GFC:								
U.S. Treasury Premium	Mean	22.60***	15.96***	9.29***	7.59***	2.41	-4.39**	-10.99***
	SE	(1.55)	(1.40)	(1.52)	(1.68)	(1.81)	(1.85)	(1.98)
U.S. Swap Spread	Mean	36.79***	29.29***	26.39***	25.76***	19.98***	13.51***	5.47***
	SE	(1.87)	(1.06)	(1.12)	(1.22)	(1.14)	(1.04)	(0.79)
Foreign Swap Spread	Mean	36.54***	31.78***	33.65***	33.41***	31.75***	30.07***	27.62***
	SE	(1.47)	(1.22)	(1.15)	(1.10)	(1.09)	(1.11)	(1.22)
Cross-Currency Basis	Mean	-22.38***	-18.63***	-16.92***	-15.67***	-13.81***	-12.40***	-10.41***
	SE	(1.14)	(1.16)	(1.16)	(1.21)	(1.32)	(1.36)	(1.38)
	N	31,246	28,553	29,707	29,390	29,608	29,516	28,216

Note: This table reports the mean, standard error of the mean based on Newey-West standard errors with a 90-day lag, and the number of observations of the U.S. Treasury Premium and its components across the following tenors: 3-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, and the following periods: full sample (2000-2019), pre-GFC period (2000-2007), and post-GFC period (2008-2019).
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries.

	Full Sample		Pre-GFC		Post-GFC	
	1Y	5Y	1Y	5Y	1Y	5Y
U.S. Treasury Premium	44.41***	32.61***	33.94**	29.81***	79.53***	42.31***
	(12.55)	(6.60)	(13.85)	(7.32)	(20.74)	(14.20)
U.S. Swap Spread	42.73***	33.11***	39.47**	36.31***	53.59***	22.57**
	(13.39)	(5.76)	(15.51)	(6.44)	(20.44)	(11.15)
Foreign Swap Spread	0.25	1.42	3.71	6.58	-11.86*	-15.96**
	(4.32)	(4.57)	(4.77)	(4.71)	(6.83)	(7.50)
Cross-Currency Basis	-1.94	-0.92	1.82*	-0.08	-14.08	-3.78
	(2.43)	(1.29)	(1.09)	(0.45)	(9.10)	(5.00)
Other Components						
U.S. Treasury Yield	100.00***	120.90***	94.54***	99.93***	118.18***	188.91***
	(17.29)	(28.56)	(19.81)	(32.99)	(30.72)	(49.21)
U.S. LIBOR	142.73***	154.01***	134.01***	136.24***	171.78***	211.48***
	(14.12)	(27.25)	(16.73)	(32.38)	(28.27)	(44.22)
Foreign Treasury Yield	44.75***	61.28***	42.32***	48.00**	54.15***	105.93***
	(10.81)	(20.03)	(12.74)	(22.92)	(14.13)	(20.80)
Foreign Benchmark Rate	44.99***	62.70***	46.03***	54.58**	42.30***	89.97***
	(11.24)	(19.87)	(13.52)	(23.80)	(16.33)	(21.90)
FX Spot Rate	11.22***	11.12***	8.59***	8.37***	19.94***	19.95***
	(2.12)	(2.08)	(1.94)	(1.90)	(6.86)	(6.58)
FX Forward Premium	-99.67***	-92.23***	-86.16***	-81.74***	-143.56***	-125.29***
	(15.83)	(14.91)	(20.17)	(18.35)	(22.74)	(29.87)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the full sample (2000-2017), pre-GFC period (2000-2007) and post-GFC period (2008-2017). Regressions are adjusted for country fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.

Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Effects of the U.S. and ECB monetary policy shocks on the U.S. Treasury Premium for Germany.

	Responses to FOMC policy shocks			Responses to ECB policy shocks		
	1Y	5Y	10Y	1Y	5Y	10Y
U.S. Treasury Premium	49.02***	43.13***	30.29**	-10.72	7.79	11.51**
	(12.99)	(9.30)	(12.79)	(7.20)	(5.48)	(5.67)
U.S. Swap Spread	44.08***	37.07***	32.83***	-7.74*	2.83	1.95
	(12.96)	(7.44)	(10.10)	(4.12)	(6.72)	(4.41)
Foreign Swap Spread	-2.82	-3.15	4.36	-3.53	-9.71	-12.58***
	(6.80)	(7.28)	(8.36)	(5.52)	(5.93)	(4.06)
Cross-Currency Basis	-2.11	-2.91	-1.82	6.51*	4.75**	3.03*
	(4.08)	(4.07)	(3.88)	(3.82)	(2.01)	(1.79)
Other Components						
U.S. Treasury Yield	100.00***	171.25***	120.69***	16.39	17.40	12.41
	(18.29)	(30.04)	(29.53)	(11.51)	(19.18)	(17.84)
U.S. LIBOR	144.08***	208.32***	153.52***	8.65	20.23	14.36
	(19.62)	(30.77)	(32.58)	(11.31)	(20.01)	(19.14)
Foreign Treasury Yield	64.19***	95.64***	80.15***	100.00***	90.85***	51.14***
	(16.33)	(24.05)	(22.60)	(8.50)	(10.50)	(12.74)
Foreign Benchmark Rate	61.36***	92.50***	84.51***	96.47***	81.14***	38.56***
	(12.46)	(23.24)	(22.56)	(8.60)	(11.22)	(10.90)
FX Spot Rate	11.50***	11.97***	11.85***	-8.21***	-8.29***	-8.19***
	(2.92)	(2.92)	(2.96)	(1.80)	(1.81)	(1.80)
FX Forward Premium	-84.83***	-118.73***	-70.83***	94.33***	65.66***	27.23**
	(21.62)	(25.35)	(25.49)	(11.82)	(15.20)	(12.50)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for Germany by tenor on monetary policy shocks by the Federal Reserve (left) and the ECB (right) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.

Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Effects of the U.S. and ECB monetary policy shocks on the U.S. Treasury Premium for the G10 countries excluding Germany.

	Responses to FOMC policy shocks			Responses to ECB policy shocks		
	1Y	5Y	10Y	1Y	5Y	10Y
U.S. Treasury Premium	55.21***	35.69***	39.22***	-40.33***	11.94	29.72**
	(13.83)	(8.54)	(10.15)	(13.28)	(19.25)	(11.67)
U.S. Swap Spread	49.82***	37.86***	38.83***	-18.55*	9.77	9.94
	(13.65)	(7.76)	(9.21)	(10.85)	(17.53)	(10.97)
Foreign Swap Spread	-2.57	1.88	0.12	13.98	-6.69	-23.18***
	(5.57)	(6.29)	(6.80)	(9.43)	(6.43)	(6.37)
Cross-Currency Basis	-2.83	0.28	-0.51	7.80*	4.52**	3.40*
	(3.71)	(2.10)	(1.76)	(4.16)	(2.15)	(1.80)
Other Components						
U.S. Treasury Yield	99.60***	169.44***	133.01***	40.51	53.40	43.03
	(19.93)	(30.68)	(32.37)	(25.40)	(43.16)	(40.00)
U.S. LIBOR	149.42***	207.30***	171.84***	21.96	63.17	52.97
	(21.27)	(31.08)	(34.96)	(24.60)	(40.80)	(40.80)
Foreign Treasury Yield	53.00***	85.07***	77.89***	80.04***	120.29***	100.89***
	(9.88)	(17.35)	(19.01)	(13.04)	(17.27)	(19.95)
Foreign Benchmark Rate	50.44***	86.96***	78.01***	94.02***	113.59***	77.70***
	(12.53)	(19.02)	(19.99)	(16.50)	(18.21)	(19.77)
FX Spot Rate	15.00***	14.92***	14.33***	-11.25***	-11.43***	-10.61***
	(2.66)	(2.65)	(2.61)	(2.48)	(2.50)	(2.44)
FX Forward Premium	-101.81***	-120.06***	-94.34***	79.87***	54.94*	28.14
	(21.51)	(20.62)	(22.31)	(19.96)	(29.31)	(25.09)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries excluding Germany by tenor on monetary policy shocks by the Federal Reserve (left) and the ECB (right) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium by tenor and currency.

	Full Sample		Pre-GFC		Post-GFC	
	1y	5y	1y	5y	1y	5y
AUD	35.96**	22.23	8.70	9.22	135.14***	70.98**
	(17.98)	(14.63)	(21.77)	(15.73)	(30.45)	(33.82)
CAD	39.68**	16.44*	30.47*	14.14	68.22**	23.83
	(15.68)	(9.03)	(18.04)	(9.98)	(31.10)	(20.67)
CHF	0.65	13.19	-2.34	18.97	10.11	-4.67
	(21.01)	(10.51)	(26.40)	(11.67)	(28.43)	(20.55)
DKK	35.36*	31.31***	27.33	25.15**	62.97*	51.94***
	(21.21)	(10.23)	(25.99)	(12.35)	(35.25)	(18.95)
EUR	28.57**	32.11***	16.65	25.43***	69.92***	55.59***
	(13.63)	(7.33)	(16.21)	(7.75)	(25.10)	(16.88)
GBP	24.03	28.09***	9.51	24.10**	74.17**	42.03**
	(15.58)	(9.34)	(16.28)	(10.36)	(31.24)	(19.03)
JPY	32.87**	36.02***	28.46	37.95***	50.93**	28.41
	(14.68)	(8.59)	(17.66)	(9.39)	(23.12)	(20.49)
NOK	45.00*	29.77**	18.11	27.32*	142.23*	37.32
	(26.60)	(14.32)	(25.53)	(15.26)	(78.76)	(35.14)
NZD	54.28**	33.14**	69.88***	32.58*	17.90	32.11
	(21.46)	(14.46)	(25.57)	(17.04)	(34.24)	(27.95)
SEK	31.31*	32.31***	17.87	28.03***	87.88**	47.90**
	(16.20)	(9.30)	(17.56)	(10.37)	(36.55)	(19.92)

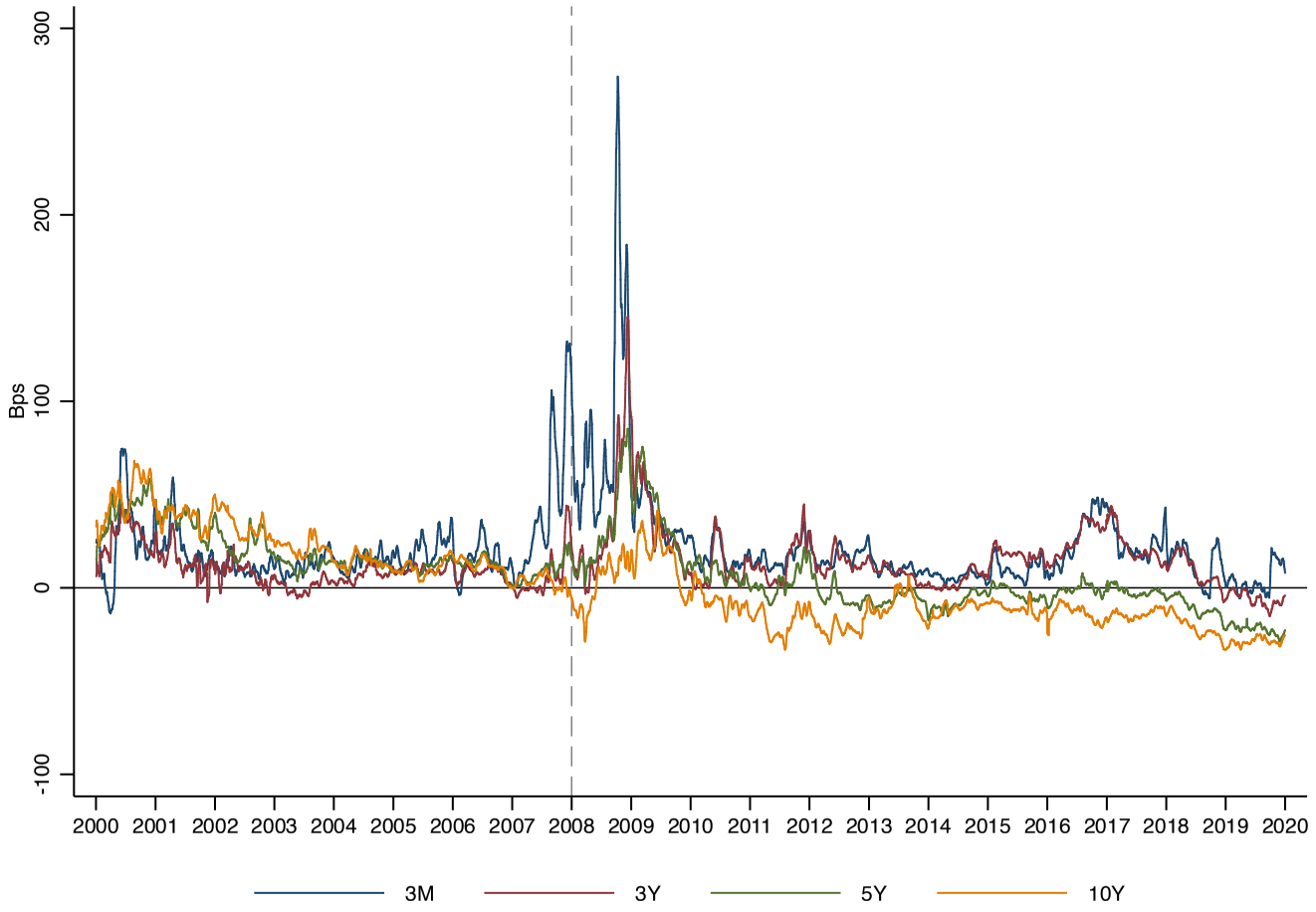
Note: This table reports panel regression results of the U.S. Treasury Premium by tenor and currency on U.S. monetary policy shocks for the full sample (2000-2017), pre-GFC period (2000-2007), and post-GFC period (2008-2017). Robust standard errors are in parentheses. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Effects of U.S. monetary policy shocks on 5-year U.S. Treasury Premium by currency.

