# Term Premia and Credit Risk in Emerging Markets: The Role of U.S. Monetary Policy

Pavel Solís [a]

February 2023

**Abstract**

This paper studies how U.S. monetary policy transmits to the sovereign yields of emerging markets without ignoring credit risk. First, investors expect emerging market central banks to follow the monetary stance of the Fed. Second, U.S. unconventional monetary policies influence the term premium in emerging markets as in the U.S. Third, U.S. monetary policy also alters the pricing of sovereign credit risk in emerging markets, a previously overlooked channel. To quantify these effects, I first identify target, forward guidance and asset purchase surprises in the U.S. using intraday data, and then propose a novel (three-part) decomposition of emerging market yields that accounts for credit risk.

*Keywords*: Credit risk, term premium, synthetic yields, monetary policy spillovers, emerging markets, affine term structure model.

*JEL Classification*: E43, F34, G12, G15, H63.

[a] Financial Stability Division, Banco de México, Av. 5 de Mayo No. 1, Centro, Cuauhtémoc, CDMX 06000, México. E-mail: `pavel.solis@banxico.org.mx`.

# 1 Introduction

U.S. monetary policy influences financial conditions abroad through its effects on the yield curves of other countries. Adjustments in U.S. monetary policy can induce changes in both the monetary stance of other countries and in the risk compensation to invest there. Sovereign bond yields capture both effects and can thus be decomposed to understand the transmission channels of U.S. monetary policy and to assess its implications for the conduct of monetary policy abroad. Yet traditional yield decompositions assume that sovereigns never default on their debt, contrary to the evidence for emerging markets.

Credit risk is an important component of emerging market sovereign yields. Since 2000, emerging markets have increasingly borrowed in local currency and at longer maturities (IMF-WB, 2020), making their sovereign yield curves key benchmarks to price other local assets. They are, however, prone to default, even in their local currency debt (Reinhart and Rogoff, 2011; Jeanneret and Souissi, 2016; Beers et al., 2020),[1] so that their sovereign yields compensate for credit risk (Du and Schreger, 2016). One thus needs to account for credit risk to adequately characterize the spillovers to their yields.

This paper studies how U.S. monetary policy transmits to the sovereign yields of emerging markets without ignoring credit risk. The Fed can influence the monetary stance and the risk compensation in U.S. yields through its interest rate policy, forward guidance and asset purchases. Due to globally integrated bond markets, those same policies can affect the sovereign yields of emerging markets. To answer how, I first identify unanticipated policy decisions by the Fed using intraday data on asset prices around monetary policy announcements, distinguishing between target, forward guidance and asset purchase surprises (Kuttner, 2001; Gürkaynak et al., 2005; Swanson, 2021) to compare the spillovers of conventional and unconventional policies; this strategy overcomes endogeneity concerns because it isolates the surprise component of monetary policy decisions (Nakamura and Steinsson, 2018). I then propose a novel three-part decomposition of emerging market sovereign yields that explicitly accounts for credit risk.[2]

[1] There have been more than 30 default episodes in local currency since 1996, including Barbados (2018), Jamaica (2013, 2010), Nicaragua (2008, 2003), Argentina (2001), Turkey (1999), Russia (1998).

[2] Credit risk here is broadly defined including, for example, (selective) default risk, currency convert-

The nominal yields of 15 emerging markets from 2000 to 2021 are decomposed into three parts. Traditionally, sovereign yields reflect an average expected future short rate, and a term premium that compensates investors for bearing interest rate risk, but this two-part decomposition assumes that the bonds are free of default risk. To account for such risk, I construct synthetic, default-free yields in local currency by essentially swapping the U.S. yield curve into a local currency one using currency derivatives,[3] to which the traditional two-part decomposition can be applied. To obtain robust decompositions of the synthetic yields, I use a standard affine term structure model augmented with survey data.[4] The first two components of emerging market nominal yields then come from the decomposition of the synthetic yields, and the third component is the spread between the nominal and the synthetic yields, which captures the compensation for credit risk (Du and Schreger, 2016).[5] This decomposition gives sensible estimates. Across emerging markets, the average expected short rate, the term premium and the credit risk compensation in the 10-year nominal yield average 4.0, 2.2 and 0.9%, respectively. Importantly, the second component is a genuine term premium, 'clean' of credit risk.[6]

This three-part decomposition is appropriate to characterize the spillovers of U.S. monetary policy. Although global investors might be interested in a decomposition of emerging market yields disentangling currency and default risks, such a decomposition would not provide readings of monetary policy expectations in emerging markets,[7] preventing one to analyze whether emerging market central banks are expected to follow or counteract the monetary stance of the Fed, or whether its unconventional policies

ibility risk, regulation risk, capital controls, and jurisdiction risk, so compensation for any of these risks is considered as compensation for credit risk, even if the country does not default per se.

[3]Synthetic yields can be seen as the borrowing rates paid by a hypothetical bond issuer in local currency with no credit risk. Under this approach, the U.S. yield curve serves as a default-free benchmark for other countries. Although Augustin et al. (2021) argue that U.S. sovereign default risk is not zero, it is not volatile enough to affect the results for emerging markets.

[4]Guimarães (2014) shows that affine term structure models augmented with survey data provide robust decompositions of the U.S. and U.K. (nominal) yield curves.

[5]The credit risk compensation captures the expected default loss under the local currency risk-neutral measure, as well as the expected default loss adjusted for the joint dynamics between currency and default risks under the dollar risk-neutral measure; see Proposition 2 in Du and Schreger (2016).

[6]Section 4.4.2 shows that this term premium compensates investors for bearing inflation uncertainty, consistent with the evidence for advanced economies (Wright, 2011)

[7]Assuming no risk correlation, emerging market yields could alternatively be decomposed into a U.S. yield plus compensations for currency and credit risks at corresponding maturities.

influence the term premium in emerging markets as in the U.S.

Loose U.S. monetary policies ease monetary conditions in emerging markets via a reassessment of policy rate expectations and a repricing of risks. First, investors expect emerging market central banks to follow the monetary stance of the Fed rather than counteract it, given that average expected future short rates decline following target, forward guidance and asset purchase easing surprises. Second, U.S. unconventional monetary policies (i.e., forward guidance and asset purchases) aimed at reducing the U.S. term premium, also decrease the term premia in emerging markets, a result only detected after accounting for credit risk. Third, U.S. monetary policy also alters the pricing of sovereign credit risk in emerging markets, since the credit risk compensation increases following easing surprises. Intuitively, loose financial conditions in the U.S. trigger a 'reach-for-yield' behavior among investors (Hausman and Wongswan, 2011) that incentivizes more borrowing in emerging markets by sovereigns in local currency (Bigio et al., 2018) and corporates in foreign currency (Turner, 2014), increasing the sovereign default risk in emerging markets (Du and Schreger, 2022).[8] U.S. monetary policies could thus be seen as having fiscal implications in emerging markets, a previously overlooked channel.

The U.S. term premium is an important driver of emerging market yields. The influence of U.S. monetary policy on those yields can also be seen through the relationship between the yield components, in what can be referred to as the yield curve channel. The U.S. term premium is positively associated with the term premia in emerging markets at the long end of the yield curve, as suggested by Turner (2014), and with their expected future short rates at the short end, what Kalemli-Özcan (2019) calls risk spillovers, yet it is negatively associated with the credit risk compensation, in line with the intuition explained above. Meanwhile, the expected future short rate in the U.S. is associated with its emerging market counterpart only at the long end. These results suggest that emerging market central banks exert relatively more control over the short end of their yield curves (Obstfeld, 2015), but remain vulnerable to global risks even when they borrow in

[8] An increase in sovereign default risk can reflect an increase in the price of such risk, not necessarily its quantity. In line with this, Jeanneret and Souissi (2016) show that global factors affect investors' compensation for holding sovereign credit risk, not the risk itself.

local currency (Carstens and Shin, 2019).

These findings have implications for the conduct of monetary policy in emerging markets. Changes in global risk premia may impact the effectiveness of their monetary policies by altering the link between the policy rate and long-term rates. By acknowledging the relevance of the term premium and the compensation for credit risk in their sovereign yields, central banks in emerging markets can better assess market expectations about their monetary policy, local macrofinancial conditions and spillovers from abroad.

This paper makes contributions to two branches of the literature. On the one hand, the literature on term structures of emerging market yields has not examined credit risk systematically.[9] This paper estimates affine term structure models augmented with survey data using synthetic instead of nominal yields to account for credit risk and to obtain a genuine term premium. To the best of my knowledge, this is the first time those models are applied to synthetic yields and that are augmented with survey data for emerging markets.[10] On the other hand, it contributes to the literature analyzing the spillover effects of U.S. monetary policy to emerging market yields by using different types of surprises in U.S. monetary policy identified with intraday data, and by acknowledging credit risk in emerging market yields to better characterize the spillover mechanisms.[11]

The rest of the paper proceeds as follows. Section 2 identifies surprises in U.S. monetary policy. Section 3 explains how to construct the local currency yield curves. Section 4 decomposes the yields of emerging markets into three parts. Section 5 analyzes the U.S. monetary policy spillovers to emerging market yields. The last section concludes.

[9] The analysis of sovereign credit risk traditionally focuses on foreign currency bonds. Hilscher and Nosbusch (2010) report the relevance of domestic factors, while Longstaff et al. (2011) document the importance of global factors. Borri and Verdelhan (2012) study the role of the lenders' risk aversion. Bostanci and Yilmaz (2020) study the connectedness of the network of sovereign credit default swaps.

[10] Synthetic yields have been widely used to study deviations from covered interest rate parity (CIP). Du et al. (2018b) show that persistent and systematic deviations from CIP reflect a higher regulatory burden for financial intermediaries. Du et al. (2018a) argue that they reflect differences in convenience yields in advanced economies, whereas Du and Schreger (2016) show that they capture a local currency credit spread for emerging markets. Hofmann et al. (2020) use that credit spread to explain the link between currency appreciations and the compression of the sovereign yield spreads of emerging markets.

[11] Hausman and Wongswan (2011) report significant spillovers, Bowman et al. (2015) compare the effects of conventional and unconventional policies, while Curcuru et al. (2018), Adrian et al. (2019) and Albagli et al. (2019) use traditional yield decompositions to analyze the spillover mechanisms. Rogers et al. (2014) and Rogers et al. (2018) also analyze the spillovers on bond yields using surprises identified with intraday data but they focus on advanced economies. Gilchrist et al. (2019) study the effects for advanced and emerging countries but for debt denominated in foreign currency.

## 2 Identification of U.S. Monetary Policy Surprises

Surprises in U.S. monetary policy decisions are identified using intraday data on asset prices around Fed announcements. Asset price changes are calculated from 15 minutes before to 1 hour and 45 minutes after each Federal Open Market Committee (FOMC) meeting between January 2000 and March 2019 giving a total of 163 events;[12] neither minute releases nor speeches by Fed officials are included. The surprises are set to zero in non-announcement days. This strategy overcomes endogeneity concerns by isolating the surprise component of monetary policy decisions (Nakamura and Steinsson, 2018).

It is important to distinguish between different types of monetary policy surprises. In 2013, the episode known as the taper tantrum triggered a sharp spike in U.S. Treasury yields without the Fed changing its policy rate or its outlook for such rate. The increase in the yields reflected the reaction of investors to news that future bond purchases by the Fed might slow or stop. Gürkaynak et al. (2005) and Swanson (2021) show empirically that U.S. monetary policy has more than one dimension, given that asset prices respond to different types of news about monetary policy.

The analysis of spillovers considers three types of U.S. monetary policy surprises. Following Rogers et al. (2018), I consider target, forward guidance and asset purchase surprises. First, target surprises are equal to the change in the yield on the current- or next-month federal funds futures contracts, as proposed by Kuttner (2001). Second, forward guidance surprises are equal to the residual from regressing the yield change in the 8-quarters-ahead Eurodollar futures contract onto the target surprise. That contract is a bet on the level of three-month interest rates about two years ahead. During the zero lower bound period, this was around the shortest point on the yield curve that monetary policy could influence. In fact, intraday changes in the 4-quarters-ahead Eurodollar futures contract are essentially zero after 2011, since market participants expected no change in the policy rate for at least a year. Third, asset purchase surprises are equal to the residual from regressing the yield change in the 10-year Treasury futures contract onto the target and forward guidance surprises. By construction, the three types of surprises

[12] The meeting of September 2001 is excluded as in Gürkaynak et al. (2005).

**Table 1.** Descriptive Statistics of U.S. Monetary Policy Surprises

| | Mean | Std. Dev. | Min. | Max. | Obs |
|---|---|---|---|---|---|
| Target Surprises (abs. values) | 2.6 | 6.7 | 0.0 | 46.5 | 163 |
| Target Surprises > 0 | 3.7 | 3.8 | 0.0 | 14.4 | 34 |
| Target Surprises < 0 | -6.2 | 11.0 | -46.5 | -0.3 | 47 |
| Forward Guidance Surprises (abs. values) | 6.0 | 6.5 | 0.0 | 54.6 | 163 |
| Forward Guidance Surprises > 0 | 5.4 | 4.9 | 0.0 | 24.9 | 90 |
| Forward Guidance Surprises < 0 | -6.8 | 7.9 | -54.6 | -0.4 | 73 |
| Asset Purchase Surprises (abs. values) | 2.2 | 3.5 | 0.1 | 29.9 | 87 |
| Asset Purchase Surprises > 0 | 2.0 | 2.2 | 0.1 | 10.3 | 41 |
| Asset Purchase Surprises < 0 | -2.4 | 4.4 | -29.9 | -0.1 | 46 |

*Notes:* This table reports summary statistics for the target, forward guidance and asset purchase surprises on FOMC announcement days from January 2000 to March 2019. Target surprises are zero between January 2009 to November 2015. Asset purchase surprises start on October 2008.

are uncorrelated. A positive value in any of the surprises represents a tightening of the monetary policy stance, and a negative value represents an easing.

The relevance of these surprises has varied over time. After 2008, there were no changes in the current policy rate until December 2015, so target surprises were essentially zero during that period. Meanwhile, asset purchase surprises are considered starting in October 2008 because their meaning is unclear before that date. In contrast, forward guidance surprises have been relevant before and after the global financial crisis.

Table 1 reports descriptive statistics for the three types of surprises. Notice that the Fed has been more aggressive in stimulating than in contracting the U.S. economy, given that easing surprises are larger on average than tightening surprises.

# 3 Construction of Local Currency Yield Curves

This section explains how to construct the nominal and synthetic local currency (LC) yield curves of emerging markets. The next section leverages the synthetic yields to decompose the nominal yields into an average expected future short rate, a term premium and compensation for credit risk. Section 5 then uses the decomposition to characterize the transmission channels of U.S. monetary policy to emerging market yields.

### 3.1 Synthetic Yield Curves

The main idea to construct the synthetic LC yield curves is to use the U.S. yield curve as the benchmark for all other countries and to swap it into LC by adding a foreign exchange forward premium at each maturity. The forward premium compensates investors for the expected depreciation of the currency. In this paper the exchange rate is expressed in LC per U.S. dollar (USD), so a currency depreciates when the exchange rate increases. This approach assumes frictionless financial markets; in particular, it assumes that (i) unconstrained arbitrageurs have access to U.S. and LC bonds, (ii) the derivatives contracts used to construct the forward premium have no counterparty risk, and (iii) U.S. yields are free of default risk.[13] Du and Schreger (2016) show that this approach is a useful benchmark to quantify credit risk in the LC debt of emerging markets.

The zero-coupon synthetic LC yield for an $n$-period bond at time $t$, $\widetilde{y}^{LC}_{t,n}$, is defined as

$$\widetilde{y}^{LC}_{t,n} = y^{US}_{t,n} + \rho_{t,n}. \tag{1}$$

in which $y^{US}_{t,n}$ denotes the zero-coupon yield for an $n$-period U.S. Treasury security at time $t$, and $\rho_{t,n}$ is the $n$-period forward premium from USD to LC at time $t$. The calculation of the forward premium depends on the maturity. For maturities shorter than one year, the forward premium is calculated as the annualized difference between the forward and the spot exchange rates. For maturities equal or larger than one year, the forward premium is calculated using cross-currency swaps because outright forwards are less liquid. Since fixed-for-fixed cross-currency swap rates are rarely observed in the market directly, they are constructed using cross-currency basis swaps and interest rate swaps with the purpose of exchanging cash flows in the two currencies, USD and LC. Start by swapping fixed payments in LC into floating-rate cash flows in USD using cross-

[13]Augustin et al. (2021) argue that U.S. sovereign default risk is not zero. Nevertheless, it is not volatile enough to affect the results in this paper.

currency basis swaps (referenced to the Libor—London interbank offered rate—in USD), which are then swapped into fixed-rate cash flows in USD using interest rate swaps. Both types of swaps are liquid, marked to market and collateralized instruments, so the bilateral counterparty risk in cross-currency swaps is negligible.

The construction of synthetic yields relies on the U.S. yield curve and currency derivatives, so no information about the nominal yields is required. Meanwhile, the nominal zero-coupon yield, $y_{t,n}^{LC}$, is constructed directly from quotes of LC bonds in the market.

According to the CIP condition, the nominal (direct) and the synthetic (indirect) LC interest rates should be equal. Essentially, CIP implies that an issuer should be able to borrow directly or indirectly (synthetically) in LC at the same yield. Du et al. (2018b) show, however, that there are persistent and systematic deviations from CIP. Indeed, the spread between the nominal and synthetic yields $(y_{t,n}^{LC} - \widetilde{y}_{t,n}^{LC})$ measures CIP deviations in sovereign yields. For advanced economies, Du et al. (2018a) argue that CIP deviations measure the difference in the convenience yield of U.S. Treasuries relative to that of the sovereign bonds of other advanced economies. For emerging markets, however, Du and Schreger (2016) point out that CIP deviations have a different interpretation.

The nominal-synthetic spread is a model-free measure of the compensation for credit risk in the LC yields of emerging markets. Whereas the nominal yields of advanced economies are usually considered free of credit risk, the nominal yields of emerging markets include a credit risk compensation given the possibility of default (Du and Schreger, 2016, 2022). Since credit risk in the components of the synthetic yields (equation (1)) is negligible, a synthetic yield in emerging markets can be seen as the borrowing rate paid by a hypothetical issuer in LC with no credit risk. Du and Schreger (2016) show that the nominal-synthetic spread is highly correlated with the rates of sovereign credit default swaps (CDS)—financial derivatives aimed to protect investors against default by a bond issuer. However, while CDS are suitable for studying the sovereign risk in foreign currency bonds (e.g., Longstaff et al. (2011)), Du and Schreger (2016) argue that the nominal-synthetic spread adequately measures credit risk on LC debt. Moreover, according to the International Swaps and Derivatives Association (ISDA), LC bonds governed under domestic law do not trigger CDS payouts;[14] and a credit event for a CDS contract is not always clearly defined. Section 4.4.3 discusses the interpretation of the nominal-synthetic spread in more detail.

### 3.2 Nominal Yield Curves

For each country, the nominal yield curve $y_{t,n}^{LC}$ is a continuously-compounded zero-coupon curve. Its construction uses the Bloomberg Fair Value (BFV) curves for all but two countries. These curves report coupon-equivalent par yields, which I convert into continuously-compounded yields to obtain implied zero-coupon curves (see Gürkaynak et al., 2007).[15] For Brazil and Israel, Bloomberg does not provide BFV curves but zero-coupon yields with coupon-equivalent compounding, known as IYC curves, which I also convert into continuously-compounded yields.[16]

### 3.3 Yield Curve Data

Nominal and synthetic yield curves are constructed for the 15 emerging markets originally studied by Du and Schreger (2016) and, to compare the results, for the 10 advanced economies considered by Du et al. (2018a).[17] All emerging markets in the sample, except Malaysia, have adopted an inflation targeting regime,[18] which supports the application of affine term structure models to the yields of these countries.

Data for the nominal and synthetic yields are available daily. The sample starts in January 2000 and ends in July 2021. The starting dates, however, vary by country. All

[14] See the ISDA credit derivatives physical settlement matrix.

[15] As a robustness check, I estimate the nominal yield curves from actual prices for some of the countries in the sample using the Nelson–Siegel model. They closely follow the curves reported by Bloomberg.

[16] For some emerging markets, Bloomberg reports both BFV and IYC curves. BFV curves are preferred for several reasons: their history is longer, IYC curves are not available for advanced economies—the benchmark for some of the results reported later—and, compared to the BFV curves, the short end of the IYC curves seems disconnected from the rest of the curve at some dates for a few countries.

[17] Emerging markets: Brazil, Colombia, Hungary, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, South Africa, Thailand, Turkey. Advanced economies: Australia, Canada, Denmark, Germany (based on the euro), Japan, Norway, New Zealand, Sweden, Switzerland, the U.K.

[18] Nevertheless, Malaysia has several characteristics that are aligned with an inflation targeting regime. Some countries adopted inflation targeting during the sample period: Hungary in June 2001, the Philippines in January 2002, Indonesia in July 2005, Turkey in January 2006 and Russia in 2014; Hungary and Poland were accepted to join the European Union in April 2003.

the yields for advanced economies start no later than September 2001. The sample sizes for emerging markets are generally smaller. The nominal yields of 9 and the synthetic yields of 7 emerging markets start before March 2004; both types of yields for the rest of the countries start no later than June 2007. There are thus at least 10 years of data for all of the countries in the sample.[19] In principle, this is a reasonable time period for the estimation of the affine term structure model presented in section 4.1, but in practice there may be too few interest rate cycles per country. The model is thus augmented with data from surveys of professional forecasters, as discussed in section 4.3.

The yields have maturities of 3 and 6 months, and 1 through 10 years, ranging from a minimum of nine to a maximum of twelve maturities per country.[20] The maximum maturity considered for the analysis is 10 years because bonds and swaps with larger maturities have less history and are less liquid, especially for emerging markets who do not issue longer-term bonds as often as advanced economies.

The construction of LC synthetic yield curves involves data from the U.S. yield curve and the forward premium for different maturities, as explained in section 3.1. Data for the U.S. zero-coupon yield curve come from two sources. For maturities of 1 through 10 years, the yields come from the dataset constructed by Gürkaynak et al. (2007), who only consider Treasury securities with coupons. Since Treasury securities with less than one year to maturity behave differently (Duffee, 2010)—partly because they are less actively traded than longer-maturity ones—the 3- and 6-month yields come from the Federal Reserve's H.15 database because they are robust at the short end of the curve.[21]

The data to compute the forward premium also come from two sources. For maturities of less than one year, I use data on the spot exchange rate along with 3- and 6-month forwards from Bloomberg for all countries but Korea, the Philippines and Thailand, for which the data come from Datastream. To construct the cross-currency swap rates, I use

[19]For Turkey, the nominal yields with a maturity of up to 10 years start on June 2010, although its synthetic yields start on May 2005. For Russia, data on both types of yields start in 2007 but due to low liquidity at the beginning of the sample, here it starts in August 2009.

[20]All countries have data for maturities from 3 months to 5 years and for 10 years. All countries except Brazil have data for the 7-year maturity. Data for 6, 8 and 9 years vary per country.

[21]The 3- and 6-month yields implied by the fitted model of Gürkaynak et al. (2007) are highly correlated with the H.15 yields (0.9985 and 0.9995) but are on average (16 and 10 basis points) higher since 1983.

data on cross-currency basis swaps and interest rate swaps for each available maturity from 1 through 10 years. The data for the swap curves come from Bloomberg.[22]

Table 2 reports descriptive statistics for different tenors of the nominal and synthetic yield curves for the emerging markets and advanced economies in the sample. The yield curves exhibit standard properties such as an upward slope. At the same time, the table provides information on how the curves of emerging markets differ from those of advanced economies. For instance, the level and the volatility (measured by the standard deviation) of their curves are larger than those of advanced economies. Also, the short end of their curves is more volatile than the long end, particularly so for the synthetic curve. Lastly, the spread between the nominal and the synthetic yields suggests that the credit risk compensation is on average positive.

### 3.3.1 Timing

The parameters of the affine term structure models are estimated using end-of-month data, as explained in section 4.3. Since the U.S. yield curve is the benchmark to construct the synthetic yield curves, the end-of-month dates are the last business days of each month according to the U.S. calendar.

Getting the timing right is key to adequately measure the responses of emerging market yields to surprises in Fed's policy decisions. The analysis of monetary policy spillovers in section 5.1 uses daily changes in nominal and synthetic yields. Since the closing prices in non-Western Hemisphere countries happen before the Fed's monetary policy announcements, their nominal yields are shifted one day back so that their daily changes adequately capture surprises in the announcements. The credit risk compensation for those countries is calculated using the shifted nominal yields.

[22]Deliverable and non-deliverable cross-currency swaps are used as well as tenor basis swaps. A spreadsheet with the tickers used in the construction of the forward premia and the estimation of the nominal yield curves consolidates and expands (with tenors and tickers) similar files kindly posted online in Wenxin Du and Jesse Schreger's websites.

**Table 2.** Descriptive Statistics of Yield Curves

| | | 3M | 6M | 1Y | 2Y | 5Y | 10Y |
|---|---|---|---|---|---|---|---|
| Nominal | Emerging Markets | | | | | | |
| | Average | 4.9 | 5.0 | 5.2 | 5.5 | 6.1 | 6.6 |
| | Std. D. | 3.4 | 3.4 | 3.4 | 3.3 | 3.2 | 3.0 |
| | Advanced Economies | | | | | | |
| | Average | 1.8 | 1.9 | 1.9 | 2.0 | 2.4 | 2.9 |
| | Std. D. | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 1.9 |
| Synthetic | Emerging Markets | | | | | | |
| | Average | 5.1 | 5.1 | 5.2 | 5.2 | 5.6 | 6.2 |
| | Std. D. | 4.5 | 4.3 | 4.1 | 3.9 | 3.5 | 3.3 |
| | Advanced Economies | | | | | | |
| | Average | 1.4 | 1.5 | 1.6 | 1.7 | 2.2 | 2.9 |
| | Std. D. | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 | 2.0 |

*Notes:* This table reports the average and the standard deviation using end-of-month data for different tenors of the nominal and synthetic yields of the emerging markets and advanced economies in the sample. All figures are expressed in annualized percentage points.

# 4 Decomposing the Yields of Emerging Markets

This section decomposes the nominal yields of emerging markets into an average expected future short rate, a term premium and compensation for credit risk. It describes the survey-augmented affine term structure model used to decompose the synthetic yields into the first two components. The third component is the spread between the nominal and the synthetic yields. Among the many potential applications of this decomposition, section 5 applies it to characterize the spillovers of U.S. monetary policy to emerging market yields.

## 4.1 Affine Term Structure Model

Let $P_{t,n}$ be the price at time $t$ of a zero-coupon *risk-free* bond with maturity $n$. The continuously compounded yield on that bond is then $y_{t,n} = -\ln P_{t,n}/n$. In particular, the one-period continuously compounded risk-free rate is $i_t = y_{t,1} = -\ln P_{t,1}$.

