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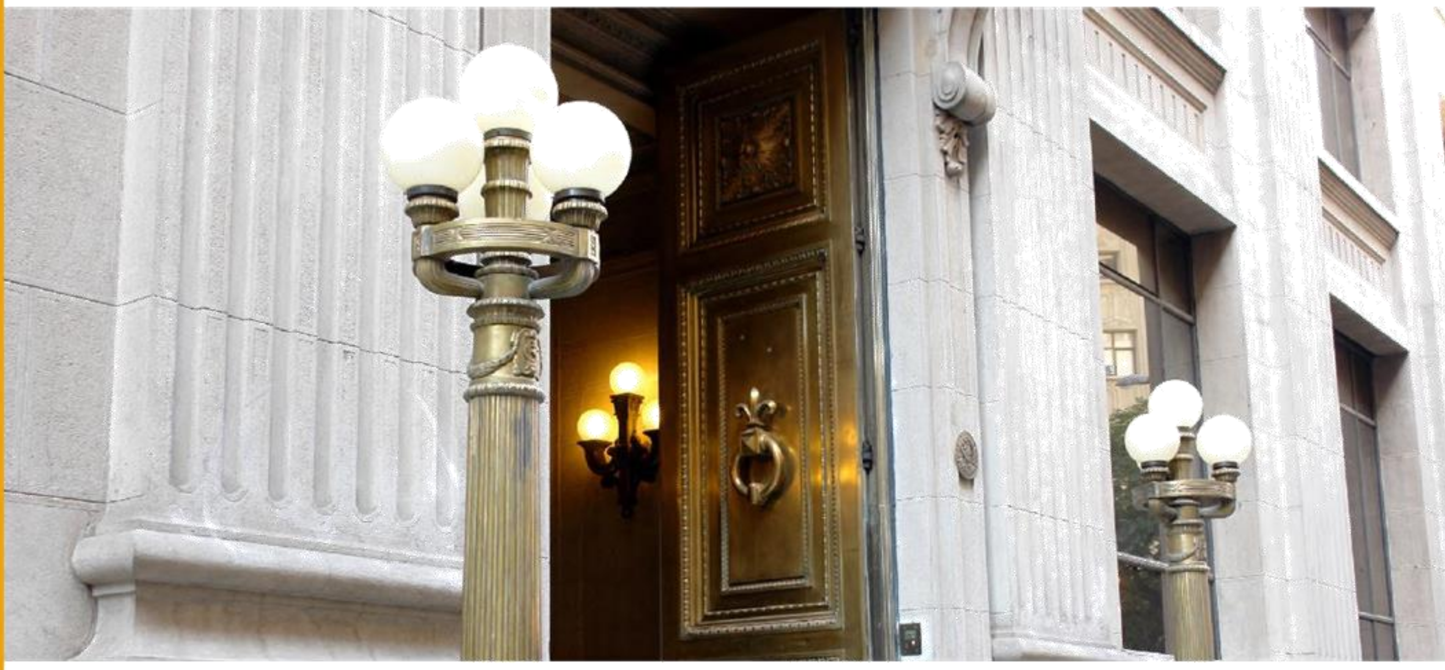

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Stocks, Bonds and the US Dollar - Measuring Domestic and International Market Developments in an Emerging Market*

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Abstract

We propose a novel specification strategy using a SVAR identified with zero and sign-restrictions to uncover real-time financial shocks in an emerging market. By adding a foreign exogenous block and differentiating between local and US risk premia, we build on the literature that employs economically intuitive sign restrictions on the comovement of stocks and bonds to distinguish between different types of news shocks. We then apply our methodology to Chile's financial markets. Our main results are the following. First, for Chilean financial assets, US shocks account for approximately 12% of the volatility of both short and long rates and 25% of the volatility of the stock market. Second, the transmission of US shocks to local assets comes mainly through risk aversion shocks and pure risk premia, followed by US monetary policy shocks. Third, the introduction of an exogenous block allows to better capture the effects of central bank communication around monetary policy meetings from both the Central Bank of Chile and the Federal Reserve.

Resumen

Se propone una nueva estrategia de identificación utilizando un SVAR identificado con restricciones de cero y signos para recuperar shocks financieros en tiempo real en un mercado emergente. Al agregar un bloque exógeno y al diferenciar entre shocks de premio por riesgo local y aquellos provenientes de USA, nos basamos en una literatura incipiente que emplea restricciones de signo económicamente intuitivas sobre los comovimientos entre tasas y mercado accionario, lo que nos permite obtener distintos tipos de shocks. Luego aplicamos esta metodología a los mercados financieros Chilenos. Nuestros resultados principales son los siguientes; primero, para los activos financieros chilenos, los shocks de USA representan en torno a un 12% de la volatilidad de la tasa corta y larga (de bonos de gobierno) y un 25% de la volatilidad del mercado accionario; segundo, la transmisión de los shocks de USA a los activos locales se transmiten a través de shocks de aversión al riesgo y premio por riesgo puro, seguidos de shocks de política monetaria de USA; tercero, la introducción de un bloque exógeno permite capturar los efectos de la comunicación del Banco Central de Chile, así como también los de la Reserva Federal.

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1. Introduction

Our primary research question centers on the relative importance of both domestic and foreign shocks shaping financial assets of small open emerging market economies. Specifically, we ask how relevant are US high frequency shocks with regard to domestic shocks in explaining the movements in local treasury yields and equity markets in Chile. To answer this question, our paper builds on the academic literature that employs economically intuitive sign restrictions on the co-movement of stocks and bonds to distinguish types of news affecting an emerging market economy (see Ehrmann et al. (2011), Matheson and Stavrev (2014), Cieslak and Pang (2019), Cieslak and Pang (2021), Brandt et al. (2021) and Lodge and Manu (2022)).

One point in common of the current literature on high frequency shocks is its exclusive focus on large developed markets, particularly the US and Eurozone. Estimating high frequency shocks to emerging markets seems a natural extension for this strand of research and one with potentially large policy implications. Moreover, there are at least two reasons to think that blindly applying the standard methodology to identify high frequency shocks to emerging markets might not be appropriate. First, while developed markets can be characterized as large close economies relatively insulated from external shocks, emerging markets are usually characterized as small open economies. This means that open emerging markets are significantly more affected by changes in global financial conditions (see Rey (2015) and Obstfeld et al. (2018) among others). Second, in small open economies with flexible exchange rate regimes, the currency plays a larger role as adjustment mechanism to external shocks (Edwards and Yeyati (2005)). Exchange rate fluctuations can affect economic activity through a number of channels. In the trade channel, an EM currency depreciation is expansionary through its stimulus on net exports (Mundell (1963)). Recent research however points to an alternative transmission channel for the currency shocks to the economy. In the financial channel, currencies affect the economy through their impact on domestic credit (Druck et al. (2018), Bussière et al. (2015)), real investment (Avdjiev et al. (2019)) and risk premia (Hofmann et al. (2020)). Importantly, the financial channel affects the economy in the opposite direction than the trade one. An EM currency depreciation is contractionary due to the tightening in financial conditions; lower equity prices, higher credit spreads and stricter credit conditions. Although the debate is far from settled, recent research points to a larger role of the financial channel over the trade one in open emerging markets (Blanchard et al. (2016), Carstens and Shin (2019)).[3]

In this paper, we expand the current methodology used to estimate high frequency shocks in developed markets to accommodate two key emerging markets characteristics: i) emerging market economies are small and open and thus subject to large external shocks relative to their size and ii) they are heavily exposed to currency fluctuations, mainly driven by global dollar appreciations. In order to account for these features, our model builds on the work of Ehrmann et al. (2011) who estimate the transmission between money, bonds, equity markets and exchange rates within and between the US and the euro area, using identification through heteroskedascity (Rigobon (2003); Rigobon and Sack (2003)). Our approach is slightly different in that we achieve identification using a zero and sign restrictions procedure (Arias et al. (2014)). To achieve identification, we follow the strategy of Cieslak and Schrimpf (2019) and Cieslak and Pang (2021) and identify three *local* shocks affecting the domestic economy: growth, monetary policy and risk premium shocks. But we additionally include an exogenous block containing US financial variables. This allows us to identify, simultaneously with the three local shocks, four *external* shocks: growth, monetary policy, risk premium and global risk aversion shocks.[4] An empirical model that carefully considers the impact of external shocks affecting emerging market economies and the global role of the US dollar in their transmission mechanism is the main contribution of our paper.[5]

This work adds to the related literature on external shocks and spillovers to emerging markets in three important ways (see Tillmann (2016), Ahmed et al. (2021), Han and Wei (2018), Ahmed et al. (2017), Azad and Serletis (2020), Caceres et al. (2016), Dedola et al. (2017), Druck

[3]EM countries exposure to the financial channel increases with larger currency mismatch in their balance sheet and lower Central Bank credibility making them more affected by US Dollar appreciations (Shousha (2019)).

[4]All shocks are identified using the interaction between yields, the equity market and the US effective exchange rate (i.e., growth shocks induce a positive correlation between *short* yields and equities, while monetary policy shocks induce a negative correlation between *short* yields and equities) whereas risk premium shocks are recovered by imposing magnitude restrictions on yields (i.e., risk premium shocks induce a negative correlation between *long* yields and equities while risk aversion shocks induce a positive correlation between *long* yields and equities).