	USD	AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Pre-GFC											
U.S. Treasury Premium	n/a	19.2	14.6	18.9	35.0**	22.1**	27.5*	29.9***	26.5	37.1*	37.4***
		(19.6)	(11.5)	(13.7)	(14.9)	(9.2)	(14.1)	(10.2)	(18.2)	(19.7)	(10.7)
Swap Spread	28.0***	11.6	10.3	9.7	-6.9	5.3	0.9	-3.6	3.0	-6.3	-9.0
	(9.2)	(17.7)	(8.4)	(7.5)	(13.5)	(6.9)	(15.0)	(5.1)	(16.5)	(20.7)	(9.4)
Cross-Currency Basis	n/a	-2.8	3.1*	-0.6	-0.1	0.6	-0.3	1.7	-1.5	-2.8	-0.4
		(3.5)	(1.6)	(1.0)	(0.7)	(2.2)	(1.3)	(2.6)	(1.4)	(2.0)	(0.9)
Treasury Yield	108.4***	112.4**	91.2**	19.4	51.8	56.4	37.3	16.8	12.8	83.5**	69.6**
	(41.8)	(47.5)	(39.4)	(20.3)	(31.9)	(37.8)	(36.0)	(12.0)	(39.8)	(40.5)	(35.0)
Benchmark Rate	136.4***	124.0**	101.5***	29.1	44.8	61.7*	38.1	13.2	15.8	77.1*	60.6**
	(40.1)	(52.3)	(37.8)	(24.3)	(35.5)	(35.4)	(26.2)	(10.0)	(36.9)	(41.8)	(29.6)
Post-GFC											
U.S. Treasury Premium	n/a	76.4**	24.9	4.6	56.1***	63.8***	43.6**	30.4	48.4	34.1	48.0**
		(37.5)	(22.8)	(21.6)	(21.1)	(18.9)	(20.8)	(21.8)	(37.5)	(30.7)	(21.4)
Swap Spread	19.7	-50.8	-9.0	15.1	-20.6	-30.2**	-9.1	-7.1	-30.9	-12.1	-17.7
	(13.0)	(31.5)	(17.4)	(13.5)	(15.3)	(11.7)	(15.8)	(10.9)	(35.8)	(26.5)	(13.5)
Cross-Currency Basis	n/a	-5.9	3.8	-0.1	-15.9	-13.9	-14.9**	-3.6	2.2	-2.3	-10.7
		(7.8)	(6.6)	(8.6)	(11.1)	(9.5)	(7.4)	(10.0)	(3.0)	(4.0)	(8.2)
Treasury Yield	165.9***	119.5***	89.8**	42.8**	116.0***	131.0***	154.8***	52.8***	87.4***	53.6	112.9***
	(53.0)	(43.8)	(41.8)	(17.9)	(31.1)	(30.8)	(34.1)	(18.9)	(30.9)	(33.7)	(25.7)
Benchmark Rate	185.5***	68.7	80.8*	58.0***	95.4***	100.7***	145.7***	45.6***	56.5*	41.5	95.2***
	(50.2)	(45.5)	(46.2)	(21.7)	(24.5)	(26.9)	(32.8)	(15.0)	(34.1)	(28.6)	(26.2)

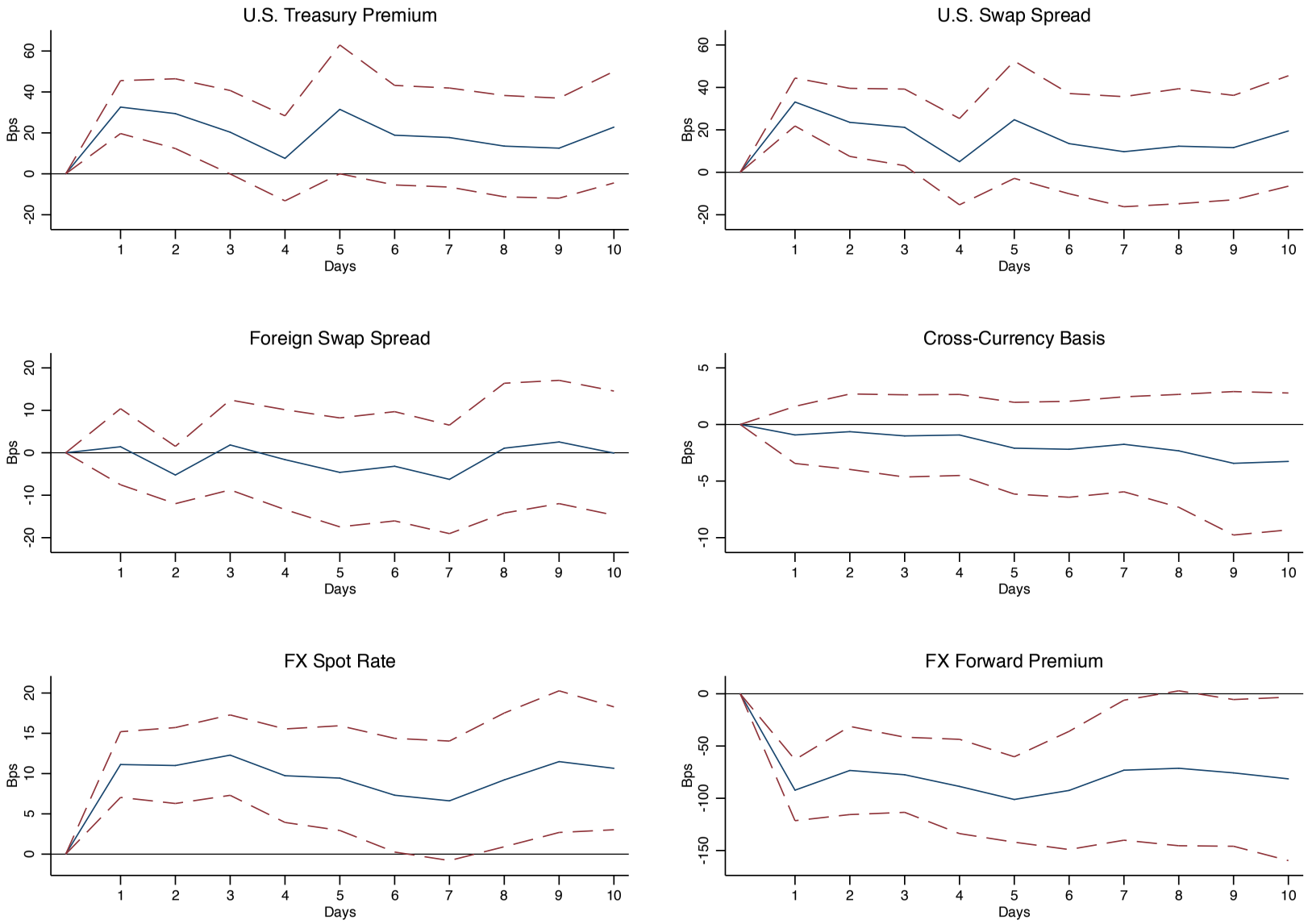
Note: This table reports panel regression results of the five-year U.S. Treasury Premium and its components by currency on U.S. monetary policy shocks for the pre-GFC (2000-2007) and post-GFC (2008-2017) periods. Robust standard errors are in parentheses. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Average U.S. Treasury Premium of the G10 countries by maturity.



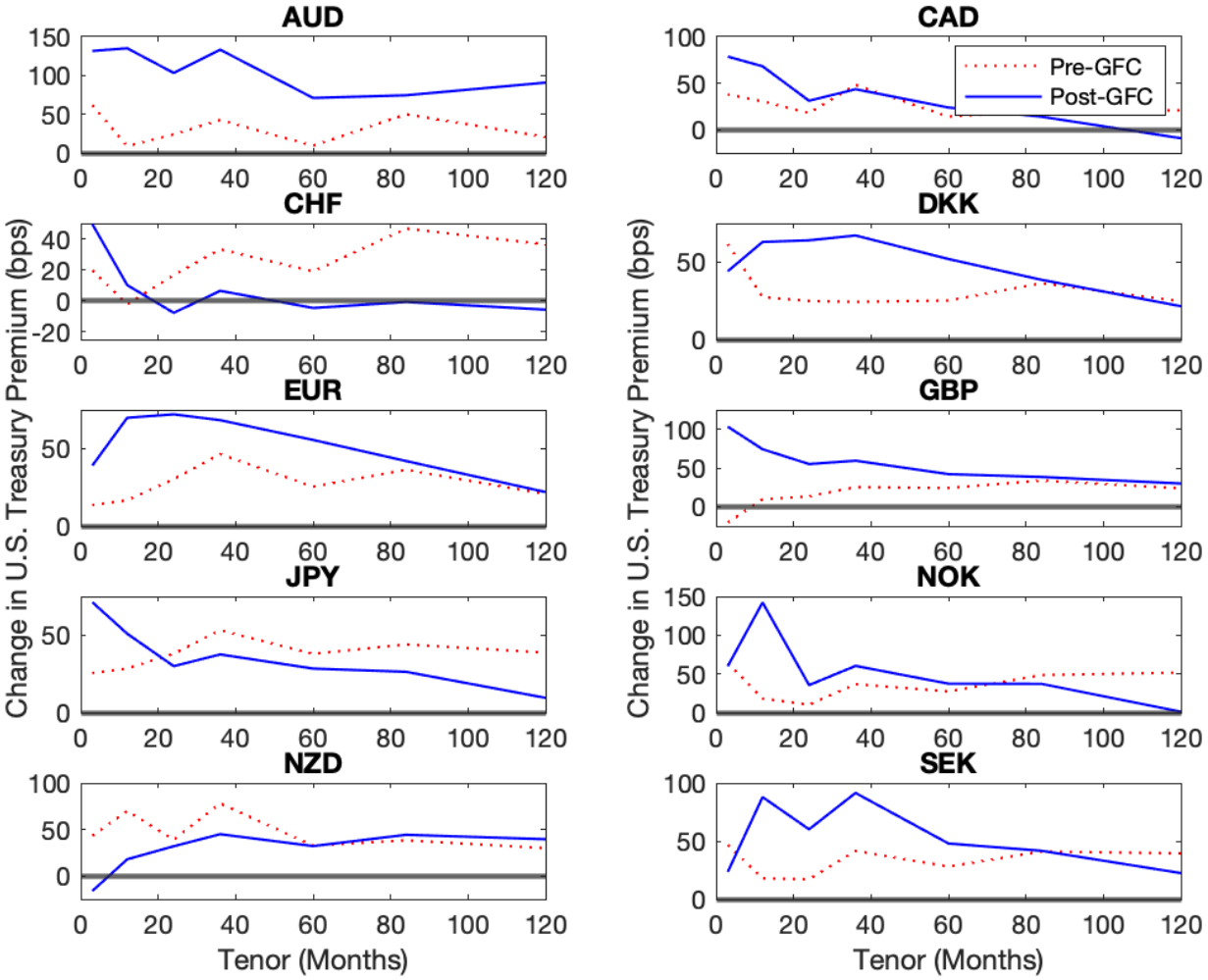
Note: This graph plots the time series of the average U.S. Treasury Premium for the G10 countries by maturity. The series reflect two-week moving averages. Dash line marks the split between the pre- and post-GFC subsamples (2008).

Figure 2: Average impulse response of the 5-year U.S. Treasury Premium to U.S. monetary policy shocks for the G10 countries.