If there is no arbitrage, there exists a strictly positive stochastic discount factor that prices all nominal bonds. Let $M_{t+1}$ be the nominal stochastic discount factor. Accordingly, the bond price today is recursively defined as follows

$$P_{t,n} = \mathrm{E}_t^{\mathbb{P}} \left[ M_{t+1} P_{t+1,n-1} \right], \tag{2}$$

in which $\mathrm{E}_t^{\mathbb{P}}[\cdot]$ denotes the conditional expectation at time $t$ taken using the actual or physical probability measure, $\mathbb{P}$, that generates the data. The existence of the stochastic discount factor also implies that there exists a theoretical risk-neutral or risk-adjusted pricing measure $\mathbb{Q}$—different from the $\mathbb{P}$ measure—that is defined as follows

$$P_{t,n} = \mathrm{E}_t^{\mathbb{Q}} \left[ \exp\left(-i_t\right) P_{t+1,n-1} \right], \tag{3}$$

in which $\mathrm{E}_t^{\mathbb{Q}}[\cdot]$ also denotes conditional expectation but taken under the $\mathbb{Q}$ measure.

A discrete-time affine term structure model assumes that the dynamics of a $\mathrm{K} \times 1$ vector of unobserved pricing factors or state variables, $X_t$, follow a first-order vector autoregression, VAR(1), under the risk-neutral measure $\mathbb{Q}$

$$X_{t+1} = \mu^{\mathbb{Q}} + \Phi^{\mathbb{Q}} X_t + \Sigma \nu_{t+1}^{\mathbb{Q}}, \tag{4}$$

in which $\mu^{\mathbb{Q}}$ is a $\mathrm{K} \times 1$ vector and $\Phi^{\mathbb{Q}}$ is a $\mathrm{K} \times \mathrm{K}$ transition matrix, $\Sigma$ is a $\mathrm{K} \times \mathrm{K}$ lower triangular matrix with positive diagonal elements, and $\nu_{t+1}^{\mathbb{Q}}$ is a $\mathrm{K} \times 1$ independent and identically distributed, normal vector with zero mean and covariance equal to the identity matrix conditional on the pricing factors, that is $\nu_{t+1}^{\mathbb{Q}} | X_t \sim \mathcal{N}_{\mathrm{K}}\left(0, I\right)$.

The pricing factors drive the dynamics of the one-period interest rate as follows

$$i_t = \delta_0 + \delta_1' X_t, \tag{5}$$

in which $\delta_0$ is a scalar and $\delta_1$ is a $\mathrm{K} \times 1$ vector of parameters.

These assumptions imply that the bond price is an exponentially affine function of the pricing factors

$$P_{t,n} = \exp\left(A_n + B_n X_t\right),$$

such that the corresponding continuously compounded yield of the bond is an affine function of those factors

$$y_{t,n}^{\mathbb{Q}} = A_n^{\mathbb{Q}} + B_n^{\mathbb{Q}} X_t, \tag{6}$$

in which $A_n^{\mathbb{Q}} = -\frac{1}{n} A_n$, $B_n^{\mathbb{Q}} = -\frac{1}{n} B_n$, where in turn the scalar $A_n = \mathcal{A}(\delta_0, \delta_1, \mu^{\mathbb{Q}}, \Phi^{\mathbb{Q}}, \Sigma, n)$ and the $1 \times \mathrm{K}$ vector $B_n = \mathcal{B}(\delta_1, \Phi^{\mathbb{Q}}, n)$ are loadings that satisfy the recursive equations

$$A_{n+1} = -\delta_0 + A_n + B_n' \mu^{\mathbb{Q}} + \frac{1}{2} B_n' \Sigma \Sigma' B_n, \quad A_0 = 0, \tag{7}$$

$$B_{n+1} = -\delta_1 + \Phi^{\mathbb{Q}\prime} B_n, \quad B_0 = 0. \tag{8}$$

The yields $y_{t,n}^{\mathbb{Q}}$ are the model's fitted yields, which means that the risk-neutral measure $\mathbb{Q}$ is sufficient for pricing bonds. However, to be able to decompose the yields into an average expected future short-term interest rate and a term premium, the model needs to specify the dynamics for the market prices of risk, which control the transformation between the $\mathbb{Q}$ and $\mathbb{P}$ measures. In this sense, the stochastic discount factor is assumed to be conditionally lognormal

$$M_{t+1} = \exp\left(-i_t - \frac{1}{2}\lambda_t' \lambda_t - \lambda_t' \nu_{t+1}^{\mathbb{P}}\right), \tag{9}$$

in which $\lambda_t$ is a $\mathrm{K} \times 1$ vector of market prices of risk. And, following Duffee (2002), it is also assumed to be an affine function of the pricing factors

$$\lambda_t = \lambda_0 + \lambda_1 X_t, \tag{10}$$

in which $\lambda_0$ is a $\mathrm{K} \times 1$ vector and $\lambda_1$ is a $\mathrm{K} \times \mathrm{K}$ matrix of parameters.

A well-known implication of this structure for the market prices of risk is that the dynamics of the pricing factors under the physical measure $\mathbb{P}$ can also be described by a VAR(1) as follows[23]

$$X_{t+1} = \mu^{\mathbb{P}} + \Phi^{\mathbb{P}} X_t + \Sigma \nu_{t+1}^{\mathbb{P}}, \tag{11}$$

in which $\mu^{\mathbb{Q}} = \mu^{\mathbb{P}} - \Sigma\lambda_0$ , $\Phi^{\mathbb{Q}} = \Phi^{\mathbb{P}} - \Sigma\lambda_1$ , $\nu_{t+1}^{\mathbb{P}} | X_t \sim \mathcal{N}_{\mathrm{K}}(0, I)$. Note that the covariance

[23] The stochastic discount factor in equation (9) and the law of motion of the vector of pricing factors in equation (11) can be formalized separately or jointly. For instance, in a utility maximization framework, the stochastic discount factor is usually interpreted as the intertemporal marginal rate of substitution.

matrix of the shocks is the same under both measures; that is, it is measure independent.

The yields consistent with the expectations hypothesis of the yield curve—as if investors were actually risk-neutral ($\lambda_0 = 0$, $\lambda_1 = 0$)—are obtained as

$$y^{\mathbb{P}}_{t,n} = A^{\mathbb{P}}_n + B^{\mathbb{P}}_n X_t,$$

in which $A^{\mathbb{P}}_n = -\frac{1}{n}A_n$, $B^{\mathbb{P}}_n = -\frac{1}{n}B_n$, and the loadings $A_n = \mathcal{A}(\delta_0, \delta_1, \mu^{\mathbb{P}}, \Phi^{\mathbb{P}}, \Sigma, n)$ and $B_n = \mathcal{B}(\delta_1, \Phi^{\mathbb{P}}, n)$ satisfy the same recursions as those above but using the parameters of the law of motion of the pricing factors under the $\mathbb{P}$ rather than the $\mathbb{Q}$ measure.[24]

The term premium for maturity $n$ at time $t$, $\tau_{t,n}$, is then estimated as the difference between the yields obtained under the $\mathbb{Q}$ and $\mathbb{P}$ measures[25]

$$\tau_{t,n} = y^{\mathbb{Q}}_{t,n} - y^{\mathbb{P}}_{t,n}. \tag{12}$$

A key assumption behind this model is that the bonds are free of credit risk, which is reasonable for bonds issued by advanced economies but not for those issued by emerging markets, for which investors require to be compensated for credit risk (Du and Schreger, 2016, 2022). Thus, while the nominal yield curve $y^{LC}_{t,n}$ is adequate for advanced economies, the synthetic yield curve $\widetilde{y}^{LC}_{t,n}$ better aligns with the risk-free assumption in the case of emerging markets.

Finally, to ensure that the decomposition of nominal yields adds up, the nominal-synthetic spread is computed as

$$\phi_{t,n} = y^{LC}_{t,n} - y^{\mathbb{Q}}_{t,n}. \tag{13}$$

This spread is henceforth referred to as the credit risk compensation. Notice that it is the difference between the nominal and the fitted ($y^{\mathbb{Q}}_{t,n}$), rather than the synthetic ($\widetilde{y}^{LC}_{t,n}$), yields. Since the model fits the synthetic yields reasonably well (see section 4.4), the spread here is largely similar to the LC credit spread reported by Du and Schreger

[24]The loadings are obtained recursively after combining the no-arbitrage condition and the functional form for bond prices. See the appendices in Lloyd (2020) for the derivations under both measures.

[25]Note that the term premium is also an affine function of the pricing factors since $\tau_{t,n}$ can be written as $(A^{\mathbb{Q}}_n - A^{\mathbb{P}}_n) + (B^{\mathbb{Q}}_n - B^{\mathbb{P}}_n)X_t$.

(2016).[26] Section 4.4.3 discusses the interpretation of the spread in more detail.

To summarize, the nominal yields of emerging markets can be decomposed as follows

$$y_{t,n}^{LC} = y_{t,n}^{\mathbb{P}} + \tau_{t,n} + \phi_{t,n}.$$

### 4.1.1 Weak Identification

The estimation of the parameters in the affine term structure model only requires zero-coupon yields as an input. However, while these data provide sufficient information to identify the pricing coefficients under the $\mathbb{Q}$ measure, $\{\mu^{\mathbb{Q}}, \Phi^{\mathbb{Q}}\}$, it is not enough to accurately identify the parameters under the $\mathbb{P}$ measure, $\{\mu^{\mathbb{P}}, \Phi^{\mathbb{P}}\}$. This information imbalance is relevant for the estimation of the term premium (see equation (12)). Indeed, poorly identified parameters under the $\mathbb{P}$ measure result in unstable yield decompositions.

Survey data help to address this instability.[27] Long-term forecasts of future interest rates provide additional information on the $\mathbb{P}$ dynamics; in particular, they help anchoring the long-run mean of interest rates. Guimarães (2014) shows that incorporating survey data on interest rate forecasts in the estimation provides robust decompositions of the U.S. and U.K. yield curves.[28] Furthermore, surveys allow to compute model-free estimates of the term premium, which serve as a robustness check for the model-implied term premium.

Survey data are especially important for emerging markets. Since bond yields are highly persistent, when sample sizes are small—as is usually the case for emerging markets—there might be too few interest rate cycles in the data. Therefore, to obtain robust decompositions of emerging market yields, I include survey data in the estimation of the term structure model.

[26]The average correlation between the two measures for the 10-year maturity is 0.971.

[27]Different solutions have been proposed in the literature, including restrictions on parameters (Duffee, 2010), bias-corrected estimators (Bauer et al., 2012) and complementing bond yield data with survey forecasts of future interest rates (Kim and Wright, 2005; Kim and Orphanides, 2012).

[28]He finds that the term premium estimated with the aid of surveys remains essentially the same after varying the number of pricing factors (from 3 to 5) and the sample periods, even with a sample starting in 1972, which includes the U.S. Great Inflation period.

## 4.2 Survey Data

Twice a year Consensus Economics provides 5-year ahead and long-term (between 6 and 10 years ahead) forecasts for consumer inflation and real GDP growth for most of the emerging countries in the sample; data are available from March 2001 to October 2017.[29] Figure 1 plots the inflation forecasts. With the exception of Brazil and Turkey, inflation expectations in emerging markets have been stable or even declining, and are generally within the upper and lower bounds of their inflation target.

Long-term forecasts of future short rates are inferred from the data. They are needed to pin down the parameters of the model under the $\mathbb{P}$ measure, $\{\mu^{\mathbb{P}}, \Phi^{\mathbb{P}}\}$, but no source provides them for emerging markets. They are inferred from existing data by considering emerging markets as small open economies and using the Fisher equation. Specifically, the implied forecast for the nominal short rate ($i_{t,n}^{survey}$) equals an expected real interest rate over the same horizon ($r_{t,n}^{*}$) plus the expected average inflation reported by Consensus Economics ($\pi_{t,n}^{CEsurvey}$). The first term is in turn equal to the expected global real interest rate in USD plus a real foreign exchange forward premium, akin to equation (1) but in real terms. The U.S. real interest rate serves as a proxy for the global real interest rate and is inferred by a combination of survey forecasts of future short-term U.S. Treasury bill yields ($i_{t,n}^{SPFsurvey}$) and future U.S. inflation ($\pi_{t,n}^{SPFsurvey}$). Finally, the real forward premium ($\rho_{t,n}^{\perp}$) is the residual of regressing the forward premium computed as explained in section 3.1 on the expected average inflation from Consensus Economics. Thus, the implied forecast for the nominal short rate is obtained as follows

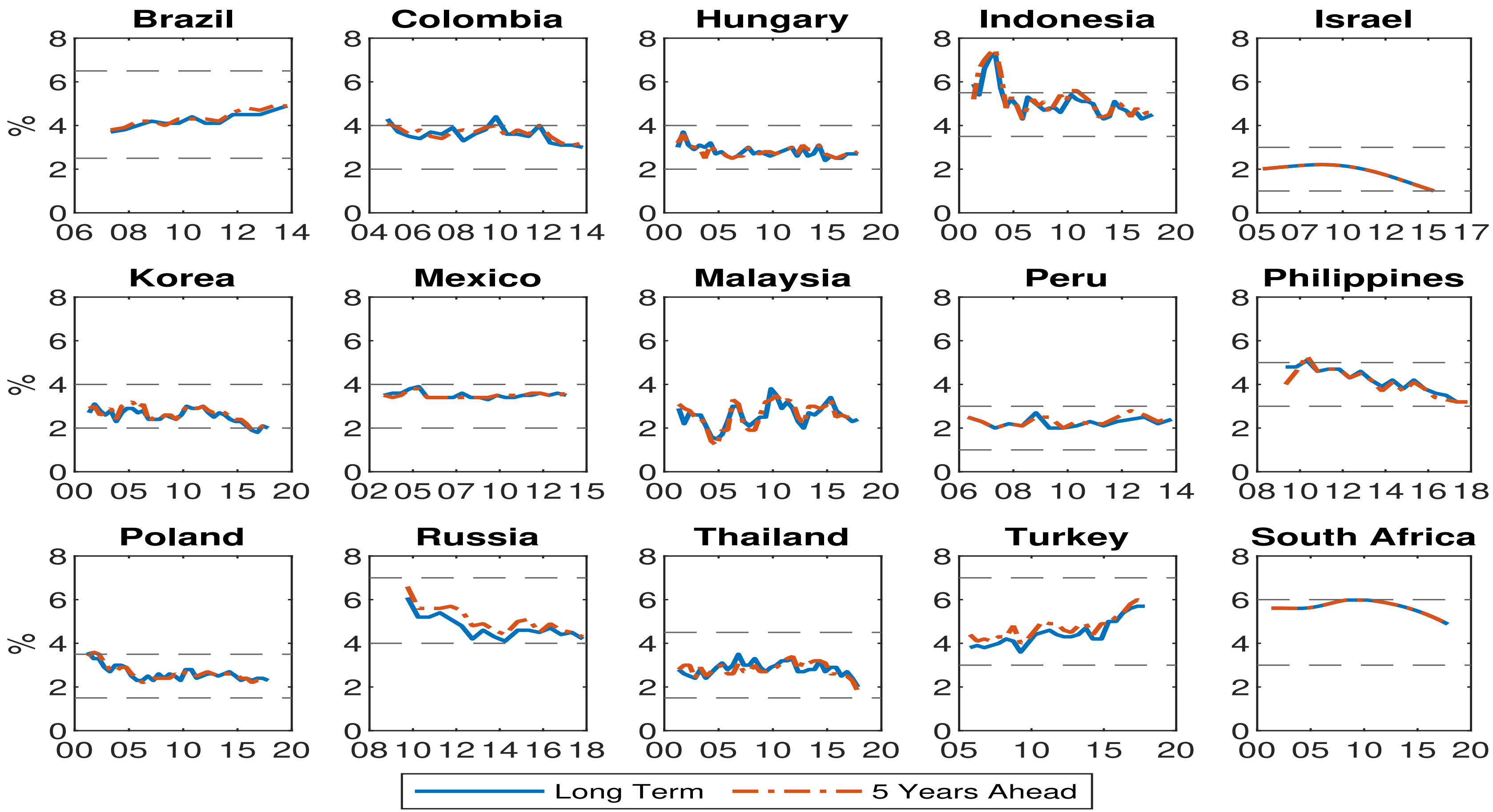
$$i_{t,n}^{survey} = r_{t,n}^{*} + \pi_{t,n}^{e} = \left(i_{t,n}^{SPFsurvey} - \pi_{t,n}^{SPFsurvey}\right) + \rho_{t,n}^{\perp} + \pi_{t,n}^{CEsurvey}. \tag{14}$$

The required U.S. data are available quarterly from the Survey of Professional Forecasters. I use the 5- and 10-year CPI inflation forecasts and, for the T-bill rate, the 10-year forecast and the second longest available one[30]—since there is no 5-year forecast

[29] Data availability varies by country; for example, data for the Philippines start in 2009, whereas it ends in October 2013 for Latin American countries. Although there is no survey data on long-term inflation forecasts for Israel and South Africa, appendix A shows that trend inflation is a good proxy.

[30] The specific series are CPI5YR, CPI10, BILL10 and TBILLD. The BILL10 series is only released in the first-quarter of a year, so I use linear interpolation for the second to fourth quarters. Consensus

**Figure 1.** Long-Horizon Forecasts of Inflation




*Notes:* This figure plots the 5-years ahead (dashed line) and the 5- to 10-years ahead or long-term (solid line) average consumer price inflation forecasts against the survey date. For Israel and South Africa, the figure shows the inflation trend, see appendix A. Where applicable, the figure includes the most recent upper and lower bounds for the domestic inflation target; for Russia, since it updated its target range almost yearly since early 2000s, the plotted band shows the highest and lowest bounds since 2009.

for the T-bill rate. To assess the implied forecasts for the U.S. real rate obtained from surveys, I compare them against the 5- and 10-year zero-coupon real yields constructed by Gürkaynak et al. (2010) who use data from the U.S. TIPS market. The levels of the two series are comparable. TIPS yields are not the benchmark, however, because they are more volatile (their term premium is time varying) and suffer from liquidity problems.

Figure 2 shows that the implied long-term forecasts for the short rates are sensible, their level is in line with the synthetic 10-year yield in each country. An alternative way to infer the embedded expectations is to use Taylor rule-type regressions for the policy rate.[31] Both approaches yield similar values for the implied forecasts of the short rates.

To incorporate the information from surveys in the affine model, I assume that the 5-year ahead (inferred) forecast for the short rate of each emerging market guides the expected average short rate under $\mathbb{P}$ given by

$$y_{t,n}^{e} = \frac{1}{n}\mathrm{E}_{t}^{\mathbb{P}}\left[\sum_{j=0}^{n-1} i_{t+j}\right] = A_{n}^{e} + B_{n}^{e} X_{t},$$

in which $A_n^e = -\frac{1}{n}A_n$, $B_n^e = -\frac{1}{n}B_n$, where in turn $A_n = \mathcal{A}(\delta_0, \delta_1, \mu^{\mathbb{P}}, \Phi^{\mathbb{P}}, 0, n)$ and $B_n = \mathcal{B}(\delta_1, \Phi^{\mathbb{P}}, n)$; that is, $A_n^e$ and $B_n^e$ also satisfy the recursions under the $\mathbb{P}$ measure but with $\Sigma = 0$ (see appendix C of Guimarães (2014)).[32]

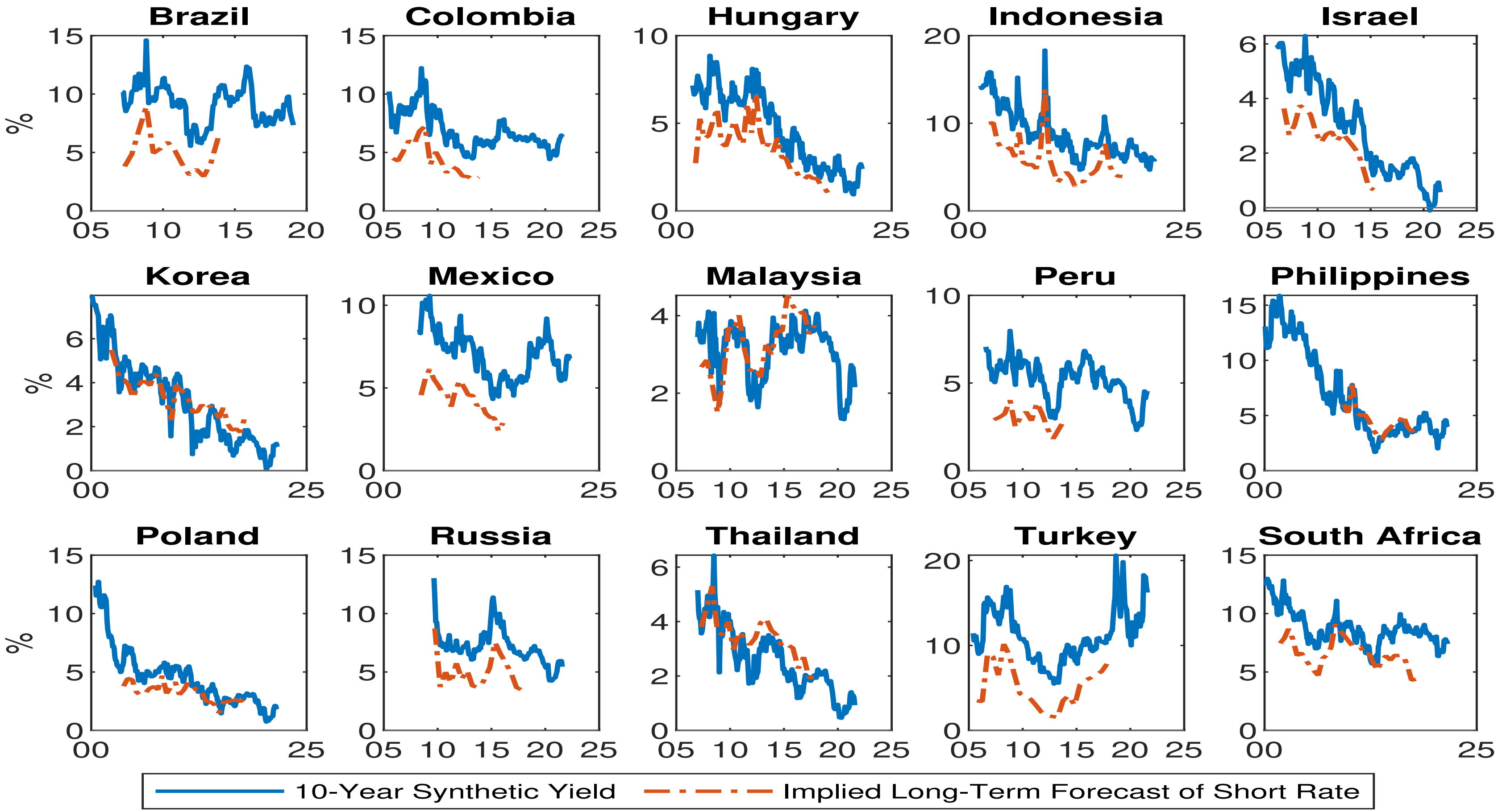
Long-term (inferred) forecasts are in turn assumed to be aligned with the 5-year forward rate starting 5 years hence. In the model, the forward rate from $n$ to $m$ periods

Economics forecasts are considered at the end of the month in which they are published; by that time, the most recent value for the U.S. real interest rate forecast is used in equation (14).

[31] For the Taylor rule-type regressions, I regress the policy rate on its lag, the year-on-year consumer price inflation and the year-on-year real GDP growth for all the countries except Israel and South Africa. The coefficient for the lag of the policy rate is a smoothing parameter that improves the fit of the model to the data. I assume that the estimated parameters for inflation and real GDP growth apply at each of the survey maturities. A potential drawback of this approach is precisely that it requires one to know the expectation of the policy rate for the previous forecast horizon. Nevertheless, it is reasonable to assume stationarity for the long-term forecasts (5 and 10 years), in which case only survey data for inflation and GDP growth are needed after dividing their coefficients by 1 minus the coefficient for the lag of the policy rate (due to stationarity). Data for the dependent variable come from the policy rate statistics of the Bank for International Settlements.

[32] The difference between $y_{t,n}^{\mathbb{P}}$ and $y_{t,n}^{e}$ is a convexity term due to Jensen's inequality, which increases with maturity. In practice, however, this term usually becomes relevant for maturities beyond ten years. Further, the term is constant across maturities in homoskedastic models like the ones used in this paper.

**Figure 2.** 10-Year Synthetic Yields and Long-Horizon Implied Forecasts of the Short Rate




*Notes:* This figure plots the long-horizon implied forecast of the domestic nominal short-term interest rate (dashed line) and the 10-year synthetic yield (solid line). The implied forecast of the short rate is equal to the forecast of the U.S. real short-term interest rate corrected for a real forward premium plus the domestic consumer price inflation forecast, see text for details. The forecast of the U.S. real short-term rate is equal to the difference between the forecast for the three-month U.S. Treasury bill rate and the forecast for the U.S. consumer price inflation.

hence given by $f_{t,n|m} = (my_{t,m} - ny_{t,n}) \,/\, (m-n)$ becomes

$$f^e_{t,n|m} = \frac{1}{m-n} \mathrm{E}^{\mathbb{P}}_t \left[ \sum_{j=n}^{m-1} i_{t+j} \right] = A^e_{n|m} + B^e_{n|m} X_t,$$

in which $A^e_{n|m} = (mA^e_m - nA^e_n) \,/\, (m-n)$ and $B^e_{n|m} = (mB^e_m - nB^e_n) \,/\, (m-n)$.

## 4.3 Estimation

The model is estimated using end-of-month data on *risk-free* yield curves; that is, synthetic yields ($\widetilde{y}^{LC}_{t,n}$) for emerging markets and nominal yields ($y^{LC}_{t,n}$) for advanced economies. The estimation for advanced economies is done just for comparison purposes.

The convergence to the global optimum in affine term structure models estimated by maximum likelihood has been traditionally subject to computational challenges and multiple local optima. Joslin et al. (2011) propose a normalization of the affine model that improves the convergence to the global optimum of the likelihood function.

The Joslin et al. (2011) normalization allows for the near separation of the model's likelihood function into the product of the $\mathbb{P}$ and $\mathbb{Q}$ likelihood functions, and reduces the dimension of the parameter space from $(\delta_0, \delta_1, \mu^{\mathbb{Q}}, \Phi^{\mathbb{Q}}, \Sigma)$ to $(i^{\mathbb{Q}}_{\infty}, \lambda^{\mathbb{Q}}, \Sigma)$, where $i^{\mathbb{Q}}_{\infty}$ is the short rate under $\mathbb{Q}$ in the long-run and $\lambda^{\mathbb{Q}}$ is a $\mathrm{K} \times 1$ vector of ordered eigenvalues of $\Phi^{\mathbb{Q}}$. It is common to assume that K linear combinations of the N observed bond yields are measured without error, $\mathrm{K} < \mathrm{N}$, so that $\mathrm{N} - \mathrm{K}$ linear combinations of yields are measured with error. Following Joslin et al. (2011), I consider that the first three principal components—usually referred to as the level, slope and curvature—of the yield curve in each country are the linear combinations of yields measured without error.[33]

The estimation of the affine model follows a two-step procedure. The first step uses the Joslin et al. (2011) normalization. Accordingly, the $\mathbb{P}$ parameters are estimated by OLS of the VAR in equation (11) using the K principal components as pricing factors, which provides initial values for the maximum likelihood estimation of the matrix $\Sigma$. Then, taking $\widehat{\mu}^{\mathbb{P}}$ and $\widehat{\Phi}^{\mathbb{P}}$ as given, the $\mathbb{Q}$ parameters are estimated by maximum likelihood.

