# Emerging Markets Sovereign Yields and U.S. Monetary Policy

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**Abstract**

Bond risk premia in advanced countries is usually associated with a term premium, a compensation demanded by investors for bearing interest rate risk. For emerging markets, however, the two concepts are different. To show this, I estimate affine term structure models using a new dataset of synthetic local currency yields and survey forecasts. This allows me to decompose the sovereign bond yields of 15 emerging markets into an expected future short-term interest rate and a bond risk premium, which consists of a credit risk premium and a pure term premium. I then discuss several new insights about the dynamics of bond yields in emerging markets, including a trade-off between explicit and implicit defaults, the levels of their long-term real interest rates, the response of their term premia to U.S. quantitative easing announcements and the asymmetric effects of global factors on their yield curves.

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# 1 Introduction

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Financial conditions across countries are widely believed to be interconnected. Yet, the international comparison of sovereign yields has mainly focused on advanced economies, which in part reflects data constraints for emerging markets. Not so long ago, emerging markets used to issue bonds at short maturities and in foreign currency.

This paper decomposes the local currency sovereign yields of emerging markets and provides new insights about their dynamics. This bears relevance given the increasingly important role played by emerging markets in the global economy. Moreover, bonds denominated in local currency have become an important source of funds for emerging markets over the last two decades (Du and Schreger, 2016b; Ottonello and Perez, 2019; Galli, 2020). A better understanding of their sovereign yields will thus improve our assessments of the vulnerabilities of the global financial system.

Since bond yields compensate investors for different risks, decomposing them provides valuable information. However, not all sovereign bonds are equal. Contrary to the debt issued by advanced countries, international investors demand a credit risk premium to hold bonds issued by emerging markets to compensate them for the risk of not receiving the promised payments.[1] Indeed, even though countries have the ability to print their own currency to avoid defaulting on their debt, emerging markets are prone to default (Reinhart and Rogoff, 2011; Erce and Mallucci, 2018).[2]

To account for credit risk in the bond yields of emerging markets, I use synthetic local currency yield curves, which essentially swap the U.S. yield curve into a local currency, something akin to the U.S. issuing bonds in that currency.[3] These synthetic yield curves can be seen as being free of credit risk and can thus be decomposed into a future ex-

[1]Credit risk here is broadly defined including, for example, (selective) default risk, currency convertibility risk, regulation risk, capital controls, jurisdiction risk and, if any, liquidity risk. Therefore, when investors require compensation for any of these risks, it is considered that they demand a premium for credit risk even if the country does not default per se.

[2]Examples of actual defaults in local currency debt include El Salvador (2017), Ecuador (2008), Argentina (2001), Russia (1998); and in 1999 after an earthquake, Turkey retroactively taxed its debt. Du and Schreger (2016b) and Galli (2020) provide theoretical explanations for these episodes.

[3]This implicitly assumes that the U.S. yield curve and the financial instruments used to swap it are free of credit risk. I argue that these are reasonable assumptions in section 2.

pected short-term interest rate and a term premium, which compensates investors for the uncertain return of locking their money over the life of the bond. The difference between the nominal (or actual) yields and the synthetic ones captures the credit risk premium in emerging markets (Du and Schreger, 2016a).

I augment the synthetic yield data with survey forecasts to decompose the sovereign yields of emerging markets. Affine term structure models are the standard tool to decompose the yield curves of advanced countries (Cochrane and Piazzesi, 2008), but they are known to be unstable. The high persistence of bond yields results in small sample bias (Kim and Orphanides, 2012). From the different solutions proposed in the literature,[4] Guimarães (2014) shows that incorporating survey data on interest rate forecasts provides robust decompositions of the U.S. and U.K. yield curves.[5] Surveys are especially relevant for emerging markets because they help to overcome both small sample sizes and regime changes, which are common in those countries.

The nominal bond yields of emerging markets can be decomposed into an expected future short-term interest rate, a term premium and a credit risk premium. The main component of the 10-year yield is the expected short rate, followed by the term premium, whose size more than doubles the credit risk premium. This decomposition will help to refine the analysis of the transmission of monetary policy in emerging markets as well as risk management and asset allocation strategies.[6]

This decomposition provides new insights about the dynamics of bond yields in emerging markets. First, there is a negative correlation between the credit risk premium and the term premium, which reflects a trade-off between explicit and implicit defaults. Second, term premia declined globally following the quantitative easing (QE) announcements in the U.S. and, in general, increased with the taper tantrum; even the expected short rate in some countries responded to the QE announcements. Third, the expected short

[4]They include restrictions on parameters (Duffee, 2010) (Bauer 2018), bias-corrected estimators (BRW 2012) and complementing bond yield data with survey forecasts of future interest rates (Kim and Wright, 2005; Kim and Orphanides, 2012).

[5]For instance, he finds that the term premia estimated with the aid of surveys remain 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.

[6]Applications include analysis of the effects of monetary policy decisions, simulations of the yield curve components for scenario analysis and investment allocation based on the term premium.

rate of emerging markets has been stable over time, and even declined in some cases; on this regard, it is worth noting that all but one of the countries in the sample have adopted (before or during the sample period) an inflation targeting regime. Fourth, the long-term expected real interest rates in emerging markets—the difference between the expected short rate and inflation expectations—fluctuate between 0 and 2% in line with the evidence for advanced countries (Holston, Laubach, and Williams, 2017). Finally, a global factor plays a role in the variation of bond yields in both advanced and emerging countries, but the yields in emerging markets are less tightly connected than those in advanced countries. Moreover, the role of the global factor is different throughout the yield curve; its importance is larger for short-term yields than for long-term ones, although it is more relevant for the components of the longer-term yields.

This paper contributes to different branches of the literature. The first contribution is to the large literature on term structure models by pioneering their application on synthetic yields, and to the literature that decomposes the bond yields of emerging markets (Blake, Rule, and Rummel, 2015; Adrian, Crump, Durham, and Moench, 2019) by correcting for credit risk and addressing the small sample problem. Synthetic yields have been used recently to study the deviations from covered interest parity (CIP).[7] Rather than concentrating on the CIP deviations, this paper focuses on the synthetic yields themselves to decompose the nominal bond yields of emerging markets more finely.

This paper also contributes to the literature on the international comparison of sovereign yields (Dahlquist and Hasseltoft, 2016), which has so far mainly focused on advanced economies. It also extends the work of Wright (2011) by considering emerging markets in the international comparison of term premia. Finally, the paper contributes to the literature on the international spillover effects of the monetary policy in the U.S. It extends the results in Gilchrist, Yue, and Zakrajšek (2019) by studying the effects of U.S. monetary policy shocks not only on sovereign yields but on its components, as in Cur-

[7] Du, Tepper, and Verdelhan (2018c) show that there are persistent and systematic deviations from CIP reflecting a higher regulatory burden for financial intermediaries. Du, Im, and Schreger (2018b) show that CIP deviations reflect differences in the convenience yield of advanced countries relative to the U.S. Du and Schreger (2016a) meanwhile show that CIP deviations capture a credit risk premium for emerging markets.

curu, Kamin, Li, and Rodriguez (2018) and Adrian et al. (2019) but for the components of the yields of emerging markets.[8]

The rest of the paper proceeds as follows. Section 2 explains how to construct the local currency yield curves. Section 3 presents the affine term structure model. Section 4 reports the yield decompositions and the analysis of the components. Section 5 studies the comovement of the sovereign yields of emerging markets. The last section concludes.

# 2 Local Currency Yield Curves

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This section explains how to construct the local currency (LC) yield curves of emerging markets, both nominal and synthetic. The difference between the two captures a credit risk premium. In the next section, the synthetic yield curve will be decomposed into an expected future short-term interest rate and a term premium.

## 2.1 Construction of Synthetic Yield Curves

The main idea to construct the synthetic LC yield curves is to swap the U.S. yield curve into LC using the forward premium at each maturity (see Du, Im, and Schreger, 2018a). The forward premium compensates investors for the expected depreciation of a currency, an increase in the exchange rate when it is expressed in LC per U.S. dollar (USD), as is used throughout this paper. The key assumption behind this approach is that the U.S. yield curve is free of default risk; as such, it serves as the benchmark for all the other countries in the sample.

The calculation of the forward premium depends on the maturity. For maturities of less 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 (XCS) since outright forwards are less liquid.[9] Although, the fixed-for-fixed XCS rates are rarely observed in

[8] Hofmann, Ilhyock, and Shin (2019) study the link between the U.S. monetary policy, the exchange rate and the credit risk premium in emerging markets.

[9] Although credit default swaps (CDS)—financial derivatives aimed to protect investors against default

the market directly, they can be constructed using cross-currency basis swaps and interest rate swaps. The idea is to start by swapping fixed payments in LC into floating-rate cash flows in USD using cross-currency basis swaps (referenced to the London interbank offered rate in USD), and swap them into fixed-rate cash flows also in USD using interest rate swaps. Both types of swaps are liquid and collateralized instruments and so the bilateral counterparty risk in XCS is small.

Let $y_{t,n}^{US}$ denote the zero-coupon yield for an $n$-period U.S. Treasury security at time $t$, and $\rho_{t,n}$ the $n$-period forward premium from USD to LC at time $t$. The zero-coupon synthetic LC yield for the $n$-period bond at time $t$, $\widetilde{y}_{t,n}^{LC}$, is calculated as

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

In contrast, the actual or nominal zero-coupon yield, $y_{t,n}^{LC}$, can be obtained directly from the quotes of the bonds traded in the market. Notice that the construction of the synthetic yield curve $\widetilde{y}_{t,n}^{LC}$ does not require to know the nominal yield curve $y_{t,n}^{LC}$,[10] as it relies on the U.S. yield curve and XCS rates.

According to the CIP condition, the nominal (direct) and the synthetic (indirect) LC interest rates should be equal. Thus, CIP implies that an issuer should be able to borrow directly or indirectly (synthetically) in LC at the same yield. Du, Tepper, and Verdelhan (2018c) show, however, that there are persistent and systematic deviations from CIP. The spread between the nominal and synthetic yields $(y_{t,n}^{LC} - \widetilde{y}_{t,n}^{LC})$ therefore measures CIP deviations in sovereign yields. In the case of advanced countries, Du, Im, and Schreger (2018b) argue that the CIP deviations reflect differences in convenience yields relative to the U.S.

CIP deviations have a different interpretation for emerging markets. Whereas the nominal yields of advanced countries are usually considered free of credit risk, it is reasonable for the nominal yields of emerging markets to include a credit risk premium.

by a bond issuer—capture credit risk in the medium to long term (Palladini and Portes, 2011), they are not used in this paper for several reasons. First, credit risk is not eliminated, it simply shifts from the bond issuer to the CDS seller, i.e. there is counterparty credit risk. Second, a credit event is not clearly defined; for instance, borrowers can intentionally circumvent the CDS payout. Third, investors do not need to hold the underlying bond to buy a CDS, so there is a chance for market manipulation.

[10] For the U.S., $\widetilde{y}_{t,n}^{US} = y_{t,n}^{US}$ since there is no forward premium for the USD relative to the USD.

In fact, emerging markets are prone to default (Reinhart and Rogoff, 2011; Erce and Mallucci, 2018). The credit risk in the components of the synthetic yields in equation (1) is small, a synthetic yield can therefore be seen as the borrowing rate paid by a hypothetical issuer in LC with no credit risk. Du and Schreger (2016a) indeed show that the nominal-synthetic spread captures a credit risk premium in the sovereign yields of emerging markets.[11]

## 2.2 Construction of Nominal Yield Curves [Go2ToC]

I use the Bloomberg Fair Value (BFV) curves to estimate the nominal yield curve $y_{t,n}^{LC}$. Since these curves report coupon-equivalent par yields, I convert them into continuously-compounded yields (see Gürkaynak, Sack, and Wright, 2007) to obtain the implied zero-coupon curves.[12] This is done for all but two countries for which there are no BFV curves. For Brazil and Israel, Bloomberg provides zero-coupon yields with coupon-equivalent compounding. I also convert these yields, known as IYC curves, into continuously-compounded yields.[13]

The resulting continuously-compounded zero-coupon curve for each LC is what this paper refers to as the nominal yield curve $y_{t,n}^{LC}$.

## 2.3 Yield Curve Data [Go2ToC]

Nominal and synthetic yield curves are constructed for 15 emerging markets (EMs) and, to compare the results, 10 advanced economies (AEs).[14] The countries are selected

[11]For instance, CDS rates are highly correlated with the CIP deviations of emerging markets, unlike the CIP deviations of advanced countries.