Note: These graphs plot the average impulse responses of the five-year U.S. Treasury Premium for the G10 countries and its components on U.S. monetary policy shocks. The impulse responses are calculated based on local projections. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample (2000-2019). Dash lines reflect the 95% confidence intervals, with standard errors clustered by dates of the monetary policy shocks.

Figure 3: Effects of U.S. monetary policy shocks on U.S. Treasury Premium for the G10 countries by tenor and period.



Note: This graph plots panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the pre-GFC (2000-2007) and post-GFC (2008-2017) periods. Regressions are adjusted for country fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample. Red dotted lines indicate results for the pre-GFC periods, and blue solid lines indicate results for the post-GFC periods.

Internet Appendix to "The Impact of Monetary Policy on the Specialness of U.S. Treasuries"

Ritt Keerati*

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A Cross-Country Heterogeneity of the U.S. Treasury Premium

Table (1) reports the five-year U.S. Treasury Premium by country for the full sample (2000-2019), the pre-GFC period (2000-2007), and the post-GFC period (2008-2019). The U.S. Treasury Premium is generally negative for commodity countries (Australia, New Zealand, Norway, and Sweden) and positive for the rest. The premium is especially high for safe-haven currency countries (Japan and Switzerland). This is presumably related to currency carry trades—see Lustig et al. (2011), for instance. In a currency carry trade, the demand for the government bonds of high interest rate countries, such as those of commodity countries, drives down their bond yields and widens their swap spreads, while the demand for local currencies drives up the cross-currency basis rates. Comparing across periods, one notices that the U.S. Treasury Premium declines for most countries, especially for commodity countries, but increases slightly for safe-haven currency countries after the crisis. This may also be related to dollar carry trades—see Lustig et al. (2011), Hassan and Mano (2014), for instance. It may also suggest that investors have heightened their preference for U.S. Treasuries over government bonds of safe-haven currency countries after the GFC.

[Table 1 about here.]

B Construction of Monetary Policy Measure

I use tick-by-tick data on interest rates to construct my measure of monetary policy shocks. Specifically, my measure is captured by the first principal component of changes in interest rates at different maturities during a narrow window around each scheduled monetary policy announcement.

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My baseline measure of U.S. monetary policy shocks uses the change over a 30-minute window around each scheduled FOMC announcement—from 10 minutes before to 20 minutes after it—of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. My alternative measure of U.S. monetary policy shocks uses the change over the same 30-minute window around each scheduled FOMC announcement of the following seven interest rates: the expected Fed funds rate at one-month horizon, the expected three-month eurodollar interest rates at horizons of one, two, four, and eight quarters, and the U.S. Treasury yields at five- and ten-year maturities. For monetary policy actions by the ECB, I use the change over a 135-minute window around each scheduled policy announcement—from approximately 15 minutes before the announcement of the policy decision to approximately 15 minutes after the conclusion of the press conference—of the following seven interest rates: the euro Overnight Index Swap (OIS) rates at horizons of one month and one, two, four, and eight quarters, and the German Bund yields at five- and ten-year maturities.

Table (2) reports the factor loading for each principal component on the unanticipated changes of interest rates over a narrow window around each policy announcement by the Federal Reserve and the ECB. My measure of monetary policy shocks is represented by the first factor in this table. This factor explains between 66 and 75 percent of the variation in monetary policy shocks from the Federal Reserve and the ECB. The measures of monetary policy shocks for both central banks are scaled such that their effects on the one-year government bond yields in their respective countries—the one-year U.S. Treasury yield for U.S. monetary policy shocks and the one-year German Bund yield for monetary policy shocks from the ECB—are 100 basis points. This allows me to compare the effect of monetary policy actions by the two central banks on the same scale.

[Table 2 about here.]

Based on this methodology, a positive shock is corresponding to a tightening action, while a negative one is corresponding to a loosening one. Table (3) reports summary statistics for monetary policy shocks from the Federal Reserve and the ECB. Based on these measures, the Federal Reserve maintained a loosening monetary policy before the GFC but became neutral after the crisis.[1] These findings are consistent under both the baseline and the alternative measures of U.S. monetary policy shocks. On the other hand, the monetary policy stance of the ECB only became dovish in the post-crisis period. Moreover, U.S. policy shocks are also more volatile before the GFC than after, as evidenced by higher standard deviations. Figure (1) plots the time series of monetary policy shocks of both the Federal Reserve and the ECB.

[Table 3 about here.]

[Figure 1 about here.]

[1]Note that the post-crisis period encompasses both the loosening actions through various QE programs and the subsequent tightening actions as the Federal Reserve eased off from asset purchases.

C Impact of U.S. Monetary Policy

C.1 Detailed Baseline Results

Tables (4), (5) and (6) report the average impact of monetary policy actions by the Federal Reserve on the U.S. Treasury Premium for the G10 countries for the full sample (2000-2017), the pre-GFC period (2000-2007), and the post-GFC period (2008-2017), respectively. These results are based on my baseline monetary policy shocks by the Federal Reserve as described in Section **??** of the main text. These results are normalized such that they reflect the impact on the U.S. Treasury Premium and its components in response to a policy shock that would increase the one-year U.S. Treasury yield by 100 basis points. They confirm the key results described in the main text, namely that (i) a monetary tightening action by the Federal Reserve increases the U.S. Treasury Premium primarily through the increase in the U.S. swap spreads, and (ii) the term structure of the impact differs slightly before versus after the GFC.

[Table 4 about here.]

[Table 5 about here.]

[Table 6 about here.]

Specifically, when the Federal Reserve tightens its monetary policy such that the one-year U.S. Treasury yield would increase by 100 basis points, the U.S. Treasury Premium would rise by 31 to 50 basis points on average for the G10 countries across the term structure. Most of the impact comes from an increase in the U.S. swap spreads (31 to 50 basis points across the term structure) as the increase in U.S. LIBOR (109 to 163 basis points) exceeds the increase in U.S. Treasury yields (68 to 121 basis points) in response to a tightening policy shock. Such an action would also cause the foreign treasury yields to rise, albeit by a lesser extent (30 to 61 basis points). The foreign benchmark rates also move by roughly the same magnitude (26 to 63 basis points), resulting in a minimal change in the foreign swap spreads (-5 to 1 basis points). Monetary policy tightening by the Federal Reserve would also make the foreign currencies depreciate relative to the U.S. dollar and reduce the forward premiums.

Before the crisis, the impact is relatively uniform across the term structure. Specifically, a tightening action that would increase the one-year U.S. Treasury yield by 100 basis points would raise the U.S. Treasury Premium by 30 to 46 basis points at different horizons. Virtually all of the impact comes from the increase in the U.S. swap spreads (36 to 52 basis points) as the increase in U.S. LIBOR (113 to 145 basis points) exceeds that of U.S. Treasury yields (71 to 108 basis points). The foreign benchmark rates and the foreign treasury yields also increase but by much less (31 to 55 basis points for the foreign benchmark rates and 34 to 53 basis points for the foreign treasury yields), and their increases offset each other, leaving a minimal net impact on the foreign swap spreads (-3 to 7 basis points). The impact on both the U.S. and foreign treasury yields and benchmark rates also exhibits a slightly inverted U-shaped term structure as in the full sample.

Movements in the cross-currency bases are muted (0 to 4 basis points), implying minimal frictions in the FX market.

After the crisis, a tightening action by the Federal Reserve still causes the U.S. Treasury Premium to increase but with a downward tilt in the term structure. Specifically, a tightening action that would increase the one-year U.S. Treasury yield by 100 basis points would increase the one-year U.S. Treasury Premium by 80 basis points but increase the ten-year premium by only 20 basis points. These results arise primarily because the U.S. swap spreads at short horizons rise more than those at long horizons (+54 and -3 basis points at one- and ten-year horizons, respectively). This arises as the increase in U.S. LIBOR (172 and 137 basis points) exceeds the increase in U.S. Treasury yields (118 and 140 basis points), particularly at short horizons.[2] While a tightening action by the Federal Reserve has a minimal impact on the foreign swap spreads before the crisis, it causes the foreign swap spreads to decline (-12 and -20 basis points) after the crisis as the increase in the foreign treasury yields (54 and 103 basis points) exceeds the increase in the foreign benchmark rates (43 and 83 basis points). Similar to the pre-crisis period, the term structures of the impact on the U.S. and foreign treasury yields and benchmark rates are still slightly hump-shaped. Such a tightening action also causes the cross-currency basis rates to decline, suggesting U.S. dollar scarcity, although the results are not statistically significant (-14 and -3 basis points). An exception to the aforementioned results is at the three-month horizon, where the movements in the U.S. Treasury Premium, the U.S. swap spreads, the U.S. and foreign treasury yields, and the U.S. and foreign benchmark rates are much more muted, potentially as these rates are more anchored to the countries' policy rates.

C.2 Robustness Tests

C.2.1 Background Noise in Interest Rates

One potential concern regarding the baseline analysis is that my measure of monetary policy shocks might be confounded by other nonmonetary shocks. If this is the case, my first identifying assumption will be violated, and my measure of monetary policy shocks will be contaminated. This concern is partially mitigated by the fact that my measure of monetary policy shocks is calculated using changes of interest rates around narrow windows—30 minutes for U.S. monetary policy and 135 minutes for ECB monetary policy—thereby reducing potential interference. Nevertheless, interest rates that I use to construct my measure of monetary policy shocks—particularly those at long maturities—fluctuate substantially during the same 30-minute windows on non-announcement days. This suggests the presence of noise in my measure of monetary policy shocks.

To assess the severity of this problem, I compare my estimates using OLS regressions versus using a heteroskedasticity-based estimation approach developed by Rigobon (2003) and Rigobon and Sack (2004). The heteroskedasticity-based estimator allows for noise in interest rates that I use to construct my measure of monetary policy shocks by comparing the movement in interest

[2] For the rest of this paragraph, the former number in each parenthesis denotes the impact at the one-year maturity and the latter denotes the impact at the ten-year maturity.

rates during the event windows on FOMC announcement days to such movement during similar windows on non-FOMC announcement days. My identifying assumption is that the variance of monetary policy shocks increases during FOMC announcements while the variance of other noise remains unchanged relative to non-FOMC announcement days. Appendix F describes the heteroskedasticity-based estimator in detail.

Table (7) and (8) compare the estimates based on OLS to those based on the heteroskedasticity-based estimator. Notice that both the point estimates and the confidence intervals are very similar under both estimation methods, suggesting that the problem of background noise in interest rates is minor. Note that given the cross-country heterogeneity of the U.S. Treasury Premium for the G10 countries, I use the heteroskedasticity-based estimator to estimate the impact of U.S. monetary policy actions on the average U.S. Treasury Premium for the G10 countries, rather than to estimate the average impact across countries. To make the results comparable, I also re-calculate OLS regressions in the same fashion. To construct the confidence intervals for the heteroskedasticity-based estimator, I use a procedure that is robust to inference problems, as similarly used by Nakamura and Steinsson (2018). Such inference problems arise when the amount of noise is large enough to render the difference in the variance of monetary policy shocks during FOMC announcements versus the variance during a similar window on non-FOMC announcement days too small. Appendix G describes this procedure in detail. Also given data availability, both estimates are based on a sample that extends only from 2000 through 2012. In any case, my results are robust to potential background noise in interest rates.

[Table 7 about here.]

[Table 8 about here.]

C.2.2 Alternative Measure of Monetary Policy Shocks

Another potential concern regarding the baseline analysis is that my measure of monetary policy shocks may not properly capture policy actions, especially in the post-crisis period. This issue arises from the fact that my measure of monetary policy shocks is calculated using the change in interest rates up to one year in maturity, while some unconventional monetary policy tools that have become widely used after the GFC aim to affect interest rates at longer horizons. To assess the severity of this concern, I re-estimate the results using my alternative measure of monetary policy shocks, which is constructed using the change over the same 30-minute window around each scheduled FOMC announcement of the following seven interest rates: the expected Fed funds rate at the one-month horizon, the expected three-month eurodollar interest rates at horizons of one, two, four, and eight quarters, and the U.S. Treasury yields at five- and ten-year maturities. Including the interest rates at longer horizons allows me to capture the effect of monetary policy that targets interest rates at the long end of the term structure.