[33] On average, the first three principal components explain more than 99.5% of the variation in the synthetic yields of emerging markets and 99.9% in the nominal yields of advanced economies.

In the second step, survey data complement the data on yields. This step only applies to emerging markets since the dataset does not include survey data for advanced economies.[34] The model is augmented with survey data on the last day of the month for which the surveys were published.[35] Since survey data from Consensus Economics are available twice a year (whereas yield data for the estimation are monthly), surveys are regarded as missing in non-release dates.

### 4.3.1 Survey-Augmented Model

The Kalman filter is well-suited to handle missing data. The transition equation is the law of motion of the pricing factors under the $\mathbb{P}$ measure given in equation (11). The dimension of the observation equation varies depending on the availability of survey data.

On months in which there is no data on survey expectations, the observation equation adds measurement error to the fitted yields in equation (6) for each of the N maturities

$$\mathbf{y}_t = \mathbf{A} + \mathbf{B}X_t + \mathbf{\Sigma}_Y \mathbf{u}_t, \tag{15}$$

in which $\mathbf{y}_t$ is an $\mathrm{N} \times 1$ vector of observed bond yields, $\mathbf{A}$ is an $\mathrm{N} \times 1$ vector with elements $A_n^{\mathbb{Q}}$, $\mathbf{B}$ is an $\mathrm{N} \times \mathrm{K}$ matrix with rows equal to $B_n^{\mathbb{Q}}$ for $n = 1, \ldots, \mathrm{N}$, $\mathbf{u}_t \sim \mathcal{N}_{\mathrm{N}}(0, I)$ and $\mathbf{\Sigma}_Y$ is a lower triangular $\mathrm{N} \times \mathrm{N}$ matrix with positive elements on the diagonal.

On months when survey data are available, the observation equation increases by the number of survey forecasts S as follows

$$\begin{bmatrix} \mathbf{y}_t \\ \mathbf{y}_t^S \end{bmatrix} = \begin{bmatrix} \mathbf{A} \\ \mathbf{A}^S \end{bmatrix} + \begin{bmatrix} \mathbf{B} \\ \mathbf{B}^S \end{bmatrix} X_t + \begin{bmatrix} \mathbf{\Sigma}_Y \mathbf{u}_t & \mathbf{0} \\ \mathbf{0} & \mathbf{\Sigma}_S \mathbf{u}_t^S \end{bmatrix}, \tag{16}$$

in which $\mathbf{y}_t^S$ is an $\mathrm{S} \times 1$ vector of survey forecasts with elements $i_{t,n}^{survey}$, $\mathbf{A}^S$ is an $\mathrm{S} \times 1$ vector with elements $A_n^e$ or $A_{n|m}^e$, $\mathbf{B}^S$ is an $\mathrm{S} \times \mathrm{K}$ matrix with rows equal to $B_n^e$ or $B_{n|m}^e$ for $n = 1, \ldots, \mathrm{S}$, $\mathbf{u}_t^S \sim \mathcal{N}_{\mathrm{S}}(0, I)$ and $\mathbf{\Sigma}_S$ is a lower triangular $\mathrm{S} \times \mathrm{S}$ matrix with positive

[34] Advanced economies are not the main focus of the paper. In addition, the results reported later for them are more comparable with other studies that do not use survey data. Also, there are less concerns about small sample sizes for advanced economies.

[35] From 2001 to 2014, data are available in March and September for countries covered in the Eastern European release of Consensus Economics; starting in October 2014, it is released on April and October. For the other emerging markets, forecasts have always been released on April and October.

elements on the diagonal.

To estimate the survey-augmented model, I follow Guimarães (2014) and Lloyd (2020) in two respects. First, the estimated parameters from the Joslin et al. (2011) normalization are the initial values for the Kalman filter. Second, the errors of yields and surveys are assumed to be homoskedastic to reduce the number of parameters to be estimated, so $\mathbf{\Sigma}_Y = \sigma_y I_\mathrm{N}$ and $\mathbf{\Sigma}_S = \sigma_s I_\mathrm{S}$, in which $I_\mathrm{N}$ and $I_\mathrm{S}$ are $\mathrm{N} \times \mathrm{N}$ and $\mathrm{S} \times \mathrm{S}$ identity matrices.

It is important to acknowledge that although surveys contain useful information, have good forecasting properties and help anchoring the model to reality, they are not a panacea. For instance, surveys might not represent market expectations nor the expectations of the marginal investor,[36] they might also be subject to measurement error, and relying too much on them can be counterproductive as it may lead to overfitting. Because of this, I consider surveys as imperfect or 'noisy' measures of expectations. Accordingly, I follow Kim and Orphanides (2012) by fixing $\sigma_s$ at a conservative level of 75 basis points.

### 4.3.2 Estimating Daily Pricing Factors

The analysis of monetary policy spillovers in section 5.1 uses daily changes in nominal and synthetic yields to adequately capture the responses of emerging market yields to surprises in Fed's policy decisions. The model, however, is not directly estimated at the daily frequency because there is noise that can undermine the estimation.

The parameters estimated with monthly data are used to estimate the pricing factors at the daily frequency. The Kalman filter maximum likelihood setup explained above gives estimates for both the parameters and the pricing factors. I regress the estimated monthly pricing factors on the end-of-month observed yields to obtain the matrix of loadings implied by those pricing factors, and the intercept. The matrix of loadings multiplied by the daily yields, plus the intercept, gives an estimate of the daily pricing factors. Finally, the estimated parameters (with monthly data) along with the estimated daily pricing factors are used to fit—and decompose—the yields at the daily frequency.

[36]Notwithstanding, in the case of the U.S., comparing the 5-year ahead CPI inflation median forecast from the Survey of Professional Forecasters against that from both the Survey of Primary Dealers and the Survey of Market Participants gives, on average, an absolute difference of 5 and 13 basis points, respectively, over the period 2015:I–2020:II.

## 4.4 Decomposition Assessment

The estimation of the model allows to decompose emerging market yields into the three parts explained in section 4.1. The model fits and decomposes the synthetic yields into two parts, and the spread between the nominal and the fitted yields gives the third part.

Figure 3 illustrates that the model fits the synthetic yields reasonably well. The focus is on the 10-year maturity for the sake of brevity. The squared root of the average (across months and maturities) squared difference between the actual and the fitted yields is commonly used to summarize the fitting errors. The average fitting error for the synthetic yields of emerging markets is 17 basis points, a reasonable fit. For reference, the average fitting error for the nominal yields of the advanced economies in the sample is 5 basis points, in line with previous studies (Wright, 2011). The dynamics of emerging market yields are thus relatively harder to capture.[37]

Table 3 summarizes the decomposition of the nominal yields of emerging markets.[38] Average expected short rates are the main component of nominal yields. Meanwhile, the relevance of the term premium increases with maturity, whereas the credit risk compensation is broadly stable. On average, the three parts respectively represent around 56, 31 and 13% of the 10-year nominal yields of emerging markets, which indicates that the term premium plays a relatively bigger role than the credit risk compensation.

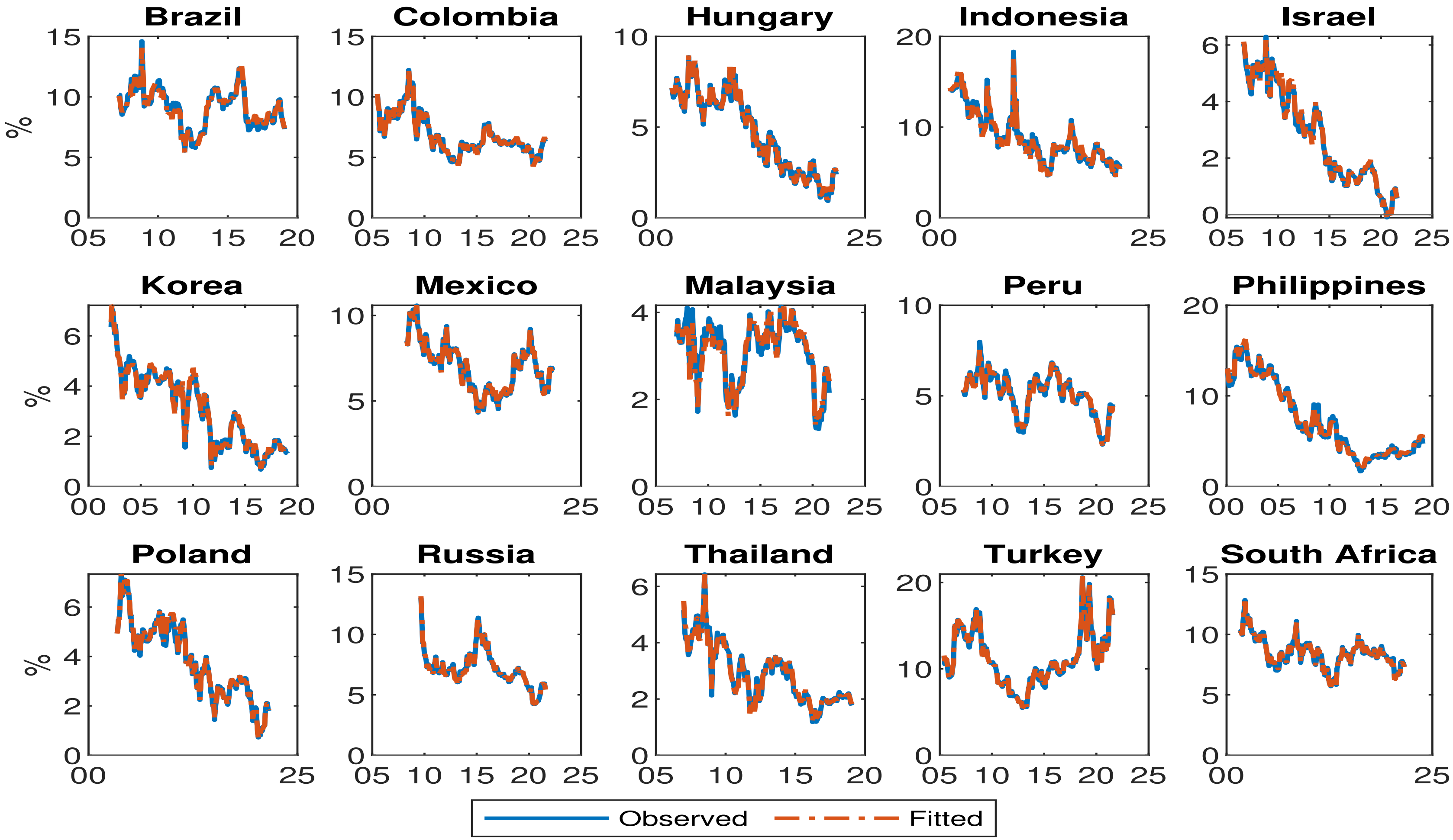
Figure 4 shows the decomposition of the 10-year yield for each country. Two patterns emerge from the figure. First, the term premium and the credit risk compensation are time-varying and both play an important role in the dynamics of emerging market yields. Although their relative importance varies by country, the term premium indeed plays a relatively bigger role, in general. Second, there is a downward trend in the expected future short rate and the term premium of several countries, consistent with the evidence for advanced economies (Wright, 2011; Adrian et al., 2019).

The results for individual countries are consistent with their particular circumstances.

[37]Notwithstanding, for some countries, large fitting errors might signal less liquid and deep markets.

[38]The decompositions for advanced economies are not displayed for two reasons. First, they have already been studied before, see for instance Wright (2011) and Adrian et al. (2019). Second, the dataset does not include survey data for advanced economies and so their decompositions may not be robust. They are nonetheless a useful benchmark to assess some results, like the average fitting errors.

**Figure 3.** Model Fit: 10-Year Synthetic Yields of Emerging Markets



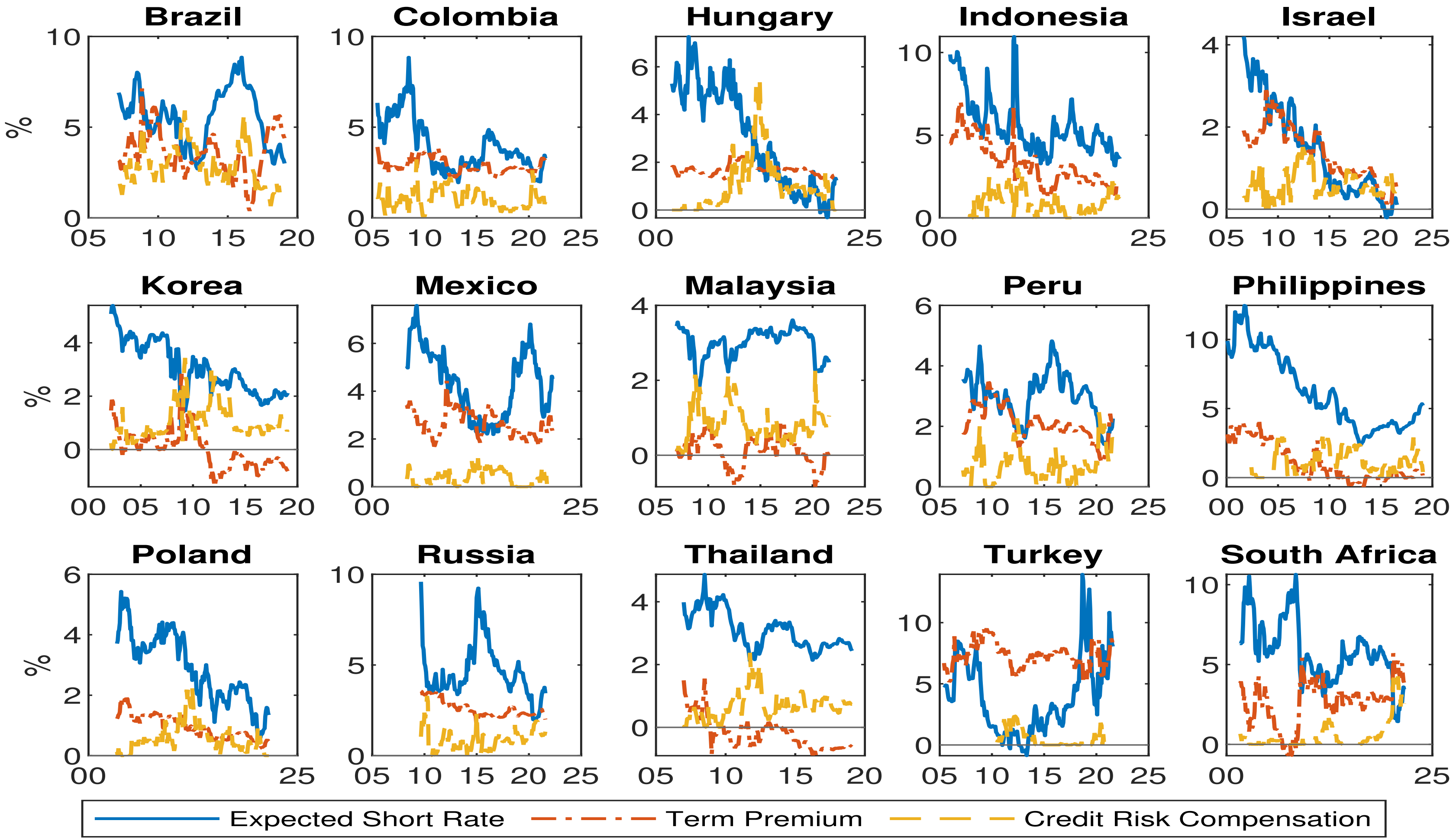

*Notes:* This figure plots the fitted (dashed line) and the actual (solid line) 10-year synthetic yields. The fitted yields are obtained after estimating the survey-augmented affine term structure model.

**Table 3.** Descriptive Statistics for the Decomposition of Emerging Market Yields

| | 3M | 6M | 1Y | 2Y | 5Y | 10Y |
|---|---|---|---|---|---|---|
| | | | Expected Short Rate | | | |
| Average | 5.0 | 5.0 | 5.0 | 5.0 | 4.7 | 4.0 |
| S. Dev. | 4.0 | 3.7 | 3.5 | 3.2 | 2.7 | 2.2 |
| | | | Term Premium | | | |
| Average | 0.0 | 0.1 | 0.1 | 0.3 | 1.0 | 2.2 |
| S. Dev. | 0.9 | 1.0 | 1.0 | 1.0 | 1.3 | 2.0 |
| | | | Credit Risk Compensation | | | |
| Average | 0.7 | 0.7 | 0.7 | 0.8 | 0.9 | 0.9 |
| S. Dev. | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |

*Notes:* This table reports the mean and the standard deviation for different tenors of the three components of emerging market nominal yields. The statistics are computed using end-of-month data. All figures are expressed in annualized percentage points.

**Figure 4.** Decomposition of the 10-Year Nominal Yields of Emerging Markets




*Notes:* This figure plots the components of the 10-year nominal yields of emerging markets. The yields are decomposed into an average expected future short-term interest rate (solid line), a term premium (dash-dotted line) and credit risk compensation (dashed line).

For instance, the expected short rate in Mexico increased during the tightening cycle that started following the 2016 U.S. presidential election, after which market participants expected a deterioration in the bilateral relation. The credit risk compensation for Hungary increased after 2010, when a populist government came into power, and around the European sovereign debt crisis. In Poland, the term premium declined after the global financial crisis in response to the unconventional monetary policies of the European Central Bank.

In what follows, each component is assessed individually.

#### 4.4.1 Average Expected Future Short Rate

Figure 5 shows that the model-implied 10-year average expected future short rate aligns reasonably well with the (inferred) long-term forecast for the short rate, even though the model does not rely too much on surveys given the conservative value for $\sigma_s$ of 75 basis points. All the results later on are based on this conservative value but, as a reference, when $\sigma_s$ is estimated, its average value across all emerging markets is 31 basis points.

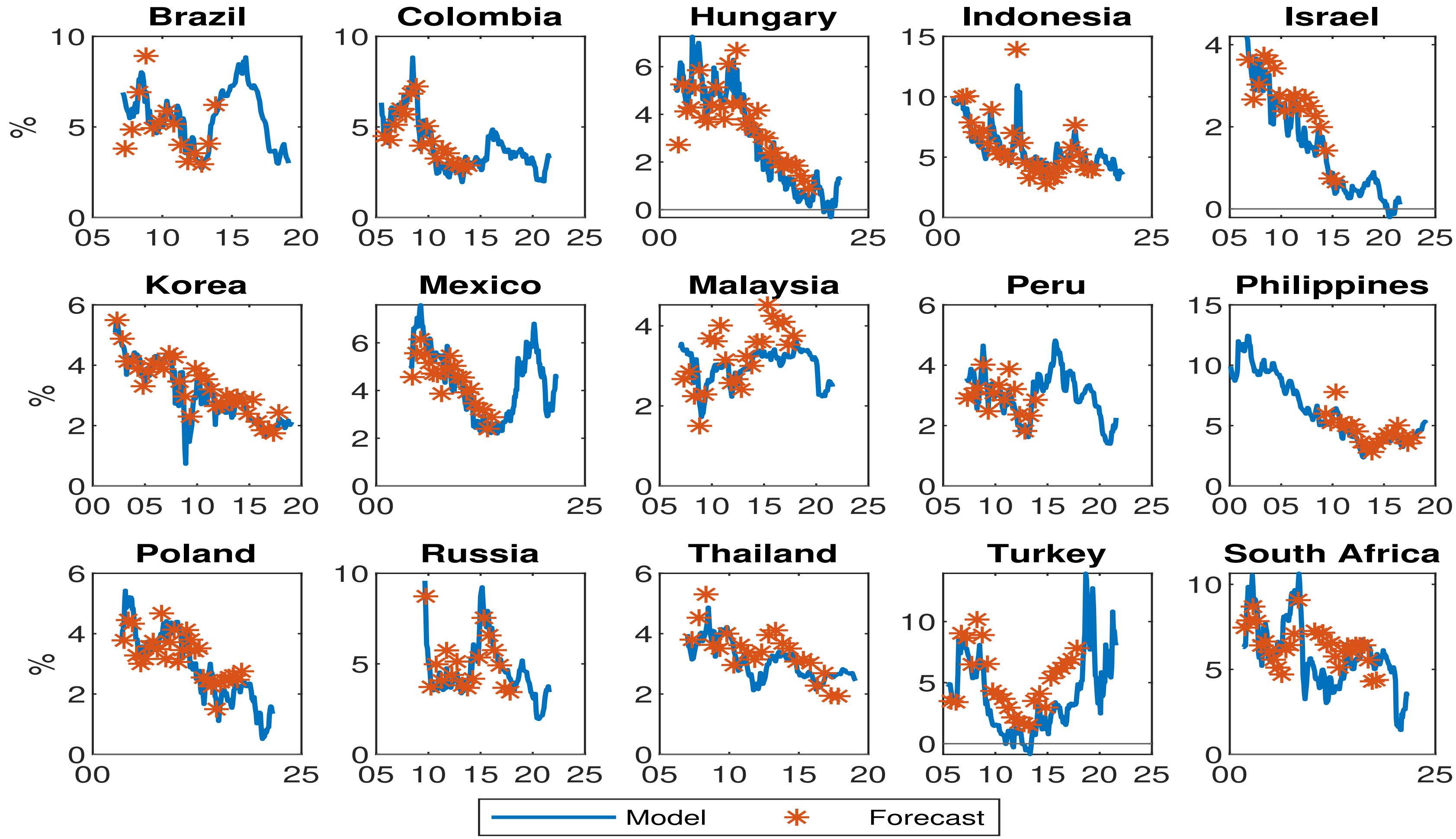
#### 4.4.2 Term Premium

While the (bond) risk premium is sometimes associated with the term premium in advanced economies, the two concepts are different in emerging markets. In fact, the purpose of leveraging synthetic yields (and surveys) is to estimate a genuine term premium, clean of credit risk. This subsection assesses the sensibility of this 'clean' term premium.

A simple robustness check for the model-implied term premium is to compare it against a model-free measure. The survey-based term premium is the difference between the *synthetic* yield and the short rate forecast over the same horizon. Since the model-implied expectations track the short rate forecasts closely (see figure 5), the two measures comove positively, with an average correlation of 0.52 for the 10-year maturity.

An alternative assessment is to test whether the term premium is related to inflation uncertainty. Wright (2011) documents a downward trend in the term premia of advanced economies and argues that it owes in part to a reduction in inflation uncertainty. Since inflation in emerging markets tends to be higher and more volatile than in advanced

**Figure 5.** Long-Horizon Forecast vs. Model-Implied 10-Year Average Expected Future Short Rate




*Notes:* This figure plots the (inferred) long-horizon forecast of the domestic short-term interest rate (asterisk) and the 10-year average expected future short-term interest rate implied by the model (solid line).

economies (Ha et al., 2019), it is reasonable to assume that the relationship between term premia and inflation uncertainty is particularly relevant in emerging markets. To test this hypothesis, I run the following panel regressions

$$\tau_{i,t} = \alpha_i + \beta_1 \sigma^{\pi}_{i,t} + \beta_2 GDP_{i,t} + u_{i,t}, \tag{17}$$

in which $\alpha_i$ are country fixed effects, $\sigma^{\pi}_{i,t}$ is a measure of inflation uncertainty, $GDP_{i,t}$ is the domestic real GDP growth to control for the business cycle, and $u_{i,t}$ is the error term. The dependent variable $\tau_{i,t}$ is the model-implied term premium at different maturities. Following Wright (2011), the measure of inflation uncertainty is the standard deviation of the permanent component of inflation in the Stock–Watson unobserved components stochastic volatility (UCSV) model, estimated using quarterly data for each country.[39] To test for significance, I use the Driscoll–Kraay estimator that allows the errors to be correlated across countries and over time.[40]

Table 4 shows that the term premium and the standard deviation of the permanent component are positively associated. The relationship is significant for medium- and long-term maturities, and the relevance increases with maturity. The results become stronger after controlling for the business cycle. Although this specification might be subject to econometric problems, since it involves persistent variables and ignores measurement error, the results are aligned with the view that the term premium in emerging markets compensates investors for bearing inflation uncertainty.

Lastly, a negative term premium is not an advanced economy phenomenon. A term premium becomes negative when investors see bonds as hedges and are therefore willing to give up some investment returns. This is a well-known phenomenon for advanced economies, especially after the global financial crisis. Figure D.3 in the appendix shows that the term premium in some emerging markets has also been negative. In particular, strong macroeconomic fundamentals in Asia increased the demand for LC bonds since 2011 (IMF-WB, 2020), which partly explains the negative term premia seen for Korea, Malaysia, the Philippines and Thailand.

[39] The UCSV model assumes that inflation has permanent and transitory components subject to uncorrelated shocks that vary over time.

[40] The Pesaran test of cross-sectional independence is rejected in all cases at the 1% significance level.

**Table 4.** Term Premia and Inflation Volatility

| | 6 Months | | 1 Year | | 2 Years | | 5 Years | | 10 Years | |
|---|---|---|---|---|---|---|---|---|---|---|
| UCSV-Perm | 43.1 | 37.8 | 26.6 | 38.6 | 18.9 | 42.2* | 31.3** | 66.9*** | 61.9*** | 108.0*** |
| | (30.2) | (27.5) | (19.9) | (25.4) | (12.8) | (18.5) | (9.42) | (13.0) | (12.3) | (15.7) |
| GDP Growth | | -0.53 | | -0.069 | | 0.73 | | 1.32 | | 0.86 |
| | | (1.46) | | (1.66) | | (1.31) | | (1.20) | | (2.14) |
| Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lags | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| No. Countries | 15 | 14 | 15 | 14 | 15 | 14 | 15 | 14 | 15 | 14 |
| Observations | 980 | 885 | 980 | 885 | 980 | 885 | 980 | 885 | 980 | 885 |
| $R^2$ | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.07 | 0.05 | 0.13 |

*Notes:* This table reports the slope coefficients of panel data regressions of the model-implied term premia for different maturities on the standard deviation of the permanent component of inflation according to the UCSV model (UCSV-Perm) and GDP growth. The sample includes quarterly data for 15 countries starting in 2000:I and ending in 2021:II. Term premia are expressed in basis points. GDP growth is expressed in percent. Driscoll–Kraay standard errors are in parenthesis; the lag length up to which the residuals may be autocorrelated is indicated. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

### 4.4.3 Credit Risk Compensation

The dynamics of the nominal-synthetic spread, referred here as the credit risk compensation, are in line with the LC credit spread reported by Du and Schreger (2016); for the 10-year maturity, the average correlation among emerging markets between the two measures is 0.97. They show that the LC credit spread is highly correlated with the CDS of the respective country, and that it captures sovereign credit risk.

It is important to acknowledge, however, that the nominal-synthetic spread is an imperfect measure of sovereign credit risk. One caveat is that, although the unconditional mean of the spread is positive (see table 3), there have been episodes in which it turns negative. These situations can reflect financial market frictions (Du and Schreger, 2016), including market segmentation and short selling constraints. Since a negative credit risk compensation is unrealistic, for the analysis it is set to zero when it turns negative in the data. Nevertheless, those episodes are brief and rare, so allowing the spread to be negative does not change the conclusions of the analysis in section 5.