[5]Large developed economies such as the US or the Eurozone can be characterized as relatively closed economies insulated from global shocks. This is of course an oversimplification. External shocks are likely to affect these economies too but to a lower extend than to small open emerging market economies.

et al. (2018), Fratzscher et al. (2018), Obstfeld (2020), Eterovic et al. (2022)). First, by explicitly accounting for a foreign exogenous block of structural shocks, we are able to map the relative contribution of different external shocks to domestic financial markets in specific periods of time in a unified framework. Second, by distinguishing US risk premium shocks from *global* risk aversion shocks, we are able to deepen our understanding of the different channels in which US monetary policy shocks transmit to emerging markets.[6] Third, we assess the effects of central bank communication and distinguish between "Delphic" and "Odyssean" components of monetary policy.[7] These two shocks move the yield curve in the same direction but have opposite effects on financial conditions and macroeconomic expectations. Both shocks have been extensively studied in the literature (Nakamura and Steinsson (2018); Breitenlechner et al. (2021)) and have different impact on macroeconomic outcomes (Jarociński and Karadi (2020); Andrade and Ferroni (2021)).

To the best of our knowledge, we are the first to simultaneously assess the effects of foreign and domestic high frequency news shocks in an emerging market. We apply our methodology to analyze Chilean financial assets. We select this country as it represents a good example of an open emerging market with deep and liquid financial markets (Cerda et al. (2018), Vial et al. (2020)). Our findings can be summarized as follows; First, we show that our decompositions are able to describe very accurately the asset price dynamics in specific periods of time, regardless of whether the shock comes from the US or it is domestically originated. We show that the effects of US shocks on domestic assets are of crucial importance. In particular, US shocks account for about 12% of the volatility of both short and long rates and 25% of the volatility of the domestic stock market. Second, our results suggest that the transmission of US shocks to local assets occurs mainly through risk aversion and pure risk premia shocks, followed in importance by US monetary policy shocks. Risk aversion shocks tend to generate a parallel downward shift of the local yield curve and a negative stock market reaction. In contrast, US monetary and risk premium shocks

[6]As pointed out by Albagli et al. (2019), the transmission channels of US monetary policy shocks differ between developed and emerging economies, where the former are more affected in their expected policy rate component, while the latter are more affected in the term premium component of market rates. These effects have not been fully accounted in literature on US spillovers to emerging markets

[7]This terminology was first introduced by Campbell et al. (2012) in their analysis of the US forward guidance and coined the first type of surprise a "Delphic" shock to a situation where the central bank provides information on the macroeconomic outlook, whereas an "Odyssean" shock describes a situation where the central bank provides guidance on its current policy stance and its path forward.

generate a bear steepening of the local yield curve, coupled with a negative stock market reaction. US growth shocks tend to generate a bear flattening of the local yield curve, together with a positive stock market response, similar to a local growth shock. Finally, the shocks identified are able to fully capture the effects of central bank communication around monetary policy meetings and reports (IPoM). In particular, our historical decompositions are able to single out the effects of monetary policy meetings on both both short and long rates, as well as the stock market, with highly significant responses, especially when coupled with a monetary policy report (IPoM). In all cases, the signs are as expected, that is, monetary policy meetings are, on average, associated with increases in both short and long rates and lower stock market returns (i.e., ”Odyssean” shock). We also find highly significant and positive responses in both short and long rates as well as the stock market during monetary policy meetings to growth shocks. This reinforces the idea that during monetary policy meetings, the Central Bank of Chile does convey information about the state of the economy, i.e., ”Delphic” shocks. We find monetary policy meetings with and without a monetary policy report (IPoM) have a statistically significant effect on short/long rates and the stock market. The effect, on average, is negative for rates and positive for the stock market, which is in line with the findings of Cieslak and Pang (2021). Another relevant finding is that the significance of pure risk premium shocks indicate that the Central Bank of Chile’s announcements materially affect not only investors’ belief abouth the path of monetary policy but also, via the pure risk premium channel, the uncertainty associated with that path.

The paper proceeds in the following structure: Section (2) presents a literature review on high frequency shocks and identification with sign restrictions. Section (3) introduces the empirical framework used in the paper and details the identification strategy used for recovering structural shocks affecting open emerging markets economies. Section (4) presents the estimated structural shocks that affect Chilean assets and also digs on the impact of US shocks on local assets. Section (5) presents historical decompositions of Chilean assets under specific events where financial markets were influenced by either local, external or a combination of both shocks. Section (6) shows the forecast error variance decompositions (FEVD) to study the importance of these shocks in explaining the volatility of Chilean asset prices, while section (7) analyzes the effects of central bank communication and its varied channels of transmission to local financial assets. Finally, section

(8) concludes and offers future research paths.

2. Literature review on sign restrictions and high frequency shocks

The study of the effects of monetary policy on asset prices requires distilling unexpected shifts in the policy instrument from the Central Bank's systematic responses to expected or realized changes in the economic conditions. To identify these exogenous monetary policy surprises one strand of the academic literature has focused on high-frequency data on future interest rates observed in a narrow window around monetary policy announcements (see Kuttner (2001) and Cochrane and Piazzesi (2002)). Once the unexpected variation in policy is isolated, causality can be infered and the shock can then be used to assess the impact of monetary policy on real activity and prices. Additionally, many of these studies have exploited the interaction between yields and the stock market to identify monetary policy shocks. Bernanke and Kuttner (2005) show that the stock market reaction to monetary policy surprises is consistent with what is expected from a monetary policy shock.[8] Gürkaynak et al. (2005) emphasize that surprises specific to expected future policy rates account for an important share of the yield curve reaction to monetary policy decisions but that US stock prices barely reacts to these path surprises. Nakamura and Steinsson (2018) argue that US monetary surprises have no impact on expected inflation. These latter two results are inconsistent with what is expected from monetary shocks. However, as suggested by Jarociński and Karadi (2020) monetary policy announcements reveal information not just about policy but also about the central bank's assessment of the economic outlook. As pointed out by Andrade and Ferroni (2021) probably a reason why monetary policy shocks fail to have the expected effects on asset prices is due to offsetting effects of Delphic and Odyssean shocks in surprises on future policy rates. On the one hand, Central Banks announcements provide news on future monetary policy shocks (Odyssean shocks), but also news on future macroeconomic conditions (Delphic shocks). These shocks move the yield curve in the same direction but have opposite effects on financial conditions and macroeconomic expectations. They also have a different impact on macroeconomic outcomes so that central bankers cannot infer the degree of stimulus they provide by looking at the

[8] Bernanke and Kuttner (2005) find that, on average, a hypothetical unanticipated 25bps cut in the federal funds rate target is associated with about a one percent increase in broad stock indexes

mere reaction of the yield curve.

Jarociński and Karadi (2020) propose separating monetary policy shocks from contemporaneous information shocks by analyzing the high-frequency movement of interest rates and stock prices in a narrow window around the policy announcement. According to a broad range of models, a pure monetary policy tightening leads to lower stock market valuation. The reason is simple: the present value of future dividends declines through two channels. First, the discount rate for future earnings increases. Second, the expected dividends decline with the deteriorating outlook caused by the policy tightening. Therefore, a monetary policy shock induces a negative co-movement between interest rate and stock price changes. If instead interest rates and stock prices co-move positively, it can be interpreted as a reflection of an accompanying information shock. Jarociński and Karadi (2020) identify these two shocks using the three-month fed funds futures and the S&P 500 index to measure changes in stock valuation within a half-hour window around FOMC announcements. They find that the effects of an unanticipated interest rate increase accompanied by a stock price decline are very different from the effects of an unanticipated interest rate increase accompanied by a stock price increase. In particular, an interest rate increase accompanied by a stock price decline leads to a significant contraction in output and a tightening of financial conditions. They also find that their purged monetary policy shock induces a more pronounced price-level decline. By contrast, an interest rate increase accompanied by a stock price increase leads to significantly higher prices level and real activity and an improvement in financial conditions.

Our paper belongs to a second strand of literature that attempts to provide a real time measurement of high frequency shocks affecting asset prices (see Ehrmann et al. (2011), Matheson and Stavrev (2014), Cieslak and Pang (2019), Cieslak and Pang (2021), Brandt et al. (2021) and Lodge and Manu (2022)). In other words, we use a more general setup that does not require to focus on a narrow time window around selected announcements. Instead, we extract information from asset prices in ”continuous time”, reflecting the fact that news which may trigger a re-appraisal by market participants of the monetary policy stance or growth outlook flows virtually every day. We follow very closely the work of Ehrmann et al. (2011) who estimate the spillovers between the US and the euro area within different asset classes. The authors use a seven variable structural VAR model, with short and long rates, stock market for each country and the EURUSD exchange rate. Identification is achieved via heterocedasticity (see, Rigobon (2003); Rigobon and Sack (2003)). Their results stress the dominance of US markets as the main driver of global financial markets. In particular, US financial markets explain, on average, around 30% of movements in euro area financial markets, whereas euro area markets account only for about 6% of US asset price changes.