[12]As a robustness check, I estimate the nominal yield curves from actual prices for some of the countries in the sample following Nelson and Siegel (1987). These estimated yield curves follow those reported by Bloomberg closely.

[13]For some emerging markets, Bloomberg reports both BFV and IYC curves. BFV curves are preferred for several reasons: they have a longer history than IYC curves, IYC curves are not available for advanced countries—the benchmark for 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 for some countries and dates.

[14]For each of the following countries, the currency identifier is shown in parenthesis. The 15 EMs are: Brazil (BRL), Colombia (COP), Hungary (HUF), Indonesia (IDR), Israel (ILS), Korea (KRW), Malaysia (MYR), Mexico (MXN), Peru (PEN), Philippines (PHP), Poland (PLN), Russia (RUB), South

based on data availability. AEs are sometimes split into two groups to assess whether the type of country plays a role. The first group (non-U.S. G3) is comprised by Germany, Japan and the U.K., and the rest of the countries make up the second group (A-SOE), which are basically advanced small open economies, arguably more directly comparable to emerging markets.

The dataset comprises nominal and synthetic yields. The data is available daily but the baseline results are obtained using end-of-month data from January 2000 to January 2019.[15] Even though the sample ends on the same date for all countries, the starting dates vary per country. All the yields for advanced countries start no later than September 2001. The sample sizes for emerging markets, however, are 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. Thus, there are at least 10 years of data for each emerging market.[16] In principle, this is a reasonable time period for the estimation of the affine term structure model presented in section 3.1, but in practice there may be too few interest rate cycles per country. This small sample problem is addressed with surveys of professional forecasters in section 3.4.

The yields have maturities of 3 and 6 months, and 1 through 10 years, ranging from a minimum of eight to a maximum of twelve maturities per country. The maximum maturity considered is 10 years because bonds and swaps with larger maturities tend to have less history and be less liquid, especially for emerging markets who do not issue bonds for, say, 20 or 30 years as often as advanced countries.

The construction of the LC synthetic yield curves involves data from the U.S. yield curve and the forward premium for different maturities, as explained in section 2.1. Data for the U.S. zero-coupon yield curve is obtained from two sources. For maturities of one through ten years, the yields come from the dataset constructed by Gürkaynak, Sack, and

Africa (ZAR), Thailand (THB) and Turkey (TRY). The 10 AEs are: Australia (AUD), Canada (CAD), Denmark (DKK), Germany (EUR), Japan (JPY), Norway (NOK), New Zealand (NZD), Sweden (SEK), Switzerland (CHF) and the U.K. (GBP).

[15]Since the U.S. yield curve is the benchmark for the synthetic yield curves, these dates are the last business days of each month according to the U.S. calendar.

[16]The only exception is Turkey for which its nominal yields with a maturity of up to 10 years start on June 2010. Nevertheless, its synthetic yields start on May 2005.

Wright (2007) (hence GSW).[17] Treasury securities with less than one year to maturity are less actively traded than longer-maturity ones. The estimates from the Center for Research in Security Prices (CRSP) are thought to be more robust at the short end of the curve (Duffee, 2010). Specifically, the 3- and 6-month yields are the annualized 13- and 26-week rates (bid/ask average) in the CRSP Risk-Free Rates Series.[18]

As mentioned before, the calculation of the forward premium varies by maturity. To compute the forward premium 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 but three countries; for Korea, Philippines and Thailand the data is obtained from Datastream. To construct the XCS rates, I use data on cross-currency basis swaps and interest rate swaps for each available maturity from one through ten years. For all the countries in the sample, the data for these swap curves comes from Bloomberg.[19]

# 3 Methodology

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This section describes the discrete-time affine term structure model that is used to estimate the dynamics of the sovereign yield curves for the countries in the sample. It then discusses the difficulty in identifying the parameters in the model and how survey data helps in the identification.

## 3.1 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 (SDF),

[17]Available at: https://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html.

[18]The 3- and 6-month yields implied by the GSW fitted model are highly correlated with the CRSP yields (0.9985 and 0.9995, respectively) but the former are on average higher (by 16 and 10 basis points, respectively) using data since 1983.

[19]A spreadsheet with the tickers used in the construction of the forward premiums and in the estimation of the nominal yield curves is available upon request. The file consolidates and expands (with tenors and tickers) similar files kindly posted online in Wenxin Du and Jesse Schreger's websites.

$M_{t+1}$, that prices all assets. Accordingly, the bond price today equals the expectation, conditioned on all current information, of tomorrow's discounted price; this is recursively defined as follows:

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

where $\mathrm{E}_t^{\mathbb{P}}[\cdot]$ denotes the conditional expectation at time $t$ of a random variable taken using the actual or physical probability measure, $\mathbb{P}$, that generates the data. The existence of the SDF also implies that there exists a theoretical risk-neutral or risk-adjusted pricing measure, $\mathbb{Q}$, different from the $\mathbb{P}$ measure, which is defined as follows:[20]

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

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 $\mathbb{Q}$:

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

where $\mu^{\mathbb{Q}}$ is a $\mathrm{K}\times 1$ vector and $\Phi^{\mathbb{Q}}$ is a $\mathrm{K}\times\mathrm{K}$ matrix of parameters, $\Sigma$ 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; this is written as $\nu_{t+1}^{\mathbb{Q}}|X_t \sim \mathcal{N}_{\mathrm{K}}(0, I)$.

The dynamics of the one-period interest rate are driven by the pricing factors as follows:

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

where $\delta_0$ 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:

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

[20]Since the price at maturity of a zero-coupon bond is 1, recursive substitution of equations (2) and (3) imply that today's price equals the conditional expectation of the product of SDFs over the life of the bond and..., $P_{t,n} = \mathrm{E}_t^{\mathbb{P}}\left[\Pi_{j=1}^{n} M_{t+j}\right]$.

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

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

where $A_n^{\mathbb{Q}} = -\frac{1}{n} A_n$, $B_n^{\mathbb{Q}} = -\frac{1}{n} B_n$, 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:[21]

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

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

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 a future expected short-term interest rate and a term premium, the model also specifies the dynamics for the market prices of risk, which control the transformation between the $\mathbb{Q}$ and $\mathbb{P}$ measures. Following Duffee (2002), the $\mathrm{K} \times 1$ vector of market prices of risk, $\lambda_t$, is also an affine function of the pricing factors:

$$\lambda_t = \lambda_0 + \lambda_1 X_t, \tag{9}$$

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

Given this structure for the market prices of risk, the dynamics of the pricing factors can also be described by a VAR(1) under the physical measure $\mathbb{P}$ as follows:

$$X_{t+1} = \mu^{\mathbb{P}} + \Phi^{\mathbb{P}} X_t + \Sigma \nu_{t+1}^{\mathbb{P}}. \tag{10}$$

where $\mu^{\mathbb{Q}} = \mu^{\mathbb{P}} - \Sigma\lambda_0$ , $\Phi^{\mathbb{Q}} = \Phi^{\mathbb{P}} - \Sigma\lambda_1$ , $\nu_{t+1}^{\mathbb{P}} | X_t \sim \mathcal{N}_{\mathrm{K}}(0, I)$. Note that the covariance matrix of the shocks is the same under both measures; that is, it is measure independent. Finally, the SDF is conditionally lognormal:[22]

$$M_{t+1} = \exp\left(-i_t - \frac{1}{2}\lambda_t' \lambda_t - \lambda_t' \nu_{t+1}^{\mathbb{P}}\right), \tag{11}$$

[21] The price coefficients can be computed recursively after combining the no-arbitrage condition and the functional form for bond prices.

[22] The law of motion of the vector of state variables in equation (10) and the SDF in equation (11) can be formalized separately or jointly (see Gürkaynak and Wright, 2012). For instance, in a utility maximization framework, the SDF is usually interpreted as the intertemporal marginal rate of substitution.

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

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

where $A^{\mathbb{P}}_n = -\frac{1}{n}A_n$, $B^{\mathbb{P}}_n = -\frac{1}{n}B_n$, 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 $\mathbb{P}$ instead of the $\mathbb{Q}$ measure.

The expected yield over the life of an $n$-period bond equals the conditional expectation under $\mathbb{P}$ of the average short rate over the period, thus:

$$y^{e}_{t,n} = A^{e}_n + B^{e}_n X_t,$$

where $A^{e}_n = -\frac{1}{n}A_n$, $B^{e}_n = -\frac{1}{n}B_n$, where in turn $A_n = \mathcal{A}(\delta_0, \delta_1, \mu^{\mathbb{P}}, \Phi^{\mathbb{P}}, 0, n)$ and $B_n = \mathcal{B}(\delta_1, \Phi^{\mathbb{P}}, n)$ also satisfy the recursions under the $\mathbb{P}$ measure but setting $\Sigma = 0$ (see Appendix C of Guimarães (2014)).[23] In this sense, information about $y^e_{t,n}$ could help in identifying the parameters under the $\mathbb{P}$ measure, $\{\mu^{\mathbb{P}}, \Phi^{\mathbb{P}}\}$, as discussed in section 3.4.

Finally, the term premium for maturity $n$ at time $t$, $\tau_{t,n}$, can then be estimated as the difference between the yields obtained under the $\mathbb{Q}$ and $\mathbb{P}$ measures:[24]

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

A key assumption behind this model is that the yield $y_{t,n}$ is free of credit risk, a reasonable assumption for advanced but not for emerging countries since investors demand a credit risk premium from them (Du and Schreger, 2016a). This implies that while the nominal yield curve $y^{LC}_{t,n}$ is the relevant one for advanced countries, it is not so for emerging markets because it is not free of credit risk. In that case, the synthetic yield curve $\widetilde{y}^{LC}_{t,n}$ better aligns with the risk-free assumption and, in turn, with the affine model.

### 3.2 Identification Problem

[23] The difference between $y^{\mathbb{P}}_{t,n}$ and $y^e_{t,n}$ 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, in homoskedastic models this term is constant across maturities.

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

In principle, the estimation of the parameters in the affine term structure model only requires zero-coupon bond yields as an input. This is enough to estimate the pricing coefficients under the $\mathbb{Q}$ measure, $\{\mu^{\mathbb{Q}}, \Phi^{\mathbb{Q}}\}$, but not to identify the parameters under the $\mathbb{P}$ measure, $\{\mu^{\mathbb{P}}, \Phi^{\mathbb{P}}\}$, which are necessary to estimate the term premium in equation (12).

This identification problem owes to the high persistence of bond yields, which results in small sample bias (Kim and Orphanides, 2012). Accordingly, the dynamics of the pricing factors will tend to mean-revert too quickly, overestimating the stability of the expected path of the short rate and, thus, attributing much of the variability in yields to fluctuations in the term premium.

Different solutions have been proposed to address this identification problem, including restrictions on parameters (Duffee 2010, Bauer 2018), bias-corrected estimators (BRW 2012) and incorporating information from surveys on interest rate forecasts in the estimation (Kim and Wright, 2005; Kim and Orphanides, 2012). Guimarães (2014) compares the three approaches and concludes that surveys provide robust decompositions of the U.S. and U.K. yield curves; for instance, 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 sample periods, unlike the other alternatives.

The importance of survey data is particularly relevant to get reliable decompositions for the bond yields of emerging markets since they help to overcome small sample sizes and regime changes. First, the sample size for these countries is relatively shorter, compared with data from advanced countries. Second, since the early 2000s there has been a considerable reduction in the inflation rates of many emerging markets, a phenomenon that can be considered as a regime change. Structural breaks is one of the reasons U.S.-focused studies use different sample periods. Nevertheless, the term premia estimated with a sample starting in 1972—including the U.S. Great Inflation period—complemented with survey data is consistent with those obtained with shorter samples (Guimarães, 2014).

In addition to supplementing the information from bond yields in the estimation of affine models, surveys can also be used to obtain a model-free estimate of the term premium, calculated as the difference between the long-term interest rate and the expected future short rate from surveys (over the same horizon). This model-free estimate serves as a robustness check for the term premia obtained from the affine model.

Although surveys have good forecasting properties, it is important to acknowledge that they are not a panacea. For instance, surveys might not represent the market expectations or the expectations of the marginal investor.

### 3.3 Survey Data

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Unfortunately, there is no source for long-term forecasts for the short rate of emerging markets. They can be inferred, however, from existing data and Taylor rule-type regressions, in the spirit of Wright (2011) for advanced countries.