Table (9) and (10) compare the impact of U.S. monetary policy actions on the U.S. Treasury Premium under the baseline versus the alternative measures of monetary policy shocks. Although

the point estimates differ slightly, key results remain the same: a tightening action by the Federal Reserve increases the U.S. Treasury Premium across the term structure, and the impact arises primarily through the increase in the U.S. swap spreads. One difference is that the alternative measure of monetary policy shocks yields stronger responses at longer horizons of both the U.S. and foreign benchmark rates and government bond yields. For example, a tightening action by the Federal Reserve that would increase the one-year U.S. Treasury yield by 100 basis points would increase the ten-year U.S. Treasury yield and the ten-year U.S. LIBOR by 87 and 118 basis points under the baseline measure, respectively. These numbers are 132 and 170 basis points under the alternative measure. Similar results apply for the impact on the foreign treasury yields (50 and 78 basis points under the baseline versus alternative measures) and the foreign benchmark rates (51 and 79 basis points). Nonetheless, net impacts on the U.S. Treasury Premium, the U.S. swap spreads, and the foreign swap spreads remain roughly the same. These results are expectable given that my alternative measure of monetary policy shocks aims to capture the impact of monetary policy at the long end of the term structure of interest rates.

[Table 9 about here.]

[Table 10 about here.]

Note that one potential concern in using this alternative measure of U.S. monetary policy shocks arises from the fact that the calculation of the change in the U.S. Treasury Premium and my measure of monetary policy shocks both include changes in U.S. Treasury yields. Since both the regressors and regressands share a common component, my results may be biased. This concern is partially mitigated by the fact that my regressors and regressands are calculated for different time frames and that my results would have been even stronger without this bias—see the main text for this discussion. I also conduct another robustness check by running the same analysis using another alternative monetary policy measure which is constructed without including U.S. Treasury yields. Specifically, this measure is captured by the first principal component of the change over the same 30-minute window around each scheduled FOMC announcement of the following five interest rates: the expected Fed funds rate at the one-month horizon, and the expected three-month eurodollar interest rates at horizons of one, two, four, and eight quarters. My results remain consistent under this measure, which suggests that my analysis is robust to how I measure monetary policy shocks.

D Impact of ECB Monetary Policy

D.1 Impact on U.S. Treasury Premium for Germany

Table (11) and (12) compare side-by-side the impacts of monetary policy actions by the Federal Reserve versus the ECB on the U.S. Treasury Premium for Germany. For comparability, this analysis uses my alternative measure of U.S. monetary policy shocks and my measure of ECB

monetary policy shocks, both of which are calculated based on the change during policy announcement windows of interest rates with matching maturities. Both policy measures are also scaled such that their impacts on the one-year U.S. Treasury yield and the one-year German Bund yield, respectively, are 100 basis points.

[Table 11 about here.]

[Table 12 about here.]

Similar to the results described in the main text, while a tightening action by the Federal Reserve would increase the U.S. Treasury Premium through its positive impact on the U.S. swap spreads, a tightening action by the ECB has a minimal impact on the U.S. Treasury Premium for Germany. Specifically, while a tightening action by the Federal Reserve would increase the U.S. Treasury Premium for Germany by 30 to 63 basis points across the term structure, a similar action by the ECB would affect the U.S. Treasury Premium for Germany by only -11 to 12 basis points. Additionally, only the result at the ten-year maturity is statistically significant, but the magnitude of the impact is relatively small.

Next, I observe the impact on the components of the U.S. Treasury Premium. A tightening action by the Federal Reserve would increase the U.S. Treasury Premium (30 to 63 basis points) through its positive impact on the U.S. swap spreads (32 to 54 basis points) as the increase in U.S. LIBOR (101 to 208 basis points) exceeds the increase in U.S. Treasury yields (64 to 171 basis points). However, such an action would have a minimal impact on the German swap spreads (-10 to 6 basis points) as the increase German Bund yields (20 to 96 basis points) offset the increase in the German benchmark rates (28 to 93 basis points). On the other hand, a tightening action by the ECB has minimal impacts on the U.S. Treasury Premium (-11 to 12 basis points), the U.S. swap spreads (-8 to 8 basis points), and the German swap spreads (-16 to -3 basis points). The muted impact of the policy shock on the German swap spreads emerges as the increase in German Bund yields (51 to 111 basis points) offset the increase in the German benchmark rates (39 to 108 basis points). A tightening action by the ECB would also induce a small increase in U.S. Treasury yields (0 to 19 basis points) that offsets a small increase in U.S. LIBOR (8 to 20 basis points). A tightening policy action by the ECB would also induce a small but statistically significant increase in the cross-currency basis (3 to 7 basis points), except at the three-month horizon where the impact is more noticeable (22 basis points). This positive impact on the cross-currency basis signals the euro shortage as a result of a tightening policy shock.

D.2 Impact on U.S. Treasury Premium for Other G10 Countries

Table (13) and (14) compare side-by-side the impact of monetary policy actions by the Federal Reserve and the ECB on the U.S. Treasury Premium for the other G10 countries besides Germany. The results show that the average response of the U.S. Treasury Premium to a policy action by the ECB is more muted when compared to the response to an action by the Federal Reserve. While a

policy shock by the Federal Reserve that would induce a 100 basis point increase in the one-year U.S. Treasury yield would increase the U.S. Treasury Premium for the other G10 countries by 36 to 55 basis points on average, a similar policy shock by the ECB would only induce a 4 to 30 basis point increase in the premium across the term structure. One exception is at the one-year horizon where the impact is a negative 40 basis points on the U.S. Treasury Premium with a negative impact on the U.S. swap spread.

[Table 13 about here.]

[Table 14 about here.]

Notice that a policy action by the ECB also has smaller impacts on U.S. Treasury yields (0 to 58 basis points), U.S. LIBOR (20 to 63 basis points), and the U.S. swap spreads (-19 to 21 basis points) compared to an action by the Federal Reserve (66 to 169 basis points for the impact on U.S. Treasury yields, 104 to 207 basis points for the impact on U.S. LIBOR, and 33 to 56 basis points for the impact on the U.S. swap spreads). In contrast, it has larger impacts on the foreign treasury yields (47 to 123 basis points) and the foreign benchmark rates (25 to 123 basis points) when compared to an action by the Federal Reserve (41 to 87 basis points for the impact on the foreign treasury yields, and 25 to 87 basis points for the impact on the foreign benchmark rates). These impacts largely offset each other, resulting in a minimal impact on the foreign swap spreads. There are exceptions at the three-month, seven-year, and ten-year horizons where the impacts on the foreign swap spreads are statistically significant, but the net impacts on the U.S. Treasury Premium at these horizons are still small in magnitude. Also, when the ECB tightens its monetary policy, the other G10 currencies appreciate relative to the U.S. dollar (by 10 to 12 basis points) whereas when the Federal Reserve tightens, the other G10 currencies depreciate (by 14 to 15 basis points).

E Cross-Country Heterogeneity of the U.S. Treasury Premium

Table (15), (16), and (17) report the impact of monetary policy actions by the Federal Reserve on the U.S. Treasury Premium by tenor and country for the full sample (2000-2017), the pre-GFC period (2000-2007), and the post-GFC period (2008-2017), respectively. These results are based on my baseline measure of U.S. monetary policy shocks. As described in the main text, in the full sample when the Federal Reserve tightens its monetary policy, it increases the U.S. Treasury Premium for all the G10 countries and across all tenors, but the magnitude of the impact varies. Before the crisis, a tightening action by the Federal Reserve would generally induce a parallel upward shift in the term structure of the U.S. Treasury Premium for most G10 countries, with the magnitude of the impact varying slightly across countries. After the crisis, the results diverge materially across countries, with the magnitude of the impact being particularly pronounced for Australia and subdued for Switzerland. Post the GFC, a tightening action by the Federal Reserve would still increase the U.S. Treasury Premium for most countries, except for Switzerland where

the impact is muted. The action would also induce a downward tilt in the term structure of the U.S. Treasury Premium for most countries. These results also illustrate the flat and the downward-sloping term structures of the impact for the pre- and post-GFC periods, respectively.

[Table 15 about here.]

[Table 16 about here.]

[Table 17 about here.]

F Rigobon's Heteroskedasticity-Based Estimator

F.1 Point Estimation

This section describes the heteroskedasticity-based estimator developed by Rigobon (2003) and Rigobon and Sack (2004) that is used in my robustness test. The approach is similar to the one used by Nakamura and Steinsson (2018) and works as follows:

Suppose that the movements in my measure of monetary policy shock, i_t, consist of a pure monetary policy shock, ϵ_t, and a non-monetary policy shock, η_t, where t is the time indicator for each policy announcement. Suppose also that my outcome variable, $\Delta s_{n,t}$ where n denotes the tenor of interest, is affected by both the monetary and non-monetary policy shocks. I can express these variables as:

$$\begin{aligned} i_t &= \alpha_i + \epsilon_t + \eta_t \\ \Delta s_{n,t} &= \alpha_s + \gamma\epsilon_t + \beta\eta_t + \delta_n \end{aligned}$$

My parameter of interest is γ, which captures the impact of the pure monetary policy shock on the outcome variable, taking into consideration the potential impact of other noises.

My identifying assumption is that the variance of monetary policy shocks increases during FOMC announcement windows, while the variance of other shocks remains unchanged. Let R_1 denote the sample of FOMC announcements ("treatment group"), and R_2 denote a sample of similar narrow and comparable windows—it captures the same time of day and days of week, for instance—on non-announcement days ("control group"). My identifying assumption can be expressed as:

$$\sigma_{\epsilon,R_1} > \sigma_{\epsilon,R_2}, \quad \text{and} \quad \sigma_{\eta,R_1} = \sigma_{\eta,R_2}.$$

Let Ω_{R_i} denote the variance-covariance matrix of $\begin{bmatrix} i_t & \Delta s_{n,t} \end{bmatrix}'$ in regime R_i. We can express Ω_{R_i} as:

$$\Omega_{R_i} = \begin{bmatrix} \sigma^2_{\epsilon,R_i} + \sum_j \sigma^2_{\eta,j} & \gamma\sigma^2_{\epsilon,R_i} + \sum_j \beta_j\sigma^2_{\eta,j} \\ \gamma\sigma^2_{\epsilon,R_i} + \sum_j \beta_j\sigma^2_{\eta,j} & \gamma^2\sigma^2_{\epsilon,R_i} + \sum_j \beta_j^2\sigma^2_{\eta,j} \end{bmatrix},$$

where j indexes the elements of η_t.

Notice that:

$$\Delta\Omega = \Omega_{R_1} - \Omega_{R_2} = \left(\sigma^2_{\epsilon,R_1} - \sigma^2_{\epsilon,R_2}\right) \begin{bmatrix} 1 & \gamma \\ \gamma & \gamma^2 \end{bmatrix}.$$

Therefore, we have that:

$$\gamma = \frac{\Delta\Omega_{12}}{\Delta\Omega_{11}} = \frac{cov_{R_1}(i_t, \Delta s_{n,t}) - cov_{R_2}(i_t, \Delta s_{n,t})}{var_{R_1}(i_t) - var_{R_2}(i_t)}$$

This serves as my heteroskedasticity-based estimator in Table (7) and (8). Notice that if the variance of non-monetary policy shocks is zero, that is $\sigma^2_{\eta,R_i} = 0$, then the heteroskedasticity-based estimator reduces to an OLS regression of $\Delta s_{n,t}$ on i_t. In other words, the heteroskedasticity-based estimator is simply the OLS regression, adjusted for the covariance between $\Delta s_{n,t}$ and i_t.

G Confidence Interval

To construct the confidence intervals in Table (7) and (8), I employ a weak-instruments robust approach as described in Nakamura and Steinsson (2018). This procedure aims to overcome a potential issue whereby the difference in the variance of i_t between the treatment and the control groups is close to zero. Specifically, it employs a test inversion approach whereby a 95% confidence interval for my parameter of interest γ is constructed by performing a hypothesis testing for all possible hypothetical true values of γ. The test statistic I use is:

$$g(\gamma) = \Delta cov(i_t, \Delta s_t) - \gamma \Delta var(i_t)$$

where $\Delta cov(i_t, \Delta s_t) \equiv cov_{R_1}(i_t, \Delta s_{n,t}) - cov_{R_2}(i_t, \Delta s_{n,t})$ and $\Delta var(i_t) \equiv var_{R_1}(i_t) - var_{R_2}(i_t)$ denote the difference between the treatment and control groups of the covariance and variance, respectively.

Since $g(\gamma) = 0$ at the true value of γ, I estimate the distribution of $g(\gamma)$ for each hypothetical value of γ and include in my confidence interval values of γ at which I cannot reject the null hypothesis that $g(\gamma) = 0$. I use a stratified bootstrap to estimate the joint distribution of $\Delta cov(i_t, \Delta s_t)$ and $\Delta var(i_t)$. This method for constructing confidence intervals is referred to as the Fieller method by Staiger et al. (1997) as it is an extension of an approach proposed by Fieller (1954).

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Table 1: Summary statistisc of the 5-year U.S. Treasury Premium and its components by country and period.