In financial applications using structural VARs identified via sign restrictions the work of Matheson and Stavrev (2014) stands out as seminal. The authors rely on sign restrictions on the impulse response functions produced by a bivariate model with 10-year US Treasury yields and the SPX Index, to identify two fundamental shocks to the US economy: monetary news (e.g., stocks returns and yields co-move negatively) and growth news (e.g., stocks returns and yields co-move positively). The authors use this approach to analyze the so-called "Taper Talk" episode in 2013 and conclude that the sharp rise in 10-year US Treasury yields during this episode was largely due to (restrictive) monetary shocks. Brandt et al. (2021) extend this model to a two-country euro area-US framework by including not only bond yields and equity prices but also bilateral euro-US dollar exchange. In addition, they also control for the role of the US dollar-denominated assets as safe haven for global investors to identify a new important source of daily market movements; the so-called "global risk aversion" shock. However, considering a single maturity at the yield curve fails to take into account variations in the different risk premia affecting asset prices in the economy. Cieslak and Schrimpf (2019) tackle this issue by identifying a risk-premium shock arising from time-varying compensation from cash-flow news manifested at the long end of the curve. This "refined risk aversion" shock arises when equity prices and long yields show positive correlation. Cieslak and Pang (2021) add one more risk premia, labeled "common premium", which arises when equity prices and long yields show negative correlation. These shocks are separated from monetary policy and growth shocks (i.e., information shocks) by imposing magnitude restrictions across yields. For instance, growth and monetary shocks are concentrated at shorter maturities, whereas risk aversion and common premium shocks are concentrated at longer maturities. These shocks are then used to explore the transmission channels through which the Fed policy affects asset prices and the economy. One of their main findings is that the risk-premium reduction is the primary reason for high stock returns on FOMC days.

Empirical applications of high frequency shocks in emerging markets so far have focused on estimating the impact of foreign shocks, mostly from developed markets, on EM asset prices. For instance, Hoek et al. (2022) studied the effects of shocks originated in the US on a set of emerging markets. They provide evidence that higher US rates stemming from the ”Delphic” component of monetary policy, i.e., information shocks from stronger US growth generate only modest spillovers, while those stemming from a more hawkish Fed policy stance, i.e., ”Odyssean” component, can lead to significant tightening of financial conditions. In a recent paper, Lodge and Manu (2022) quantify the importance of global structural shocks for changes in daily financial conditions in emerging market economies (EMEs). They identify US monetary and growth news shocks as well as shocks that reflect oil supply and shifts in global risk sentiment. One of their main findings is that while global factors influence EME financial conditions, the transmission of global shocks differs across financial variables, with equities and sovereign spreads more strongly affected than interest rates and currencies. The degree to which global shocks transmit to emerging market economies is estimated using a local projection approach (Jordà (2005)), but neglects the existence of local shocks. Our paper fills that gap by jointly estimating both external and domestic shocks, using a BVAR with an exogenous block identified with zero and sign restrictions.

3. Empirical framework

In this section, we describe our proposed empirical framework to uncover financial shocks permeating an open emerging markets economy. Our work builds on the current methodology used to estimate high frequency shocks in developed markets to accommodate the two key emerging markets characteristics: emerging market economies are small open economies and they are heavily exposed to currency fluctuations and global financial conditions.

Our aim is to: (i) identify *domestic* shocks while controlling for external variables; (ii) estimate the contribution of those shocks to local financial variables and their evolution under specific financial episodes and (iii) quantify the importance of foreign shocks as well as the channels through which these shocks propagate into local variables.

3.1. Structural VAR with Block Exogeneity: Bayesian Approach

Let us consider a structural vector autoregression (SVAR) model:

$$A_0 y_t = \mu + A_1 y_{t-1} + ... + A_k y_{t-k} + \epsilon_t, \qquad t == 1, ..., T. \tag{1}$$

where y_t is an $Nx1$ vector of observed variables, the A_j are fixed NxN coefficient matrices with invertible A_0, μ is an $Nx1$ fixed vector and ϵ_t are the structural shocks with zero mean and covariance matrix I_N. The reduced form VAR model obtained from (1) can be written as:

$$y_t = c + B_1 y_{t-1} + ... + B_k y_{t-k} + u_t, \qquad t == 1, ..., T. \tag{2}$$

where $B_j = A_0^{-1} A_j$, $c = A_0^{-1}\mu$ and $u_t = A_0^{-1}\epsilon$ and thus $E(u_t u_t') = \Omega = (A_0' A_0')^{-1}$. The model in (2) can be expressed in a more convenient form for Bayesian simulation of reduced form parameters:

$$y_t = X_t' \beta + u_t. \tag{3}$$

where

$$X_t' = I_n \otimes [1, y_{t-1}', ..., y_{t-k}'] \; (n\ x(kn^2 + n)), \qquad \beta = vec([c\ B_1 ... B_k]') \; ((kn^2 + n)\ x1). \tag{4}$$

Block exogeneity is a common assumption when modelling the transmission of economic shocks between a large and a small open economy using VAR models. It refers to a certain type of restrictions where shocks originating in the large economy (or foreign block from a small country point of view) can influence the small economy, but not the other way around. To illustrate this point, let y_{1t} be an n_1 dimensional vector of foreign variables and y_{2t} and $n_2 = n - n_1$ dimensional vector of domestic variables so y_t can be decomposed into $y_t' = [y_{1t}', y_{2t}']$. In order to account for block exogeneity matrices A_j from (2) need to be triangular:

$$A_j = \begin{bmatrix} A_{11}^j & 0 \\ A_{21}^j & A_{22}^j \end{bmatrix} \quad j = 0, ..., k, \tag{5}$$

and it can be shown that reduced form coefficient matrices B_j inherit the block exogeneity form so that:

$$B_j = \begin{bmatrix} B_{11}^j & 0 \\ B_{21}^j & B_{22}^j \end{bmatrix} \quad j = 0, ..., k, \tag{6}$$

In order to implement the block exogeneity assumption both impact matrix A_0 and VAR coefficients need to be restricted. The impact matrix is restricted by placing zeros so that a small country cannot affect a big country at $t = 0$. In order to prevent the propagation of domestic (small economy) shocks through the foreign block beyond impact ($h = 1, 2, ...$), some parameters of the VAR need to be restricted as well. Within the Bayesian framework this can be achieved by assuming an appropriate prior distribution for parameters to be restricted. The natural conjugate (i.e., normal inverse Wishart) prior is not suitable for this purpose as it assumes that the prior covariance of coefficients in any two equations are proportional to each other (see Koop and Korobilis (2010)). However, the independent normal inverse Wishart prior helps to tackle this problem. Under this prior reduced-form coefficients and the error covariance matrix are independent:

$$\beta \sim N(\underline{\beta}, \underline{V_\beta}), \qquad \Omega \sim IW(\underline{M}, \underline{\gamma}) \tag{7}$$

and the conditional posterior distributions $p(\beta|y, \Omega)$ and $p(\Omega|y, \beta)$ now have the following form:

$$\beta|y, \Omega \sim N(\overline{\beta}, \overline{V}_\beta), \quad \Omega|y, \beta \sim IW(\overline{M}, \overline{\gamma}), \tag{8}$$

where

$$\overline{V}_\beta = \left(\underline{V}_\beta^{-1} + \sum_{t=1}^{T} X_t \Omega_{-1} X_t' \right)^{-1}, \quad \overline{\beta} = \overline{V}_\beta \left(\underline{V}_\beta^{-1} \underline{\beta} + \sum_{t=1}^{T} X_t \Omega^{-1} y_t \right) \tag{9}$$

and

$$\overline{\gamma} = T + \underline{\gamma}, \quad \overline{M} = \underline{M} + \sum_{t=1}^{T} (y_t - X_t'\beta)(y_t - X_t'\beta)'. \tag{10}$$

To restrict VAR parameters needed for block exogeneity, we assume zero mean priors with extremely small variance for all the small-country parameters in every equation of the big country block. In other words, if we want to restrict the $j-th$ element of β we can set $(\underline{\beta})_j = 0$ and $(\underline{V_\beta})_{jj} = \epsilon$ where ϵ is some small positive number. By doing so we attach dominant weight to the (zero mean) prior parameters when calculating the posterior. Thus, sample information is ignored as the posteriors of these coefficients will be predominantly influenced by the prior. A sample from the posterior of the reduced form parameters and the residual covariance matrix is drawn by using a Gibbs sampler (see Koop and Korobilis (2010)).

3.2 Identification of financial shocks in an emerging market

Our main specification follows the work of Ehrmann et al. (2011) and includes changes in the Chilean zero swap 2-year, the 10-year rates and the log-returns of the IPSA Index. The foreign block includes changes in the US zero swap 2-year, 10-year rates, the log-returns of the SPX Index and the US nominal broad effective exchange rate (NEER), published by the BIS.[9] We obtain reduced-form innovations from a VAR(1) estimated using the methodology described in section (1). More specifically, we define:

$$y_t = (\Delta r^{cl}_{2y}, \Delta r^{cl}_{10y}, \Delta s^{cl}_{ipsa}, \Delta fx^{us}_{neer}, \Delta r^{us}_{2y}, \Delta r^{us}_{10y}, \Delta s^{us}_{spx}) \tag{11}$$

In this benchmark specification, the local components included are: Δr^{cl}_{2y} and Δr^{cl}_{10y}, which stand for the change in 2-year and 10-year Chilean zero swap rates, Δs^{cl}_{ipsa}, which stands for the log returns of IPSA Index. The foreign variables included in the exogenous block are: Δr^{us}_{2y} and Δr^{us}_{10y}, which stand for the change in 2-year and 10-year US zero swap rates and Δs^{us}_{spx}, which stands for the log returns of SPX Index and Δfx^{us}_{neer} the nominal effective exchange rate. All returns are

[9] Our specification slightly differs from the one used by Ehrmann et al. (2011). They include the EURUSD exchange rate as an endogenous variable for their analysis of spillovers between the US and the euro area, two large economies. In this work we are interested in distinctively mapping the impact that external and domestic shocks have on an small open economy financial assets. The advantage of using US NEER is that it can be included in the exogenous block allowing us to calculate a fourth external shock; the US risk aversion shock. On the other hand, using the USDCLP exchange rate, which is affected by global as well as domestic factors would have to be included in the endogenous block. This would increase to four the number of domestic shocks making the identification more complex. Finally, risk aversion is likely to be a less prevalent type of shock for emerging markets than in developed ones.

normalized to have zero mean. The model is estimated as described in the previous section, that is, by restricting the influence of local variables in the US block. Regarding identification, we identify as many shocks as variables. More formally, let ϵ_t denote the structural shocks and u_t reduced-form shocks from (2). While the structural shocks have an economic interpretation, as they are derived from specific asset price responses, reduced form residuals do not. Structural shocks can be calculated from reduced form residuals by:

$$\epsilon_t = A_0 u_t, \tag{12}$$

where A_0 is the matrix of contemporaneous dependencies of asset prices with $Var(u_t) = \Sigma_u$ and $Var(\epsilon_t) = I_{NxN}$ with I denoting an identity matrix. To identify the structural shocks, it is required that the columns of A_0 fulfill the sign restrictions given by:

Sign restrictions.