Twice a year Consensus Economics provides 1- through 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. This data is available from March 2001 to October 2017.[25]

To obtain the embedded expectations for the policy rate in the survey responses, I first estimate the following model with quarterly data for each emerging market:

$$i_t = \beta_0 + \beta_i i_{t-1} + \beta_\pi \pi_t + \beta_g g_t + \epsilon_t, \tag{13}$$

where $i_t$ is the policy rate, $\pi_t$ is the year-on-year consumer price inflation and $g_t$ is the year-on-year real GDP growth; $\beta_i$ is a smoothing parameter that improves the fit of the model to the data. The information for $i_t$ is obtained from the policy rate statistics of the Bank for International Settlements, and the data for inflation and real GDP growth comes from Bloomberg.

[25]The availability of data varies by country; for example, data for the Philippines starts in 2009, whereas data for Latin American countries ends in October 2013. Survey data for Israel and South Africa is not available.

I then assume that the estimated parameters from equation (13) apply to each of the survey maturities $n = 1, 2 \ldots, 5, 10$ for inflation and real GDP growth.[26] The expected future policy rate is then calculated as:[27]

$$i_{t,n}^{survey} = \frac{\hat{\beta}_0}{1-\hat{\beta}_i} + \frac{\hat{\beta}_\pi}{1-\hat{\beta}_i}\pi_{t,n}^{survey} + \frac{\hat{\beta}_g}{1-\hat{\beta}_i}g_{t,n}^{survey}. \tag{14}$$

I account for the uncertainty in the estimation of $i_{t,n}^{survey}$ when estimating the survey-augmented affine model. The model-free estimate for the $n$-period term premium $\tau_{t,n}$ is obtained as the difference between $y_{t,n}^{LC}$ and $i_{t,n}^{survey}$.

Figures 1 and 2 respectively plot the long-horizon forecasts for inflation and real GDP growth from Consensus Economics. Only Brazil and Turkey show an upward trend in their inflation expectations; for the rest of the countries, those expectations have been stable or even declining. Meanwhile, for half of the EMs in the sample, there is a declining trend in their expected real GDP growth. Figure 3 shows the estimated long-horizon forecasts for the short rate. The estimates are sensible, they have magnitudes in line with the nominal 10-year yield in each country.

An alternative way to use the surveys from Consensus Economics is to assume that the emerging markets in the sample are small open economies, and so their real interest rate would be determined abroad. The forecast for the local short rate would then be equal to the forecast for the international real short rate plus the forecast for inflation at each of the available maturities. This approach requires to define the international real short rate and to have long-term forecasts for it. As before, the U.S. can be the benchmark for all emerging markets. Long-term forecasts for its real rate can be obtained as the difference between the respective forecasts for the nominal short rate and inflation. This approach will be included in a future version of this paper.

### 3.4 Estimation [Go2ToC]

Affine term structure models can be estimated by maximum likelihood, but the convergence to the global optimum has been traditionally subject to computational challenges

[26]The long-term forecasts are allocated to the 10-year maturity.

[27]Under stationarity, $\mathrm{E}(i_t) = \mathrm{E}(i_{t-1})$.

and multiple local optima. Joslin, Singleton, and Zhu (2011) (hence JSZ) propose a normalization of the affine model that improves the convergence to the global optimum of the likelihood function.[28]

The JSZ 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 $(i_\infty^{\mathbb{Q}}, \lambda^{\mathbb{Q}}, \Sigma)$, where $i_\infty^{\mathbb{Q}}$ is the short rate under $\mathbb{Q}$ in the long-run and $\lambda^{\mathbb{Q}}$ is a K $\times$ 1 vector of ordered eigenvalues of $\Phi^{\mathbb{Q}}$.

The affine model can be estimated using the JSZ normalization following a two-step procedure. First, the $\mathbb{P}$ parameters are estimated by OLS of the VAR in equation (10) using the K principal components of the yield curve. This provides initial values for the maximum likelihood estimation of the matrix $\Sigma$. Then, taking $\hat{\mu}^{\mathbb{P}}$ and $\hat{\Phi}^{\mathbb{P}}$ as given, the $\mathbb{Q}$ parameters can be estimated by maximum likelihood.

As mentioned before, to estimate the affine model, the relevant yield curve for advanced countries is the nominal one $y_{t,n}^{LC}$, whereas for emerging markets it is the synthetic one $\widetilde{y}_{t,n}^{LC}$. In addition, the model for emerging markets is augmented with survey forecasts of the short rate.[29] The model is augmented with survey data on the last day of the month for which the data was published.[30] Notice that yield curve data is monthly whereas survey data is available twice a year.

The survey-augmented model is estimated by maximum likelihood using the Kalman filter, which 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 (10). 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

[28]The model can also be estimated using linear regressions (see Adrian, Crump, and Moench, 2013) but the model is overidentified. Goliński and Spencer (2019) correct for this based on JSZ.

[29]The model for advanced countries in the sample is not augmented with survey data because I do not have access to it. They are, however, not the main focus of this paper, the affine model is estimated for them just for comparison purposes. Moreover, the results reported later for them are more comparable with other studies that do not use survey data. Finally, there are less concerns about small sample sizes for advanced countries and, for some of them, even for a regime change during the sample period.

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

adds measurement error to the fitted yields in equation (6) for each of the N maturities:

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

where $\mathbf{y}_t$ 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 is available, the observation equation increases by the number of survey forecasts S as follows:

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

where $\mathbf{y}_t^S$ is a $\mathrm{S} \times 1$ vector of survey forecasts with elements $i_{t,n}^{survey}$, $\mathbf{A}^S$ is a $\mathrm{S} \times 1$ vector with elements $A_n^e$, $\mathbf{B}^S$ is a $\mathrm{S} \times \mathrm{K}$ matrix with rows equal to $B_n^e$ 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 elements on the diagonal.

To estimate the survey-augmented model, I follow Guimarães (2014) and Lloyd (2018) in two aspects. First, I use the estimated parameters from the JSZ normalization as initial values for the Kalman filter. Second, I assume homoskedasticity in yields and survey errors, so that $\mathbf{\Sigma}_Y = \sigma_y I_{\mathrm{N}}$ and $\mathbf{\Sigma}_S = \sigma_s I_{\mathrm{S}}$, where $I_{\mathrm{N}}$ and $I_{\mathrm{S}}$ are $\mathrm{N} \times \mathrm{N}$ and $\mathrm{S} \times \mathrm{S}$ identity matrices, respectively. This reduces the number of parameters to be estimated.

Finally, although survey data helps to discipline the model, relying too much on it can be counterproductive due to, for instance, measurement error[31] and overfitting. To strike a balance between these two considerations, I follow Kim and Orphanides (2012) in fixing $\sigma_s$ at a conservative level of 75 basis points. This essentially means that survey data is seen as a noisy measure of expectations for the short rate.[32]

# 4 Yield Curve Decompositions

[Go2ToC]

[31] Recall that Consensus Economics does not report long-term forecasts for the short rate of emerging markets.

[32] When $\sigma_s$ is allowed to be estimated, its average value among all emerging markets is 24 basis points. For most of the countries in the sample, the estimated term premia remains largely the same.

This section reports the decomposition of the nominal yields of emerging markets and the analysis of the components. The results are assessed against those of advanced countries. The analysis highlights the benefits of using synthetic yields and survey data when studying the yields of emerging markets.

## 4.1 Model Fit [Go2ToC]

The affine model is estimated separately for each country. The survey-augmented model is estimated using the synthetic yields of emerging markets, and the yields-only model is estimated using the nominal yields of advanced countries.[33]

In all cases, the pricing factors are the first three principal components (PCs) of the respective yield curves, which are commonly known as level, slope and curvature (Litterman and Scheinkman, 1991) . On average, the first three PCs explain more than 99.5 and 99.9% of the variation in the synthetic yields of EMs and the nominal yields of AEs, respectively. Interestingly, the level factor plays a relatively bigger role in AEs than in EMs (96% vs 88%), as a consequence the slope (4 vs 10%) and curvature (0 vs 2%) factors play a relatively bigger role in EMs.

Figure 4 exemplifies the fit of the model for the 10-year synthetic yields of EMs. As it can be seen, fitting errors are small, indicating that the affine model successfully captures the dynamics of the yields.

## 4.2 Decomposing EM Yields [Go2ToC]

Once the affine model is estimated for each country, the nominal yield curves of EMs can be decomposed into three parts. The difference between the nominal and synthetic yields is a measure of the credit risk premium in EMs (Du and Schreger, 2016a). The other two components come from the decomposition of the synthetic yield curves into an expectation of the future short-term interest rate and a term premium; this two-part decomposition is equivalent to the standard one for the nominal yields of AEs. The yields

[33] For Israel and South Africa, for which no survey data is available, the yields-only model is estimated using their synthetic yield curves.

can be decomposed in this way at each maturity but, unless otherwise stated, the analysis focuses on the 10-year maturity for the sake of brevity.

Figure 5 plots the three components of the nominal yields for each EM. Several patterns emerge from the figure. The most immediate one is that the credit risk and the term premia are both time-varying. In addition, for most countries, the term premium plays a relatively bigger role than the credit risk premium in the dynamics of the EM yields. A more in-depth discussion of these decompositions follows below after assessing the sensibility of each component.

**Expected Future Short Rate.** The model-implied expectation of the short rate for the 10-year maturity is assessed against the interest rate forecasts calculated as explained in section 3.3. The model acknowledges that the survey forecasts are estimated by treating them as noisy measures of the expected short rate, it therefore does not rely too much on them. Nevertheless, the model-implied expectations track the interest rate forecasts reasonably well, as can be seen in figure 6. Surveys do in fact help the model pinning down the parameters under the $\mathbb{P}$ measure. Indeed, when no survey data is used in the estimation, the model-implied expectations are weakly connected to the forecasts. For some countries, for instance, the yields-only model-implied expectations of the short rate were low relative to the survey forecasts and, thus, the estimated term premium was relatively high. Once survey data was incorporated into the estimation, the model-implied expectations increased in line with the interest rate forecasts and the estimated term premium decreased, and even became negative for some countries.

An alternative model-free measure of the expectation of the future short-term interest rate is the 2-year yield. The correlation of the model-implied expectation of the short rate for the 10-year maturity with the 2-year yield is close to 70%.

These results show the relevance of incorporating surveys in the estimation of the model for EMs, they help in dealing with the small sample problem characteristic in EM data.

**Term Premium.** There are two model-free measures commonly used to assess the model-implied term premium. One of them is the survey-based term premium obtained as the difference between the synthetic yield and the survey-expectation of the short rate for the same maturity. Since the model-implied expectations track the interest rate forecasts very closely, as mentioned above, the model-implied and the survey-based term premia are highly correlated as well. The other alternative measure is the residual from the regression of the 10-year yield on the 3-month yield (both synthetic). The model-implied term premium is also closely related to this residual, the average correlation between the two measures among all EMs is close to 70%.

**Credit Risk Premium.** The dynamics of the credit risk premium are in line with the results reported by Du and Schreger (2016a) who, in particular, show that it is highly correlated with the CDS of the respective country.

The credit risk premium is on average positive. In fact, it is not realistic for it to be negative. Instances in which the premium actually turns negative can reflect moments in which financial market frictions play a role (Du and Schreger, 2016a), including market segmentation between foreign and local investors and short selling constraints. The premium is thus a valid measure of credit risk that is far from perfect, but definitely better than ignoring credit risk.

## 4.3 Analyzing the Components

This section exploits the decomposition of the nominal yields in EMs to better understand their dynamics.

### 4.3.1 Effects of U.S. Unconventional Monetary Policy [Go2ToC]

The decomposition of the nominal yields can be used to see the effects of the large-scale asset purchases that were part of the unconventional monetary policy (UMP) tools implemented by the U.S. Fed as part of its response to the global financial crisis (GFC).

One of the goals of those policies was to lower long-term bond yields and, in particular, the term premium.[34] Figures 7 and 8 plot the estimated term premia for EMs and AEs, respectively, along with the dates of the announcements of the three rounds of the Quantitative Easing (QE) program, the Maturity Extension Program (MEP) and the Taper Tantrum (TT). As can be seen, term premia declined globally following the QE announcements and, in general, increased with the TT announcement. Even the expectation part of the short rate in some countries coincided with the UMP announcements. Figures 9 and 10 show that, in general, expectations of future short rates declined during the QE announcements across both AEs and EMs, and increased with the TT announcement.

It is noteworthy that more than half of the EMs in the sample experienced negative term premia—which implies that investors considered EM bond yields as hedges and were therefore willing to give up some return in their EM bond investments. For comparison, the U.S. term premium estimated by Kim and Wright (2005) has been negative for most of the time since mid-2011, fluctuating between $-1$ and 0%. In addition, Wright (2011) reports that the 5-to-10-year forward term premium for six of the AEs considered here turned negative even before the GFC. [35] Moreover, for the EMs with a negative term premia, the phenomenon can be seen during and after the GFC, in some cases it coincided with the QE announcements. Interestingly, for Brazil and Turkey the decline in their term premia between 2008 and 2013 happened even when their inflation expectations were increasing (see figure 1).