		AUD	CAD	CHF	DKK	EUR	GBP	JPY	NOK	NZD	SEK
Full Sample:											
U.S. Treasury Premium	Mean	-22.0***	3.2	32.6***	26.9***	19.3***	8.6***	59.0***	-6.5**	-29.9***	-3.9
	SE	(3.1)	(3.0)	(2.2)	(2.6)	(2.2)	(2.1)	(2.5)	(3.2)	(3.1)	(3.2)
U.S. Swap Spread	Mean	33.7***	33.7***	33.7***	33.7***	33.7***	33.7***	33.7***	33.7***	33.7***	33.7***
	SE	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)
Foreign Swap Spread	Mean	38.8***	23.8***	21.4***	34.4***	30.0***	30.7***	8.7***	49.8***	42.6***	42.5***
	SE	(2.7)	(1.7)	(1.2)	(1.6)	(1.6)	(2.5)	(0.7)	(2.9)	(3.5)	(1.9)
Cross-Currency Basis	Mean	17.1***	5.3***	-21.4***	-29.4***	-16.5***	-5.5***	-33.9***	-10.9***	19.0***	-3.7***
	SE	(1.1)	(1.0)	(2.1)	(2.7)	(1.8)	(1.1)	(3.3)	(1.0)	(1.6)	(0.7)
	N	5,147	4,915	4,957	4,869	5,026	4,956	4,885	4,516	4,578	4,649
Pre-GFC:											
U.S. Treasury Premium	Mean	3.0	22.7***	28.6***	29.8***	31.5***	12.1***	49.1***	12.2***	-22.0***	19.1***
	SE	(2.6)	(2.3)	(2.6)	(2.1)	(1.6)	(1.5)	(3.7)	(2.0)	(4.7)	(1.4)
U.S. Swap Spread	Mean	54.2***	54.2***	54.2***	54.2***	54.2***	54.2***	54.2***	54.2***	54.2***	54.2***
	SE	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)
Foreign Swap Spread	Mean	41.9***	19.2***	26.6***	25.2***	21.7***	43.0***	9.3***	44.9***	64.8***	36.6***
	SE	(2.3)	(2.1)	(1.3)	(2.0)	(1.9)	(3.1)	(1.0)	(2.4)	(4.1)	(2.5)
Cross-Currency Basis	Mean	9.2***	9.9***	-2.1***	-2.3***	0.1	-0.7*	-4.2***	-4.7***	4.1***	-1.8***
	SE	(0.4)	(0.7)	(0.1)	(0.4)	(0.3)	(0.4)	(0.8)	(0.3)	(0.5)	(0.1)
	N	2,075	1,880	1,865	1,860	1,951	1,936	2,058	1,807	1,564	1,894
Post-GFC:											
U.S. Treasury Premium	Mean	-38.8***	-8.9**	35.0***	25.1***	11.5***	6.4**	66.3***	-19.0***	-34.0***	-19.7***
	SE	(2.9)	(3.9)	(3.1)	(4.0)	(2.9)	(3.2)	(2.9)	(4.3)	(4.0)	(4.1)
U.S. Swap Spread	Mean	20.0***	20.0***	20.0***	20.0***	20.0***	20.0***	20.0***	20.0***	20.0***	20.0***
	SE	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)	(3.6)
Foreign Swap Spread	Mean	36.7***	26.9***	18.0***	40.8***	35.6***	22.3***	8.2***	53.0***	27.7***	46.4***
	SE	(4.2)	(2.3)	(1.7)	(1.8)	(2.0)	(3.1)	(0.9)	(4.5)	(3.7)	(2.6)
Cross-Currency Basis	Mean	22.3***	2.5*	-32.9***	-45.5***	-26.9***	-8.4***	-53.6***	-15.0***	26.7***	-5.0***
	SE	(1.3)	(1.3)	(2.0)	(2.2)	(1.8)	(1.7)	(3.1)	(1.4)	(1.6)	(1.2)
	N	3,072	3,035	3,092	3,009	3,075	3,020	2,827	2,709	3,014	2,755

Note: This table reports the mean, standard error of the mean based on Newey-West standard errors with a 90-day lag, and the number of observations of the 5-year U.S. Treasury Premium and its components by country and for the following periods: full sample (2000-2019), pre-GFC period (2000-2007), and post-GFC period (2008-2019).
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Principal component analysis of monetary policy shocks by the Federal Reserve and the European Central Bank.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
U.S. Monetary Policy Shocks – Baseline:							
Fed Funds Rate	0.346	0.722	0.574	0.172	−0.009		
Expected Fed Funds Rate	0.425	0.398	−0.800	0.144	0.020		
Expected 3m Eurodollar Rate at 6M	0.497	−0.102	0.076	−0.808	0.290		
Expected 3m Eurodollar Rate at 9M	0.491	−0.331	0.088	0.066	−0.798		
Expected 3m Eurodollar Rate at 1Y	0.460	−0.448	0.132	0.541	0.527		
Cumulative Variance	0.745	0.920	0.978	0.999	1.000		
U.S. Monetary Policy Shocks – Alternative:							
Expected Fed Fund Rate at 1M	0.205	0.559	0.780	−0.089	−0.160	0.007	−0.055
Expected 3M Eurodollar Rate at 3M	0.322	0.531	−0.309	0.240	0.462	−0.007	0.498
Expected 3M Eurodollar Rate at 6M	0.409	0.300	−0.391	0.083	−0.122	0.003	−0.754
Expected 3M Eurodollar Rate at 1Y	0.445	−0.061	−0.218	−0.229	−0.721	0.002	0.422
Expected 3M Eurodollar Rate at 2Y	0.420	−0.262	0.091	−0.523	0.397	0.560	−0.043
5Y U.S. Treasury Yield	0.420	−0.310	0.154	−0.125	0.257	−0.788	−0.034
10Y U.S. Treasury Yield	0.368	−0.382	0.252	0.765	−0.053	0.257	0.010
Cumulative Variance	0.656	0.878	0.952	0.981	0.993	0.997	1.000
ECB Monetary Policy Shocks:							
1M Euro OIS Rate	0.289	−0.555	0.681	−0.340	0.167	−0.029	0.020
3M Euro OIS Rate	0.391	−0.356	−0.052	0.522	−0.516	0.423	0.027
6M Euro OIS Rate	0.420	−0.181	−0.243	0.278	0.143	−0.717	−0.346
1Y Euro OIS Rate	0.426	−0.022	−0.351	−0.085	0.375	0.060	0.737
2Y Euro OIS Rate	0.422	0.151	−0.256	−0.357	0.242	0.478	−0.565
5Y German Bund Yield	0.382	0.394	0.084	−0.437	−0.644	−0.264	0.129
10Y German Bund Yield	0.287	0.594	0.528	0.457	0.270	0.063	0.014
Cumulative Variance	0.741	0.925	0.974	0.987	0.994	0.998	1.000

Note: This table reports factor loading for each principal component on the unanticipated changes of interest rates over a narrow window around each policy announcement by the Federal Reserve and the ECB. For U.S. monetary policy, changes are calculated over 30-minutes windows around FOMC announcements. The baseline measure is calculated using the following interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The alternative measure is calculated using the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. The interest rate changes are calculated from 10 minutes before the FOMC announcement to 20 minutes after it. For monetary policy by the ECB, changes are calculated over 135-minutes windows around ECB policy communications—including both the announcements of the policy decisions and the subsequent press conferences—of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. The interest rate changes are calculated from 10 minutes before the ECB policy announcements to 15 minutes after the press conferences.

Table 3: Summary statistics for monetary policy shocks by the Federal Reserve and the ECB.

	U.S. monetary policy shocks			ECB monetary policy shocks		
	Mean	SD	N	Mean	SD	N
Baseline:						
Pre-GFC	-0.0013	0.0409	58			
Post-GFC	0.0001	0.0203	70			
Full sample	-0.0005	0.0312	128			
Alternative:						
Pre-GFC	-0.0006	0.0302	58	0.0017	0.0177	104
Post-GFC (through 2017)	-0.0001	0.0185	70	-0.0009	0.0203	95
Post-GFC (through 2019)				-0.0011	0.0193	106
Full sample	-0.0003	0.0244	128	0.0003	0.0185	210

Note: This table reports the mean, standard deviation, and the the number of observations for monetary policy shocks by the Federal Reserve and the ECB by periods. The baseline measure of U.S. monetary policy shocks are calculated based on changes of the following interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The alternative measure of U.S. monetary policy shocks are calculated based on changes of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. The measure of ECB monetary policy shocks are calculated based on changes of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. U.S. monetary policy shocks are scaled such that the effect on the one-year Treasury yield is 100 basis points across the full sample (2000-2017). Monetary policy shocks by the ECB are scaled such that the effect on the one-year German Bund yield is 100 basis points across the full sample (2000-2019).