Shock	Impulse response functions to						
	Δr^{cl}_{2y}	Δr^{cl}_{10y}	Δs^{cl}_{ipsa}	Δr^{us}_{2y}	Δr^{us}_{10y}	Δs^{us}_{spx}	Δe^{us}_{dxy}
Growth Chile	+	+	+	0	0	0	0
Monetary Policy Chile	+	+	-	0	0	0	0
Pure Risk Premium Chile	+	+	-	0	0	0	0
Risk Aversion	?	?	?	-	-	-	+
Growth US	?	?	?	+	+	+	-
Monetary Policy US	?	?	?	+	+	-	+
Pure Risk Premium US	?	?	?	+	+	-	-

Table 1: Sign restrictions are imposed on impact on the impulse responses.

In order to distinguish monetary policy shocks from risk premium shocks, we need to add further restrictions along the curve. Following Cieslak and Pang (2021), we assume that growth and monetary policy shocks drive the short end of the yield curve more than the long end, while the opposite holds for risk-premium shocks. The same logic applies to separate risk aversion shocks from US growth shocks, with the former concentrated at the long end of the curve and the latter at the short end.

The interpretation of the shocks is straightforward. Growth news reflect shocks to investors's cash-flow expectations. In this context, we should expect that good growth news raise both stock prices and yields. On the other hand, monetary news reflect pure discount-rate shocks via the current or expected risk-free rate. This means that good monetary news, i.e., more monetary easing, should be positive for the stock market and depresses yields. On the other hand, risk premium shocks can be understood as: (i) the discount-rate risk premium that drives the common component in compensation required by stock and bond investors due to be exposed to pure discount rate shocks (pure risk premium shocks); and (ii) the cash-flow risk premium which drives stock and bond premium in opposite directions, that is, increases premium on stocks but lowers premium on bonds, as bonds provide a hedge against bad economic times. This hedging premium reflects the 'flight-to-safety' effect and is captured by our risk aversion shock. The response of local variables to US shocks is left unrestricted as we are interested in the transmission channels of foreign shocks to local markets.

In our paper structural shocks are identified by imposing both zero and sign restrictions on the impulse response functions (IRFs). Sign restrictions alone are efficiently implemented by iterating the steps suggested in Rubio-Ramirez et al. (2010). In short, for each posterior draw of the reduced form parameters (regression parameters and covariance matrix) they first calculate an uniformly distributed orthogonal matrix Q. After that they multiply the Cholesky based impact matrix A_0 by the orthogonal matrix Q and construct the resulting IRFs. If the impulse responses satisfy the sign restrictions the posterior draw is accepted. Otherwise they repeat the procedure with a new posterior draw of reduced form parameters. If a model has both sign and zero restrictions imposed the algorithm outline above cannot be applied in that case - the impulse responses based on QA_0 almost surely do not satisfy zero restrictions. To cope with that problem Arias et al. (2014) propose an algorithm that produces an orthogonal Q such that QA_0 do satisfy the zero restrictions at various horizons of the IRFs. Sign restrictions are checked in similar fashion as before. Worth mentioning, is that besides the details of the algorithm ARRW also provide a rigorous proof of validity of their algorithm from the Bayesian perspective. They show that their algorithm effectively draws from the posterior distribution of structural parameters conditional on the sign and zero restrictions, which is a property that other identification strategies fail to satisfy.

We estimate our models covering the period 2010-2022. We generate and save $i = \{1, ..., 1000\}$ valid solutions for our analysis. By construction, these shocks are normalized to have zero mean and unit standard deviation over the 2010-2022 sample.

4. Structural shocks permeating Chilean markets

4.1 Median target solution

One of the main criticism to the use of sign restrictions as identification strategy is that it leads to model multiplicity, with each model corresponding to different draws of Q_i. In particular, summary statistics such as the mean or median responses used to estimate the structural shocks $\epsilon_t(Q_i)$, mix different solutions. Structural shocks will be uncorrelated within a single draw, but nothing guarantees that will be uncorrelated across time. With this in mind, we follow the approach of Fry and Pagan (2005, 2011) and select the median target (MT) solution, such that contemporaneous asset price responses to structural shocks are the closest to the median response. That is, for each $Q_i \in \mathbb{R}$, we denote the vector of contemporaneous responses as $\theta_i = vec(\tilde{A}_0(Q_i))$. We then standardize each solution, θ_i, by substracting the element-wise media and dividing by the standard deviation, both measured over the set of models that satisfy identification restrictions:

$$\theta^{MT} = \min_i \left[\frac{\theta_i - median(\theta_i)}{std(\theta_i)}\right]' \left[\frac{\theta_i - median(\theta_i)}{std(\theta_i)}\right]. \tag{13}$$

In Figure (1) we plot the daily cumulative shocks defined by the MT solutions across specifications. The cumulated shocks display economically intuitive business cycle properties. For example, in panels (a) and (d) growth shocks seem to be highly correlated with the Chilean and the US GDP, while panels (b) and (e) seem to track monetary policy cycles in Chile and the US during the COVID Crisis and the start of a tightening cycle in Chile in 2021 and the Fed's recent tightening. Similarly, in panel (f) we observe the 'flight-to-safety' mode during the COVID Crisis and other market episodes while in (c) we observe the rise in pure risk premium in Chile during the "Social Unrest" in October 2019, which triggered a large stock market correction, a rise in long end rates and a large currency depreciation.

4.2 The impact of US spillovers on Chilean asset prices

In our identification matrix A_0, the response of local variables to US shocks was left unrestricted with the objective to remain "agnostic" about their responses. In Figure (2), in rows (1) and (2) we plot the median of the posterior responses of local variables to US growth and monetary policy shocks, respectively. In the first row, we find that a positive US growth shock tends to be associated with a positive domestic stock market response and with a ”bear flattening” of the local yield curve, e.g., the short end increasing more than the long end, which is similar to a local growth shock. In contrast, the effects of US monetary policy shocks (second row) tend to be associated with a ”bear steepening” of the local yield curve and a negative stock market response[10]. This response resembles to a local pure risk premium shock, which is in line with the literature of the transmission channels of US monetary policy in emerging markets (see, Albagli et al. (2019)).

Finally, in Figure (3), in rows (1) and (2) we plot the median of the posterior responses of local variables to global risk aversion shocks and US pure risk premium shocks, respectively. In the first row, we observe that a negative risk aversion shock tends to be associated with a negative stock market response and with a parallel downward movement of the local yield curve, e.g., where both the short and long end decreased in an equal amount. In contrast, the effects of pure risk premium in US (second row) tends to be associated with a ”bear steepening” of the local curve, coupled with a negative stock market reaction, very similar to the effects of a monetary policy shock in the US.

5. Historical decompositions during specific market episodes

Historical decompositions consist in explaining the observed values of the endogenous variables in terms of the structural shocks and the path of exogenous variables. This kind of exercises is present in the DSGE literature (for example, in Smets and Wouters (2007)) but have been mostly absent in the structural VAR literature.

Historical decomposition allows us to make a statement over what has actually happened to the series in the sample period, in terms of the recovered values for the structural shocks. This technique is particularly useful when addressing the relative importance of the shock over a set of variables.

[10] We refer by ”bear steepening” of the yield curve to a situation where the long end of the curve increases more than the short end.

More formally, we can represent each asset in y_t as a sum of initial conditions y_0 and subsequent shocks:

$$y_t = \phi_y^{t-1} y_0 + \sum_{k=0}^{t-2} \phi_z^k \tilde{A}_0 \epsilon_{t-k} \;\; for \;\; t > 1. \tag{14}$$

Let $y_t^j(\epsilon^i)$ be the contributions of *i-th* shock to *j-th* element of y_t:

$$y_t(\epsilon^i) = \sum_{k=0}^{t-2} \phi_z^k \tilde{A}_0 J_{ii} \epsilon_{t-k}, \tag{15}$$

where J_{ii} is a square matrix with*(i,i)-th* element equal to one and zeros elsewhere. Summing across shocks, $\sum_i y_t^j(\epsilon^i)$ we recover the overall stock return or yield change on day t (up to initial condition).[11]

There are several points that are worth mentioning. First, on any given day, reduced form innovations in asset prices u_t are a linear combination of all structural shocks in ϵ_t. This allows to separate different news coming out on a daily basis, including days of major macroeconomic announcements, without zeroing out any of the shocks by assumption. Second, structural shocks ϵ_t are only orthogonal contemporaneously. This means that shocks can affect asset prices and other state variables in periods ahead. For instance, a positive growth shock leads to a tighter policy rate in subsequent periods or a negative growth shock raises pure risk premia going forward. Similarly, on any given day, we may find that there is an exogenous monetary shock or a pure risk premium shock and those shocks can affect other state variables going forward.