### 4.3.2 Trends in Yield Components

The main component of the nominal yield curves of most EMs is the expectation of the future short rate (see figure 5). In fact, for some countries the expectation of the future short rate is relatively stable, whereas for others it even declined over the sample period.

The term premia in EMs is generally higher than the term premia in AEs. Neverthe-

[34]Kuttner (2018) discusses the effects of the QE announcements on U.S. bond yields.

[35]The estimates of the term premia for AEs obtained here, however, do not turn negative. In his estimation, Wright (2011) augments the affine model with data from macroeconomic variables. This might support the case of supplementing the estimation of the affine model of AEs either with macro or survey data.

less, in addition to the declining trend in the term premia of both AEs and EMs since the start of the QE program, figure 7 also shows that for some EMs,[36] a declining trend in their term premia can be perceived even before the GFC; this is consistent with the evidence for AEs documented by Wright (2011) with data going back to 1990.[37] The largest declines can be seen in Asian and European countries.[38] Interestingly, Mexico, Russia and Turkey experienced reversals in their term premia, they increased after declining to historic lows.

It is worth noting that all of the EMs in the sample, with the exception of Malaysia, have adopted an inflation targeting regime. In fact, the central banks in Hungary, Philippines, Indonesia, Russia and Turkey adopted inflation targeting during the sample period.[39]

Finally, in addition to comparing the term premia across countries, one can also compare them across maturities per country, known as the term structure of term premia. In general, the term premium increases with maturity. As one would expect, when long-term bonds are seen as riskier than short-term bonds, investors would require a higher compensation for holding long-term bonds.

#### 4.3.3 Effects of Local Conditions

The estimated term premia also seems to be related to local conditions. Figure 11 plots the term premium of some EMs along with the dates of relevant local events.[40]

[36] HUF, IDR, KRW, MXN, PHP, PLN

[37] He argues that this downward trend reflects a reduction in inflation uncertainty.

[38] HUF, IDR, KRW, PHP, PLN, THB.

[39] Hungary in June 2001, Philippines in January 2002, Indonesia in July 2005, Turkey in January 2006 and Russia in 2014. In addition, Hungary and Poland were accepted to join the European Union in April 2003.

[40] For Brazil, the events highlighted are the announcements of capital controls in response to UMP announcements by central banks in AEs. For Colombia, the events are announcements of capital controls before the GFC. For Hungary, the events are the approval of the treaty to join the European Union, the adoption of an explicit medium-term inflation target by the central bank, and a demand by the European parliament to prevent the Hungarian authorities from breaching the EU's founding values. For Indonesia, the event is the adoption of inflation targeting. For South Korea, the event is the announcement of measures to limit financial firms' positions in foreign exchange derivatives to control currency flows. For Poland, the event is the approval of the treaty to join the European Union and the publication of a law threatening the independence of the judiciary. For Turkey, the events are the adoption of inflation targeting by the central bank and the killing of the journalist Jamal Khashoggi who disappeared after he visited the consulate of Saudi Arabia in Istanbul.

#### 4.3.4 Is There a Global Neutral Real Interest Rate? [Go2ToC]

The neutral real interest rate is an important concept in monetary economics. It is a key reference for inflation-targeting central banks. However, it is an unobserved variable. Estimates of it generally focus on AEs.

The decomposition of the nominal yields of EMs opens the door to glimpse the long-term real interest rates of EMs. The expected long-term real interest rate can be obtained as the difference between the long-term expectation for the short rate implied by the model and the long-term inflation forecast from Consensus Economics.

Figure 12 plots the expected real rates of the EMs. The evidence for AEs shows that real interest rates have converged across countries and that they have declined to zero over the past years (Holston, Laubach, and Williams, 2017). It is remarkable that for all but one of the EMs their real rates fluctuate around similar levels of 0 and 2%.[41] This evidence shows that, after correcting for credit risk and inflation, the real interest rates of EMs behave similarly to the real rates documented for AEs. Obstfeld (2020) discusses the global determinants of real interest rates, including the increase in savings from East Asian countries following the regional crises of the late-1990s.

#### 4.3.5 Bond Risk Premia in EMs [Go2ToC]

Since the credit risk premium is statistically different from zero (Du and Schreger, 2016a), the nominal yield curve is not free of credit risk. Therefore, the decompositions obtained by estimating the affine model using nominal yields will provide biased estimates of the expected short rate and the term premium.

This shows that while bond risk premia is usually associated with the term premium in AEs, for emerging markets they are two different concepts. Incorporating survey data in the model estimated with nominal yields produces an expected short rate similar to the one obtained using synthetic yields. Therefore, the difference between the nominal yields and the expected short rate obtained with the survey-augmented model is actually capturing bond risk premia not a term premia in EMs. By estimating the model using synthetic yields and surveys, I am then able to estimate a genuine term premium. As a

[41]The real rate of Brazil fluctuates around 6%.

result, I define the bond risk premia in EMs as the sum of a term premium and a credit risk premium.[42]

The two components of the bond risk premium in EMs play an important role in its dynamics. Figure 13 shows the decomposition of the bond risk premia. The role of its two components varies by country. For some countries the relative importance of both components changed over time; for instance, for Hungary and South Korea, the term premium declined relative to the credit risk premium over the sample period. For several countries,[43] the term premium plays a bigger role; the exception is Brazil, for which the credit risk premium is more salient. For the rest of the countries,[44] both components are important.

In sum, it does matter which curve is used to estimate the term premia in EMs. In particular, there are gains by using synthetic yields to account for credit risk in EMs.

#### 4.3.6 Term Premia and Measures of Risk and Uncertainty

Term premia captures the uncertainty risk of investing in bond yields. It is expected then for the term premium to be related to risk and uncertainty measures.

The components of the bond risk premium capture different risks. Indeed, for all EMs their estimated term premium correlates negatively with their credit risk premium.[45] When EMs face difficulties servicing their debt, they can either default or inflate away their debt, which can be referred to as explicit and implicit default. The first option would increase the credit risk premium, whereas the second essentially generates inflation risk that would be reflected in a higher term premium. Choosing one of the two options reduces the need for the other, which would explain the negative correlation. The evidence for EMs thus shows a trade-off between explicit and implicit defaults.

Baker, Bloom, and Davis (2016) construct an economic policy uncertainty (EPU) index based on the frequency of articles in local newspapers containing key words such

[42]This measure of the bond risk premia is highly correlated with the residual obtained by estimating the survey-augmented model with nominal yields.

[43]COP, IDR, ILS, MXN, PEN, RUB, TRY, ZAR.

[44]MYR, PHP, PLN, THB.

[45]The correlation is not statistically significant only in the case of Indonesia.

as ‘economy’, ‘uncertainty’ and ‘central bank’. That index is, however, only available for 5 of the EMs in the sample, Brazil, Colombia, Mexico, Russia and South Korea. In principle, the EPU index can be correlated with any of the two components of bond risk premia in EMs. Indeed, it is positively correlated with the term premia in Colombia and Mexico, and with the credit risk premium in Russia and South Korea, but it is negatively correlated with the term premia in South Korea and with the credit risk premium in Mexico. The EPU index is not related with any of the two components in the case of Brazil.

Two variables commonly used in the global financial cycle literature (see Rey, 2013) are the monetary policy stance in the U.S. and the Cboe’s volatility index (Vix), the latter is usually considered as a measure of risk aversion and economic uncertainty. A natural variable in the former case, is the U.S. term premia as estimated by Kim and Wright (2005). The correlation of the term premia in EMs with the U.S. term premium is 62%, compared to 77% in the case of the term premia in AEs. At the same time, increases in the Vix are also positively associated with increases in the term premia of both EMs (32%) and AEs (37%).

Finally, the term premia in EMs is positively correlated with the local inflation rate.

# 5 International Spillovers of U.S. Monetary Policy

Although a global factor plays a role in the variation of yields in both AEs and EMs, the bond yields in EMs are not as tightly connected as they are in AEs. Pooling all yields together, there is a global-level factor—associated with the first PC—that explains around 50% of the variation in EMs but as high as 90% in AEs. When yields are separated by maturity, a similar pattern emerges for the 1-year yields, whereas for the 10-year yields, a global factor explains around 95% in AEs and 40% in EMs. These percentages are largely the same after the GFC.

A similar conclusion can be drawn for the yield components. A global factor explains around 40% of the variation of all the three components of yields in EMs.[46] For AEs, in

[46] Du and Schreger (2016a) also show that the credit risk premium has a low reaction to global variables.

contrast, a global factor explains 90% of the variation in the expected short rate and 80% in their term premia. After the GFC, these percentages increased for the term premia in AEs and for the two components of the synthetic yields in EMs.

The role of a global factor seems to be different throughout the yield curve. Obstfeld (2015) shows that the effects of the global financial cycle are different at the short than at the long end of the yield curve. In particular, he argues that long-term bonds are more globally connected. Kalemli-Özcan (2019) meanwhile argues the opposite, that short-term yields suffer more the effects of global influences. When yields are separated by maturity, a global factor explains around 50% of the variation in the 1-year yields of EMs, compared to 90% for AEs. For the 10-year yields, a global factor explains around 40% of the variability in EMs, relative to 95% in AEs. However, the role of the global factor is larger for the two components of the synthetic yield curve in the long end than for the short end. In sum, the role of a global component is larger for short-term yields than for the long-term yields, but it is more relevant for the components of the longer-term yields.

Kalemli-Özcan (2019) further argues that U.S. spillovers work through changes in risk premia, especially for EMs. For instance, the expected short rate in EMs reacts to changes in the U.S. term premium. In this case, the effect is similar among all countries. On average, the 10-year U.S. term premium explains around 40% of the variation in the expected short rates in both EMs and AEs. Moreover, for EMs, the 10-year U.S. term premium explains more of the variation of the expected short rate than the U.S. expected rate itself. After the GFC, the 10-year U.S. term premium explained more than the U.S. expected rate in both AEs and EMs.

### 5.0.1 Is There A Non-U.S. Common Factor?

To assess whether the global factor is associated with U.S. variables, I regress the components of the yield curves of AEs and EMs on the respective components of the U.S. yield curve based on the methodology of Kim and Wright (2005). I then perform a PC analysis on the residuals (i.e. the part of a country's term premium orthogonal to the

U.S. term premium) to see whether there is a common non-U.S. factor.

The expectation of the short rate and the term premium in the U.S. explain around 70% of the variation—measured by the $R^2$ statistic—in the respective components of the yield curves in AEs, and around 30% and 40%, respectively, for the components of the yields in EMs. After the GFC, these numbers largely remained for the term premia but declined for expected part.

There seems to be a non-U.S. common factor. Again, its relevance is lower for EMs than for AEs. It explains up to 85% of the variation in the yields of AEs and up to 50% in the yields of EMs. The importance of a non-US factor slightly increased after the GFC.

These results show that while the yields of EMs are indeed globally connected, they are less so than the yields of AEs; that is, they are still far from being fully integrated in the global financial markets, at least relative to the levels seen for AEs. Several factors can explain these patterns, including segmented markets, capital controls, home bias and regional differences. Local factors therefore seem to play a bigger role in the yields of EMs, and its components, than they do for AEs.

# 6 Concluding Remarks [Go2ToC]

This paper proposes a novel decomposition of the sovereign yields of emerging markets into an expected future short-term interest rate, a credit risk premium and a (pure) term premium. This is achieved by using synthetic local currency yields to estimate affine term structure models augmented with survey data.

Several new insights about the dynamics of bond yields in emerging markets were discussed. There is a negative relationship between the credit risk premium and the term premium reflecting a trade-off between explicit and implicit default. Term premia declined after announcements of U.S. quantitative easing. The long-term real interest rates of emerging markets behave similarly to that of advanced countries. Global factors have different effects on different parts of the yield curves of emerging markets.

Future versions of this paper will explore the effects of U.S. monetary policy shocks, identified with high frequency data, on the components of the yields of emerging markets. The role of debt capital flows in explaining the negative term premia of some emerging markets will also be explored. Another potential avenue of research is to test whether the term premium is actually capturing monetary policy risks, while the credit risk premium captures fiscal policy risks in emerging markets.