Table 4: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - Baseline Analysis (Full sample).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Premium	43.80*	44.41***	39.44***	50.48***	32.61***	36.03***	31.03***
	(25.99)	(12.55)	(10.88)	(8.05)	(6.60)	(8.16)	(7.97)
U.S. Swap Spread	38.13	42.73***	37.06***	50.06***	33.11***	33.97***	31.11***
	(27.34)	(13.39)	(10.46)	(7.84)	(5.76)	(7.38)	(7.88)
Foreign Swap Spread	-4.77	0.25	-2.45	0.25	1.42	-0.91	0.57
	(9.57)	(4.32)	(3.90)	(4.12)	(4.57)	(4.74)	(5.22)
Cross-Currency Basis	-0.92	-1.94	0.07	-0.67	-0.92	-1.16	-0.49
	(6.57)	(2.43)	(1.56)	(1.38)	(1.29)	(1.28)	(1.23)
Other Components							
U.S. Treasury Yield	67.57**	100.00***	121.35***	113.40***	120.90***	102.41***	87.36***
	(30.07)	(17.29)	(25.51)	(25.82)	(28.56)	(30.24)	(30.16)
U.S. LIBOR	108.55***	142.73***	158.41***	163.46***	154.01***	136.38***	118.47***
	(25.63)	(14.12)	(21.05)	(23.50)	(27.25)	(28.38)	(31.68)
Foreign Treasury Yield	30.06***	44.75***	59.14***	59.03***	61.28***	58.45***	50.38**
	(7.67)	(10.81)	(16.61)	(17.86)	(20.03)	(21.06)	(21.41)
Foreign Benchmark Rate	25.69***	44.99***	56.70***	59.28***	62.70***	57.55***	50.95**
	(6.33)	(11.24)	(14.78)	(16.70)	(19.87)	(20.70)	(21.14)
FX Spot Rate	11.26***	11.22***	11.26***	11.33***	11.12***	11.30***	10.73***
	(2.05)	(2.12)	(2.13)	(2.14)	(2.08)	(2.12)	(2.03)
FX Forward Premium	-81.31***	-99.67***	-101.65***	-104.85***	-92.23***	-79.99***	-68.01***
	(20.35)	(15.83)	(18.46)	(17.34)	(14.91)	(15.36)	(17.29)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the full sample (2000-2017). Regressions are adjusted for currency fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - Baseline Analysis (Pre-GFC).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Premium	45.96*	33.94**	33.58***	45.54***	29.81***	36.19***	34.29***
	(23.56)	(13.85)	(12.38)	(7.71)	(7.32)	(8.52)	(9.21)
U.S. Swap Spread	44.47	39.47**	35.59***	51.55***	36.31***	40.77***	41.33***
	(27.06)	(15.51)	(12.37)	(7.45)	(6.44)	(7.73)	(7.41)
Foreign Swap Spread	-2.92	3.71	0.80	5.77	6.58	4.85	6.81
	(11.31)	(4.77)	(4.30)	(3.97)	(4.71)	(4.61)	(5.21)
Cross-Currency Basis	4.19	1.82*	1.20**	0.24	-0.08	-0.28	0.23
	(6.57)	(1.09)	(0.50)	(0.46)	(0.45)	(0.46)	(0.56)
Other Components							
U.S. Treasury Yield	71.50**	94.54***	108.17***	93.92***	99.93***	81.99**	71.17**
	(27.93)	(19.81)	(30.48)	(29.70)	(32.99)	(34.91)	(35.72)
U.S. LIBOR	120.01***	134.01***	143.76***	145.48***	136.24***	122.76***	112.50***
	(30.17)	(16.73)	(25.61)	(28.19)	(32.38)	(33.61)	(38.24)
Foreign Treasury Yield	33.64***	42.32***	52.73***	48.68**	48.00**	42.72*	34.53
	(9.48)	(12.74)	(19.44)	(20.49)	(22.92)	(24.13)	(24.27)
Foreign Benchmark Rate	31.08***	46.03***	53.54***	54.45***	54.58**	47.58*	41.34*
	(7.21)	(13.52)	(17.47)	(19.79)	(23.80)	(24.74)	(24.90)
FX Spot Rate	8.59***	8.59***	8.34***	8.42***	8.37***	8.40***	8.37***
	(1.91)	(1.94)	(1.93)	(1.94)	(1.90)	(1.91)	(1.94)
FX Forward Premium	-83.82***	-86.16***	-89.02***	-90.79***	-81.74***	-75.46***	-70.93***
	(24.04)	(20.17)	(23.59)	(21.80)	(18.35)	(18.34)	(20.58)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the pre-crisis period (2000-2007). Regressions are adjusted for currency fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - Baseline Analysis (Post-GFC).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Premium	38.79	79.53***	58.07***	67.54***	42.31***	36.15*	20.32
	(83.50)	(20.74)	(18.38)	(21.03)	(14.20)	(19.46)	(16.36)
U.S. Swap Spread	17.26	53.59***	41.76**	45.17**	22.57**	12.45	-3.01
	(80.55)	(20.44)	(16.88)	(22.30)	(11.15)	(11.56)	(20.62)
Foreign Swap Spread	-12.38**	-11.86*	-12.64**	-18.56***	-15.96**	-19.65**	-20.29*
	(5.94)	(6.83)	(5.48)	(7.19)	(7.50)	(9.53)	(11.45)
Cross-Currency Basis	-19.31	-14.08	-3.67	-3.81	-3.78	-4.05	-3.04
	(13.92)	(9.10)	(6.21)	(5.39)	(5.00)	(4.96)	(4.78)
Other Components							
U.S. Treasury Yield	51.09	118.18***	164.07***	177.36***	188.91***	167.13***	140.22***
	(91.06)	(30.72)	(34.95)	(42.81)	(49.21)	(52.79)	(49.60)
U.S. LIBOR	68.35***	171.78***	205.83***	222.53***	211.48***	179.57***	137.21***
	(24.63)	(28.27)	(26.21)	(33.49)	(44.22)	(51.03)	(52.02)
Foreign Treasury Yield	18.37***	54.15***	80.54***	94.16***	105.93***	109.74***	103.49***
	(6.30)	(14.13)	(18.30)	(19.27)	(20.80)	(23.99)	(22.99)
Foreign Benchmark Rate	6.06	42.30***	67.90***	75.60***	89.97***	90.08***	83.21***
	(4.50)	(16.33)	(18.97)	(20.17)	(21.90)	(23.76)	(25.57)
FX Spot Rate	20.42***	19.94***	20.63***	20.72***	19.95***	20.46***	18.55***
	(6.61)	(6.86)	(6.80)	(6.81)	(6.58)	(6.66)	(6.40)
FX Forward Premium	-71.51**	-143.56***	-141.61***	-150.74***	-125.29***	-93.54***	-57.04*
	(32.29)	(22.74)	(28.83)	(31.40)	(29.87)	(31.76)	(29.50)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the post-crisis period (2008-2017). Regressions are adjusted for currency fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - OLS vs. Rigobon Estimators.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Premium							
OLS	52.52	44.51**	44.54***	54.03***	37.52***	37.64***	29.68**
	[-3.68,108.71]	[17.36,71.67]	[21.66,67.43]	[36.35,71.71]	[22.01,53.04]	[18.53,56.76]	[8.23,51.12]
Rigobon	52.52*	45.72***	45.21***	54.01***	37.74***	36.83***	29.72**
	[-2.10,127.50]	[18.15,76.95]	[20.93,71.17]	[35.33,74.70]	[22.05,55.95]	[17.25,57.83]	[6.38,51.60]
U.S. Swap Spread							
OLS	46.95	45.38**	43.78***	55.97***	38.66***	36.82***	31.58**
	[-12.50,106.41]	[16.94,73.82]	[22.23,65.33]	[40.09,71.86]	[27.08,50.24]	[20.90,52.73]	[12.67,50.49]
Rigobon	49.36	46.72***	44.36***	56.21***	38.88***	35.98***	31.70***
	[-12.38,121.12]	[17.62,76.73]	[19.95,67.50]	[38.03,73.42]	[25.43,51.53]	[18.22,52.20]	[9.15,49.73]
Foreign Swap Spread							
OLS	-4.36	-1.32	-1.46	1.94	2.26	1.25	2.67
	[-24.50,15.78]	[-10.94,8.31]	[-8.91,5.99]	[-6.14,10.02]	[-6.93,11.45]	[-8.15,10.65]	[-7.59,12.92]
Rigobon	-2.68	-1.33	-1.94	1.89	2.07	1.10	2.64
	[-23.82,16.90]	[-12.98,7.47]	[-11.20,5.07]	[-8.70,9.07]	[-9.72,10.70]	[-11.10,9.70]	[-10.05,12.52]
Cross-Currency Basis							
OLS	-0.56	0.65	0.47	-0.17	-0.57	-0.96	-0.31
	[-14.31,13.19]	[-2.88,4.18]	[-2.23,3.17]	[-2.32,1.98]	[-2.45,1.32]	[-2.71,0.80]	[-2.02,1.41]
Rigobon	0.42	0.66	0.56	-0.11	-0.53	-0.96	-0.25
	[-15.30,14.62]	[-3.65,4.17]	[-2.75,3.12]	[-2.62,2.07]	[-2.77,1.40]	[-2.90,0.92]	[-2.32,1.50]

Note: This table reports the regression results using OLS and a heteroskedasticity-based estimator (Rigobon) of the average U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the partial sample (2000-2012). I report a point estimate and 95% confidence intervals. The sample of "treatment" days for the Rigobon method is all regularly scheduled FOMC meeting days from January 1, 2000 to December 31, 2012; this is also the period for which the policy news shock is constructed in all regressions. The sample of "control" days for the Rigobon method is all Tuesdays and Wednesdays that are not FOMC meeting days over the same period of time. In both the treatment and control samples, I drop July 2008 through June 2009, and September 11, 2001 through September 21, 2001. Confidence intervals for the Rigobon method are calculated using the weak-IV robust approach with 5,000 iterations—see Appendix G for the description of this calculation. Standard errors for OLS regressions are robust to potential heteroskedasticity. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample (2000-2017).
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - OLS vs. Rigobon Estimators.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Yield							
OLS	66.44*	91.18***	105.22***	92.35***	96.27**	80.67**	72.53*
	[2.53,130.35]	[52.69,129.66]	[52.69,157.75]	[40.31,144.40]	[37.50,155.04]	[20.20,141.14]	[11.48,133.58]
Rigobon	67.01	88.93***	101.25***	88.37***	92.09***	77.65**	68.93**
	[-21.00,124.00]	[42.30,127.80]	[40.60,157.50]	[35.50,144.80]	[32.30,154.00]	[18.30,140.70]	[6.90,132.70]
U.S. LIBOR							
OLS	116.72***	136.55***	149.00***	148.33***	134.93***	117.49***	104.11**
	[64.05,169.38]	[105.03,168.08]	[104.48,193.51]	[97.68,198.98]	[77.09,192.76]	[58.05,176.92]	[37.50,170.72]
Rigobon	119.83***	135.65***	145.61***	144.58***	130.98***	113.63***	100.63***
	[62.60,168.60]	[97.40,166.70]	[95.30,193.00]	[92.30,199.90]	[71.90,193.60]	[55.80,176.60]	[32.40,171.30]
Foreign Treasury Yield							
OLS	31.83***	44.56***	57.03***	53.27**	52.67**	46.75*	39.13
	[15.27,48.38]	[21.45,67.67]	[23.22,90.84]	[17.31,89.23]	[13.27,92.08]	[6.00,87.51]	[-1.35,79.61]
Rigobon	30.86***	43.44***	56.03***	51.72***	51.14***	45.01**	37.40*
	[15.35,49.10]	[17.40,70.90]	[23.95,88.65]	[16.70,89.30]	[14.90,92.25]	[4.10,86.85]	[-1.30,81.70]
Foreign Benchmark Rate							
OLS	28.43***	44.16***	55.94***	55.38**	54.86**	48.09*	41.77*
	[15.36,41.51]	[18.87,69.44]	[24.36,87.52]	[20.63,90.13]	[14.47,95.24]	[6.93,89.25]	[0.64,82.90]
Rigobon	29.03***	43.13***	54.49***	53.83***	53.18***	46.27**	37.40*
	[14.05,41.05]	[17.40,70.90]	[23.95,88.65]	[19.05,90.35]	[14.70,95.55]	[4.95,87.50]	[-1.30,81.70]
FX Spot Rate							
OLS	9.23***	9.23***	9.23***	9.23***	9.23***	9.23***	9.23***
	[5.34,13.12]	[5.34,13.12]	[5.34,13.12]	[5.34,13.12]	[5.34,13.12]	[5.34,13.12]	[5.34,13.12]
Rigobon	9.25***	9.25***	9.25***	9.25***	9.25***	9.25***	9.23***
	[5.25,13.85]	[5.20,14.00]	[5.15,13.65]	[5.15,13.80]	[5.05,13.70]	[5.05,13.80]	[5.30,13.85]
FX Forward Premium							
OLS	-87.14***	-90.79***	-91.09***	-91.78***	-80.86***	-70.52***	-62.90***
	[-129.62,-44.65]	[-124.66,-56.92]	[-130.21,-51.97]	[-129.26,-54.30]	[-112.52,-49.20]	[-102.89,-38.15]	[-99.81,-25.99]
Rigobon	-88.65***	-90.69***	-88.58***	-89.23***	-78.30***	-68.31***	-60.88***
	[-127.80,-41.30]	[-123.00,-51.10]	[-125.20,-41.60]	[-126.10,-44.30]	[-109.90,-41.10]	[-100.30,-31.90]	[-99.10,-18.80]