Figure (4) plots cumulative historical decompositions for the whole sample. These results suggest two things. First, *domestic* shocks have quantitatively different effects on every asset class, with *local* growth and monetary shocks being more relevant for the 2-year yield and the stock market, whereas *local* pure risk premium shocks being more important for the 10-year. Second, we also find that the transmission channels of *foreign* shocks differ depending on the asset class we are analyzing. For example, risk aversion shocks matter more for the local stock

[11]The initial condition y_0 has a negligible effect that dies out very quicky because daily stock returns and yield changes are not highly autocorrelated. Since vector y_t is demeaned, the historical decompositions describe how much each shock pushes y_t away from the unconditional mean of zero.

market, whereas US pure risk premium shocks seem to be more important for the local 10-year rates. The latter result is in line with the findings of Albagli et al. (2019) who present evidence that the transmission of US monetary policy shocks in emerging markets works through the term premium component of rates rather than the expected policy rate component.

Now we apply the methodology developed analyzing four specific market events: i) the Taper Tantrum of 2013, an example of US originated shock ii) the Chilean Social Unrest of October 2019, which serves as example of a domestically originated shock iii) the COVID-19 pandemic, as an example of a global shock and finally iv) the period between July 2021 and February 2022, as an example of several local and global shocks intertwined.

During the "Taper Tantrum" of 2013[12] in Figure (5) we plot the historical decompositions around these dates. The effects on local 10-year rates can be found in panel (b). Here the model suggests that the rise in rates between Bernanke's speech and the 30th August of approximately 57bps can be attributed to a rise in local risk premia (37bps), US risk premia (25bps) and lower risk aversion (17bps), partially compensated with lower growth news (-27bps). Our model also allows to explain what happens to US rates during this episode. In Panel (f), we observe that US risk premium rises about 50bps together with lower risk aversion (+45bps), with an overall increase in 10-year rates of 85bps and a stock market correction of 4.2% (panel g). In short, the Taper Tantrum can be seen as a repricing of US monetary policy that increased US risk premia and triggered an increase in local risk premia. Results from an empirical model that neglects the exogenous block would have overestimated the effects of domestic risk premia on long rates.

When analyzing idiosyncratic events, a clear example is the so-called "Social Unrest" of October 2019. What started as a student protest due to a subway tariff hike led to large violent gatherings all over the country. Subway stations were vandalized, stores were looted and destroyed leading President Piñera to declare state of emergency and curfew in Santiago on saturday 19th October. By the 23rd of October, the state of emergency was already declared in 15 out 16 regions

[12]The 22nd May, Federal Reserve Chair Ben Bernanke announced that the Fed would, at some future date, reduce the volume of its bond purchases. This prospective policy of reducing the rate of Fed asset purchases generated a massive negative shock to investor expectations, as the Fed had become one of the worlds biggest buyers of Treasuries. This period is known as the "Taper Tantrum" episode with great repercutions across global financial markets, where emerging markets were particularly hit.

of the country. Figure (6) shows the market reaction during this episode between the 21st October 2019 and the 28th february 2020. Initially, market rates did not react but then started quickly rising as risk premia started to creep up. Over the period analized long rates increased by 60bps (panel b), mainly due to local risk premia, which was contributing around 85bps over the same period. Had it not been because of subdued growth expectations (-26bps), *local* long rates would have risen even further. Regarding the stock market reaction (panel c), we observed that the reaction after the event was almost instantaneous with nearly half of the stock market correction (-20%) explained by greater risk premia (-8.7%).

Another interesting episode is the COVID-19 pandemic. In Figure (7) we plot the asset responses and their drivers during this period. Here we find that market rates in both, the US and Chile (panel b and f) initially decreased due to lower growth expectations when the pandemic hit. Thereafter, in both countries risk premia increased but as we approached the end of August 2020 it quickly reversed. In Chile between the 2nd march and 31st august 2020, long rates decreased by nearly 112bps, where -56bps can be attributed to lower growth expectations, -25bps to risk premia reduction and -22bps to US monetary policy. The Chilean Central Bank slashed interest rates by 125bps in a matter of weeks hitting its lower bound by April 2020. Thereafter, it resorted to unconventional monetary policy measures[13] as well as forward guidance to guarantee smooth financial markets functioning. The result of this was a sharp fall in market rates and some stock market recovery due to easy monetary policy, where US monetary policy shocks were also pulling in the same direction. It is worth mentioning that during this period, the dollar initially appreciated due to subdued growth expectations and then started to depreciate as easy monetary policy started to permeate financial markets.

The final historical example shows how these decompositions can be mapped to multiple market events, regardless of whether these events are local or foreign. Figure (8) shows the asset responses since the start of the recent hiking cycle in Chile (July 2021) and the US (March 2022), as well as the start of the war between Russia and Ukraine (February 2022). The sample also covers the first and second round of the 2021 Presidential Elections in Chile (November and December

[13]e.g., Repo Operations, Central Bank debt buy-back, purchase of banking sector bonds, FCIC (similar to the ECB's TLTRO), etc.

2021). Here we observe that local rates dynamics (panels (a) and (b)) has been influenced by less accommodative monetary policy and better growth news and the stock market roughly flat over the sample, where less easy money is compensated with better growth news. Also the long end of the curve saw some stabilization after the first round of the presidential elections with a subsequent fall in pure risk premia. We can also see that that US monetary policy started to kick in local rates after some FOMC members started to turn more hawkish in line with some unusually high CPI prints in the US. Regarding US variables, the short end has been influenced by an increasingly hawkish monetary policy and better growth news. The war between Russia and Ukraine coupled with higher than expected CPI prints has elevated US pure risk premia, especially at the long end of the curve. This has been partially compensated by global risk aversion where US assets provide a hedge against market downturns. In this context, the US dollar has started to appreciate and the stock market has been hit badly.

To summarize, by adding an exogenous block our decompositions are able to accurately describe Chilean asset price dynamics in specific periods of time, regardless of whether the shocks are global or domestically originated.

6. How important are high-frequency shocks in explaining Chilean asset price volatility?

Another application of the structural VAR models is the forecast error variance decomposition (FEVD). This technique consists in decomposing the variance of the forecast error in each endogenous variable h periods ahead, similarly to the calculation of the IRFs. Figure (9) plots the results of this exercise. Regarding local variables; first we find that short rates are mainly determined by monetary policy (45%) and growth shocks (41%), as expected, whereas long rates are mainly determined by pure risk premia (55%), followed by growth shocks (29%). The stock market is mainly driven by growth (36%) and monetary policy shocks (26%) and pure risk premia shocks (12%). Second, we find that the contribution of US shocks to be important, around $\approx 12\%$ for both short and long rates, respectively and $\approx 25\%$ for the stock market. Third, the channels through which these foreign shocks transmit to local rates are mainly through risk aversion and pure risk premium, and to a lower extent to monetary policy. In fact, nearly half of the total contribution of US shocks to local rates can be attributed to risk aversion shocks (5-6%), with the rest explained by US pure risk premia (3-4%) and US monetary shocks ($\approx 1\%$). Similarly, for the stock market, risk aversion shocks matter the most (10%), followed by US growth ($\approx 7\%$) and monetary policy shocks ($\approx 4\%$). Finally, with respect to US variables; we first find that the short end is dominated by monetary policy and growth shocks, whereas the long end is more dominated by global risk version rather than pure risk premia shocks. This is in contrast to what we found for Chilean long rates, where pure risk premia was the main driver, but it is very much in line with the findings of Cieslak and Pang (2021), who report an increasing dominance of risk aversion shocks in US rates and their role as a safe haven during market downturns. In sum, the effects of US shocks are of crucial importance for understanding the volatility of domestic financial assets.

7. What are the effects of Central Bank communication on Chilean asset prices?

In this section we ask what are the effects of central bank communication on Chilean asset prices. We are particularly interested in understanding the channels through which monetary policy permeates financial markets and we do this by considering periods where monetary policy should be most effective, that is around monetary policy meeting days and other monetary events. We frame the discussion of monetary policy shocks as in Campbell et al. (2012). In their terminology, a ”Delphic” shock carries news about the expected future macroeconomic state of the economy. An ”Odyssean” shock, on the other hand, contains news about future policy rates deviations from the central bank policy rule once calibrated given the expected future macroeconomic state of the economy. Our aim then is to identify the ”Delphic” and ”Odyssean” components of monetary policy. This is particularly relevant as academic research has focused on analyzing central banks communication in developed markets neglecting emerging markets so far. We use the historical decompositions estimated in section (5) and we regress each of the shock contributions against dummy variables indicating the following events; (i) the next trading day after the monetary policy meeting[14], (ii) the release of monetary policy minutes, (iii) FOMC meetings and (iv) FOMC minutes.

The results of this exercise can be found in table (2). First, our historical decompositions are

[14] In Chile monetary policy announcements are released at 6pm, therefore, there is no immediate market reaction, which comes the next trading day.

able to single out the effects of monetary policy meetings on both both short and long rates, as well as the stock market, with highly significant responses. This is especially true when coupled with a monetary policy report (IPoM). In all cases, the signs are as theoretically expected. Monetary policy meetings are, on average, associated with increases in both short and long rates and lower stock market returns (i.e., ”Odyssean” shock). Second, we find highly significant and positive responses in both short and long rates as well as the stock market during monetary policy meetings to growth shocks. This reinforces the idea that during monetary policy meetings, the Central Bank of Chile does convey information about the state of the economy, i.e., ”Delphic” shocks. Third, monetary policy meetings with and without a monetary policy report (IPoM) both have a statistically significant effect on short/long rates and the stock market (column (4)). The effect is negative for rates and positive for the stock market. This is in line with Cieslak and Pang (2021), who find that Central Bank risk premium reduction helps to explain high S&P 500 returns around FOMC meetings. The significance of pure risk premium shocks indicates that the Central Bank of Chile’s announcements materially affect not only investors’ belief about the path of monetary policy but also, via the pure risk premium channel, the uncertainty associated with that path.