The nominal-synthetic spread may also be capturing things other than credit risk. In every yield decomposition, the fitting error is left in one of the components. In the three-part decomposition described in section 4.1, the fitting error is left in the nominal-synthetic spread since the spread is computed using the fitted synthetic yields. Notwithstanding, the fitting error is relatively small; on average across emerging markets, it represents only 6% of the spread, so it is unlikely that it materially influences the dynamics of the spread. Similarly, although other factors might as well be captured by the spread, they are also likely to be small and to vary slowly over time.

On balance, the spread is a valid measure of credit risk that is far from perfect, but is definitely better than ignoring it. Otherwise, estimates of the term premium would be contaminated with credit risk. In fact, the main benefit of using synthetic yields is that the term premium so obtained is genuine in the sense that it is 'clean' of credit risk.[41] Table 3 and figure 4 above show that the role of the credit risk compensation in explaining yield variation is non-negligible,[42] and thus it matters which curve is used

[41]More generally, the term premium is clean of all that is captured by the nominal-synthetic spread.
[42]Even though no clear trend is visible for it nor a pattern is detected when looking across maturities.

(nominal or synthetic) when decomposing the yields of emerging markets.

Given that both the term premium and the credit risk compensation help explain yield variation in emerging markets, a natural question is whether and how they are related. However, while the term premium compensates investors for bearing the uncertainty that interest rates might suddenly change, the credit risk compensation actually rewards them for two things. One compensates investors for the *expected* loss owing to default, whereas the other compensates them for bearing the *uncertainty* that defaults might be larger than expected. Therefore, interpreting any correlation between the term premium and the credit risk compensation is not straightforward,[43] and attempting to decompose the latter into those two parts is beyond the scope of this paper.

## 4.5 Robustness

The extent to which any application of the yield decompositions provides valuable insights hinges on how reliable they are. To assess their robustness, I compute the standard errors for each component using the delta method. Specifically, since each yield component $\Psi$ is a function of the parameters $\theta$ in the model, $\Psi = g(\theta)$, its distribution is calculated based on the following

$$\sqrt{\mathrm{N}}\left(\widehat{\Psi} - \Psi\right) \xrightarrow{d} \mathcal{N}\left(0,\, \Gamma\,\Omega\,\Gamma'\right),$$

in which $\Omega$ is the asymptotic covariance matrix of the estimator $\widehat{\theta}$ and $\Gamma$ is the Jacobian matrix of partial derivatives calculated numerically. $\Omega$ is estimated using the sample Hessian estimator $\widehat{\Omega} = \widehat{\mathcal{H}_\theta}^{-1}$, for which the second derivative matrix of the log-likelihood function evaluated at the optimum, $\widehat{\mathcal{H}_\theta}$, is also calculated numerically.

Although there is uncertainty in both the parameters and the pricing factors after the estimation, the effect of uncertainty associated with the pricing factors on each component

[43] One the one hand, the term premium and the *uncertainty* component of the credit risk compensation are likely to move in the same direction. On the other hand, the average expected future short rates and the *expected* component of the credit risk compensation are likely to move in opposite directions. In the data, the term premium and the credit risk compensation are negatively correlated for several countries as is the case between the average expected future short rates and the credit risk compensation, which suggests that the expected component of the credit risk compensation is empirically more relevant. Intuitively, inflating away the debt would reduce the need to default. Galli (2020) shows that inflation and default are indeed substitutes in models of debt dilution, but he argues for a positive correlation between inflation and default.

is usually small.[44] Therefore, when applying the delta method, I assume that the pricing factors are known with certainty. Figures D.1 and D.2 in the appendix display the term premium and the credit risk compensation along with their confidence bands. The bands are narrow, which illustrates the benefits of using survey data during the estimation. Therefore, in line with the findings of Guimarães (2014) for the U.S. and the U.K., surveys help in obtaining robust decompositions of emerging market yields.

# 5 U.S. Monetary Policy Spillovers to Emerging Market Yields

This section uses the decomposition described in the previous section to analyze the transmission channels of U.S. monetary policy to emerging market yields. It shows that loose U.S. monetary policies ease monetary conditions in emerging markets via a reassessment of policy rate expectations and a repricing of risks. It also shows that the U.S. term premium is an important driver of emerging market yields.

## 5.1 Transmission Channels

The transmission of U.S. monetary policy to the yields of emerging markets is assessed using panel local projections for the daily changes in the yields.[45] While event studies report the response of the variables on the day of a surprise, local projections additionally provide the responses over subsequent periods. It is important to be able to capture the persistence in the response of emerging market yields given the pervasive post-announcement drift in the bond markets of advanced economies documented by Brooks et al. (2019). Importantly, I leverage the yield decompositions at the daily fre-

[44] To verify this, at each period, I compute the standard errors by pre- and post-multiplying the variance of the pricing factors (generated by the Kalman filter) by the respective factor loadings for the fitted yields, the average expected future short rate and the term premium. In all cases, the average standard error (over time and across countries) is less than 9 basis points for emerging markets, and less than 3 basis points for advanced economies.

[45] Jordà (2005) advocates the use of local projections as an alternative to VAR models in order to generate impulse responses that are robust to misspecification. See Adrian et al. (2019) and Hofmann et al. (2020) for recent applications of panel local projections on related issues.

quency to better understand the transmission of Fed's decisions to the yields.

Specifically, I run the following panel local projections

$$y_{i,t+h} - y_{i,t-1} = \alpha_{h,i} + \sum_{j=1}^{3} \beta_h^j \epsilon_t^j + \gamma_h \Delta y_{i,t-1} + \eta_h s_{i,t-1} + u_{i,t+h}, \tag{18}$$

in which $h$ indicates the horizon (in days) with $h = 0, 1, \ldots, 45$ and each $\epsilon_t^j$ represents one of the three types of monetary policy surprises described in section 2.[46] The regressions include country fixed effects $\alpha_{h,i}$, a lag of the dependent variable,[47] and a lag of the exchange rate $s_{i,t-1}$ to rule out explanations due to currency movements. The regressions are run for the 10- and 2-year nominal yields and each of their components. The confidence bands are constructed using Driscoll–Kraay standard errors, which allow for time and cross-sectional dependence.

The parameters of interest, $\beta_h^j$, measure the average response of the nominal yield and each of its components to monetary policy surprise $j$ at horizon $h$. The contemporaneous effects (when $h = 0$) are indicated with an arrow in the figures below. All responses are assessed relative to a one basis point reduction (an easing) in any of the surprises, since the Fed has been more aggressive in that direction over the sample period (see table 1).

The response of U.S. yields and their components to the three surprises serves as a benchmark to assess the responses of the yields of emerging markets. As before, U.S. yields come from the dataset of Gürkaynak et al. (2007). The components of U.S. yields come from the decomposition proposed by Kim and Wright (2005), who address the small sample problem using survey forecasts of future short rates. The responses, reported in figures D.4 to D.8 in the appendix, are consistent with the findings in the existing literature. For instance, target easing surprises reduce the yields, mainly driven by a decline in the average expected future short rates; while forward guidance and asset purchase easing surprises decrease yields, in part due to a reduction in the term premium.[48]

[46]There is no need to control for past or future surprises since, by definition, they are unanticipated by the market. On the other hand, even though the three types of surprises are uncorrelated by construction, the estimation is more efficient when the three types of surprises are included simultaneously.

[47]As argued by Hofmann et al. (2020), the large number of daily observations reduces the potential for Nickell bias that arises by including a lagged dependent variable in panel regressions with fixed effects and small time dimensions. Indeed, the impulse responses reported here are essentially the same when the lag of the dependent variable is excluded.

[48]Figure D.10 in the appendix shows the response of the forward premium, the term added to the U.S.

Lastly, figures D.11 to D.16 in the appendix report the responses of the 10-year yields of emerging markets to the three surprises grouped by regions to better assess the cross-country heterogeneity.[49]

### 5.1.1 Target Surprises

Figure 6 shows the response of emerging market yields to a target easing surprise. Although the magnitude of the contemporaneous yield response is lower than in the U.S., it builds over time. This delayed response is documented by Brooks et al. (2019) for the U.S. and by Adrian et al. (2019) for a sample mostly comprising advanced economies,[50] which they attribute to a portfolio rebalancing channel and slow-moving capital. Although the U.S. Treasuries market is deep and liquid, some players (like pension funds and foreign investors) might respond gradually. Moreover, the reaction of emerging market yields to forward guidance and asset purchase surprises is also sluggish, as discussed later; therefore, slow-moving capital is also present in the bonds of emerging markets.

Looking at the effects of a target easing surprise on the yield components in figure 6, investors expect central banks in emerging markets to follow the monetary stance of the Fed rather than counteract it, as can be seen in the eventual decline of the expected future short rate. The term premia at the short end also declines a few days after the surprise. Notice that the credit risk compensation turns out to be an important factor to understand the transmission of U.S. monetary policy to emerging market yields.

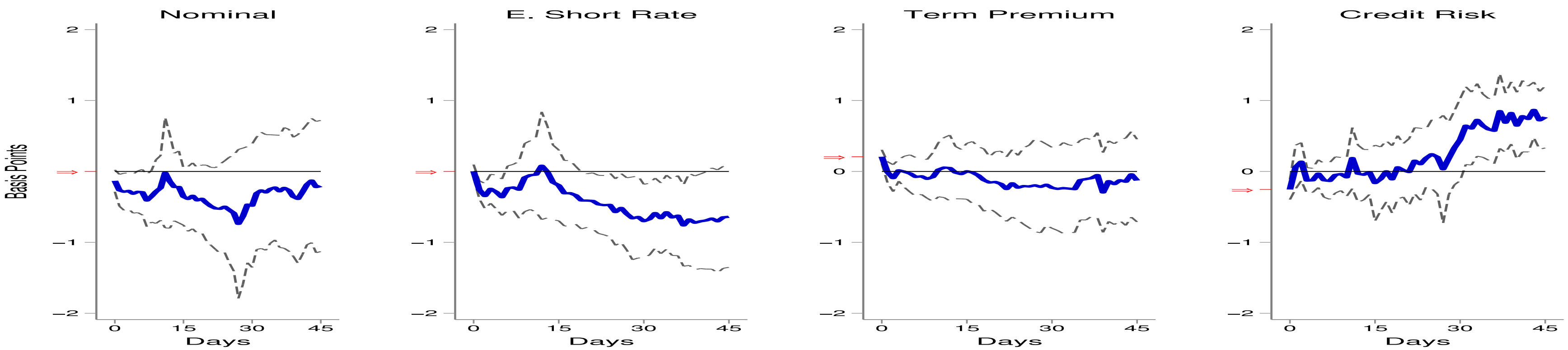
While there is no effect on the credit risk compensation at the short end, it initially declines at the long end and eventually increases one month after the surprise. Intuitively, loose financial conditions in the U.S. trigger a 'reach-for-yield' behavior among investors (Hausman and Wongswan, 2011) that incentivizes more borrowing in emerging markets by sovereigns in local currency (Bigio et al., 2018) and corporates in foreign currency (Turner,

yield curve to construct the synthetic yields (see equation (1)). This figure can be combined with the rightmost columns in figures 6, 9 and D.9, and the leftmost columns in figures D.4, D.7 and D.8 to see the spillovers using the alternative decomposition of emerging market yields mentioned in footnote 7.

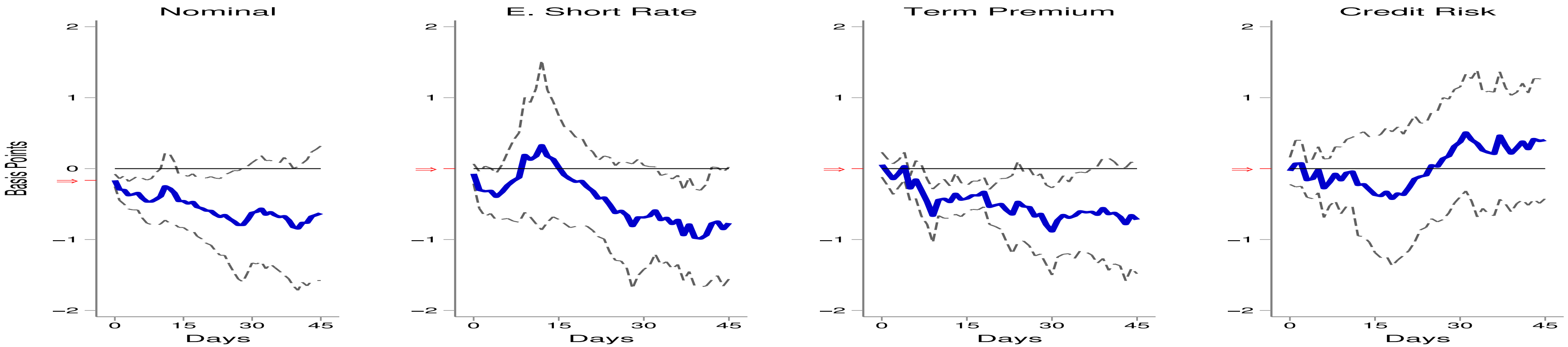
[49] The emerging markets in the sample are classified in four regions. Latin America: Brazil, Colombia, Mexico and Peru. Emerging Europe: Hungary, Poland and Russia. Emerging Asia: Indonesia, Korea, Malaysia, Philippines and Thailand. Middle East and Africa: Israel, Turkey and South Africa.

[50] It is also seen in the responses of U.S. yields reported in appendix D.

**Figure 6.** Response of the Yield Curve to a Target Surprise



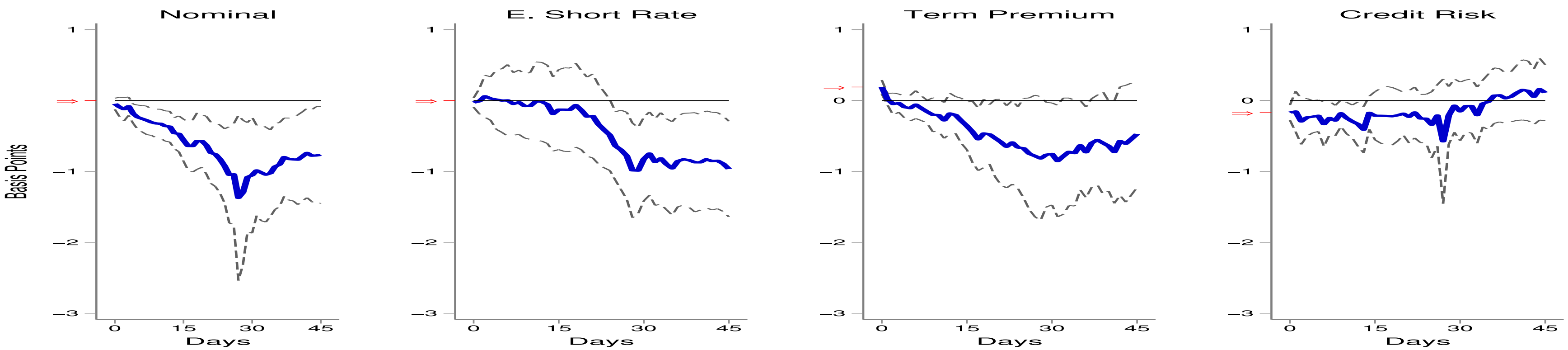

**(a)** 10-Year Yield



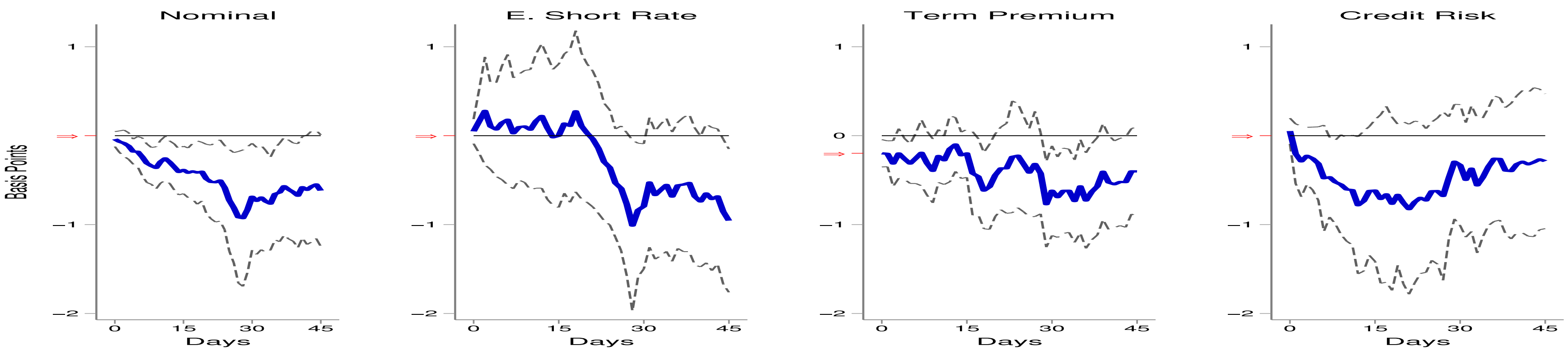

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year emerging market nominal yields and their components to a target easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Target surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure 7.** Response of the Yield Curve to a Forward Guidance Surprise: 2000-2008



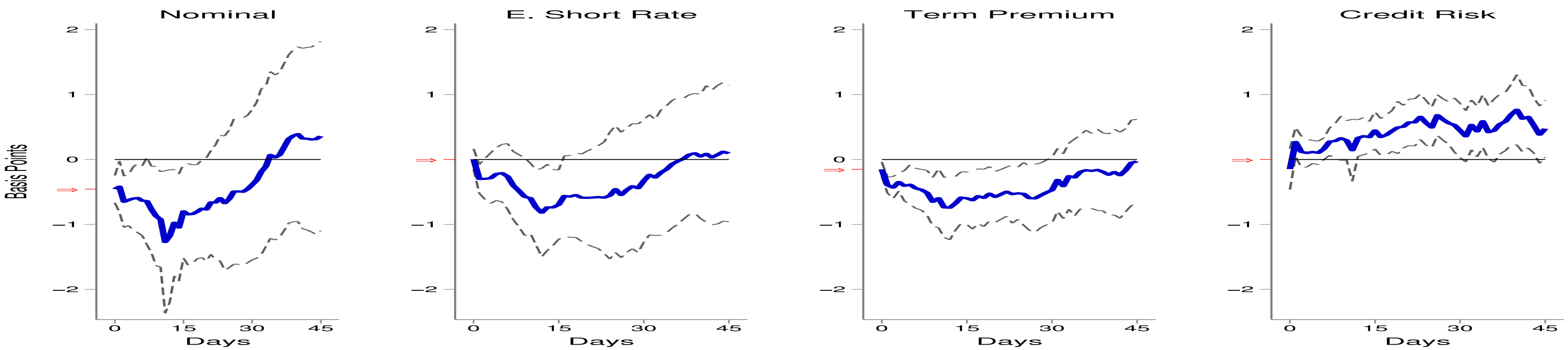

**(a)** 10-Year Yield



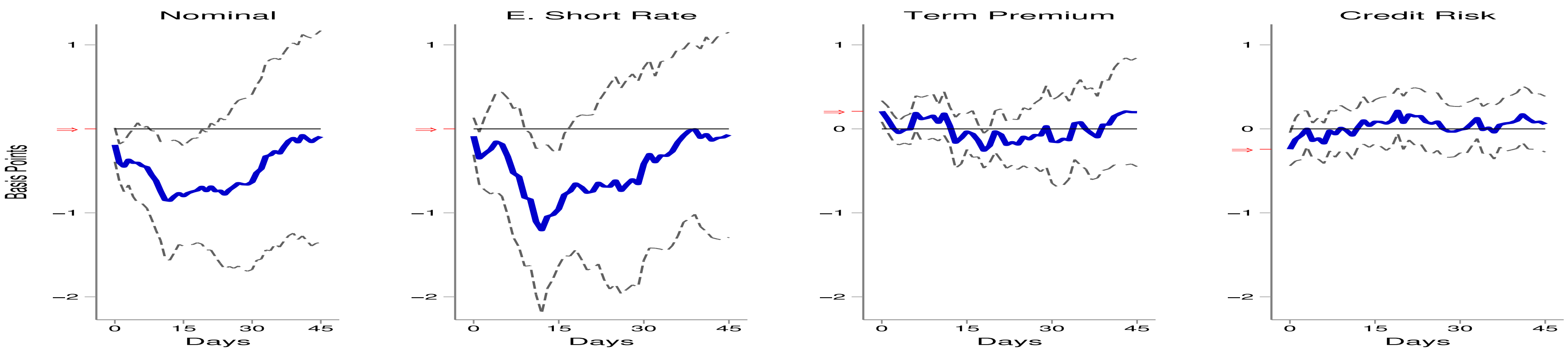

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year emerging market nominal yields and their components to a forward guidance easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure 8.** Response of the Yield Curve to a Forward Guidance Surprise: 2008-2019



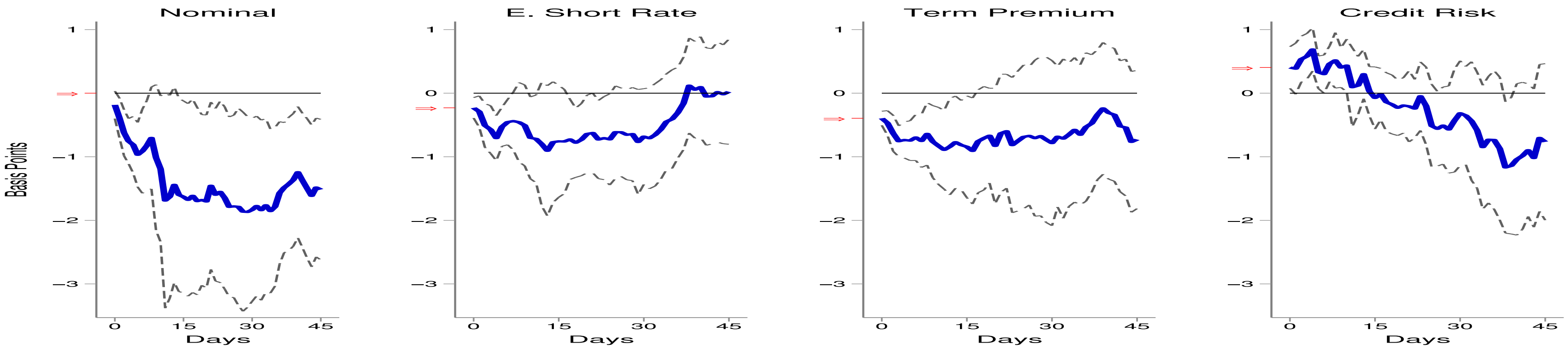

**(a)** 10-Year Yield




**(b)** 2-Year Yield

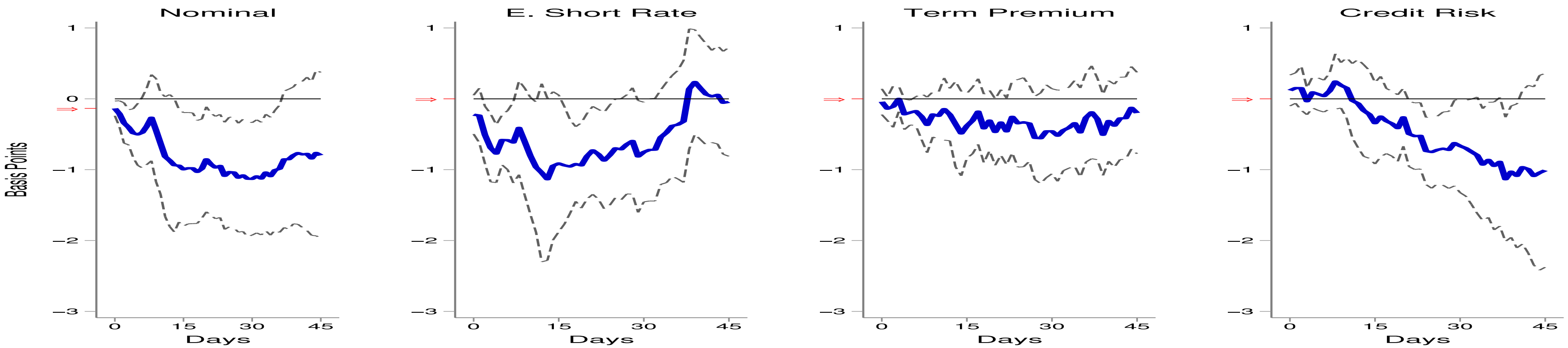
*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year emerging market nominal yields and their components to a forward guidance easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure 9.** Response of the Yield Curve to an Asset Purchase Surprise




**(a)** 10-Year Yield






**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year emerging market nominal yields and their components to an asset purchase easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Asset purchase surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

2014), increasing the sovereign default risk in emerging markets (Du and Schreger, 2022). In which case, the price of default risk (not necessarily the risk itself) increases. In line with this, Jeanneret and Souissi (2016) conclude that global factors affect investors' compensation for holding sovereign credit risk, but not the risk itself. The effect on the credit risk compensation at the long end is driven by the European and Asian countries (see figures D.11 and D.12).

In sum, economically significant spillovers from target easing surprises build over time reducing the expected future short rate and the term premium (at the short end), but increasing the credit risk compensation at the long end.

### 5.1.2 Forward Guidance Surprises

Since U.S. monetary policy spillovers to long-term yields increased after the global financial crisis (Albagli et al., 2019), figures 7 and 8 display the responses of emerging market yields to a forward guidance easing surprise before and after October 2008, respectively.[51] In both cases, the yield responses are sluggish.

Before the global financial crisis, a forward guidance easing surprise led to a downward parallel shift in the yield curves of emerging markets in the month following the surprise. The effect on emerging market yields lasted longer than on U.S. yields (cf. figure D.5), and was generally driven by declines in the expected future short rate at the long end and in the term premium *at the short end*.

After the global financial crisis, the transmission of forward guidance easing surprises changed. The reduction in the expected future short rate mainly happens at the short end, whereas in the term premium occurs *at the long end*. This effect on the term premium is usually associated with unconventional easing policies. In addition, the decline in the nominal yields of emerging markets at the long end lasts less than in long-term U.S. yields. Therefore, the nominal yield curve in emerging markets steepens relative to the U.S. yield curve in the month following the surprise, so the nominal-synthetic spread in emerging market yields widens at the long end, primarily in Asian countries (see figure

[51]Figure D.9 in the appendix reports the results for the whole sample period.

D.14). The intuition is similar as for target surprises, in which loose future financial conditions increase the price of default risk.

The characterization of the response of the term premia to forward guidance surprises is where accounting for credit risk pays off. By signaling a loose future path for the federal funds rate, the Fed attempts to reduce long-term U.S. yields mainly by reducing the term premium (see figure D.6). Figure 8 shows that the response of the term premia is similar in emerging markets than in the U.S., since forward guidance easing surprises also reduce the term premia in emerging market yields at the long end, in line with Turner (2014). If, instead, credit risk were to be ignored, one would incorrectly conclude that forward guidance does not affect the term premia in emerging markets. The reason is that the 'clean' term premium and the credit risk compensation components respond in opposite directions with magnitudes that almost offset each other, so there is no net effect in the term premium contaminated with credit risk.