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

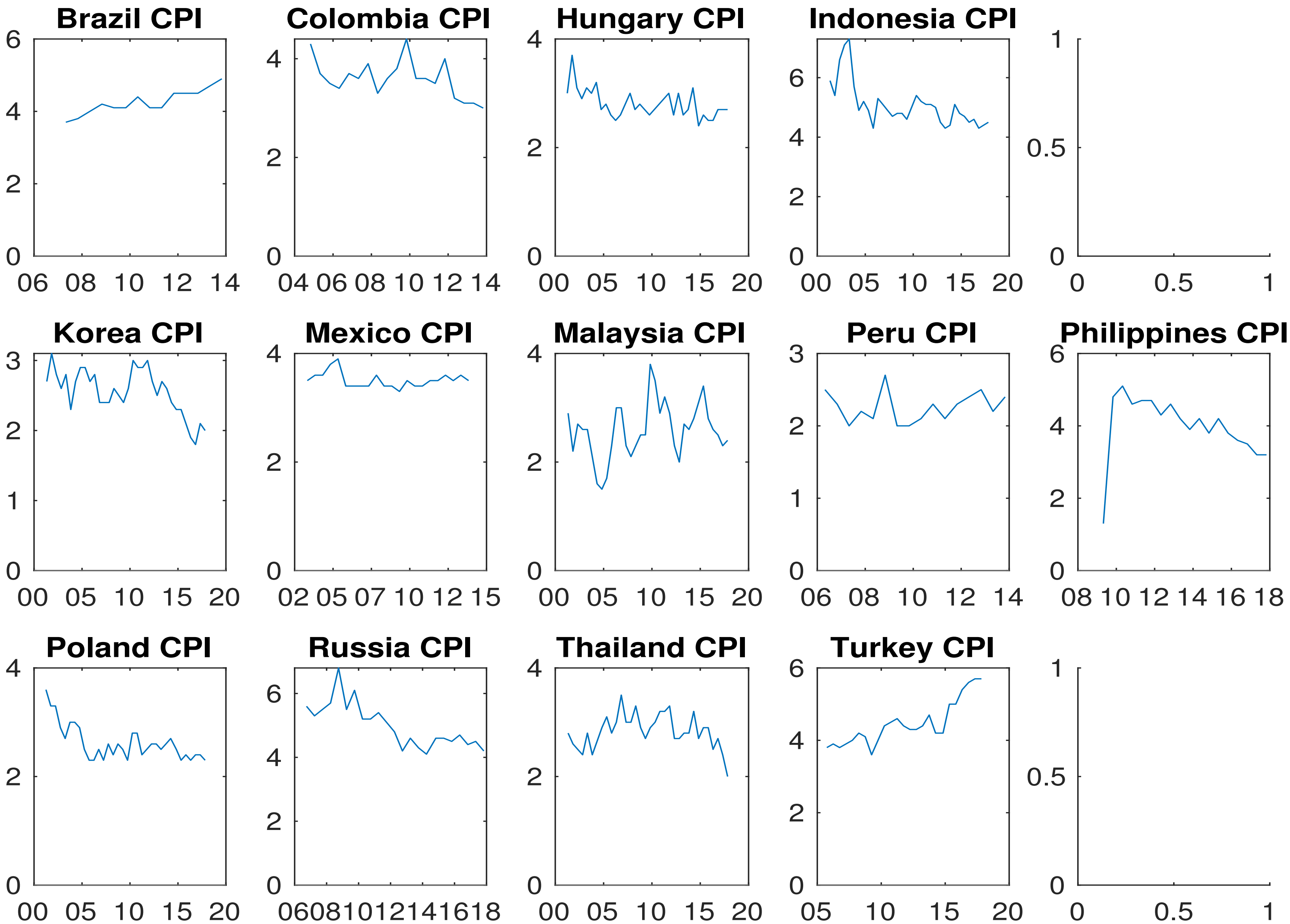


**Figure 2.** Long-Horizon Forecasts of Real GDP Growth

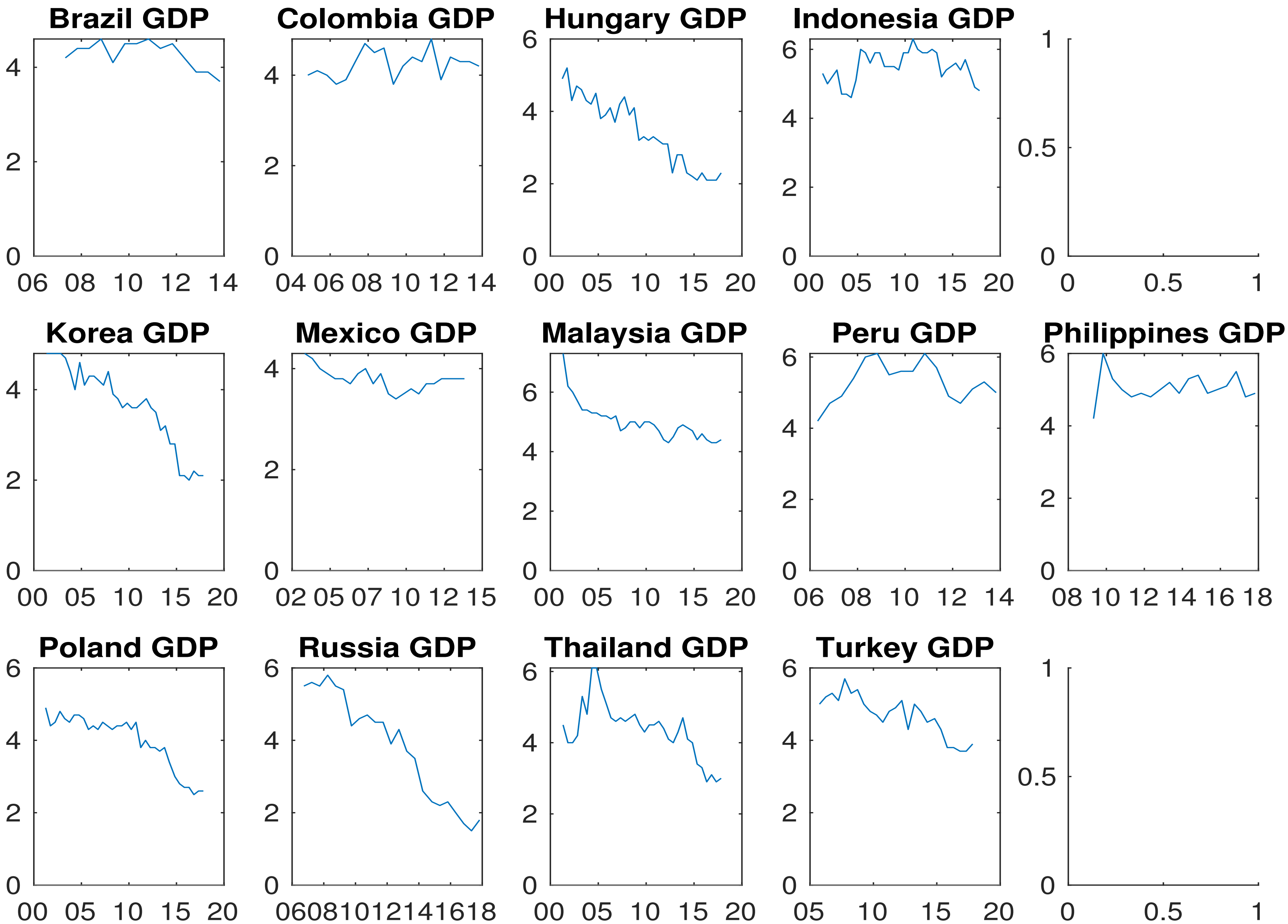


**Figure 3.** 10-Year Yield and Long-Horizon Forecasts of the Short Rate

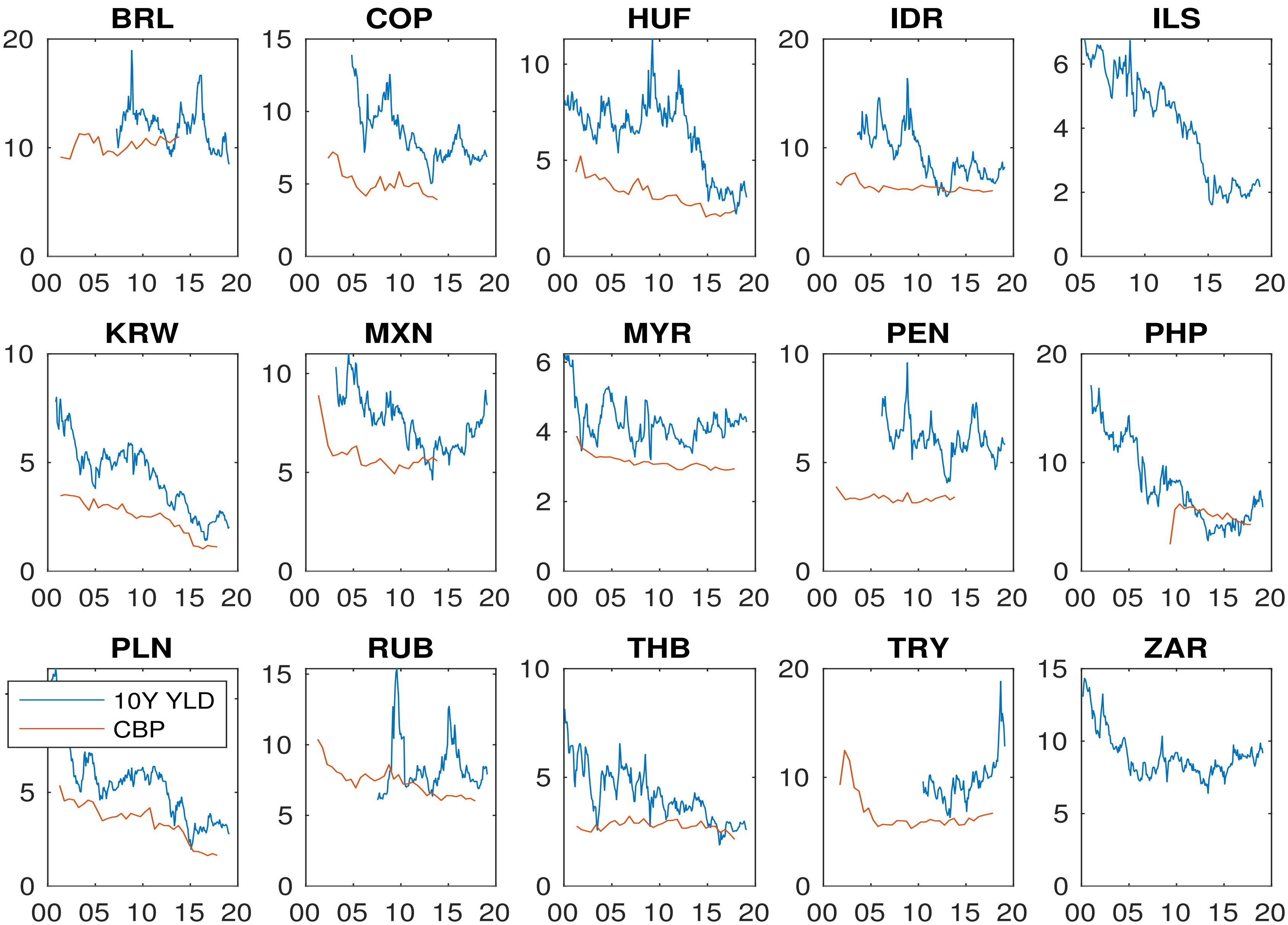