Now we turn to analyzing the effects of FOMC announcements on local variables (columns (5)-(6)). First, in column (5), we find that FOMC minutes convey information about US growth, with highly positive and significant responses in both local rates and the stock market. In contrast, FOMC meetings convey information about US monetary stance (column (6)), where the effects tend to be associated, on average, to lower local rates. The effects on the stock market are not statistically significant. For global risk aversion shocks (column (7)), FOMC meetings lose significance, while for pure risk premia shocks, FOMC minutes are highly significant for market rates, but not for the local stock market.

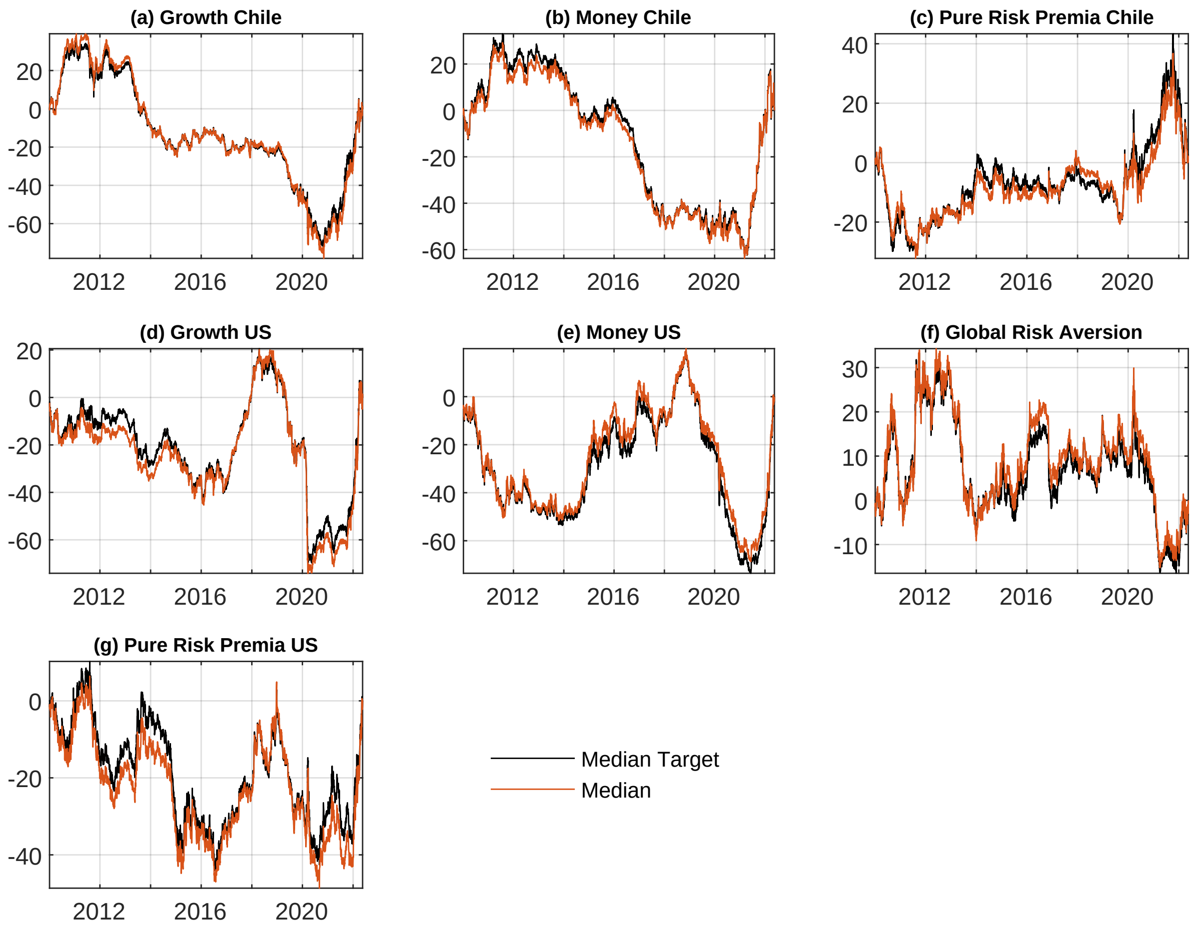
In this section we present evidence that in its monetary policy meetings, the central bank of Chile is able to convey market moving information through its expectation of the future state of the economy (”Delphic”) and through its expectation of policy deviation forward guidance (”Odyssean”).

8. Conclusion

Building on the work of Ehrmann et al. (2011) this paper investigates the role of local and foreign shocks on financial assets in an small and open emerging market. The identification strategy follows the work of Cieslak and Schrimpf (2019) and Cieslak and Pang (2021) to identify three *local* shocks affecting the domestic economy: growth, monetary policy and risk premium. But to accommodate key emerging markets characteristics (small and open economy exposed to global shocks and currency fluctuations), the model includes an exogenous block with US financial variables. This allows us to identify four *external* shocks: growth, monetary policy, risk premium and global risk aversion. We then apply the methodology to analyze the drivers of volatility of Chilean financial assets during a number of historical episodes. Our findings can be summarized as follows: First, we show that our decompositions are able to accurately describe the asset price dynamics in specific periods of time, regardless of whether the shock is global or domestically originated. We also show that the effects of US shocks on domestic assets are of crucial importance. In particular, US shocks account for more than 12% of the volatility of both short and long rates and 25% of the volatility of the domestic stock market. Second, the transmission of US shocks to domestic assets occurs mainly through risk aversion shocks and pure risk premia, followed by US monetary policy shocks. Risk aversion shocks tend to generate a parallel downward shift of the local yield curve and a negative stock market reaction. In contrast, US monetary and risk premium shocks generate a bear steepening of the local yield curve, coupled with a negative stock market reaction. US growth shocks tend to generate a bear flattening of the local yield curve, together with a positive stock market response, similar to a local growth shock. Finally, the shocks identified are able to capture the effects of Central Bank communication around monetary policy meetings and reports (IPoM). Our historical decompositions suggest that monetary policy meetings are important for both short and long rates as well as the stock market with highly significant responses, especially when coupled with a monetary policy report (IPoM). In all cases the signs are as theoretically expected. Monetary policy meetings are associated, on average, with increases in both short and long rates and lower stock market returns (i.e., ”Odyssean” shock). We also find highly significant and positive responses to growth shocks in both short and long rates as well as the stock market during monetary policy meetings . This reinforces the idea that during monetary policy meetings, the Central Bank of Chile conveys information about the state of the economy, i.e., ”Delphic” shocks. We also find monetary policy meetings with and without a monetary policy report (IPoM) both have a statistically significant effect on short/long rates and the stock market. The effect is, on average, negative for rates and positive for the stock market, in line with the findings of Cieslak and Pang (2021). The significance of pure risk premium shocks suggest that the Central Bank of Chile’s announcements materially affect not only investors’ belief about the path of monetary policy but also, via the pure risk premium channel, the uncertainty associated with that path.

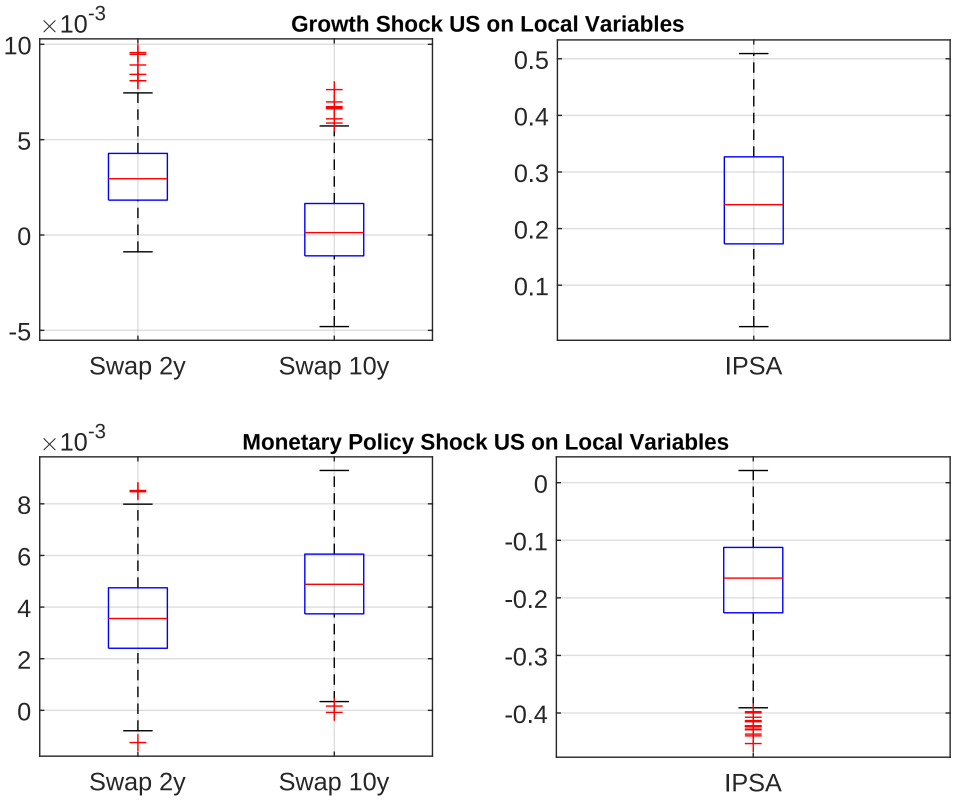
An interesting question is whether we can identify similar shocks and their contributions in other EM economies and what determines the dominance of a certain shock over the other. We leave this endeavour for future research.