Note: This table reports the regression results using OLS and a heteroskedasticity-based estimator (Rigobon) of the average U.S. Treasury Premium and its components for the G10 countries by tenor on U.S. monetary policy shocks for the partial sample (2000-2012). I report a point estimate and 95% confidence intervals. The sample of "treatment" days for the Rigobon method is all regularly scheduled FOMC meeting days from January 1, 2000 to December 31, 2012; this is also the period for which the policy news shock is constructed in all regressions. The sample of "control" days for the Rigobon method is all Tuesdays and Wednesdays that are not FOMC meeting days over the same period of time. In both the treatment and control samples, I drop July 2008 through June 2009, and September 11, 2001 through September 21, 2001. Confidence intervals for the Rigobon method are calculated using the weak-IV robust approach with 5,000 iterations—see Appendix G for the description of this calculation. Standard errors for OLS regressions are robust to potential heteroskedasticity. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample (2000-2017).
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - Baseline vs. Alternative Measures.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Premium							
Baseline	43.80*	44.41***	39.44***	50.48***	32.61***	36.03***	31.03***
	(25.99)	(12.55)	(10.88)	(8.05)	(6.60)	(8.16)	(7.97)
Alternative	47.56**	54.74***	46.97***	55.75***	36.64***	36.70***	38.39***
	(20.52)	(13.40)	(10.81)	(10.65)	(8.34)	(10.74)	(10.12)
U.S. Swap Spread							
Baseline	38.13	42.73***	37.06***	50.06***	33.11***	33.97***	31.11***
	(27.34)	(13.39)	(10.46)	(7.84)	(5.76)	(7.38)	(7.88)
Alternative	33.21	49.37***	45.42***	55.66***	37.92***	33.90***	38.32***
	(22.81)	(13.61)	(10.10)	(10.43)	(7.75)	(10.00)	(9.30)
Foreign Swap Spread							
Baseline	-4.77	0.25	-2.45	0.25	1.42	-0.91	0.57
	(9.57)	(4.32)	(3.90)	(4.12)	(4.57)	(4.74)	(5.22)
Alternative	-14.78	-2.61	-2.66	0.04	1.35	-1.99	0.59
	(9.29)	(5.18)	(4.86)	(5.41)	(6.04)	(6.15)	(6.51)
Cross-Currency Basis							
Baseline	-0.92	-1.94	0.07	-0.67	-0.92	-1.16	-0.49
	(6.57)	(2.43)	(1.56)	(1.38)	(1.29)	(1.28)	(1.23)
Alternative	2.09	-2.76	1.10	-0.13	-0.06	-0.81	-0.66
	(6.65)	(3.45)	(2.46)	(2.23)	(2.21)	(2.10)	(1.91)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on the baseline and alternative measure of U.S. monetary policy shocks for the full sample (2000-2019). Regressions are adjusted for currency fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first pricipal components of the change over a 30-minute window around each scheduled FOMC announcement. The baseline measure is calculated using the following interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The alternative measure is calculated using the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Effects of U.S. monetary policy shocks on the U.S. Treasury Premium for the G10 countries - Baseline vs. Alternative Measures.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
U.S. Treasury Yield							
Baseline	67.57**	100.00***	121.35***	113.40***	120.90***	102.41***	87.36***
	(30.07)	(17.29)	(25.51)	(25.82)	(28.56)	(30.24)	(30.16)
Alternative	66.15**	100.00***	136.05***	147.54***	170.27***	157.88***	132.15***
	(27.51)	(19.80)	(26.98)	(26.61)	(30.68)	(31.96)	(31.90)
U.S. LIBOR							
Baseline	108.55***	142.73***	158.41***	163.46***	154.01***	136.38***	118.47***
	(25.63)	(14.12)	(21.05)	(23.50)	(27.25)	(28.38)	(31.68)
Alternative	103.94***	149.37***	181.47***	203.20***	208.19***	191.79***	170.47***
	(32.13)	(21.14)	(25.03)	(27.11)	(31.12)	(32.75)	(34.46)
Foreign Treasury Yield							
Baseline	30.06***	44.75***	59.14***	59.03***	61.28***	58.45***	50.38**
	(7.67)	(10.81)	(16.61)	(17.86)	(20.03)	(21.06)	(21.41)
Alternative	39.32***	54.45***	73.35***	77.40***	86.54***	87.92***	78.44***
	(7.92)	(10.36)	(14.60)	(15.71)	(17.77)	(18.98)	(19.17)
Foreign Benchmark Rate							
Baseline	25.69***	44.99***	56.70***	59.28***	62.70***	57.55***	50.95**
	(6.33)	(11.24)	(14.78)	(16.70)	(19.87)	(20.70)	(21.14)
Alternative	24.94***	51.84***	70.70***	77.43***	87.88***	85.93***	79.03***
	(8.17)	(12.33)	(14.70)	(16.23)	(19.29)	(20.03)	(20.04)
FX Spot Rate							
Baseline	11.26***	11.22***	11.26***	11.33***	11.12***	11.30***	10.73***
	(2.05)	(2.12)	(2.13)	(2.14)	(2.08)	(2.12)	(2.03)
Alternative	14.88***	14.67***	14.92***	15.08***	14.65***	14.95***	14.11***
	(2.60)	(2.67)	(2.77)	(2.73)	(2.66)	(2.71)	(2.64)
FX Forward Premium							
Baseline	-81.31***	-99.67***	-101.65***	-104.85***	-92.23***	-79.99***	-68.01***
	(20.35)	(15.83)	(18.46)	(17.34)	(14.91)	(15.36)	(17.29)
Alternative	-74.39***	-100.29***	-109.67***	-125.89***	-120.36***	-106.66***	-92.10***
	(24.11)	(21.41)	(23.01)	(21.95)	(20.89)	(21.42)	(22.27)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries by tenor on the baseline and alternative measure of U.S. monetary policy shocks for the full sample (2000-2019). Regressions are adjusted for currency fixed effect, and standard errors are clustered by dates of the monetary policy shocks. U.S. monetary policy shocks are captured by the first pricipal components of the change over a 30-minute window around each scheduled FOMC announcement. The baseline measure is calculated using the following interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The alternative measure is calculated using the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Effects of the ECB and U.S. monetary policy shocks on U.S. Treasury Premium for Germany.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
Effect of U.S. Monetary Policy Shocks							
U.S. Treasury Premium	31.49	49.02***	57.76***	63.43***	43.13***	35.88***	30.29**
	(30.60)	(12.99)	(13.29)	(13.38)	(9.30)	(10.92)	(12.79)
U.S. Swap Spread	32.28	44.08***	44.42***	54.25***	37.07***	32.03***	32.83***
	(22.08)	(12.96)	(9.71)	(10.55)	(7.44)	(9.68)	(10.10)
Foreign Swap Spread	6.25	-2.82	-9.92	-6.41	-3.15	-0.44	4.36
	(12.79)	(6.80)	(6.17)	(7.66)	(7.28)	(7.90)	(8.36)
Cross-Currency Basis	-6.59	-2.11	-3.43	-2.77	-2.91	-3.42	-1.82
	(15.54)	(4.08)	(4.03)	(3.85)	(4.07)	(3.89)	(3.88)
Effect of ECB Monetary Policy Shocks							
U.S. Treasury Premium	2.46	-10.72	-0.20	2.41	7.79	9.97	11.51**
	(13.40)	(7.20)	(6.56)	(5.63)	(5.48)	(6.31)	(5.67)
U.S. Swap Spread	8.24	-7.74*	3.96	1.20	2.83	-0.73	1.95
	(5.21)	(4.12)	(4.05)	(4.40)	(6.72)	(4.92)	(4.41)
Foreign Swap Spread	-16.46	-3.53	-3.31	-7.63	-9.71	-14.18***	-12.58***
	(11.40)	(5.52)	(7.33)	(6.22)	(5.93)	(5.18)	(4.06)
Cross-Currency Basis	22.25***	6.51*	7.47**	6.43**	4.75**	3.49*	3.03*
	(7.13)	(3.82)	(3.11)	(2.52)	(2.01)	(1.94)	(1.79)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for Germany by tenor on monetary policy shocks from the Federal Reserve (top) and the ECB (bottom) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Effects of the ECB and U.S. monetary policy shocks on U.S. Treasury Premium for Germany.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
Effect of U.S. Monetary Policy Shocks							
U.S. Treasury Yield	63.94**	100.00***	136.10***	147.89***	171.25***	151.66***	120.69***
	(26.63)	(18.29)	(24.34)	(24.96)	(30.04)	(30.77)	(29.53)
U.S. LIBOR	100.63***	144.08***	180.52***	202.14***	208.32***	183.69***	153.52***
	(31.06)	(19.62)	(23.07)	(26.31)	(30.77)	(32.33)	(32.58)
Foreign Treasury Yield	21.40*	64.19***	90.46***	91.38***	95.64***	90.58***	80.15***
	(12.47)	(16.33)	(20.62)	(20.65)	(24.05)	(22.95)	(22.60)
Foreign Benchmark Rate	27.88**	61.36***	80.55***	84.97***	92.50***	90.15***	84.51***
	(10.88)	(12.46)	(20.22)	(22.42)	(23.24)	(22.29)	(22.56)
FX Spot Rate	11.40***	11.50***	11.97***	11.97***	11.97***	11.93***	11.85***
	(2.92)	(2.92)	(2.92)	(2.92)	(2.92)	(2.87)	(2.96)
FX Forward Premium	-74.03*	-84.83***	-103.40***	-119.94***	-118.73***	-96.96***	-70.83***
	(40.13)	(21.62)	(25.95)	(25.19)	(25.35)	(25.07)	(25.49)
Effect of ECB Monetary Policy Shocks							
U.S. Treasury Yield	-0.04	16.39	15.24	19.00	17.40	18.30	12.41
	(5.64)	(11.51)	(15.34)	(15.94)	(19.18)	(18.40)	(17.84)
U.S. LIBOR	8.20***	8.65	19.21	20.20	20.23	17.57	14.36
	(2.66)	(11.31)	(15.44)	(17.74)	(20.01)	(19.80)	(19.14)
Foreign Treasury Yield	61.69***	100.00***	111.13***	103.92***	90.85***	69.88***	51.14***
	(7.88)	(8.50)	(9.05)	(9.10)	(10.50)	(11.91)	(12.74)
Foreign Benchmark Rate	45.31***	96.47***	107.82***	96.28***	81.14***	55.70***	38.56***
	(9.04)	(8.60)	(12.38)	(11.95)	(11.22)	(10.99)	(10.90)
FX Spot Rate	-7.96***	-8.21***	-8.28***	-8.16***	-8.29***	-8.19***	-8.19***
	(1.78)	(1.80)	(1.81)	(1.80)	(1.81)	(1.80)	(1.80)
FX Forward Premium	59.27***	94.33***	96.09***	82.51***	65.66***	41.62***	27.23**
	(8.21)	(11.82)	(14.92)	(15.08)	(15.20)	(14.06)	(12.50)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for Germany by tenor on monetary policy shocks from the Federal Reserve (top) and the ECB (bottom) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Effects of the ECB monetary policy shocks on the U.S. Treasury Premium for the G10 countries excluding Germany.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
Effect of U.S. Monetary Policy Shocks							
U.S. Treasury Premium	49.23**	55.21***	45.40***	54.56***	35.69***	36.65***	39.22***
	(20.76)	(13.83)	(10.69)	(10.54)	(8.54)	(11.01)	(10.15)
U.S. Swap Spread	33.20	49.82***	45.34***	55.59***	37.86***	33.99***	38.83***
	(22.81)	(13.65)	(10.12)	(10.39)	(7.76)	(10.02)	(9.21)
Foreign Swap Spread	-17.17*	-2.57	-1.73	0.83	1.88	-2.17	0.12
	(9.89)	(5.57)	(5.16)	(5.56)	(6.29)	(6.37)	(6.80)
Cross-Currency Basis	3.08	-2.83	1.67	0.20	0.28	-0.48	-0.51
	(7.37)	(3.71)	(2.35)	(2.12)	(2.10)	(1.99)	(1.76)
Effect of ECB Monetary Policy Shocks							
U.S. Treasury Premium	7.12	-40.33***	4.31	4.01	11.94	13.20	29.72**
	(20.72)	(13.28)	(10.65)	(11.14)	(19.25)	(13.49)	(11.67)
U.S. Swap Spread	20.56	-18.55*	15.47	7.26	9.77	1.03	9.94
	(13.01)	(10.85)	(10.14)	(10.21)	(17.53)	(11.73)	(10.97)
Foreign Swap Spread	-19.90**	13.98	6.13	-1.59	-6.69	-15.72***	-23.18***
	(9.97)	(9.43)	(8.21)	(5.07)	(6.43)	(5.34)	(6.37)
Cross-Currency Basis	31.32***	7.80*	5.02*	4.84*	4.52**	3.56*	3.40*
	(11.62)	(4.16)	(3.02)	(2.67)	(2.15)	(2.06)	(1.80)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries excluding Germany by tenor on monetary policy shocks from the Federal Reserve (top) and the ECB (bottom) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Effects of the ECB monetary policy shocks on the U.S. Treasury Premium for the G10 countries excluding Germany.

	3M	1Y	2Y	3Y	5Y	7Y	10Y
Effect of U.S. Monetary Policy Shocks							
U.S. Treasury Yield	66.15**	99.60***	135.47***	146.88***	169.44***	157.98***	133.01***
	(27.51)	(19.93)	(27.21)	(26.73)	(30.68)	(32.04)	(32.37)
U.S. LIBOR	103.94***	149.42***	180.81***	202.47***	207.30***	191.97***	171.84***
	(32.13)	(21.27)	(25.20)	(27.15)	(31.08)	(32.75)	(34.96)
Foreign Treasury Yield	41.22***	53.00***	70.87***	75.34***	85.07***	87.22***	77.89***
	(8.11)	(9.88)	(14.18)	(15.34)	(17.35)	(18.76)	(19.01)
Foreign Benchmark Rate	24.51***	50.44***	69.14***	76.17***	86.96***	85.04***	78.01***
	(8.32)	(12.53)	(14.34)	(15.80)	(19.02)	(19.91)	(19.99)
FX Spot Rate	15.22***	15.00***	15.23***	15.40***	14.92***	15.26***	14.33***
	(2.58)	(2.66)	(2.77)	(2.73)	(2.65)	(2.71)	(2.61)
FX Forward Premium	-74.16***	-101.81***	-110.00***	-126.09***	-120.06***	-107.41***	-94.34***
	(22.70)	(21.51)	(22.95)	(21.97)	(20.62)	(21.19)	(22.31)
Effect of ECB Monetary Policy Shocks							
U.S. Treasury Yield	-0.12	40.51	44.24	54.74	53.40	57.96	43.03
	(14.10)	(25.40)	(32.76)	(33.43)	(43.16)	(41.08)	(40.00)
U.S. LIBOR	20.46***	21.96	59.71*	62.00*	63.17	58.99	52.97
	(6.64)	(24.60)	(32.20)	(35.13)	(40.80)	(41.10)	(40.80)
Foreign Treasury Yield	47.22***	80.04***	117.36***	123.25***	120.29***	115.08***	100.89***
	(9.30)	(13.04)	(15.41)	(16.35)	(17.27)	(18.69)	(19.95)
Foreign Benchmark Rate	25.66***	94.02***	123.49***	121.65***	113.59***	99.35***	77.70***
	(8.38)	(16.50)	(18.04)	(16.68)	(18.21)	(19.07)	(19.77)
FX Spot Rate	-10.12***	-11.25***	-11.17***	-11.30***	-11.43***	-11.57***	-10.61***
	(2.75)	(2.48)	(2.47)	(2.45)	(2.50)	(2.49)	(2.44)
FX Forward Premium	40.22***	79.87***	68.81***	64.50**	54.94*	43.91	28.14
	(12.85)	(19.96)	(25.27)	(26.07)	(29.31)	(27.18)	(25.09)