**Figure 4.** Model Fit for Emerging Markets: 10-Year Yields

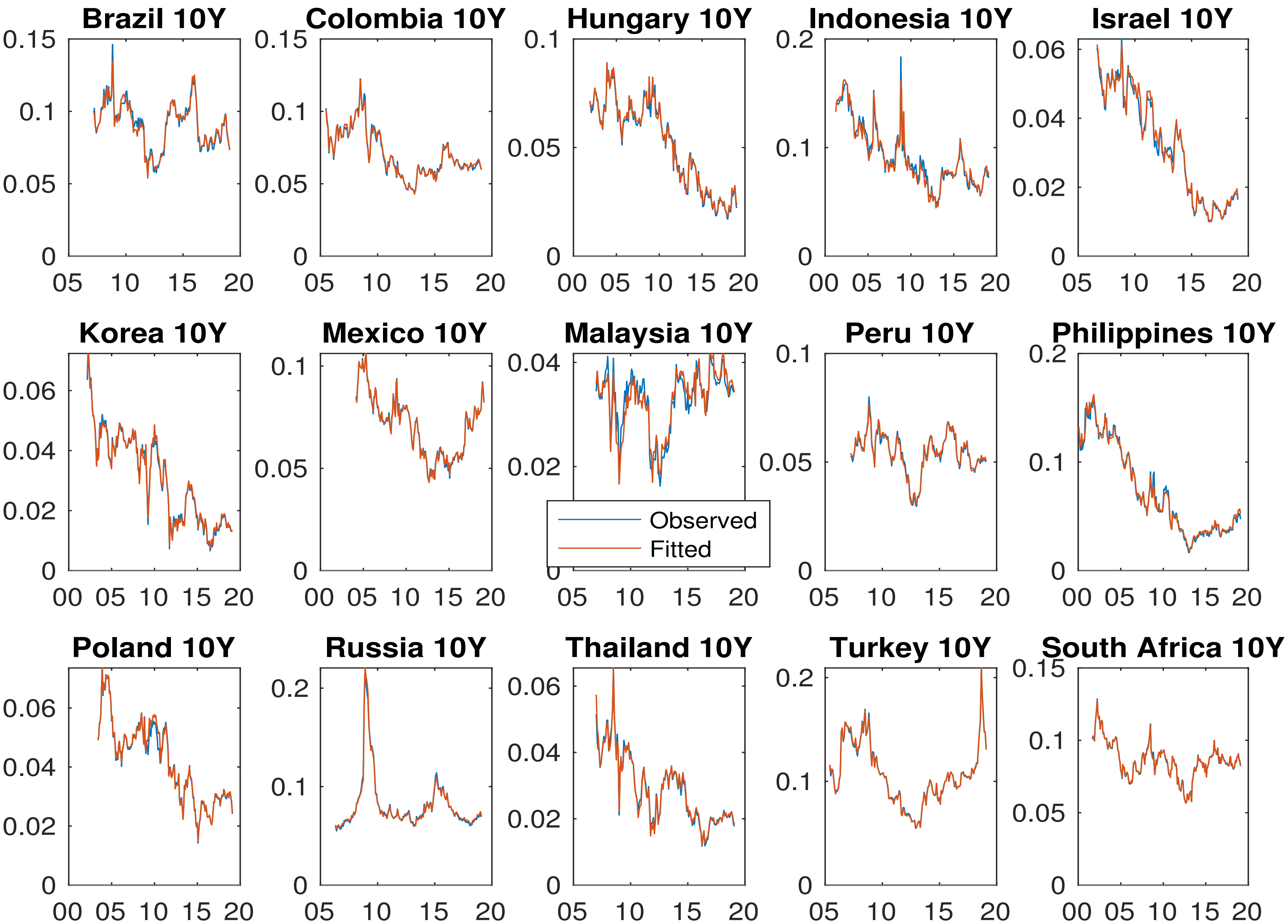


**Figure 5.** Decomposition of EM Nominal Yields: 10-Year Yields

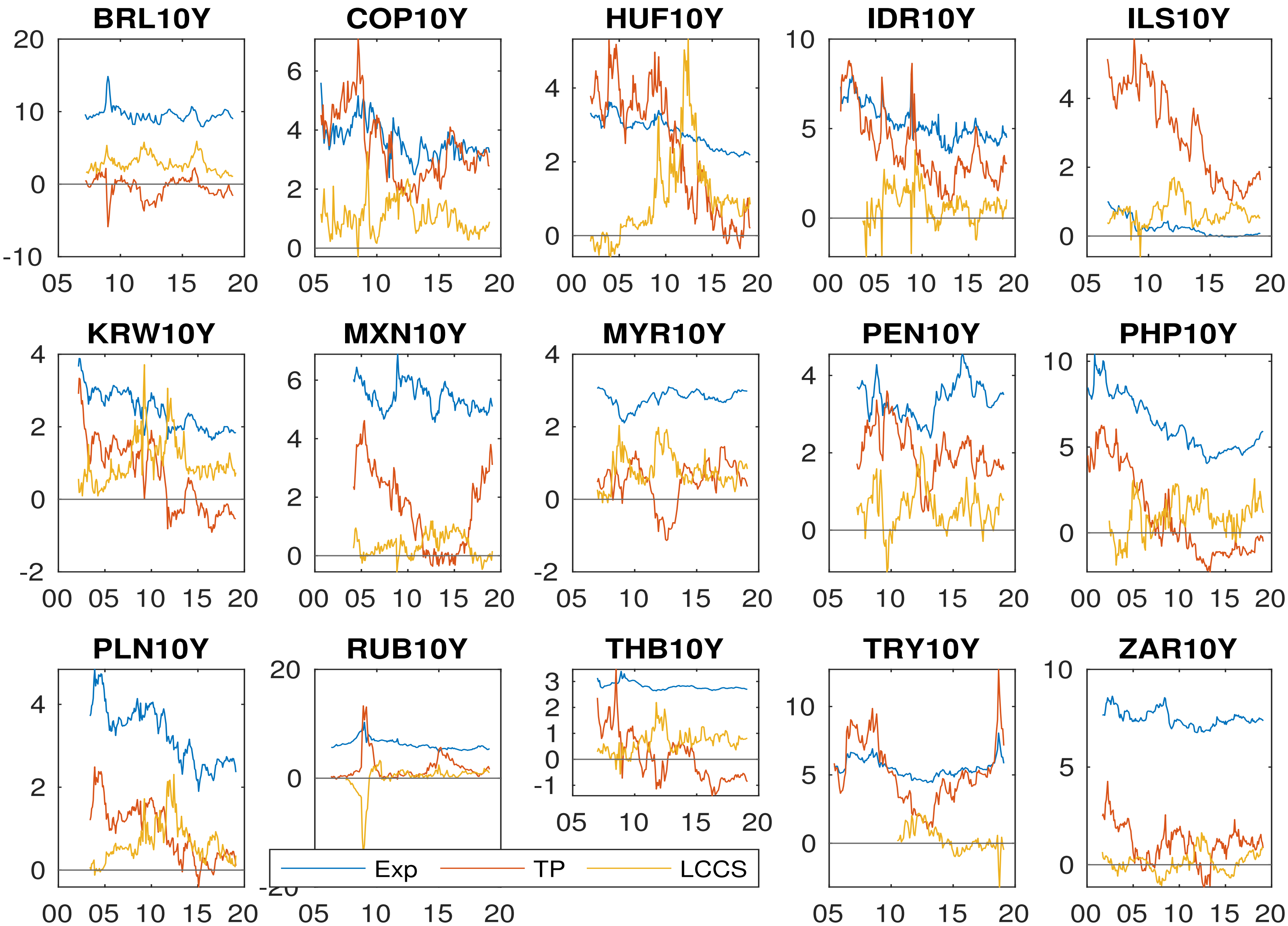


**Figure 6.** Interest Rate Forecasts vs Model-Implied Expectation: 10-Year Yields

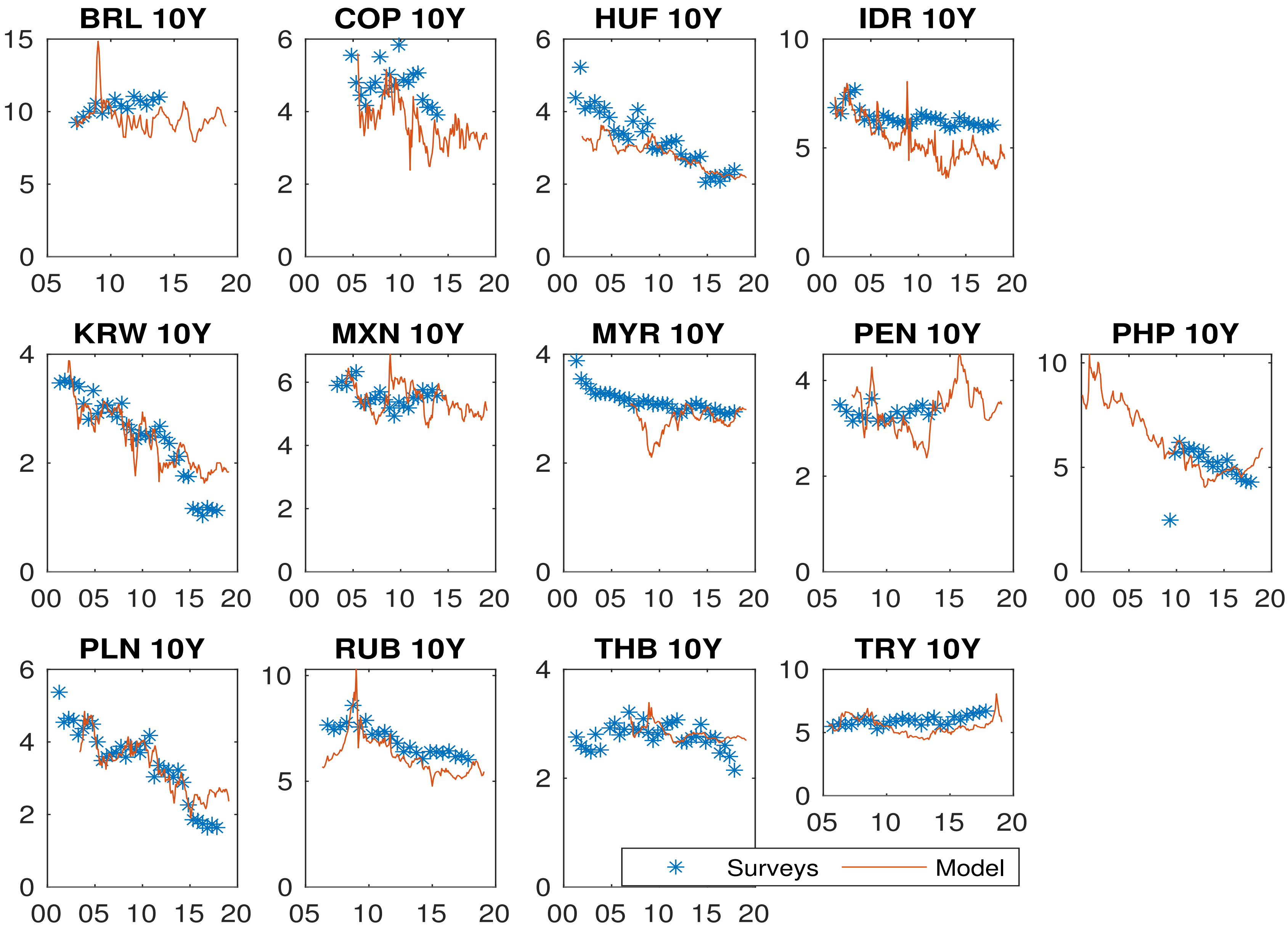


**Figure 7.** 10-Year Term Premium and UMP Announcements: EMs

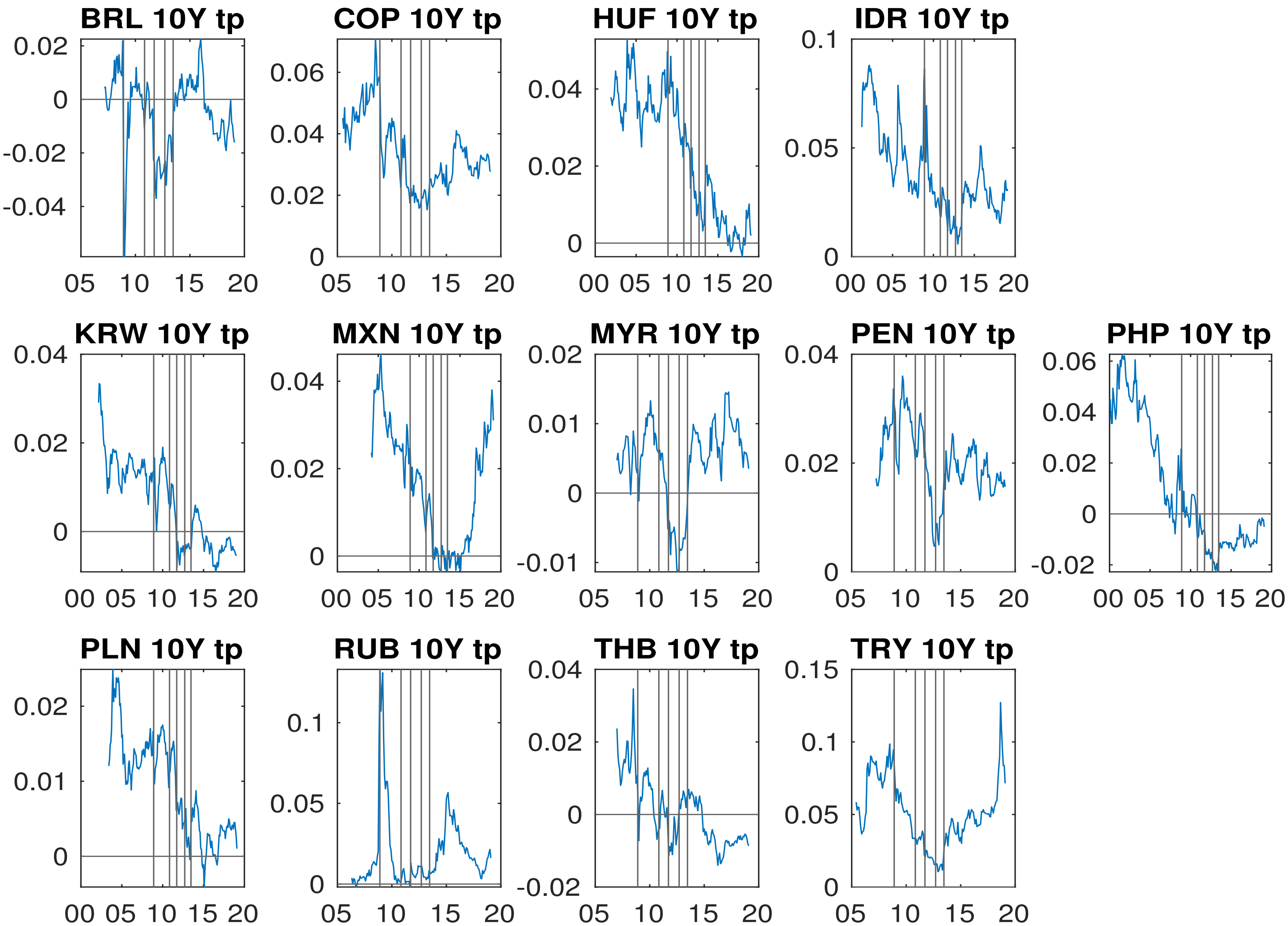