Figure 1: **Cumulated Structural Shocks**



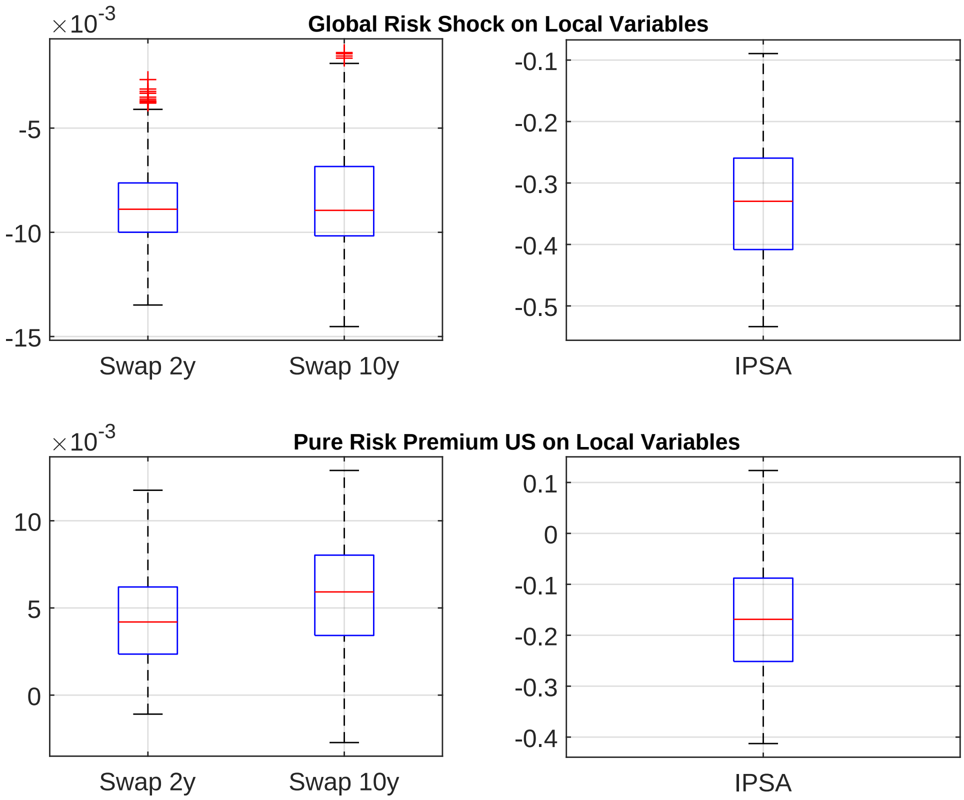
Note: Blue line depicts structural shocks using the median target solution (Fry and Pagan (2011)), while the red line depicts the median structural shocks. By construction, shocks are standardized and start at zero and end at zero.

Figure 2: **Posterior Median Response in Structural Impact Matrix A_0**



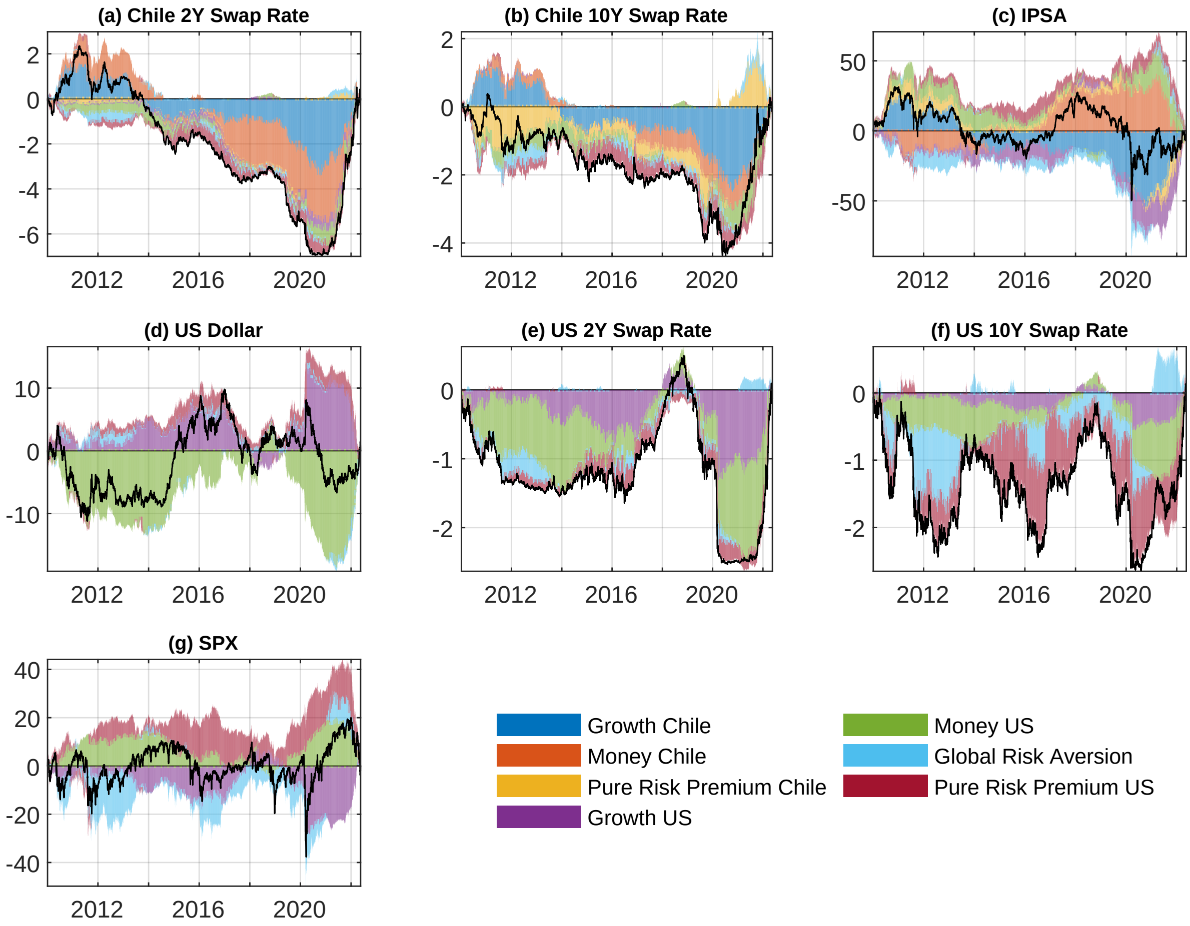
Note: Posterior estimates of structural impact matrix, A_0. First row reports the median response of local variables to a positive growth shock in the US, while the second row reports the median response of local variables to a monetary policy shock in the US.

Figure 3: **Posterior Median Response in Structural Impact Matrix** A_0



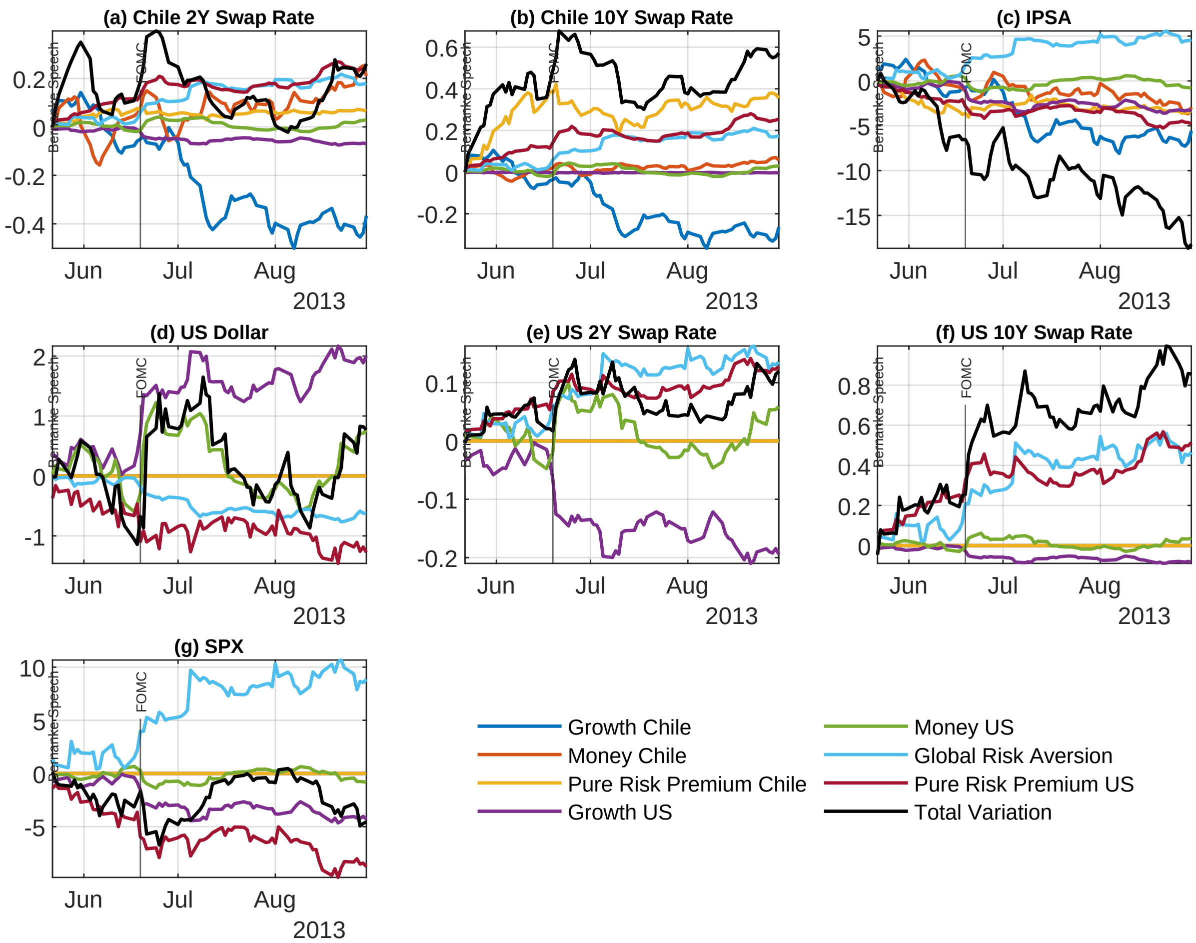
Note: Posterior estimates of structural impact matrix, A_0. First row reports the median response of local variables to a global risk aversion shock in the US, while the second row reports the median response of local variables to a pure risk premium shock in the US.