### 5.1.3 Asset Purchase Surprises

Figure 9 displays the response of emerging market yields to an asset purchase easing surprise. Asset purchase surprises not only give rise to sluggish responses in the yields, as target and forward guidance surprises do, but their effects last longer in emerging market yields than in U.S. yields. This result suggests that portfolio rebalancing involving emerging market bonds following asset purchases is slower.

An asset purchase easing surprise also flattens the yield curve in emerging markets, similar to the effect on the U.S. yield curve (see figure D.7). In both cases, the effect at the long end is larger than at the short end over time. The on-impact response of U.S. yields is larger, whereas the response of the nominal yields of emerging markets lasts longer. These two effects in turn explain the response of the credit risk compensation at the long end, which initially increases followed by a sluggish and considerable decline. The counterintuitive initial increase is more a reflection of the response in the U.S. Treasuries market than on the bond markets in emerging economies. Indeed, an asset purchase easing surprise triggers a strong investor reaction in the U.S. Treasuries market, leading to a more than one-to-one on-impact decline in the long-term U.S. yield (see figure D.7a).

As for forward guidance surprises after the global financial crisis, the reduction in the term premium happens at the long end. This effect is widespread across emerging market regions (see figures D.15 and D.16).

Overall, U.S. monetary policy is an important driver of emerging market yields. Appendix B shows that the long-term yields of emerging markets comove less than those of advanced economies and that the components of emerging market yields comove similarly, while the term premium in advanced economies has been increasingly correlated over time due to the risk attitudes of global bond investors (Adrian et al., 2019). These results suggest that local investors remain key holders of emerging market bonds, so their yields are largely determined by domestic factors. Regardless, U.S. monetary policy is able to influence those yields through all their components. Importantly, U.S. unconventional easing policies spread abroad; in fact, their spillovers are more persistent than conventional policies. Lastly, through their effect on the compensation for credit risk, U.S. monetary policies could be seen as having fiscal implications in emerging markets.

## 5.2 The Yield Curve Channel

The influence of U.S. monetary policy on emerging market yields can also be seen through the link between the yield components, henceforth referred to as the yield curve channel. The literature describes different mechanisms through which U.S. yields can influence the yields of emerging markets. Since long-term yields are more influenced by global forces than short-term yields, Obstfeld (2015) argues that central banks exert more control over the short rather than the long end of their yield curves. In addition, changes in the U.S. term premium can spill over into the term premia of emerging markets (Turner, 2014), and into the expected future short rate, particularly at the short end, due to risk spillovers (Kalemli-Özcan, 2019).

The assessment of the yield curve channel requires the decomposition of U.S. and emerging market yields. The goal is to assess the role of the components of U.S. yields (the average expected future short rate and the term premium) in explaining the components of emerging market yields at different maturities. For this purpose, I run the following panel regressions using monthly data

$$y_{i,t} = \alpha_i + \gamma_1' z_{i,t}^1 + \gamma_2' z_{i,t}^2 + u_{i,t}, \tag{19}$$

in which $\alpha_i$ are country fixed effects, $z_{i,t}^1$ is a vector containing the components of the U.S. yield curve, $z_{i,t}^2$ is a vector of global and domestic variables that potentially drive emerging market yields, and $u_{i,t}$ is the error term. The dependent variable $y_{i,t}$ is either the nominal yield or any of its three components for both 10- and 2-year maturities.[52] As before, I use Driscoll–Kraay standard errors to test for significance.[53]

The explanatory variables of interest are the components of U.S. yields at corresponding maturities. Again, the decomposition of U.S. yields comes from the model of Kim and Wright (2005). I control for the domestic monetary stance and local macroeconomic conditions by using the policy rate reported by each country to the Bank for International Settlements, as well as domestic inflation and unemployment rates. Rey (2013) highlights the role of the Cboe Volatility Index (VIX) as an important driver of the global financial cycle, which reflects the implied volatility in stock option prices and is usually seen as a measure of risk aversion and economic uncertainty.[54] Baker et al. (2016) construct a news-based economic policy uncertainty (EPU) index that serves as the basis for the global and U.S. versions,[55] which are used as alternative, and arguably exogenous, measures of global uncertainty. The index of global economic activity proposed by Hamilton (2021) captures real variables. Finally, the exchange rate (LC per USD) is included to rule out explanations of changes in yields due to currency movements; the exchange rate is standardized for each country over the sample period.

The results reported in tables 5 and 6 are in line with the yield curve channel.[56] On

[52] Kalemli-Özcan (2019) focuses on yields with maturities up to 1 year. The shortest maturity for which the decomposition of U.S. yields is available is the 1-year one, but I focus here on the 2-year yield because it is a benchmark commonly used by market participants. Nevertheless, the conclusions based on the 10- and 2-year maturities carry over to the 5- and 1-year maturities, see appendix C.

[53] The Pesaran test of cross-sectional independence is rejected in all cases at the 1% significance level.

[54] Given the sudden spikes in the index, it is common to use it in logs. For consistency, the other uncertainty indexes are also used in logs.

[55] Although the EPU index has been replicated for different countries, it is only available for five of the emerging markets in the sample: Brazil, Colombia, Mexico, Russia and South Korea.

[56] The tables report the estimates for the full specification of the model. The results are robust to

the one hand, the response of the average expected future short rates of emerging markets to the domestic policy rate decreases with maturity and is positively associated with its U.S. counterpart only at the long end, both results are in line with the argument that monetary autonomy is stronger at the short end than at the long end of the curve.[57]

On the other hand, the U.S. term premium is an important driver of emerging market yields. First, the term premia in emerging markets are positively associated with the U.S. term premium and the VIX only at the long end, both results align with the claim that the global financial cycle (represented here by those two variables) is more relevant for the long end than for the short end of the curve (Obstfeld, 2015). Second, the U.S. term premium not only influences the yields in emerging markets through its effect on their term premia, as suggested by Turner (2014), but through the other components too. In particular, the influence on the average expected future short rates of emerging markets supports the risk spillovers mechanism highlighted by Kalemli-Özcan (2019), which can be directly tested thanks to the yield decompositions; further, those risk spillovers are indeed stronger at the short end and operate through the U.S. term premium rather than the VIX.[58] Importantly, these conclusions would be different if default risk in emerging market yields were to be ignored since the term premium and the credit risk compensation would be mixed together.

In addition to direct and cross relationships between the components of U.S. and emerging market yields described in the literature, U.S. yield components are negatively associated with the credit risk compensation in emerging markets, especially at the long end. Similar to the findings for the different types of U.S. monetary policy surprises, changes in the U.S. yield curve can thus have fiscal implications in emerging markets.

A glimpse on the drivers of emerging market yields is a byproduct of the analysis on the yield curve channel. First, local factors are important drivers of emerging market yields. In particular, the term premium and the credit risk compensation are countercyclical,

specifications of the model that progressively include the regressors for each dependent variable.

[57]In line with this, appendix B shows that the long end of the yield curves of emerging markets comoves relatively more than the short end.

[58]The effects of U.S. unconventional monetary policies reported in figures 8 and 9 are in line with these findings. Namely, forward guidance (after 2008) and asset purchase easing surprises reduce the term premia at the long end and the expectation for the policy rate at the short end.

**Table 5.** Drivers of the Emerging Market 10-Year Nominal Yield and Its Components

| | Nominal | E. Short Rate | Term Premium | Credit Risk |
|---|---|---|---|---|
| U.S. Term Premium | 0.93*** | 0.56*** | 0.71*** | -0.31*** |
| | (0.12) | (0.08) | (0.06) | (0.08) |
| U.S. E. Short Rate | 0.18* | 0.36*** | 0.00 | -0.22*** |
| | (0.09) | (0.05) | (0.04) | (0.06) |
| Local Policy Rate | 0.27*** | 0.44*** | -0.10*** | -0.04*** |
| | (0.02) | (0.02) | (0.02) | (0.01) |
| Inflation | 12.81*** | 4.25 | 4.51** | 3.68* |
| | (2.26) | (2.28) | (1.43) | (1.43) |
| Unemployment | 22.23*** | 0.38 | 9.80*** | 11.29*** |
| | (2.67) | (2.48) | (2.33) | (1.52) |
| LC per USD (Std.) | 45.60*** | 39.22*** | 20.29*** | -9.65* |
| | (6.44) | (4.87) | (2.35) | (3.99) |
| Log(VIX) | 46.29*** | -9.70 | 19.37* | 37.19*** |
| | (11.35) | (10.81) | (7.76) | (7.65) |
| Log(EPU U.S.) | 5.51 | -8.65* | 2.90 | 10.73* |
| | (5.88) | (3.60) | (2.01) | (4.14) |
| Log(EPU Global) | -51.07** | -32.41** | -11.72 | -10.27 |
| | (19.56) | (10.45) | (10.02) | (9.38) |
| Global Ind. Prod. | 0.78 | -0.98 | 0.97* | 0.92 |
| | (1.06) | (0.89) | (0.40) | (0.85) |
| Fixed Effects | Yes | Yes | Yes | Yes |
| Lags | 4 | 4 | 4 | 4 |
| No. Countries | 15 | 15 | 15 | 15 |
| Observations | 2493 | 2493 | 2493 | 2493 |
| $R^2$ | 0.69 | 0.76 | 0.31 | 0.25 |

*Notes:* This table reports the estimated slope coefficients of panel data regressions of the 10-year nominal yield and its components (expected short rate, term premium and credit risk compensation) on selected explanatory variables. The sample includes monthly data for 15 emerging markets starting in 2000:1 and ending in 2021:7. The dependent variables are expressed in basis points. The explanatory variables are the U.S. term premium and the U.S. expected short rate according to Kim and Wright (2005) with the same maturity as the dependent variables, the policy rate, domestic inflation and unemployment, the standardized exchange rate (local currency per USD), the log of the VIX, the log of the U.S. and global economic policy uncertainty indexes based on Baker et al. (2016), the global economic activity index of Hamilton (2021). Driscoll–Kraay standard errors in parenthesis. The lag length up to which the residuals may be autocorrelated is indicated. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

**Table 6.** Drivers of the Emerging Market 2-Year Nominal Yield and Its Components

| | Nominal | E. Short Rate | Term Premium | Credit Risk |
|---|---|---|---|---|
| U.S. Term Premium | 1.73*** | 1.55*** | 0.23 | -0.19 |
| | (0.19) | (0.22) | (0.13) | (0.18) |
| U.S. E. Short Rate | -0.02 | 0.05 | 0.06*** | -0.14*** |
| | (0.03) | (0.04) | (0.02) | (0.03) |
| Local Policy Rate | 0.64*** | 0.67*** | -0.00 | 0.01 |
| | (0.02) | (0.03) | (0.01) | (0.02) |
| Inflation | 7.26** | 4.15 | 4.09* | 1.57 |
| | (2.24) | (3.07) | (1.66) | (1.81) |
| Unemployment | 6.11** | 0.71 | 0.75 | 5.25** |
| | (2.20) | (2.70) | (1.26) | (1.63) |
| LC per USD (Std.) | 24.36*** | 27.19*** | 21.60*** | -14.43** |
| | (5.06) | (5.37) | (3.19) | (4.64) |
| Log(VIX) | 45.06*** | -3.22 | -13.84* | 62.28*** |
| | (7.33) | (14.30) | (5.85) | (11.57) |
| Log(EPU U.S.) | 6.31 | -4.79 | -2.43 | 10.92** |
| | (3.76) | (5.21) | (2.24) | (3.85) |
| Log(EPU Global) | -53.73*** | -34.24** | -6.50 | -9.61 |
| | (12.73) | (12.25) | (6.99) | (9.18) |
| Global Ind. Prod. | 2.34*** | -1.94* | 0.17 | 3.40*** |
| | (0.59) | (0.97) | (0.47) | (0.77) |
| Fixed Effects | Yes | Yes | Yes | Yes |
| Lags | 4 | 4 | 4 | 4 |
| No. Countries | 15 | 15 | 15 | 15 |
| Observations | 2493 | 2493 | 2493 | 2493 |
| $R^2$ | 0.82 | 0.78 | 0.18 | 0.30 |

*Notes:* This table reports the estimated slope coefficients of panel data regressions of the 2-year nominal yield and its components (expected short rate, term premium and credit risk compensation) on selected explanatory variables. The sample includes monthly data for 15 emerging markets starting in 2000:1 and ending in 2021:7. The dependent variables are expressed in basis points. The explanatory variables are the U.S. term premium and the U.S. expected short rate according to Kim and Wright (2005) with the same maturity as the dependent variables, the policy rate, domestic inflation and unemployment, the standardized exchange rate (local currency per USD), the log of the VIX, the log of the U.S. and global economic policy uncertainty indexes based on Baker et al. (2016), the global economic activity index of Hamilton (2021). Driscoll–Kraay standard errors in parenthesis. The lag length up to which the residuals may be autocorrelated is indicated. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

investors demand higher compensations during recessions, when the unemployment rate increases. Moreover, the positive association between inflation and the term premium conforms with the idea that inflation erodes the value of nominal bonds and so, in periods of rising inflation investors demand a higher term premium. Second, as expected for measures of risk and uncertainty, changes in the VIX are positively associated with the term premium (at the long end) and the credit risk compensation.

In summary, the direct and cross relationships between the components of U.S. and emerging market yields align with the yield curve channel. This suggests that emerging market central banks exert relatively more control over the short end of their yield curves (Obstfeld, 2015), but remain vulnerable to global risks even when they borrow in local currency (Carstens and Shin, 2019).

# 6 Concluding Remarks

This paper decomposes the sovereign yields of 15 emerging markets taking into account the credit risk embedded in them, and empirically quantifies the transmission channels of U.S. monetary policy to them. Emerging market nominal yields are decomposed into an average expected future short rate, a term premium and compensation for credit risk.

Surprises in U.S. monetary policy lead to a reassessment of policy rate expectations and a repricing of interest rate and credit risks in emerging markets. Specifically, investors expect monetary authorities in emerging markets to follow the monetary stance of the Fed rather than counteract it, the response to unconventional policies of the term premia in emerging markets is similar to that of the U.S. term premium, and Fed's monetary policy decisions also affect investors' compensation for holding emerging markets' sovereign credit risk. This effect on credit risk is a prospective area for future research.

Overall, to adequately characterize the transmission channels of U.S. monetary policy, it is important to distinguish between the different types of surprise in U.S. monetary policy, to explicitly account for credit risk in emerging market yields and to examine the effects at different maturities.

The results presented here can be extended in several directions. The proposed three-part decomposition of emerging market yields has many potential applications, such as analyzing the transmission of monetary policy domestically and further decomposing each part (e.g., average expected short rates can be split into inflation and real interest rate expectations). The results might also inform theoretical models for pricing sovereign defaultable bonds. Finally, monetary policy surprises from other central banks in advanced economies could be included in the analysis of spillovers to see whether and how they influence the yields of emerging markets.

# Appendix

## A A Proxy for Long-Term Inflation Forecasts

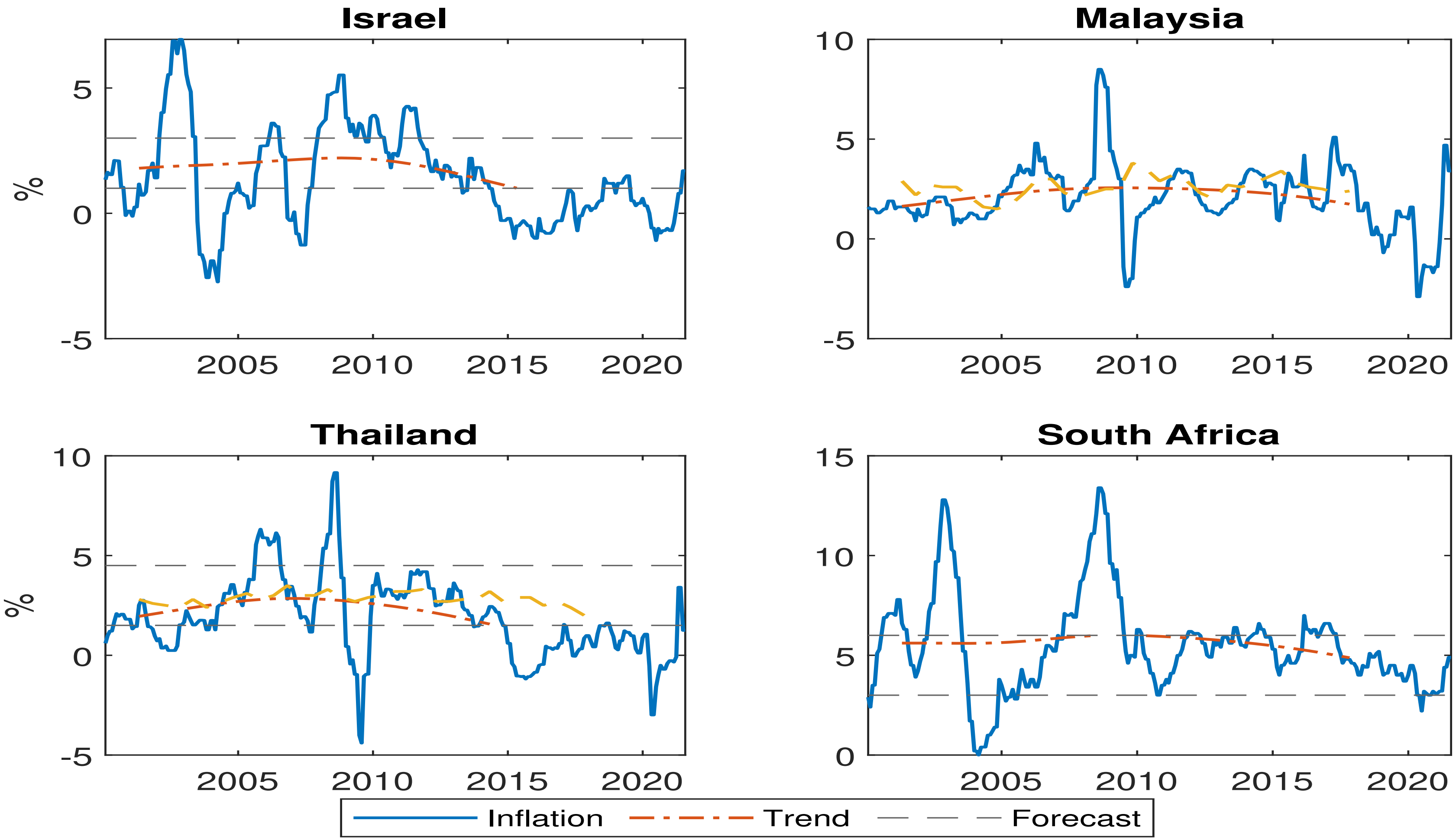
An advantage of the small open economy approach to infer long-term forecasts for the short rate is that, for emerging markets, it only requires data on inflation forecasts, or a proxy in the case of countries with no long-term forecasts available as is the case for Israel and South Africa.

Inflation expectations are hoped to match measures of inflation that exclude unexpected shocks and better reflect the inflation environment. Different measures of core inflation exist. I use the inflation trend obtained by applying the Hodrick–Prescott filter to the series of realized inflation of each country.

There are two main concerns for using this approach. Namely, the filter is sensitive to the sample period used and the resulting trend can be outside of the target inflation band due to the innate dynamics of the series, which would be at odds with survey data (see figure 1). In the case of Israel and South Africa, however, there is no marked upward or downward trend in their inflation during the sample period. Therefore, for both countries, trend inflation is calculated for the whole period for which survey data is available for the rest of the countries in the sample, and as long as the resulting trend is within the respective inflation target band.

Figure A.1 shows the realized and trend inflation for Israel and South Africa along with those of Malaysia and Thailand, two countries with a similar pattern for inflation (i.e., no marked upward or downward trend) and for which survey data is available. The figure shows that trend inflation seems to be a good proxy for the long-term inflation forecasts in Malaysia and Thailand. Also, as can be seen in the main text (figure 1), 5-year and long-term inflation forecasts follow each other closely, therefore trend inflation is used as the proxy for both the 5-year and the long-term inflation forecasts in the case of Israel and South Africa.

**Figure A.1.** Inflation Trend and Long-Horizon Forecast for Inflation




*Notes:* This figure plots the consumer price inflation (solid line), inflation trend based on the Hodrick–Prescott filter (dash-dotted line) and long-term inflation forecast (dashed line) for each country. The figure includes the the most recent upper and lower bounds for the domestic inflation target.

# B Comovement of Yields

This section shows that the long end of the yield curves of emerging markets comoves relatively more than the short end, that synthetic yields comove relatively more than nominal yields, and that the components of emerging market yields comove similarly.

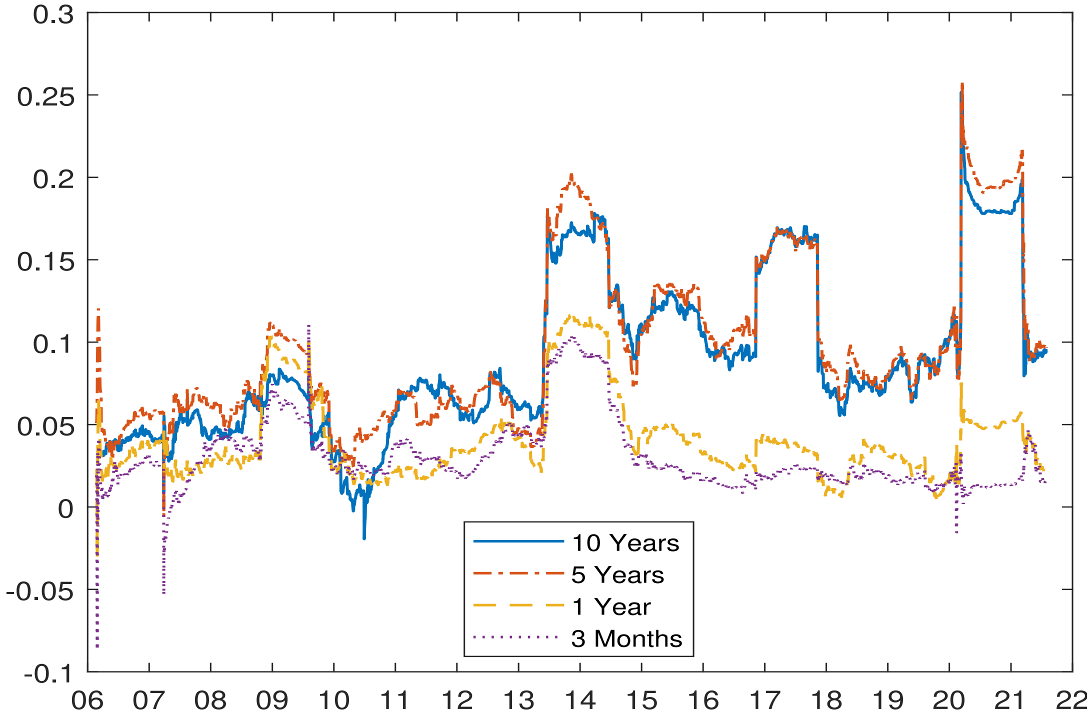
Two indicators help in assessing the comovement of yields. One approach is to use rolling correlations of daily yield changes. Another approach is to use the connectedness index of Diebold and Yilmaz (2014), which assesses shares of forecast error variation in a country's yields due to shocks arising elsewhere; the index ranges from 0 to 100%.

The long-term yields of emerging markets comove relatively more than short-term ones, yet local factors remain relevant. Figures B.1 and B.2 use each indicator to capture the comovement of the nominal yields of emerging markets and advanced economies at different maturities. Both figures exhibit the same patterns. In particular, they show that the long-term yields of emerging markets became more connected after the global financial crisis, and more so since the 2013 taper tantrum; whereas those of advanced economies have been more connected since the beginning of the sample period. Intuitively, shocks to emerging market yields are mainly idiosyncratic. Moreover, regardless of the indicator, the level of comovement among the long-term yields of emerging markets is less than half relative to advanced economies, suggesting that local investors remain key holders of their long-term bonds. The low connectedness among emerging market yields supports estimating the term structure models for their yield curves separately rather than jointly.

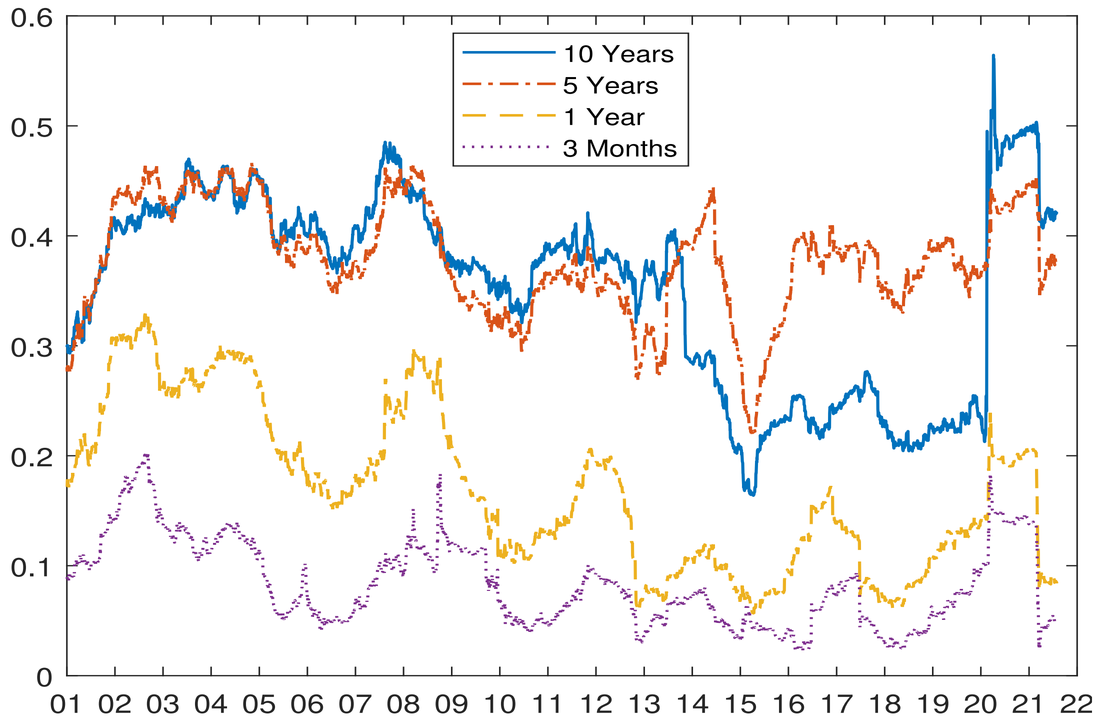
Synthetic yields comove relatively more than nominal yields. Figure B.3a compares the connectedness index for the nominal and synthetic yields of emerging markets. The level of the index for synthetic yields tends to be higher than for nominal yields, suggesting that the credit risk component is more idiosyncratic.

The components of emerging market yields comove similarly. Figure B.3b compares the connectedness index of their components. They all comove similarly, although the expected future short rate comoves slightly more over the sample period, suggesting that the monetary stance of some emerging markets tends to be aligned.