**Figure 8.** 10-Year Term Premium and UMP Announcements: AEs

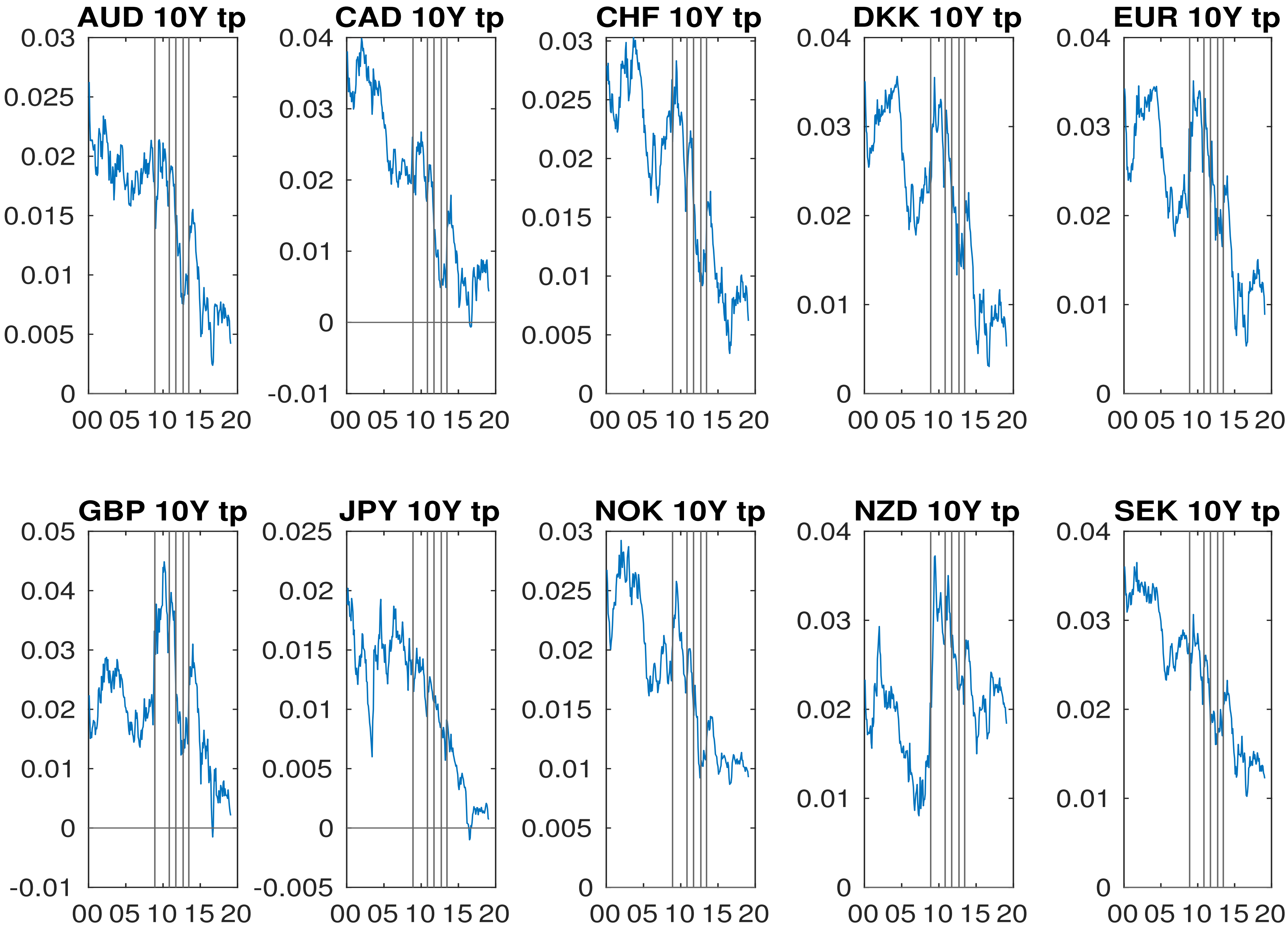


**Figure 9.** 10-Year Expected Short Rate and UMP Announcements: EMs

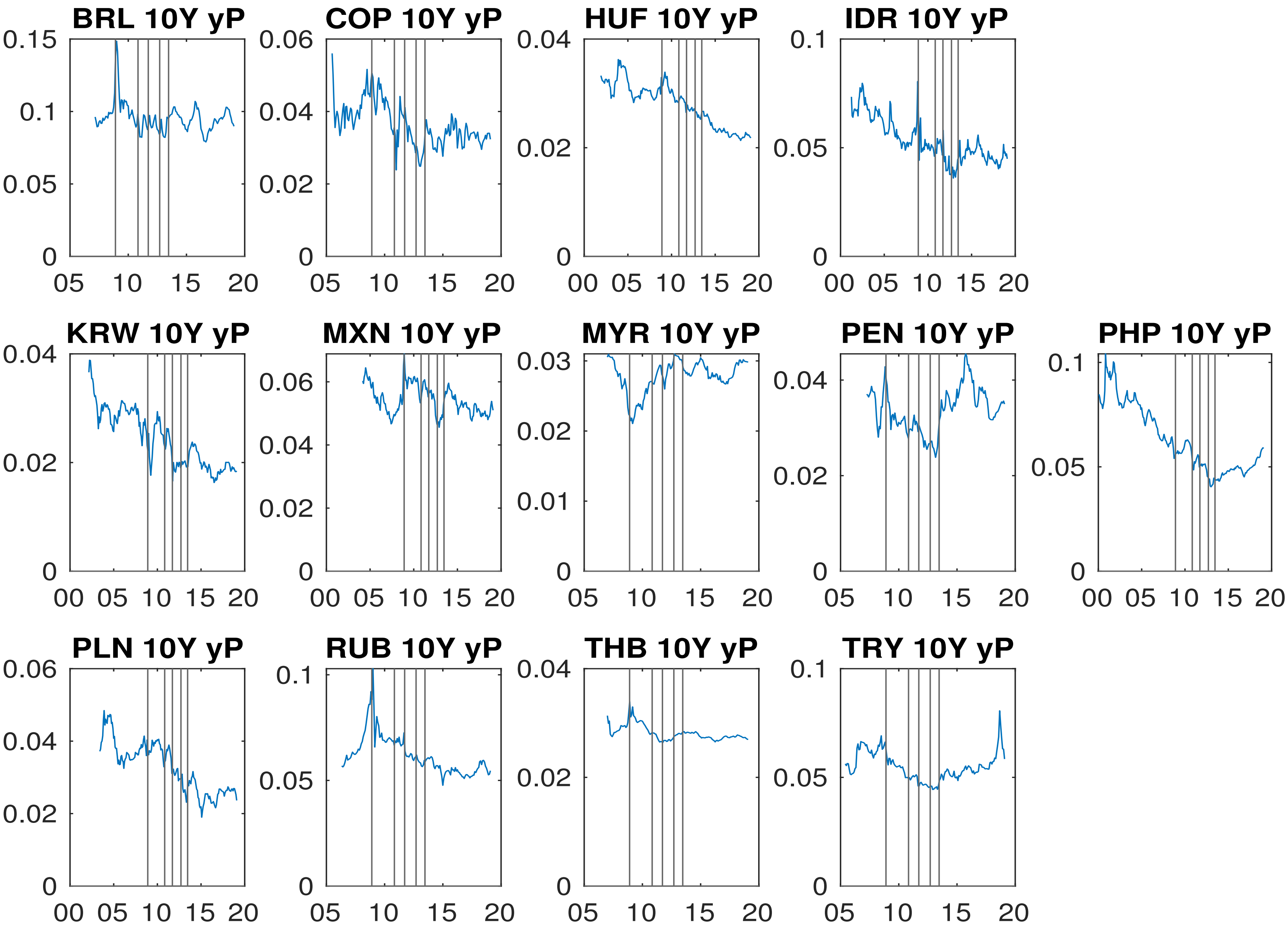


**Figure 10.** 10-Year Expected Short Rate and UMP Announcements: EMs

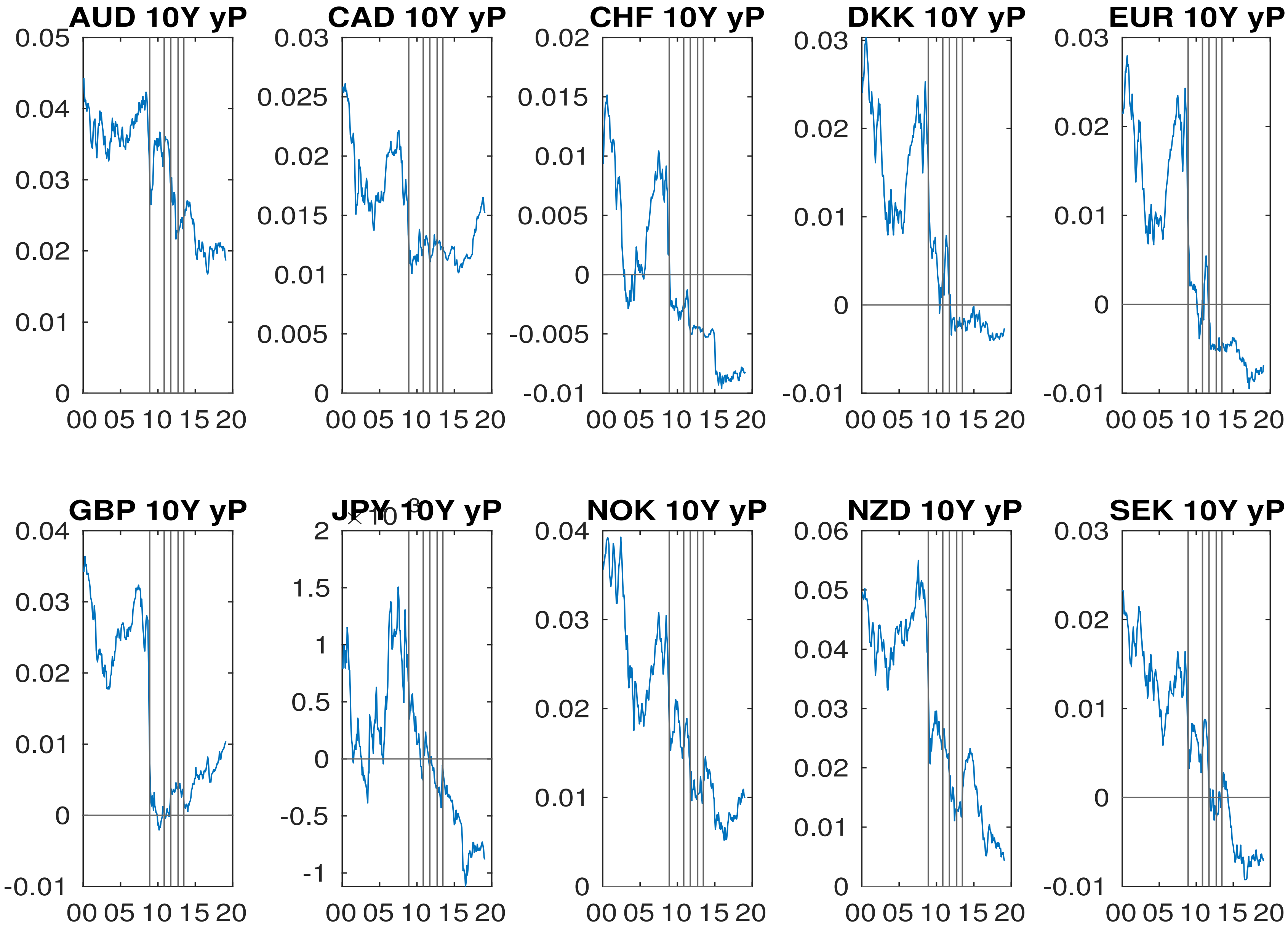