Note: This table reports panel regression results of the U.S. Treasury Premium and its components for the G10 countries excluding Germany by tenor on monetary policy shocks from the Federal Reserve (top) and the ECB (bottom) for the full sample (2000-2017). U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled policy announcement of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. ECB monetary policy shocks are captured by the first principal components of the change over a 135-minute window around each scheduled policy announcement of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. Robust standard errors are in parentheses. The ECB monetary policy shocks and U.S. monetary policy shocks are scaled such that the effects on the one-year German Bund yield and the one-year U.S. Treasury yield are 100 basis points across the full sample, respectively.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Effects of U.S. monetary policy shocks on U.S. Treasury Premium by tenor and currency (Full sample).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
AUD	77.20**	35.96**	41.01***	62.31***	22.23	55.02***	35.54**
	(30.82)	(17.98)	(12.52)	(13.60)	(14.63)	(16.54)	(15.82)
CAD	47.03*	39.68**	21.10*	47.10***	16.44*	18.35*	13.67
	(26.82)	(15.68)	(11.91)	(10.02)	(9.03)	(9.60)	(9.14)
CHF	26.60	0.65	10.64	26.68**	13.19	34.72***	25.81**
	(24.24)	(21.01)	(15.57)	(11.85)	(10.51)	(9.70)	(10.58)
DKK	58.30**	35.36*	33.77***	34.29**	31.31***	36.86***	23.91*
	(23.30)	(21.21)	(12.73)	(13.34)	(10.23)	(9.92)	(12.33)
EUR	19.46	28.57**	39.68***	51.35***	32.11***	37.56***	20.97**
	(32.06)	(13.63)	(10.91)	(9.87)	(7.33)	(7.51)	(9.92)
GBP	6.21	24.03	23.32*	32.95***	28.09***	34.56***	24.94**
	(32.08)	(15.58)	(14.14)	(11.91)	(9.34)	(8.78)	(10.09)
JPY	35.77	32.87**	36.35***	49.97***	36.02***	40.32***	32.80***
	(26.01)	(14.68)	(10.28)	(9.49)	(8.59)	(9.14)	(11.09)
NOK	63.78***	45.00*	15.93	42.27***	29.77**	45.74***	42.76***
	(24.27)	(26.60)	(17.20)	(12.85)	(14.32)	(17.11)	(15.12)
NZD	30.83	54.28**	36.34**	68.04***	33.14**	40.33*	33.09*
	(30.00)	(21.46)	(15.79)	(18.21)	(14.46)	(22.06)	(19.07)
SEK	42.27*	31.31*	25.43**	51.11***	32.31***	41.15***	35.94***
	(24.84)	(16.20)	(11.16)	(10.22)	(9.30)	(7.30)	(10.99)

Note: This table reports panel regression results of the U.S. Treasury Premium by tenor and currency on U.S. monetary policy shocks for the full sample (2000-2017). Robust standard errors are in parentheses. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Effects of U.S. monetary policy shocks on U.S. Treasury Premium by tenor and currency (Pre-GFC).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
AUD	61.81**	8.70	23.85*	42.55***	9.22	49.94***	20.61
	(29.59)	(21.77)	(13.92)	(13.91)	(15.73)	(17.56)	(17.43)
CAD	38.02	30.47*	17.86	48.17***	14.14	19.85*	20.91**
	(27.97)	(18.04)	(14.14)	(10.79)	(9.98)	(10.94)	(10.39)
CHF	19.68	-2.34	16.65	33.22***	18.97	46.60***	36.38***
	(23.22)	(26.40)	(18.17)	(11.64)	(11.67)	(10.05)	(10.86)
DKK	61.66***	27.33	24.85	24.26	25.15**	36.31***	24.68*
	(22.69)	(25.99)	(15.18)	(16.36)	(12.35)	(11.58)	(14.77)
EUR	13.52	16.65	30.30**	46.41***	25.43***	36.35***	20.67*
	(37.89)	(16.21)	(12.32)	(9.55)	(7.75)	(8.10)	(11.20)
GBP	-20.73	9.51	13.26	25.23**	24.10**	33.75***	23.66**
	(32.03)	(16.28)	(15.36)	(11.88)	(10.36)	(10.12)	(11.47)
JPY	25.50	28.46	38.01***	53.20***	37.95***	44.00***	38.74***
	(24.17)	(17.66)	(11.27)	(10.06)	(9.39)	(9.57)	(12.68)
NOK	64.38**	18.11	10.23	36.75***	27.32*	48.45***	51.68***
	(26.07)	(25.53)	(17.61)	(12.87)	(15.26)	(18.55)	(14.69)
NZD	43.29	69.88***	38.99**	78.03***	32.58*	38.29	29.87
	(29.75)	(25.57)	(18.97)	(23.29)	(17.04)	(26.97)	(23.16)
SEK	46.77*	17.87	17.08	41.56***	28.03***	41.02***	39.41***
	(26.10)	(17.56)	(12.15)	(9.26)	(10.37)	(8.08)	(12.09)

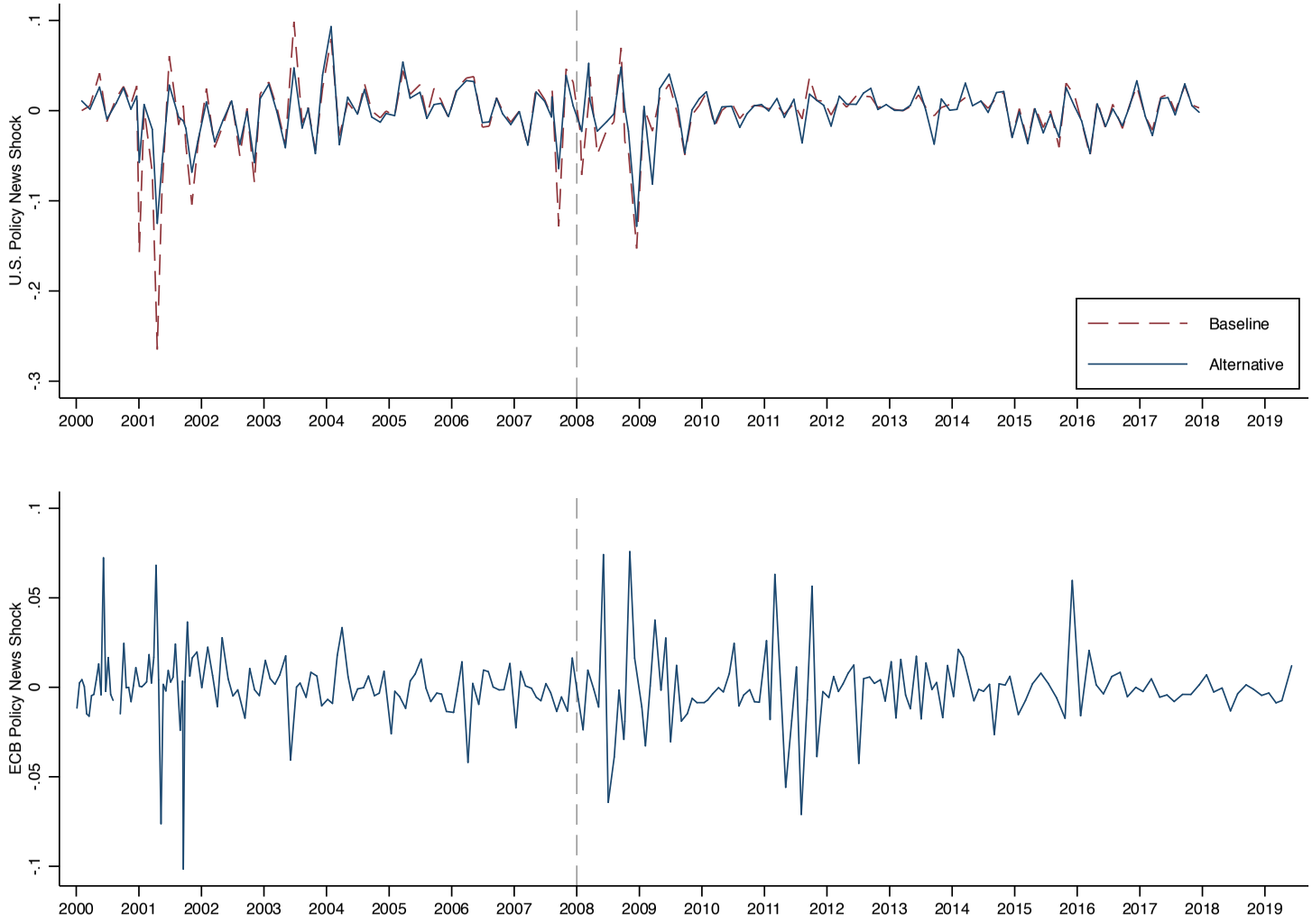
Note: This table reports panel regression results of the U.S. Treasury Premium by tenor and currency on U.S. monetary policy shocks for the pre-GFC period (2000-2007). Robust standard errors are in parentheses. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Effects of U.S. monetary policy shocks on U.S. Treasury Premium by tenor and currency (Post-GFC).

	3M	1Y	2Y	3Y	5Y	7Y	10Y
AUD	131.72	135.14***	103.33***	133.30***	70.98**	74.44*	90.76**
	(93.71)	(30.45)	(27.23)	(35.21)	(33.82)	(43.29)	(39.30)
CAD	78.73	68.22**	31.13	43.55*	23.83	13.96	-9.21
	(65.49)	(31.10)	(21.03)	(24.25)	(20.67)	(19.69)	(18.25)
CHF	49.46	10.11	-7.79	6.41	-4.67	-0.81	-5.74
	(74.10)	(28.43)	(28.18)	(31.63)	(20.55)	(18.05)	(27.37)
DKK	44.02	62.97*	64.03***	67.15***	51.94***	38.53**	21.47
	(69.74)	(35.25)	(24.61)	(24.26)	(18.95)	(19.27)	(20.51)
EUR	39.03	69.92***	72.13***	68.37**	55.59***	41.96**	21.94
	(60.30)	(25.10)	(22.34)	(29.03)	(16.88)	(18.36)	(21.37)
GBP	103.36	74.17**	55.04**	59.38**	42.03**	38.38**	29.91
	(71.87)	(31.24)	(25.76)	(28.75)	(19.03)	(17.61)	(21.20)
JPY	71.27	50.93**	29.98	37.55	28.41	26.33	9.51
	(85.60)	(23.12)	(25.58)	(24.61)	(20.49)	(24.23)	(22.15)
NOK	59.76	142.23*	35.50	60.29*	37.32	37.11	1.06
	(62.09)	(78.76)	(44.32)	(33.49)	(35.14)	(40.35)	(53.46)
NZD	-16.26	17.90	31.92	44.91	32.11	44.27	39.52
	(84.08)	(34.24)	(29.02)	(28.75)	(27.95)	(38.60)	(34.07)
SEK	23.30	87.88**	60.12**	91.45***	47.90**	41.63**	22.42
	(65.60)	(36.55)	(26.36)	(34.63)	(19.92)	(16.79)	(26.63)

Note: This table reports panel regression results of the U.S. Treasury Premium by tenor and currency on U.S. monetary policy shocks for the post-GFC period (2008-2017). Robust standard errors are in parentheses. U.S. monetary policy shocks are captured by the first principal components of the change over a 30-minute window around each scheduled FOMC announcement of the following five interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The monetary policy shocks are scaled such that the effect on the one-year U.S. Treasury yield is 100 basis points across the full sample. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Monetary policy shocks by the Federal Reserve and the ECB.



Note: This graph plots the time series of monetary policy shocks by the Federal Reserve and the ECB. The baseline measure of U.S. monetary policy shocks are calculated based on changes of the following interest rates: the Fed Funds rate immediately following the FOMC meeting, the expected Fed funds rate immediately following the next FOMC meeting, and expected three-month eurodollar interest rates at horizons of two, three and four quarters. The alternative measure of U.S. monetary policy shocks are calculated based on changes of the following interest rates: the expected Fed Fund rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year U.S. Treasury yields. The measure of ECB monetary policy shocks are calculated based on changes of the following interest rates: the Euro OIS rate at 1-month, 3-month, 6-month, 1-year, and 2-year; and the 5-year and 10-year German Bund yields. U.S. monetary policy shocks are scaled such that the effect on the one-year Treasury yield is 100 basis points across the full sample (2000-2017). Monetary policy shocks by the ECB are scaled such that the effect on the one-year German Bund yield is 100 basis points across the full sample (2000-2019).