**Figure B.1.** Comovement of Yield Curves: Rolling Correlations



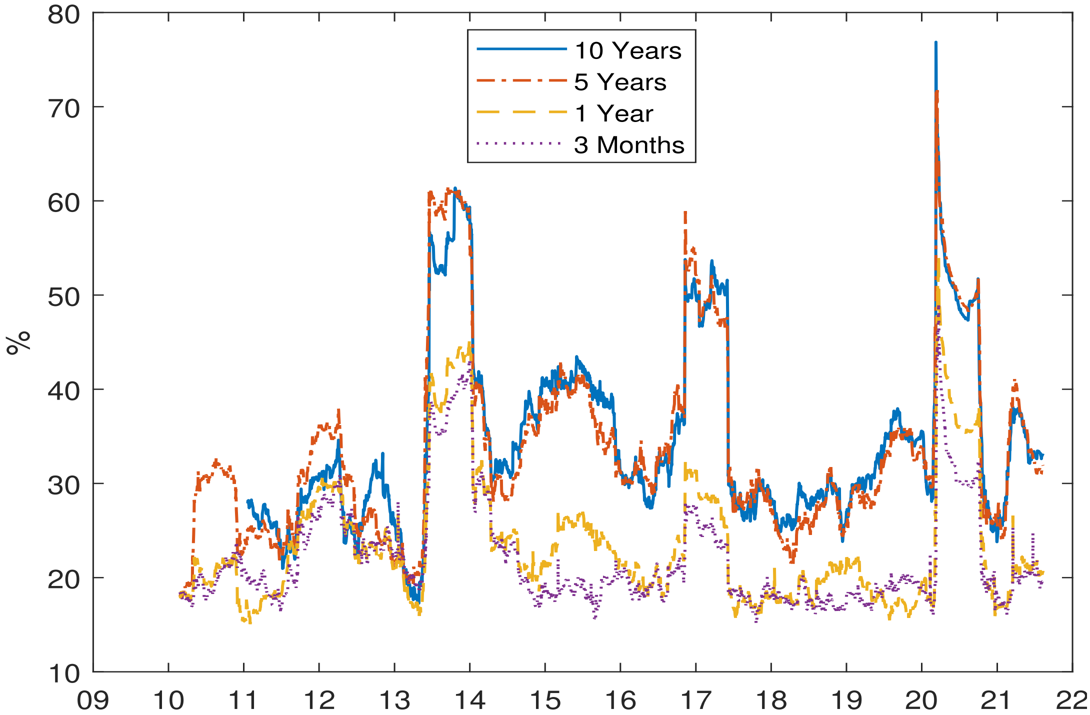

**(a)** Emerging Markets



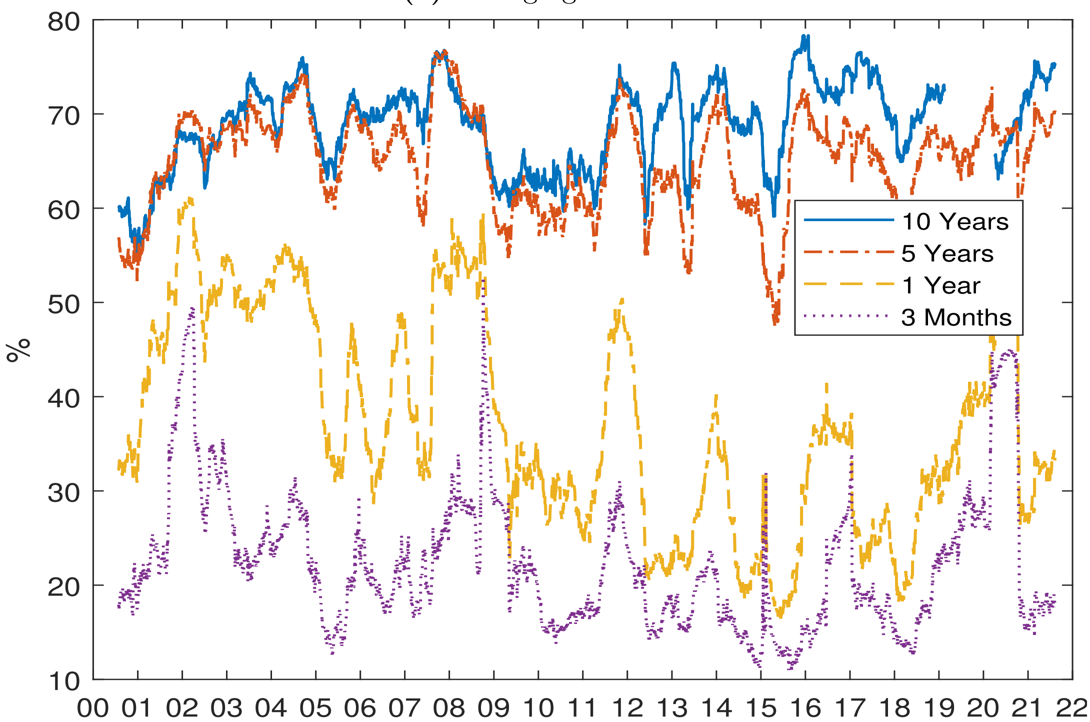

**(b)** Advanced Economies

*Notes:* This figure plots one-year rolling correlation coefficients of daily changes in the nominal yields of emerging markets (panel a) and advanced economies (panel b) averaged across country pairs for different maturities: 10 years (solid line), 5 years (dash-dotted line), 1 year (dashed line), and 3 months (dotted line).

**Figure B.2.** Comovement of Yield Curves: Connectedness Index



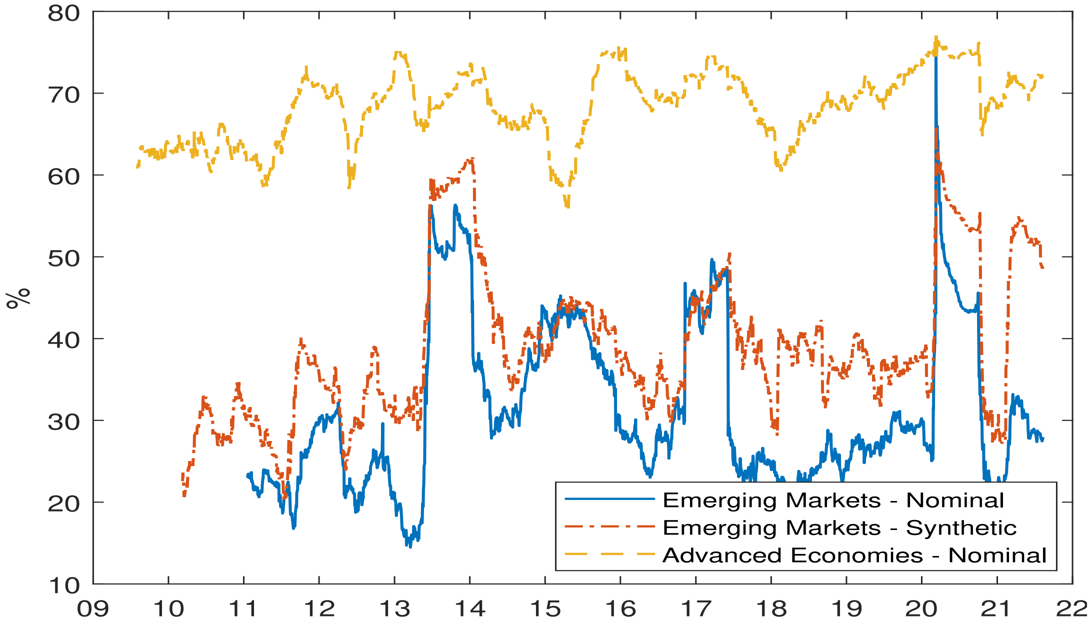

**(a)** Emerging Markets



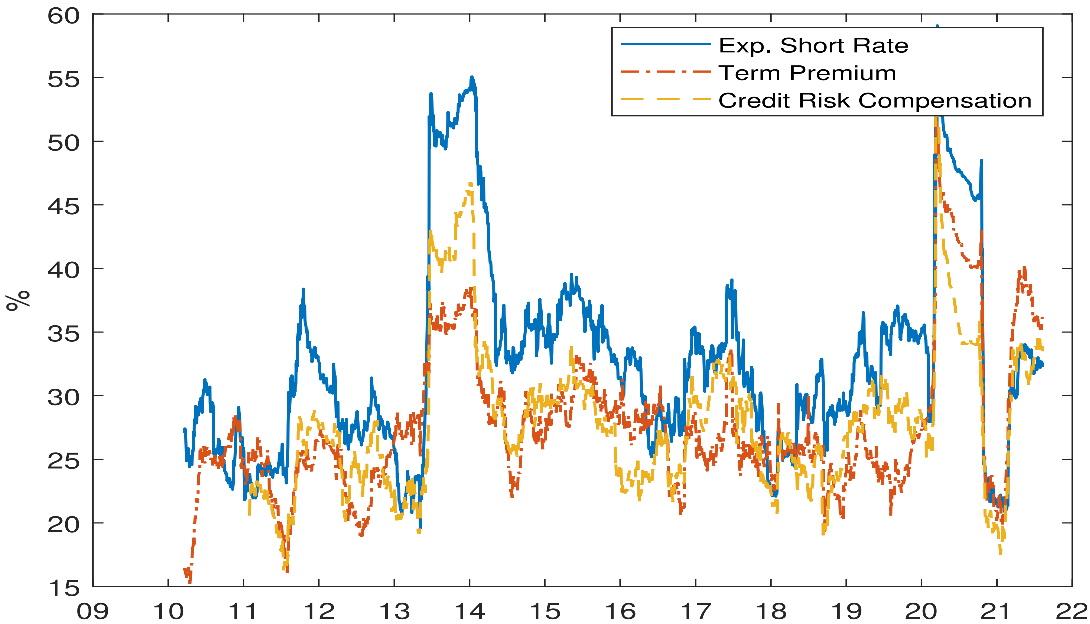

**(b)** Advanced Economies

*Notes:* This figure plots the connectedness index of Diebold and Yilmaz (2014) for the nominal yields of emerging markets (panel a) and advanced economies (panel b) for different maturities: 10 years (solid line), 5 years (dash-dotted line), 1 year (dashed line), and 3 months (dotted line). The index is obtained using a vector autoregression of order 1, with a forecast horizon of 10 days and a rolling window of 150 days for the daily changes of the nominal yields at each maturity, see Adrian et al. (2019) and Bostanci and Yilmaz (2020).

**Figure B.3.** Connectedness of 10-Year Yields and Components




**(a)** Nominal and Synthetic Yields




**(b)** Nominal Yield Components

*Notes:* This figure plots the connectedness index of Diebold and Yilmaz (2014) for 10-year yields. Panel (a) compares the connectedness index of nominal (solid line) and synthetic (dash-dotted line) yields of emerging markets and the nominal (dashed line) yields of advanced economies. Panel (b) compares the connectedness index of each component of the nominal yields of emerging markets: the expected future short rate (solid line), the term premium (dash-dotted line) and the credit risk compensation (dashed line). The index for some components has a shorter history because its computation requires a balanced panel and the components do not start on the same date (e.g., the construction of the synthetic curves does not involve nominal yields). The index is obtained using a vector autoregression of order 1, with a forecast horizon of 10 days and a rolling window of 150 days for the daily changes of the 10-year yields and their components.

## C Supplementary Tables

**Table C.1.** Drivers of the Emerging Market 5-Year Nominal Yield and Its Components

| | Nominal | E. Short Rate | Term Premium | Credit Risk |
|---|---|---|---|---|
| U.S. Term Premium | 1.31*** | 0.95*** | 0.58*** | -0.25* |
| | (0.15) | (0.12) | (0.07) | (0.12) |
| U.S. E. Short Rate | 0.06 | 0.20*** | 0.01 | -0.17*** |
| | (0.05) | (0.04) | (0.03) | (0.04) |
| Local Policy Rate | 0.44*** | 0.56*** | -0.08*** | -0.00 |
| | (0.02) | (0.03) | (0.01) | (0.02) |
| Inflation | 10.06*** | 4.33 | 3.49** | 2.58 |
| | (2.30) | (2.71) | (1.29) | (1.67) |
| Unemployment | 14.20*** | 0.83 | 5.69** | 7.53*** |
| | (2.65) | (2.67) | (1.99) | (1.76) |
| LC per USD (Std.) | 32.72*** | 30.89*** | 18.95*** | -12.92** |
| | (5.69) | (4.87) | (2.48) | (4.22) |
| Log(VIX) | 52.05*** | -6.76 | 9.55 | 49.41*** |
| | (9.12) | (13.19) | (5.69) | (10.16) |
| Log(EPU U.S.) | 6.51 | -7.07 | 3.02 | 9.08* |
| | (4.97) | (4.32) | (1.84) | (3.97) |
| Log(EPU Global) | -56.23*** | -27.38* | -16.93* | -13.46 |
| | (15.43) | (11.16) | (7.62) | (9.09) |
| Global Ind. Prod. | 1.85* | -1.46 | 1.08*** | 2.22* |
| | (0.79) | (0.96) | (0.29) | (0.87) |
| Fixed Effects | Yes | Yes | Yes | Yes |
| Lags | 4 | 4 | 4 | 4 |
| No. Countries | 15 | 15 | 15 | 15 |
| Observations | 2493 | 2493 | 2493 | 2493 |
| $R^2$ | 0.76 | 0.77 | 0.20 | 0.24 |

*Notes:* This table reports the estimated slope coefficients of panel data regressions of the 5-year nominal yield and its components (expected short rate, term premium and credit risk compensation) on selected explanatory variables. The sample includes monthly data for 15 emerging markets starting in 2000:1 and ending in 2021:7. The dependent variables are expressed in basis points. The explanatory variables are the U.S. term premium and the U.S. expected short rate according to Kim and Wright (2005) with the same maturity as the dependent variables, the policy rate, domestic inflation and unemployment, the standardized exchange rate (local currency per USD), the log of the VIX, the log of the U.S. and global economic policy uncertainty indexes based on Baker et al. (2016), the global economic activity index of Hamilton (2021). Driscoll–Kraay standard errors in parenthesis; lag length up to which the residuals may be autocorrelated is indicated. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

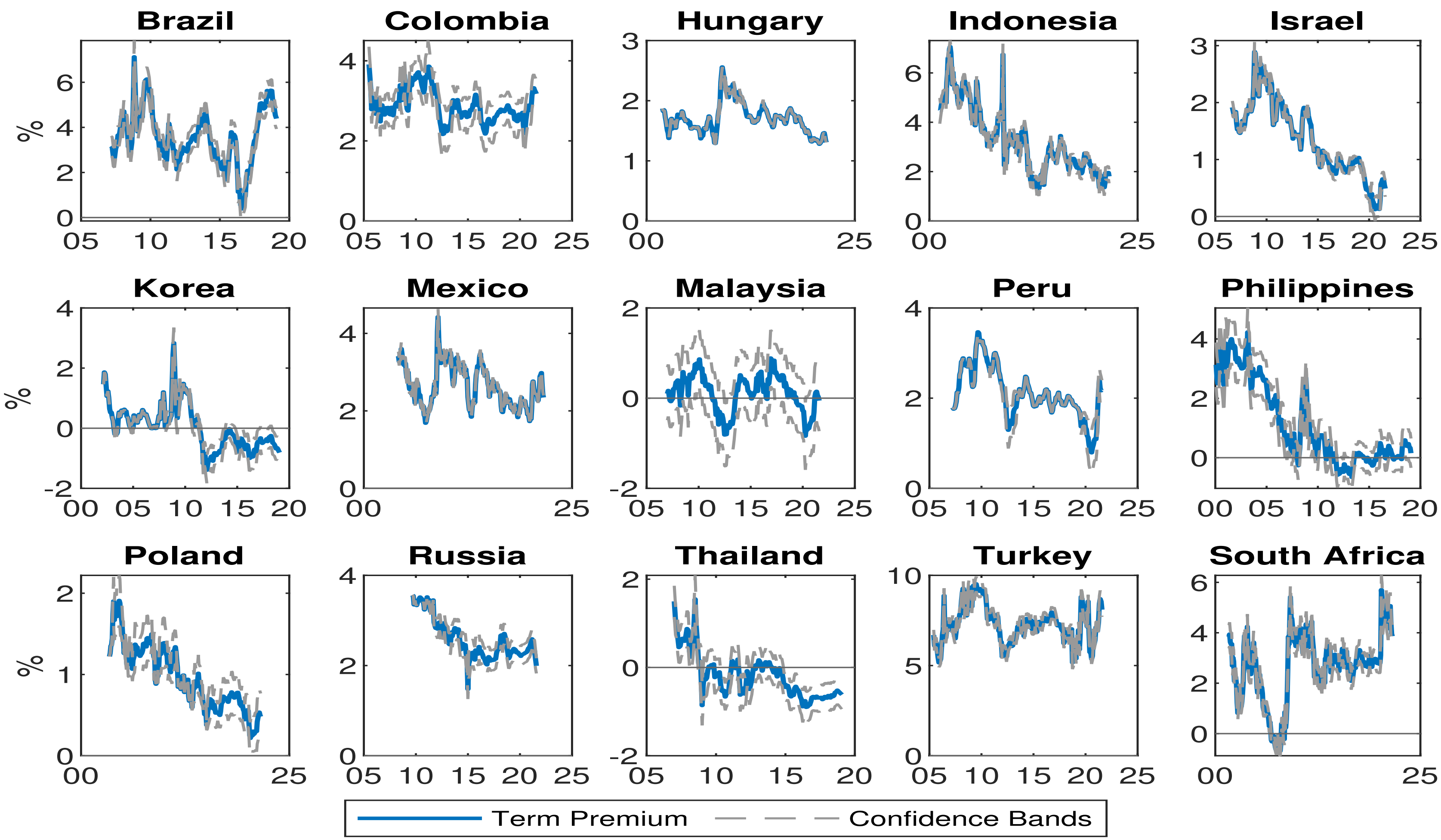
**Table C.2.** Drivers of the Emerging Market 1-Year Nominal Yield and Its Components

| | Nominal | E. Short Rate | Term Premium | Credit Risk |
|---|---|---|---|---|
| U.S. Term Premium | 2.16*** | 2.15*** | -0.14 | -0.07 |
| | (0.32) | (0.38) | (0.25) | (0.30) |
| U.S. E. Short Rate | -0.01 | 0.02 | 0.07*** | -0.12*** |
| | (0.03) | (0.04) | (0.02) | (0.03) |
| Local Policy Rate | 0.72*** | 0.75*** | 0.04** | -0.01 |
| | (0.02) | (0.03) | (0.02) | (0.02) |
| Inflation | 6.07** | 3.50 | 4.61* | 2.24 |
| | (2.29) | (3.21) | (1.96) | (1.58) |
| Unemployment | 3.33 | -0.05 | -1.62 | 4.51** |
| | (1.95) | (2.64) | (1.22) | (1.55) |
| LC per USD (Std.) | 25.90*** | 29.37*** | 21.59*** | -12.80** |
| | (5.00) | (5.68) | (3.69) | (4.71) |
| Log(VIX) | 34.13*** | -4.69 | -20.64** | 65.56*** |
| | (7.00) | (13.90) | (7.07) | (11.42) |
| Log(EPU U.S.) | 2.94 | -4.61 | -6.31* | 10.19** |
| | (3.26) | (5.85) | (2.46) | (3.87) |
| Log(EPU Global) | -44.88*** | -34.23** | 1.29 | -8.10 |
| | (11.84) | (12.77) | (7.86) | (8.89) |
| Global Ind. Prod. | 2.09** | -2.42** | -0.80 | 3.72*** |
| | (0.66) | (0.91) | (0.68) | (0.71) |
| Fixed Effects | Yes | Yes | Yes | Yes |
| Lags | 4 | 4 | 4 | 4 |
| No. Countries | 15 | 15 | 15 | 15 |
| Observations | 2493 | 2493 | 2493 | 2493 |
| $R^2$ | 0.84 | 0.78 | 0.20 | 0.27 |

*Notes:* This table reports the estimated slope coefficients of panel data regressions of the 1-year nominal yield and its components (expected short rate, term premium and credit risk compensation) on selected explanatory variables. The sample includes monthly data for 15 emerging markets starting in 2000:1 and ending in 2021:7. The dependent variables are expressed in basis points. The explanatory variables are the U.S. term premium and the U.S. expected short rate according to Kim and Wright (2005) with the same maturity as the dependent variables, the policy rate, domestic inflation and unemployment, the standardized exchange rate (local currency per USD), the log of the VIX, the log of the U.S. and global economic policy uncertainty indexes based on Baker et al. (2016), the global economic activity index of Hamilton (2021). Driscoll–Kraay standard errors in parenthesis; lag length up to which the residuals may be autocorrelated is indicated. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

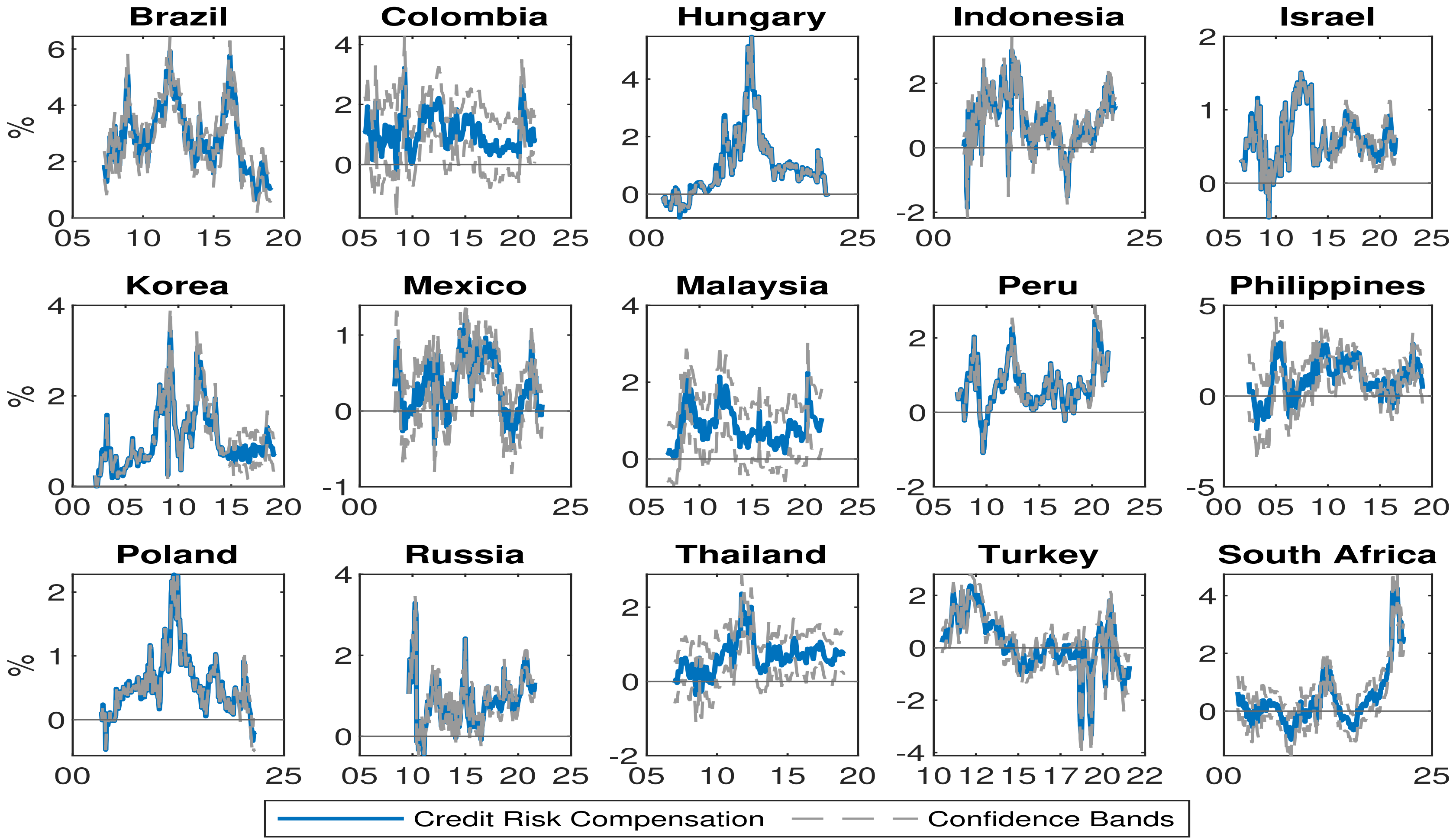
# D Supplementary Figures

**Figure D.1.** The 10-Year Term Premium of Emerging Markets



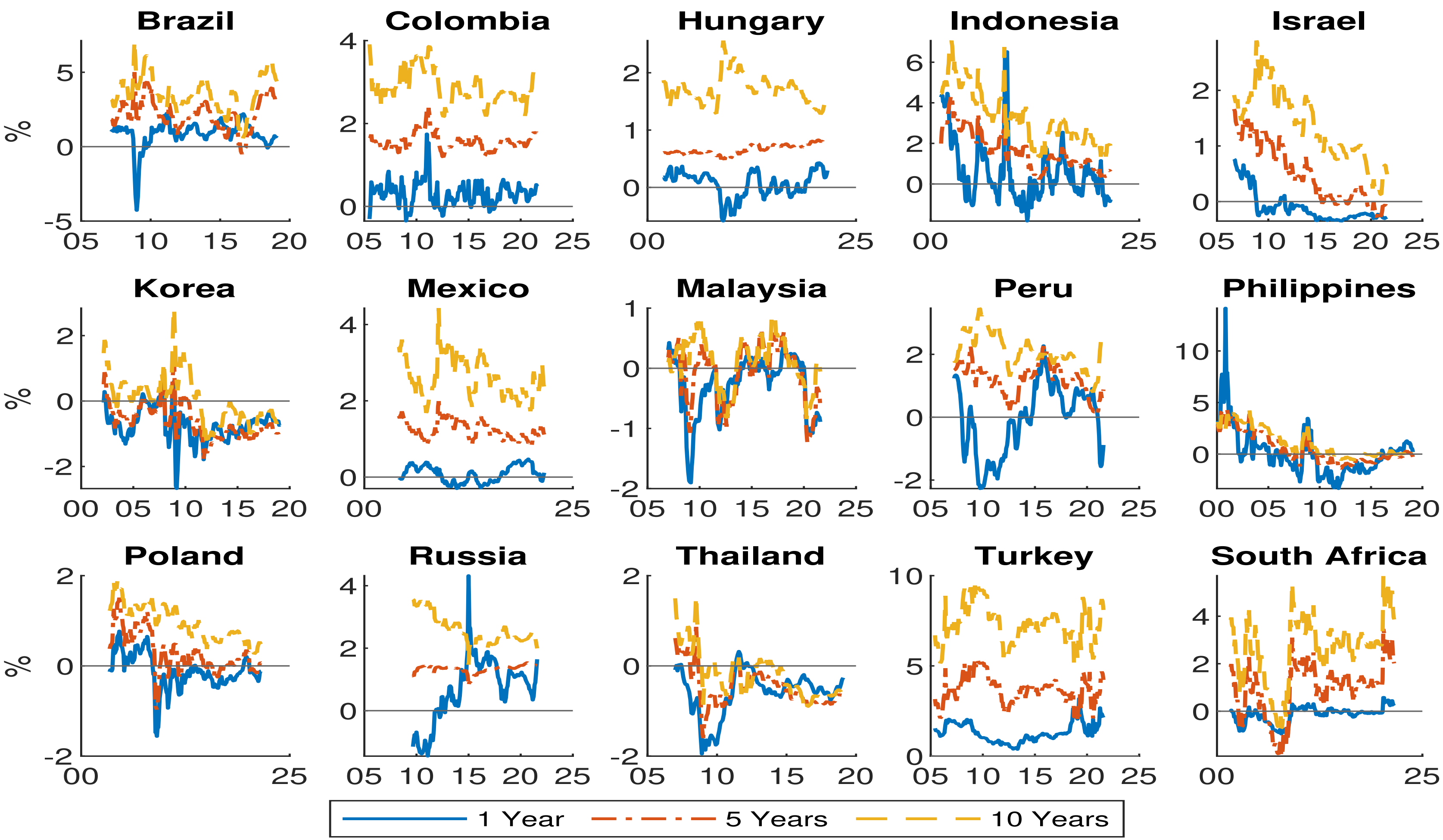

*Notes:* This figure plots the model-implied 10-year term premium (solid line) along with 2-standard-error confidence intervals (dashed lines). The standard errors are estimated using the delta method. The covariance matrix is estimated using the sample Hessian estimator calculated numerically from the joint log density.