**Figure 11.** 10-Year Term Premium and Local Events

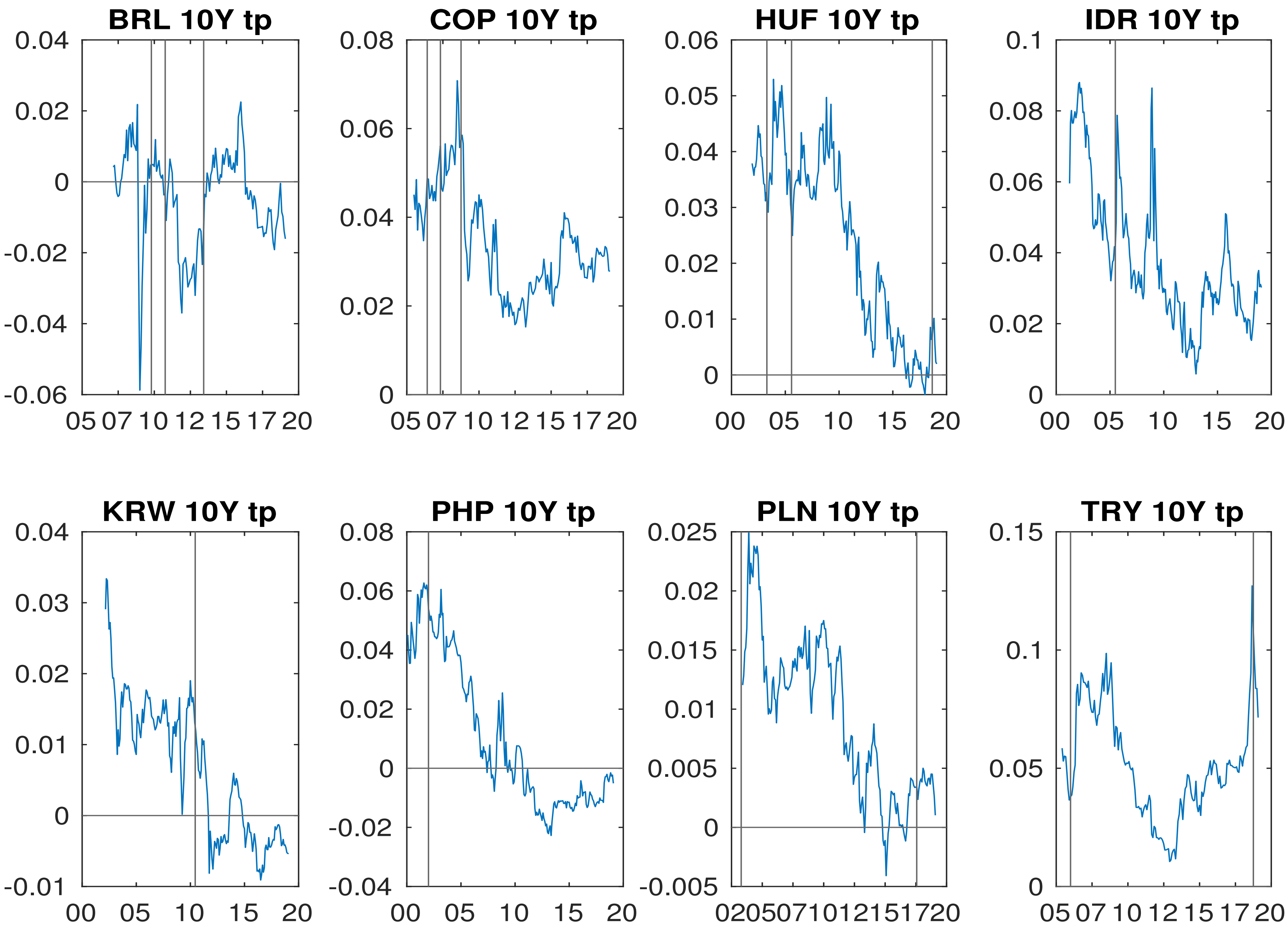


**Figure 12.** 10-Year Expected Real Interest Rate

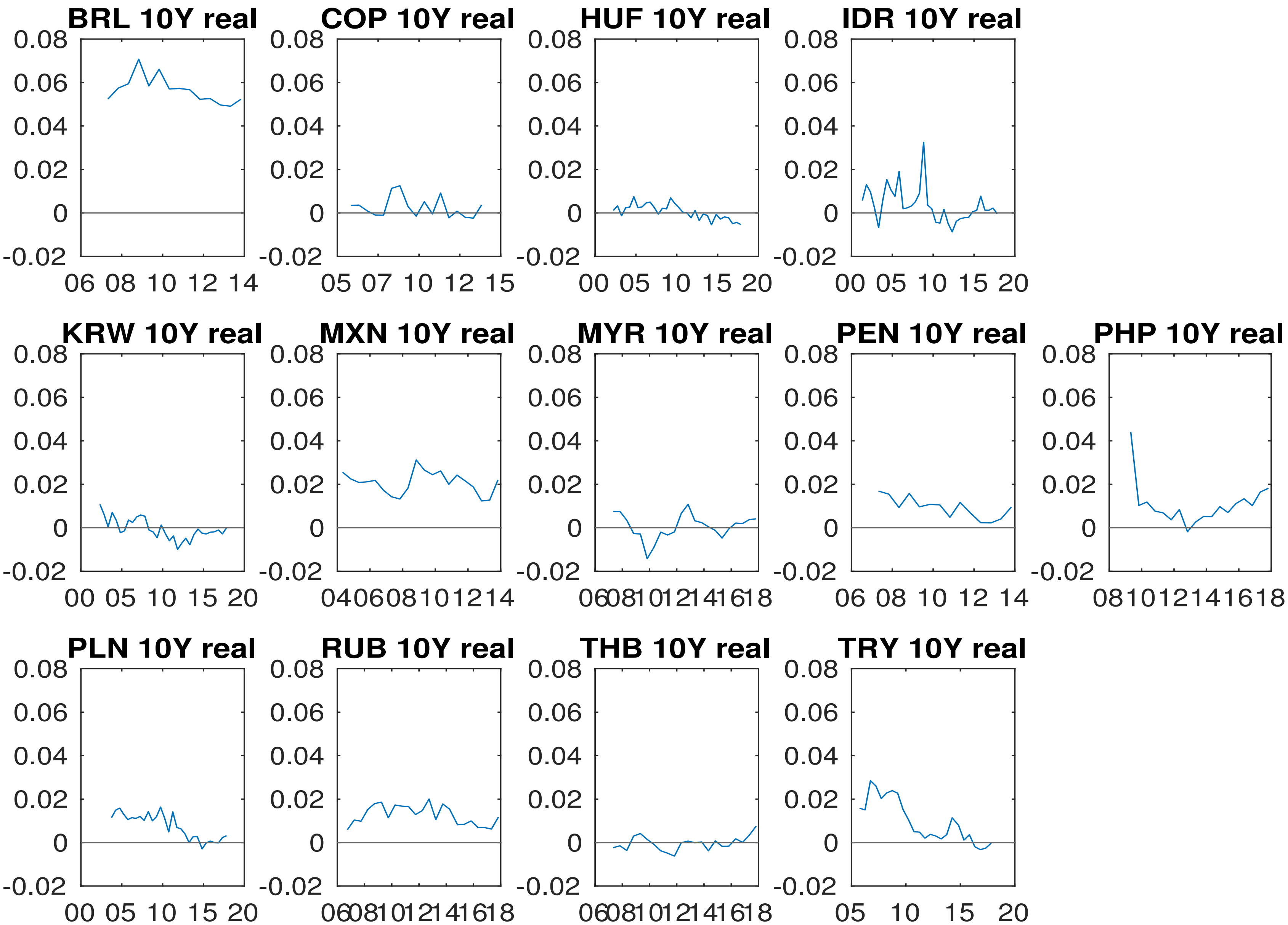
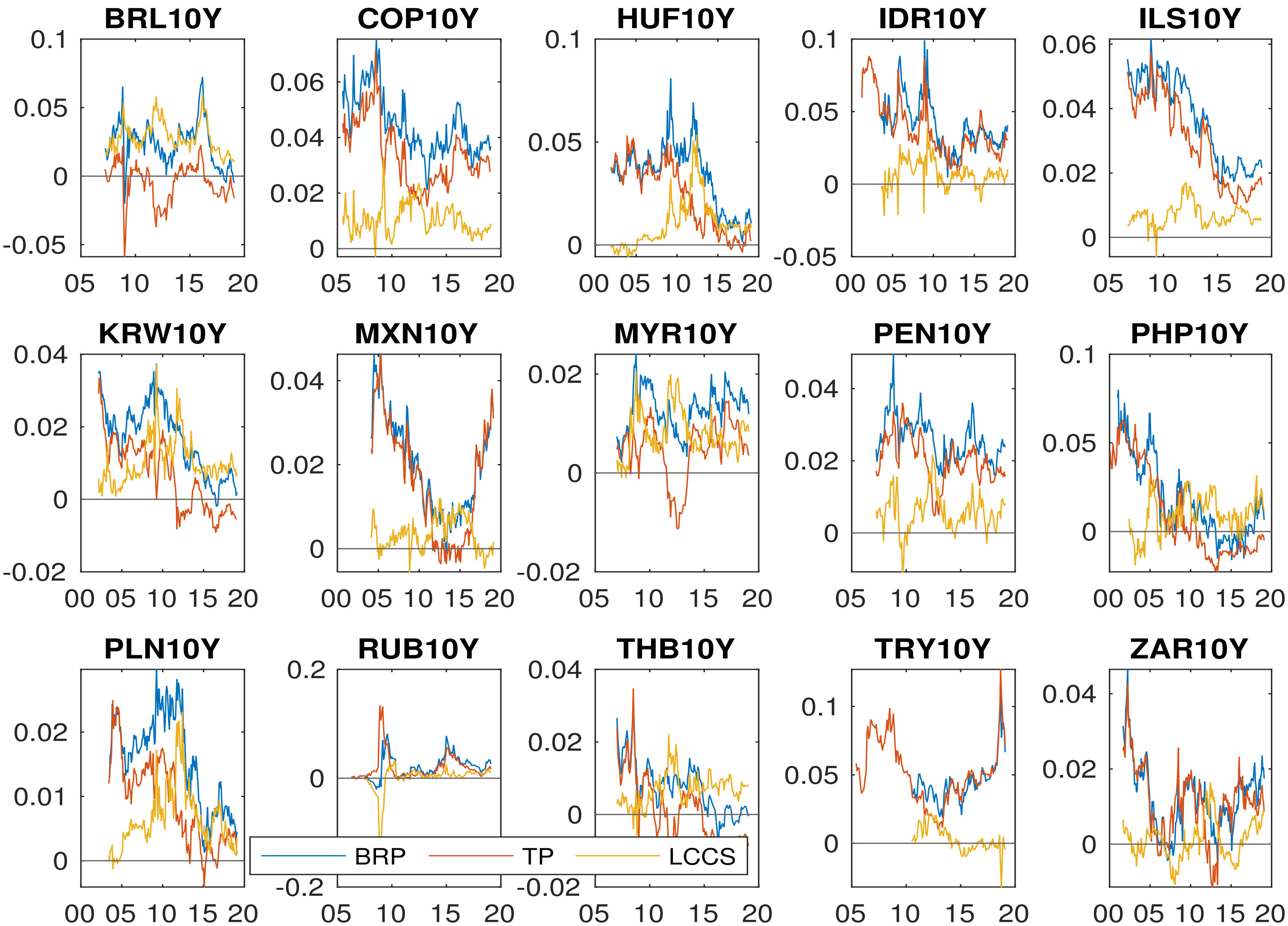


**Figure 13.** Decomposition of Bond Risk Premia in EMs: 10-Year



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