**Figure D.2.** The 10-Year Credit Risk Compensation of Emerging Markets



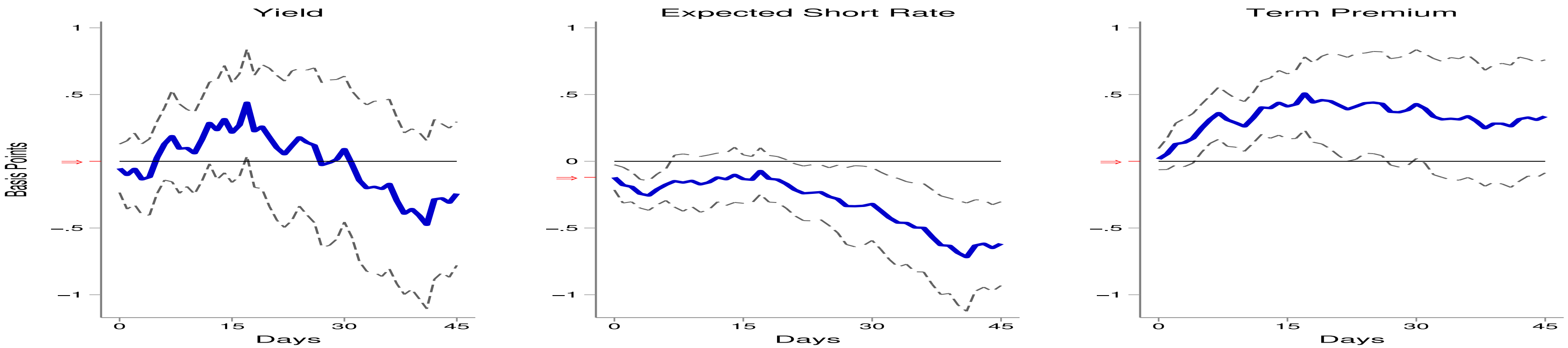

*Notes:* This figure plots the model-implied 10-year credit risk compensation (solid line) along with 2-standard-error confidence intervals (dashed lines). The standard errors are estimated using the delta method. The covariance matrix is estimated using the sample Hessian estimator calculated numerically from the joint log density.

**Figure D.3.** Term Structure of Term Premia

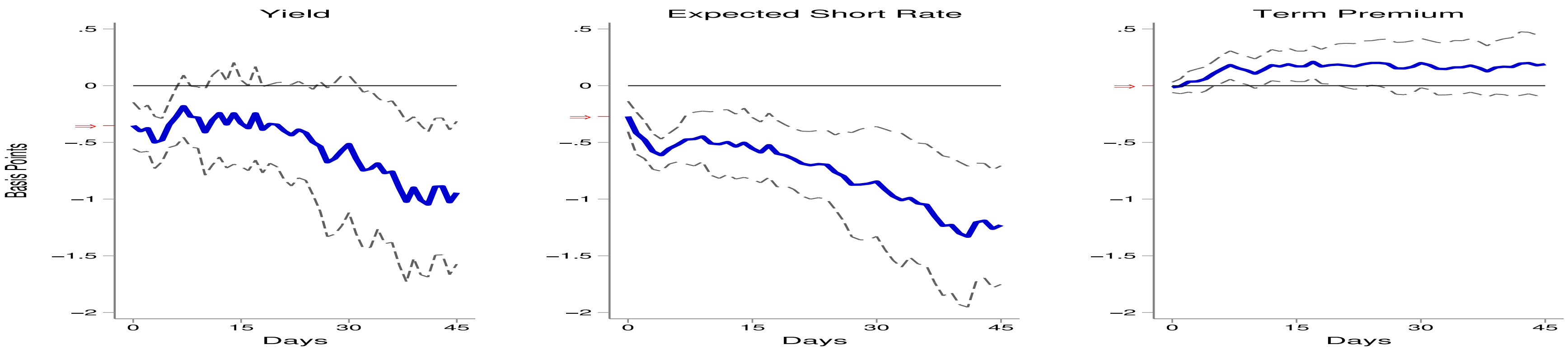



*Notes:* This figure plots the model-implied term premium for different maturities: 1 year (solid line), 5 years (dashed line) and 10 years (dash-dotted line).

**Figure D.4.** Response of the U.S. Yield Curve to a Target Surprise



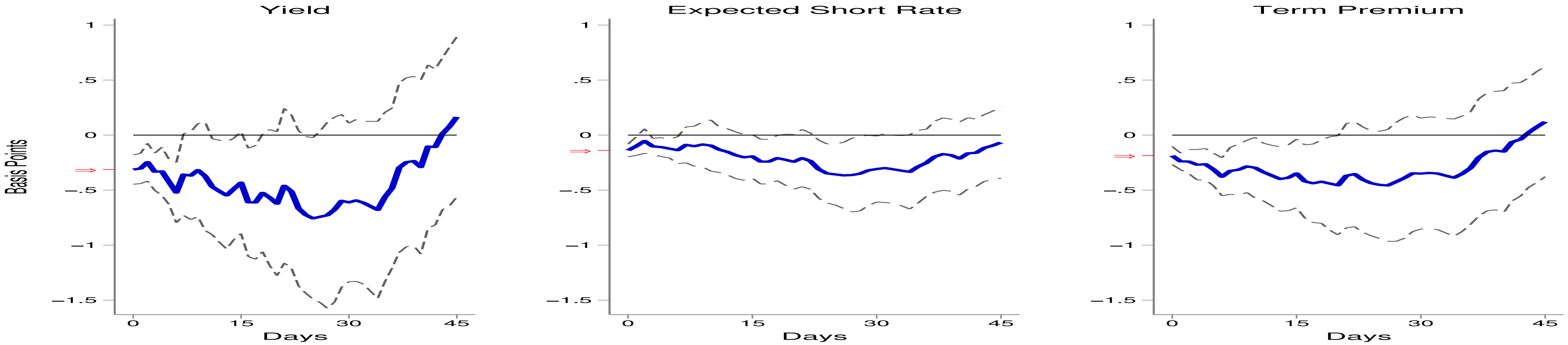

**(a)** 10-Year Yield



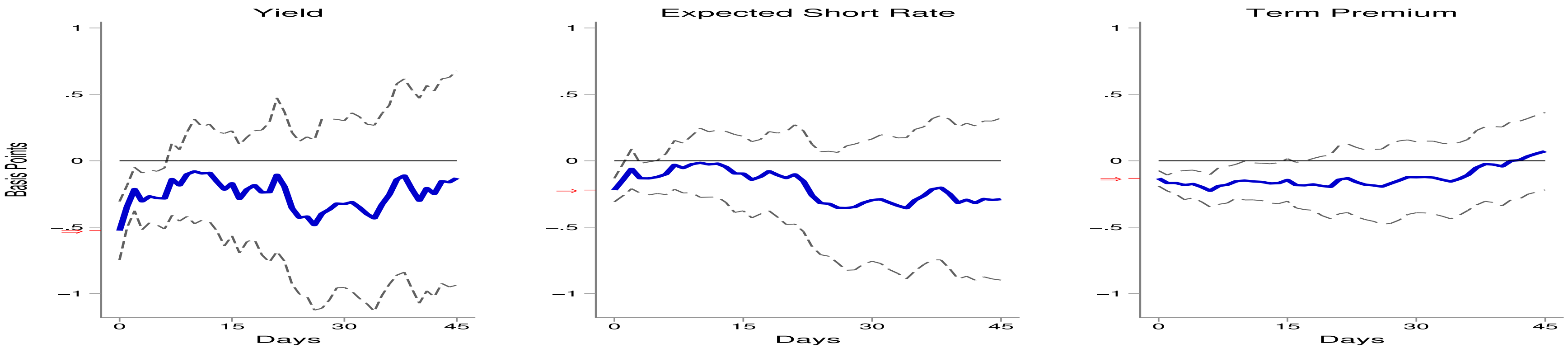

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year U.S. yields and their components to a target easing surprise of 1 basis point. U.S. yields are zero-coupon yields from Gürkaynak et al. (2007), and are decomposed into an expected future short-term interest rate and a term premium following Kim and Wright (2005). Target surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.5.** Response of the U.S. Yield Curve to a Forward Guidance Surprise: 2000-2008



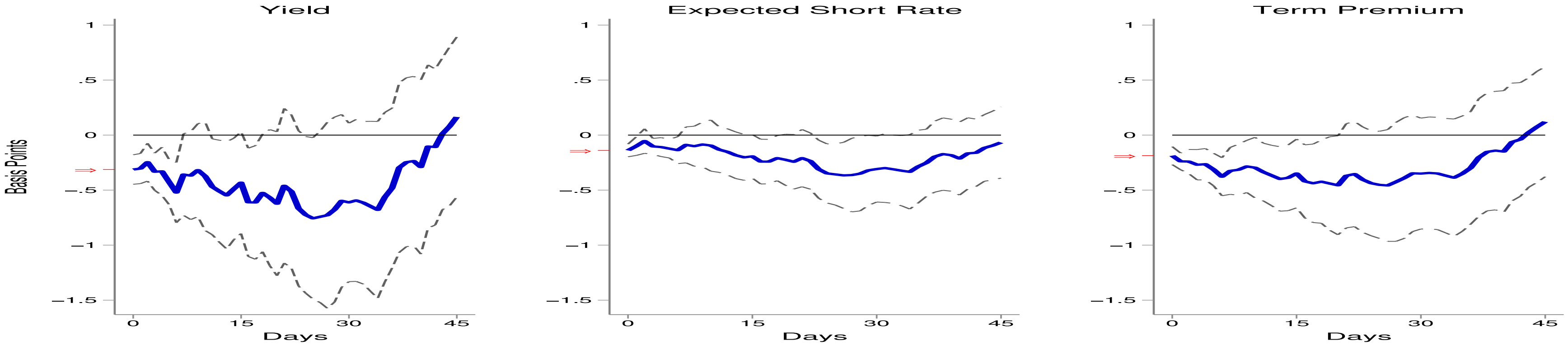

**(a)** 10-Year Yield



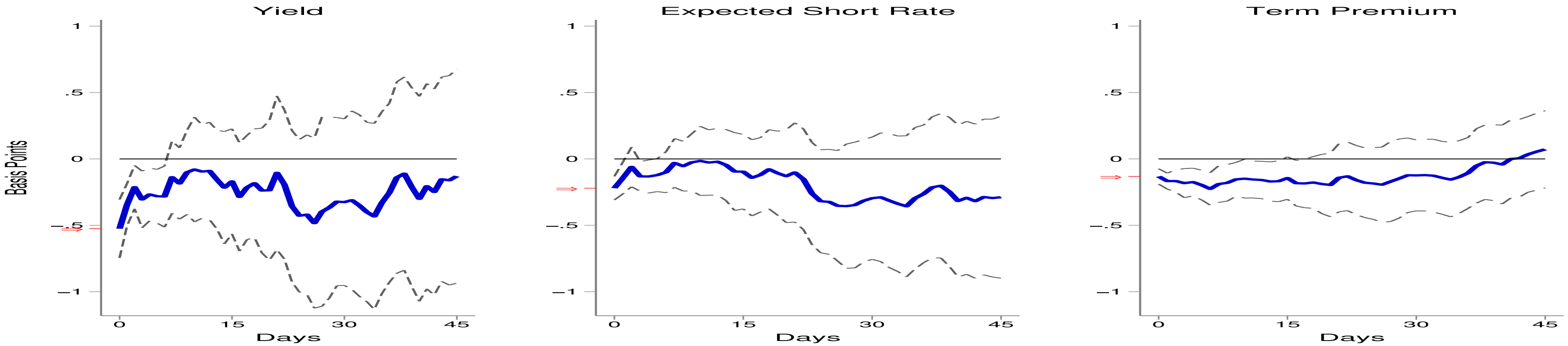

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year U.S. yields and their components to a forward guidance easing surprise of 1 basis point. U.S. yields are zero-coupon yields from Gürkaynak et al. (2007), and are decomposed into an expected future short-term interest rate and a term premium following Kim and Wright (2005). Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.6.** Response of the U.S. Yield Curve to a Forward Guidance Surprise: 2008-2019



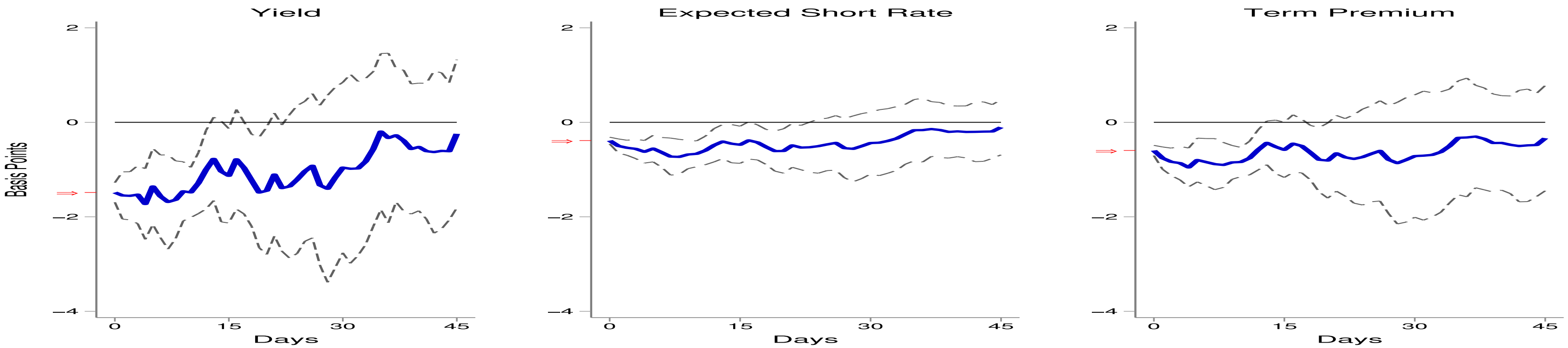

**(a)** 10-Year Yield



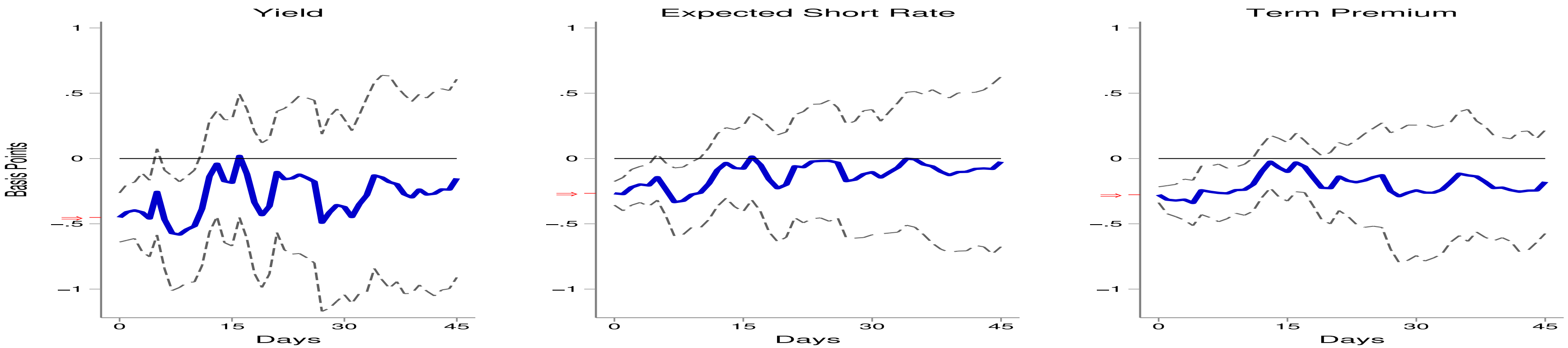

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year U.S. yields and their components to a forward guidance easing surprise of 1 basis point. U.S. yields are zero-coupon yields from Gürkaynak et al. (2007), and are decomposed into an expected future short-term interest rate and a term premium following Kim and Wright (2005). Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.7.** Response of the U.S. Yield Curve to an Asset Purchase Surprise



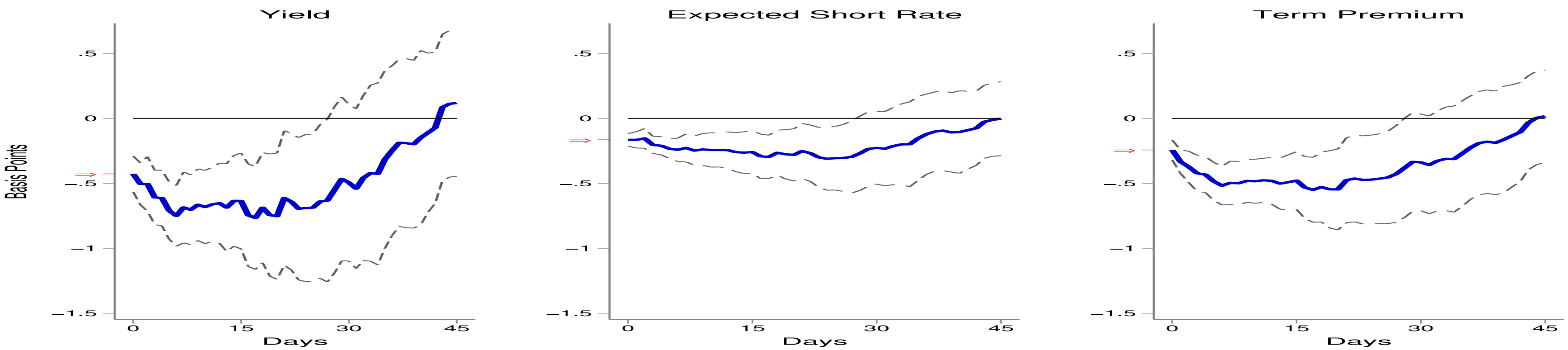

**(a)** 10-Year Yield



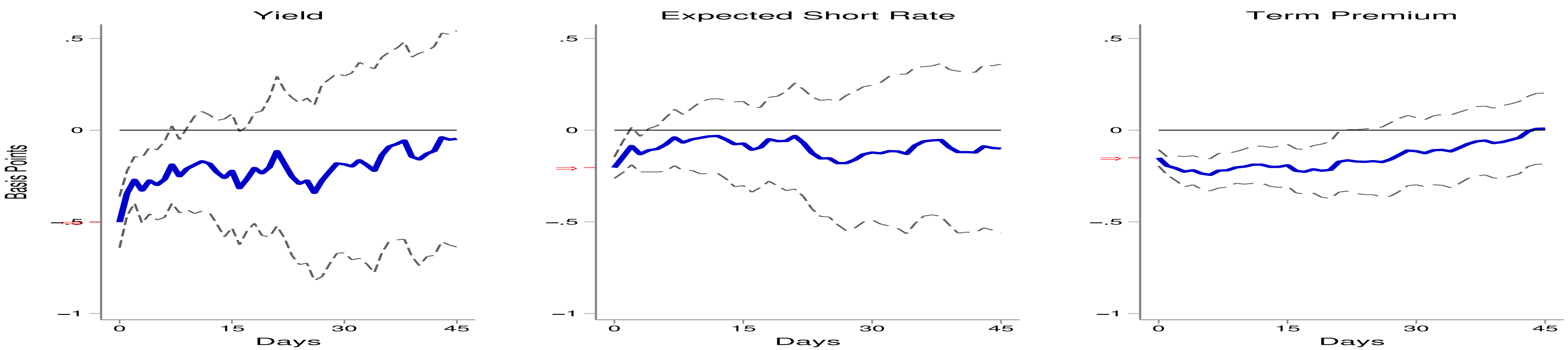

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year U.S. yields and their components to an asset purchase easing surprise of 1 basis point. U.S. yields are zero-coupon yields from Gürkaynak et al. (2007), and are decomposed into an expected future short-term interest rate and a term premium following Kim and Wright (2005). Asset purchase surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.8.** Response of the U.S. Yield Curve to a Forward Guidance Surprise: 2000-2019



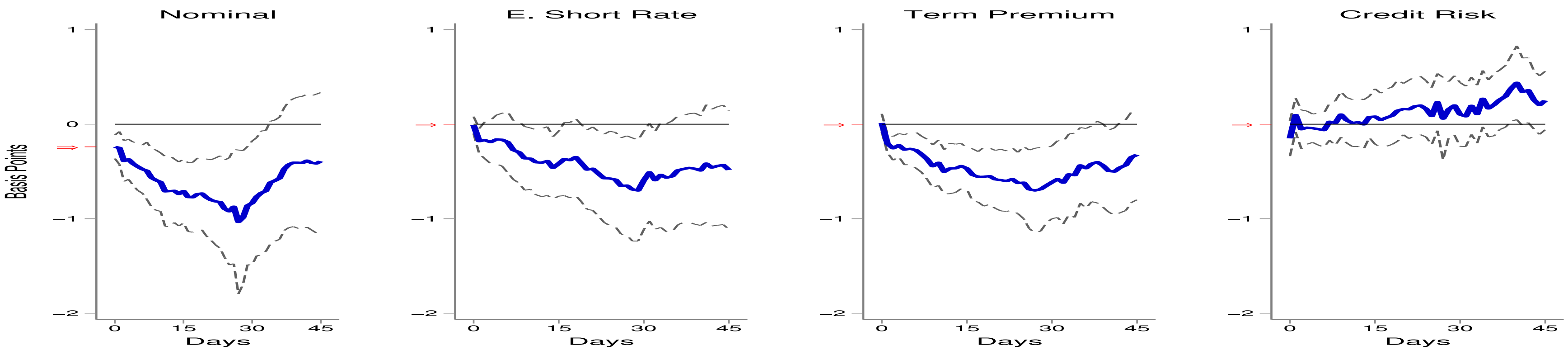

**(a)** 10-Year Yield



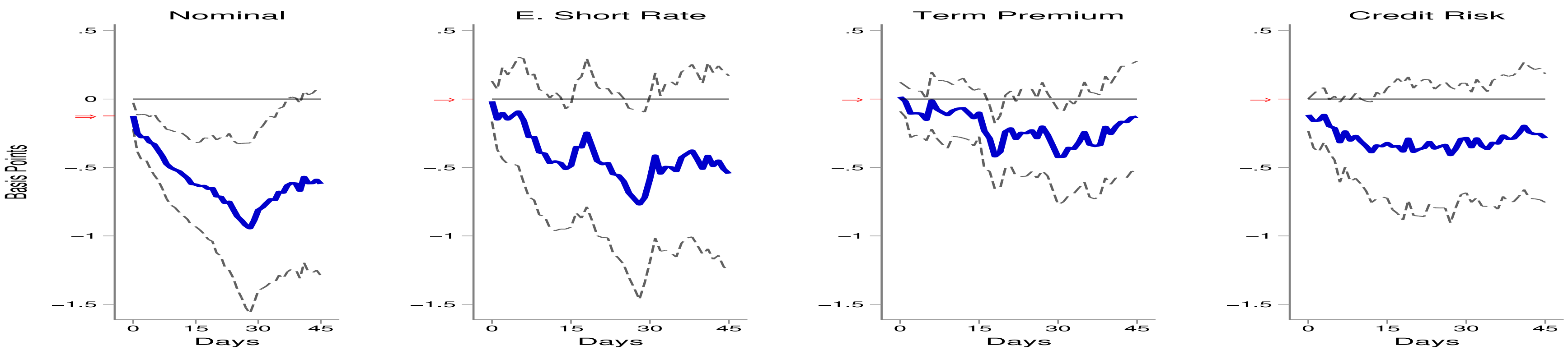

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year U.S. yields and their components to a forward guidance easing surprise of 1 basis point. U.S. yields are zero-coupon yields from Gürkaynak et al. (2007), and are decomposed into an expected future short-term interest rate and a term premium following Kim and Wright (2005). Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.9.** Response of Emerging Market Yield Curves to a Forward Guidance Surprise: 2000-2019



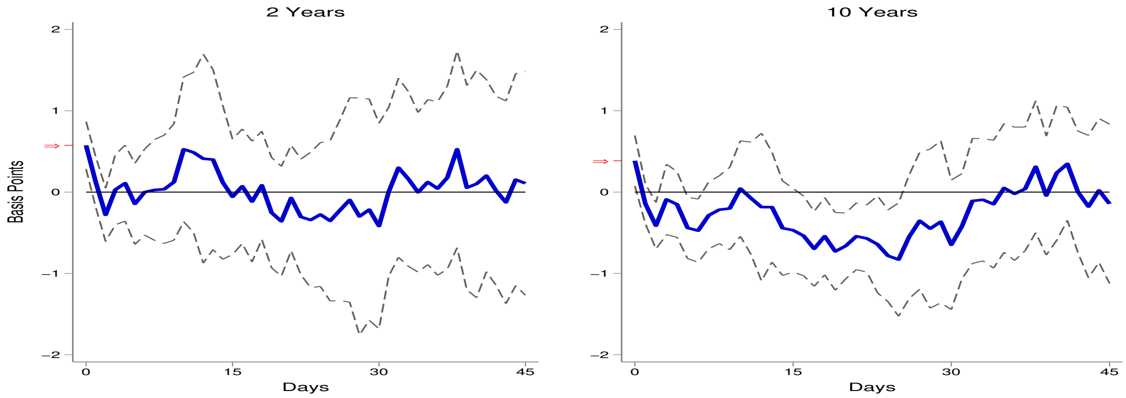

**(a)** 10-Year Yield



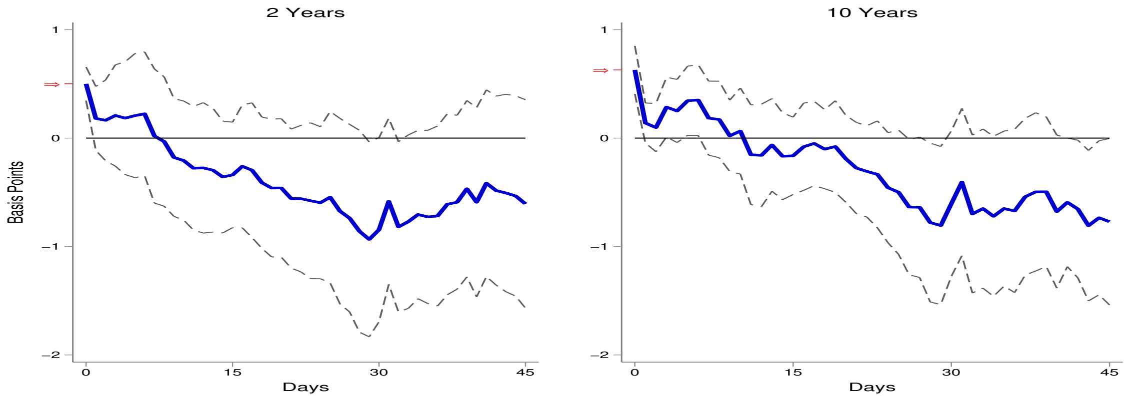

**(b)** 2-Year Yield

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year emerging market nominal yields and their components to a forward guidance easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

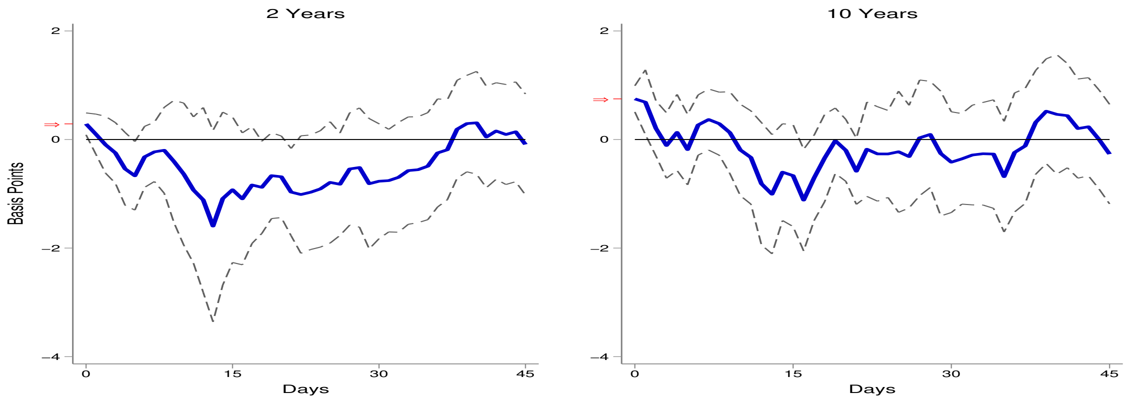
**Figure D.10.** Response of the Forward Premium to U.S. Monetary Policy Surprises




**(a)** Target Surprise: 2000-2008



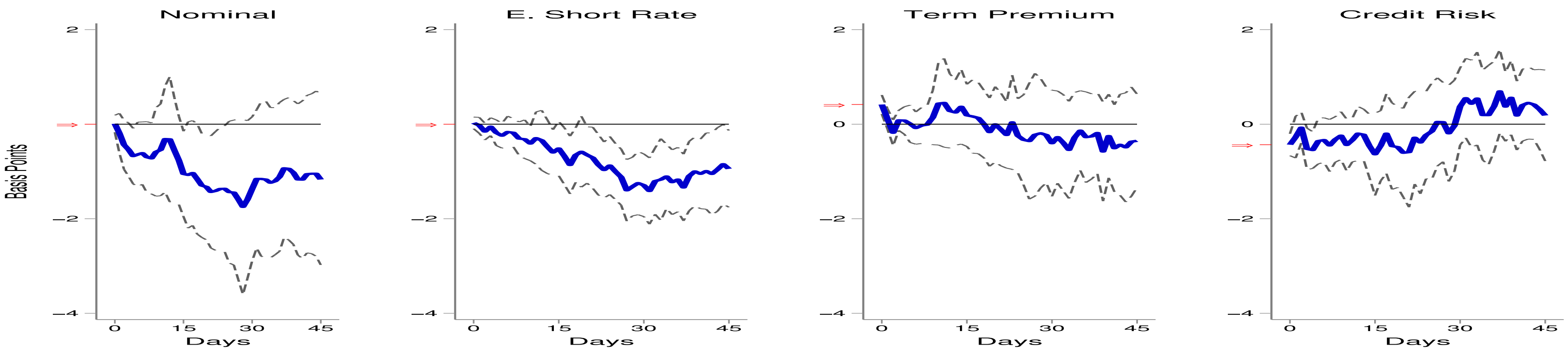

**(b)** Forward Guidance Surprise: 2000-2019



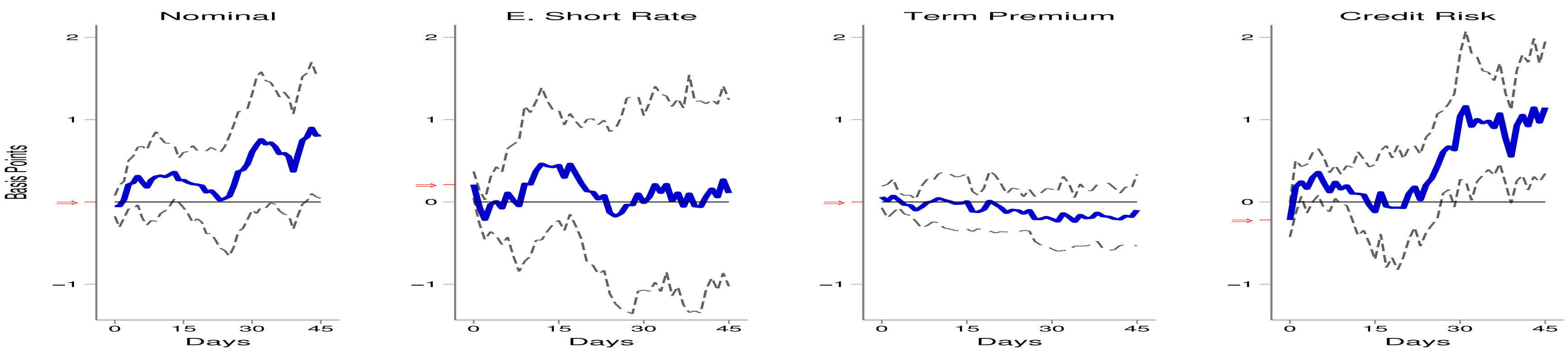

**(c)** Asset Purchase Surprise: 2009-2019

*Notes:* This figure shows the response following Jordà (2005) of the 10- and 2-year foreign exchange forward premium of emerging markets to easing surprises in U.S. monetary policy of 1 basis point. The forward premium is calculated using cross-currency swaps, which are in turn constructed using cross-currency basis swaps and interest rate swaps, see section 3.1 for details. The target, forward guidance and asset purchase surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.11.** Response of the 10-Year Emerging Market Yield by Region to a Target Surprise



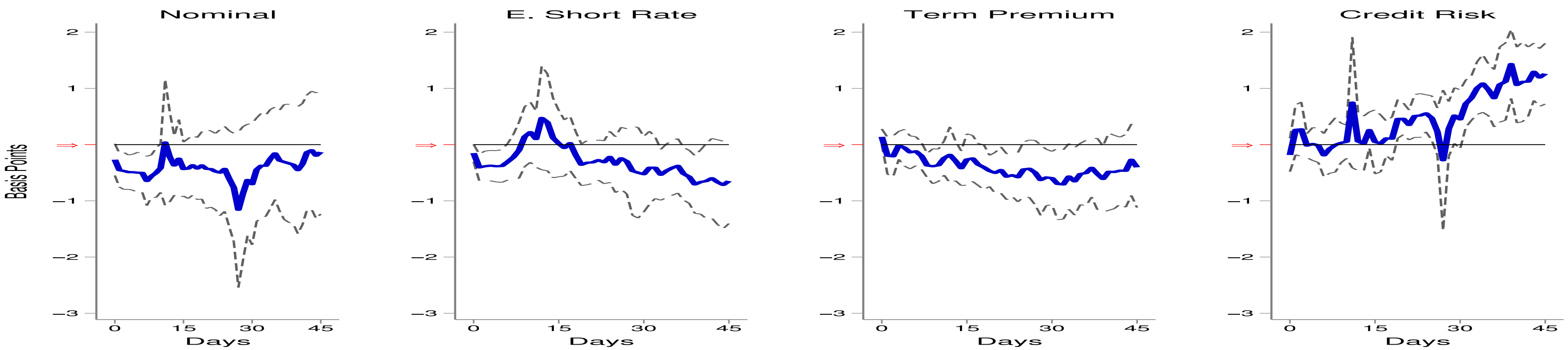

**(a)** Latin America




**(b)** Emerging Europe

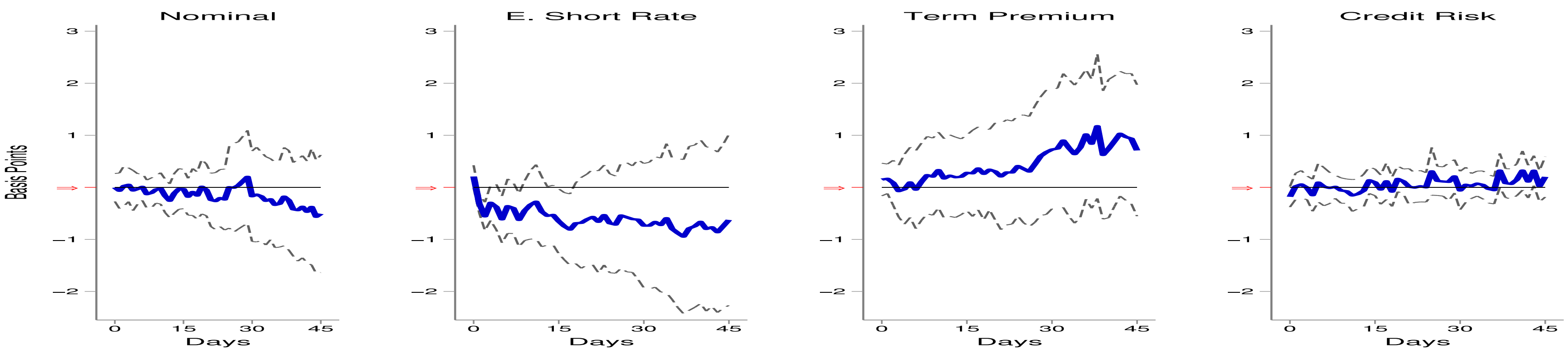
*Notes:* This figure shows the response following Jordà (2005) of the 10-year emerging market nominal yields and their components by region to a target easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Target surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.12.** Response of the 10-Year Emerging Market Yield by Region to a Target Surprise (cont.)




**(a)** Emerging Asia

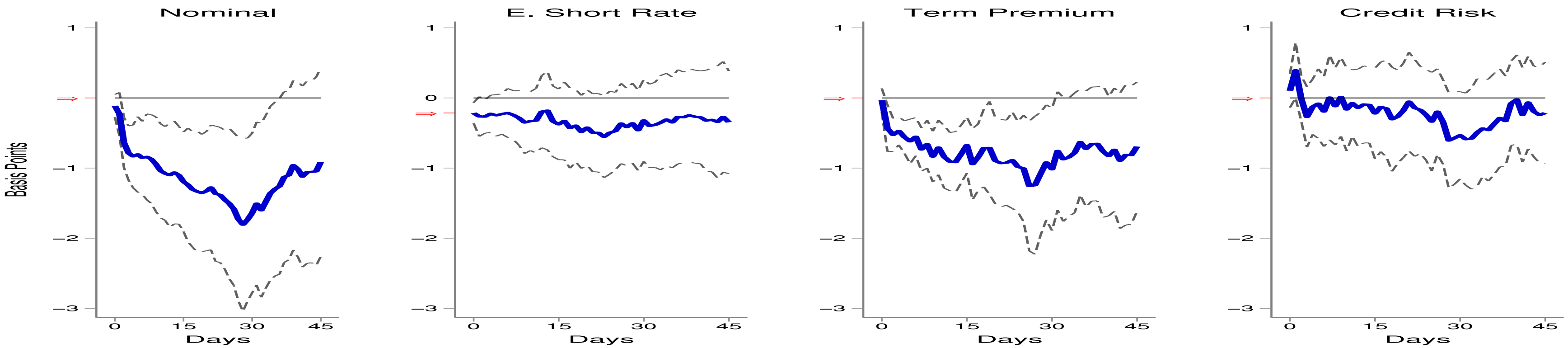




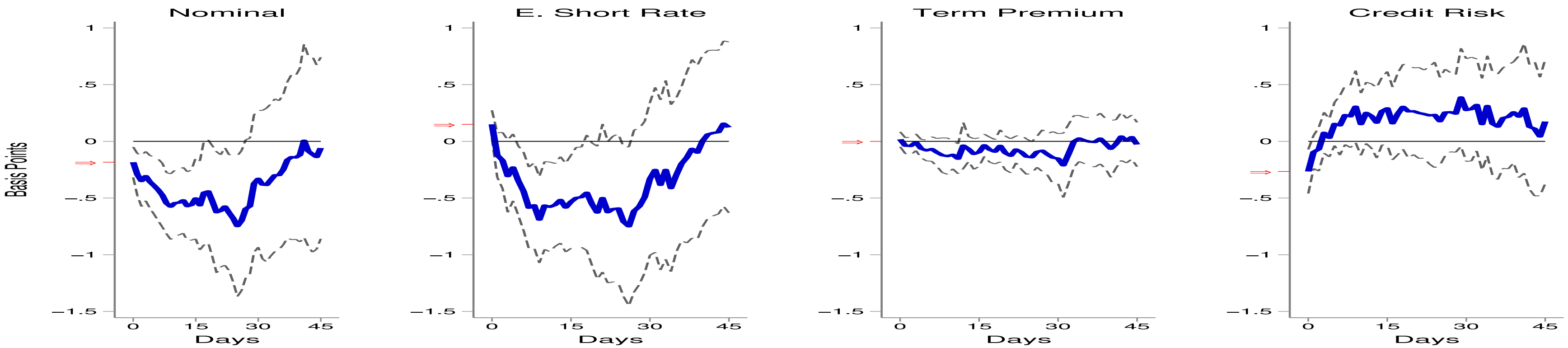

**(b)** Middle East and Africa

*Notes:* This figure shows the response following Jordà (2005) of the 10-year emerging market nominal yields and their components by region to a target easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Target surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.13.** Response of the 10-Year Emerging Market Yield by Region to a Forward Guidance Surprise: 2000-2019



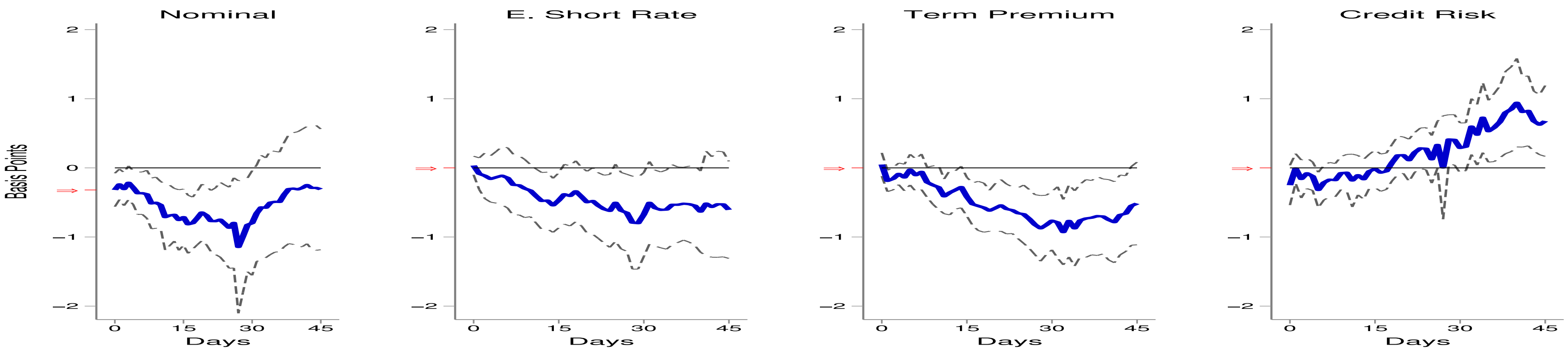

**(a)** Latin America



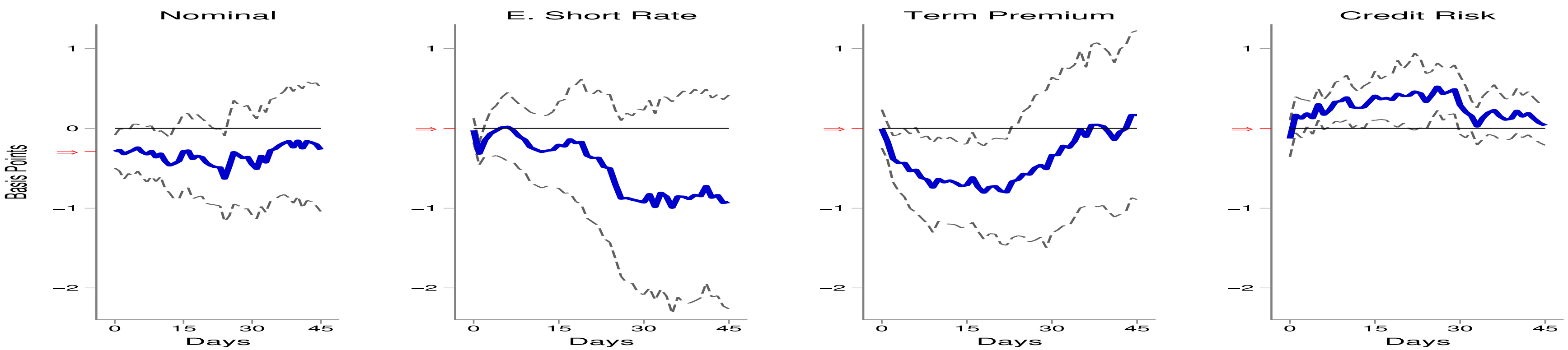

**(b)** Emerging Europe

*Notes:* This figure shows the response following Jordà (2005) of the 10-year emerging market nominal yields and their components by region to a forward guidance easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.14.** Response of the 10-Year Emerging Market Yield by Region to a Forward Guidance Surprise: 2000-2019 (cont.)



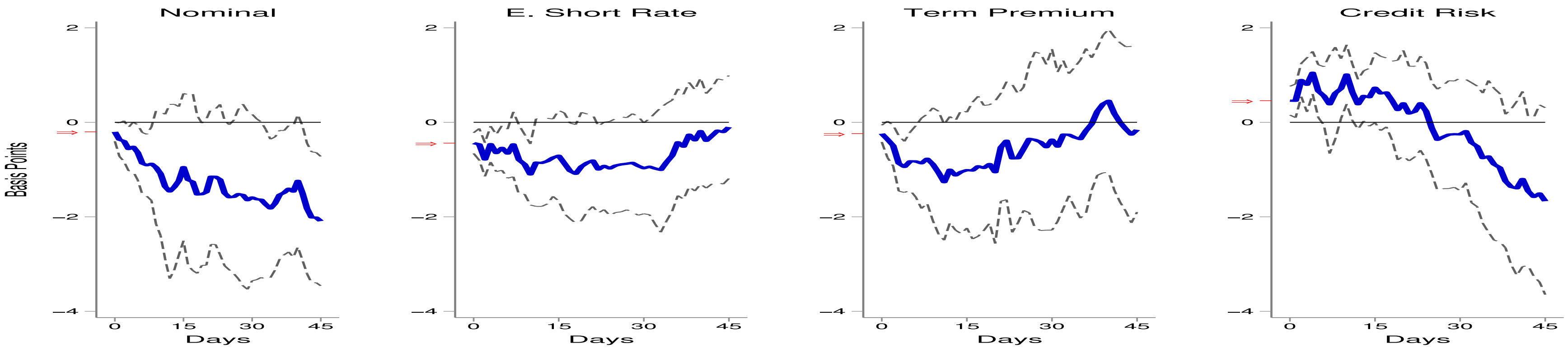

**(a)** Emerging Asia



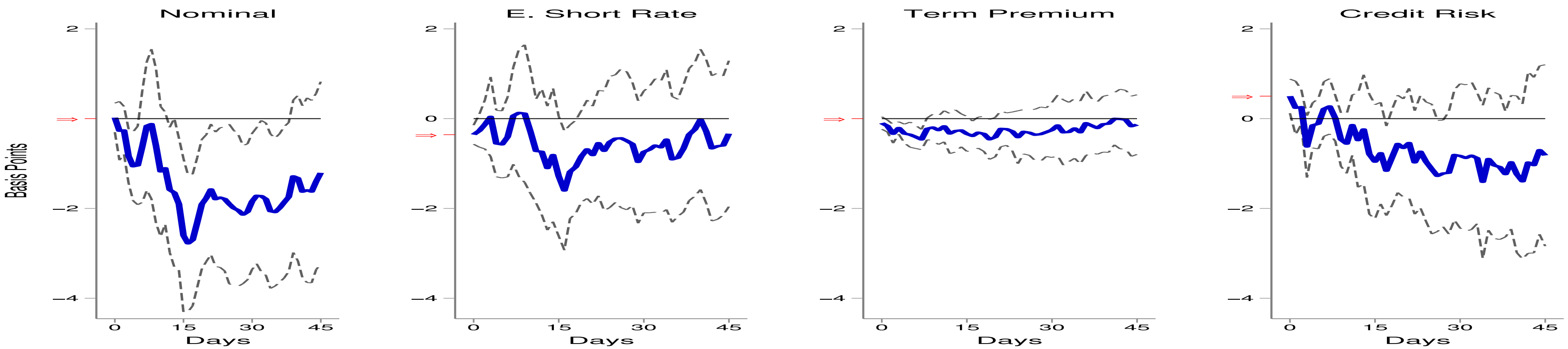

**(b)** Middle East and Africa

*Notes:* This figure shows the response following Jordà (2005) of the 10-year emerging market nominal yields and their components by region to a forward guidance easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Forward guidance surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.15.** Response of the 10-Year Emerging Market Yield by Region to an Asset Purchase Surprise



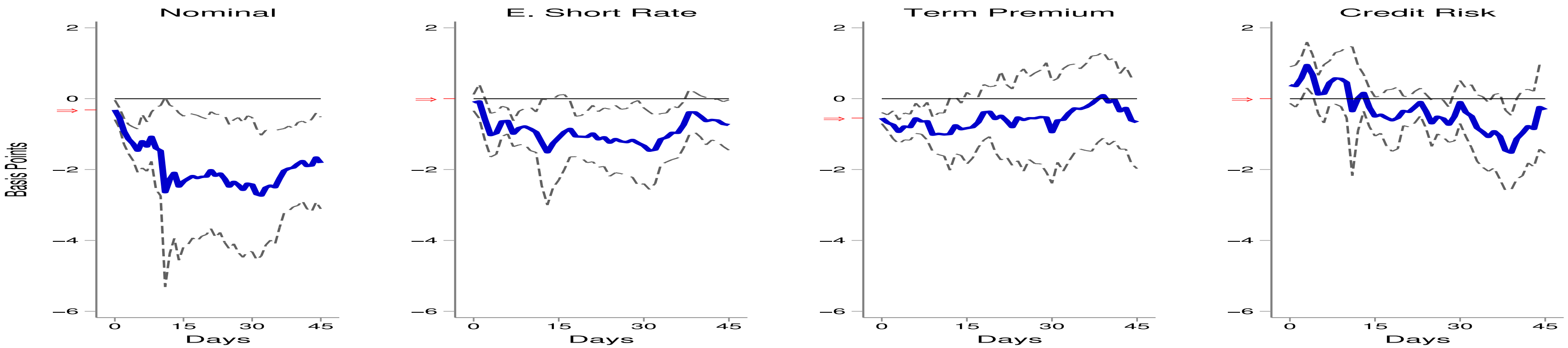

**(a)** Latin America



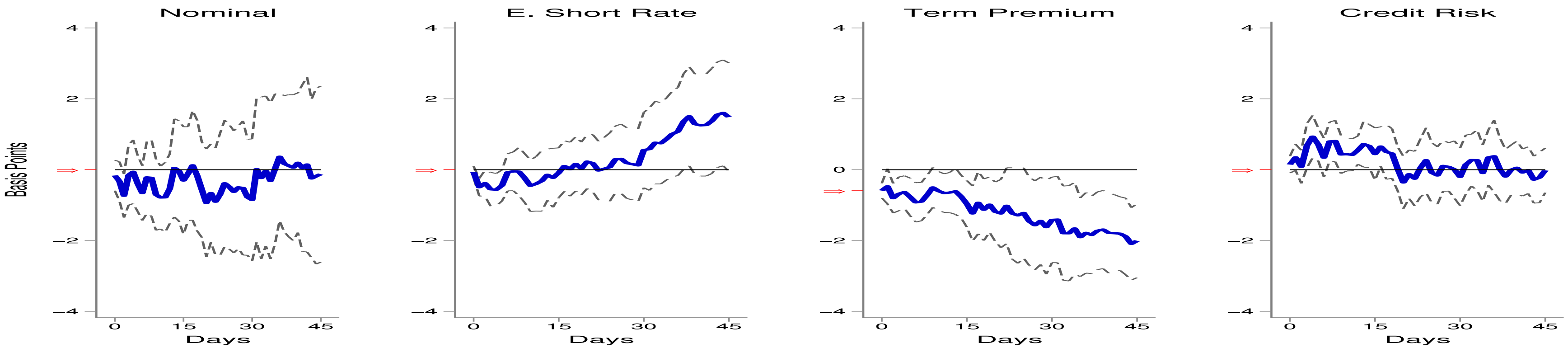

**(b)** Emerging Europe

*Notes:* This figure shows the response following Jordà (2005) of the 10-year emerging market nominal yields and their components by region to an asset purchase easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Asset purchase surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

**Figure D.16.** Response of the 10-Year Emerging Market Yield by Region to an Asset Purchase Surprise (cont.)




**(a)** Emerging Asia




**(b)** Middle East and Africa

*Notes:* This figure shows the response following Jordà (2005) of the 10–year emerging market nominal yields and their components by region to an asset purchase easing surprise of 1 basis point. Nominal yields are decomposed into an expected future short-term interest rate, a term premium and credit risk compensation, see section 4 for details. Asset purchase surprises are identified using intraday data around Fed's monetary policy announcements, see section 2 for details. An arrow indicates the contemporaneous ($h = 0$) effect. The 90% confidence bands are based on Driscoll–Kraay standard errors.

## Acknowledgements

I am deeply grateful to Jonathan Wright for his invaluable advice and guidance, and to Greg Duffee and Olivier Jeanne for insightful discussions and suggestions. I also thank Tobias Adrian, Derin Aksit, Laurence Ball, Bob Barbera, Christopher Carroll, Lalit Contractor, Jon Faust, Daniel Millimet, Alessandro Rebucci, Tatjana Schulze, Fabian Valencia and seminar participants at Johns Hopkins University, Loyola University, Carey Business School, the Bank of Spain, the Bank of Mexico, CNBV, Finance Research Letters Virtual Conference and EEA-ESEM Virtual Congress for their helpful comments and suggestions. All remaining errors are mine.

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