Figure 4: **Historical Decompositions - Whole sample 2010-2021**



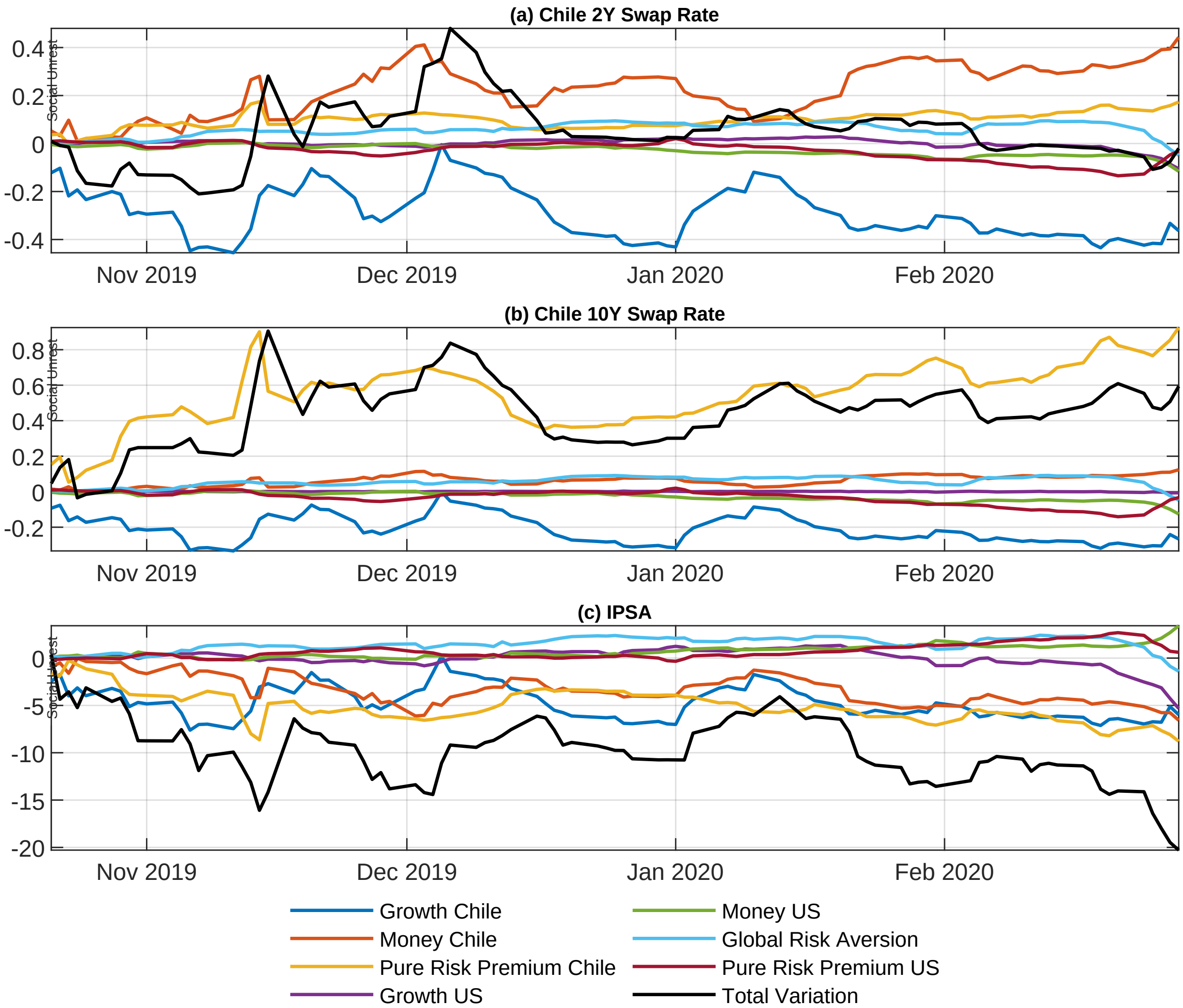
Note: Historical decompositions (henceforth, HD) for the whole sample (1/5/2010-7/12/2021). The HD are demeaned and therefore are expressed as deviations from zero. By construction, the HDs start at zero and end at zero.

Figure 5: **Historical Decompositions - Taper Tantrum in 2013**



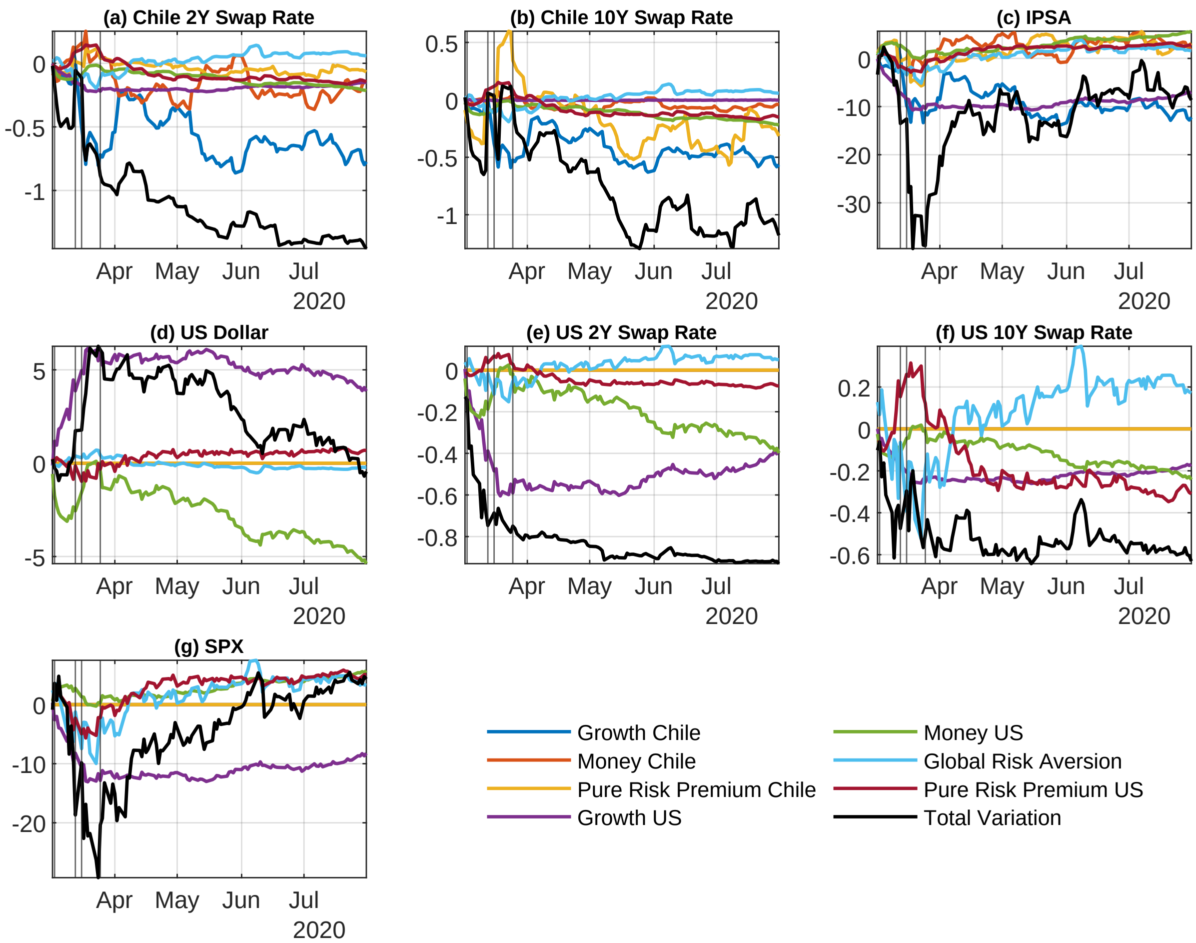
Note: Historical decompositions (henceforth, HD) for the sample (5/22/2013-08/30/2013). Vertical lines depict the "Taper Tantrum" episode during the 22nd May 2013 and 19th June 2013 FOMC Meeting. The HD are demeaned and therefore are expressed as deviations from zero.

Figure 6: **Historical Decompositions - Social Unrest 2019**



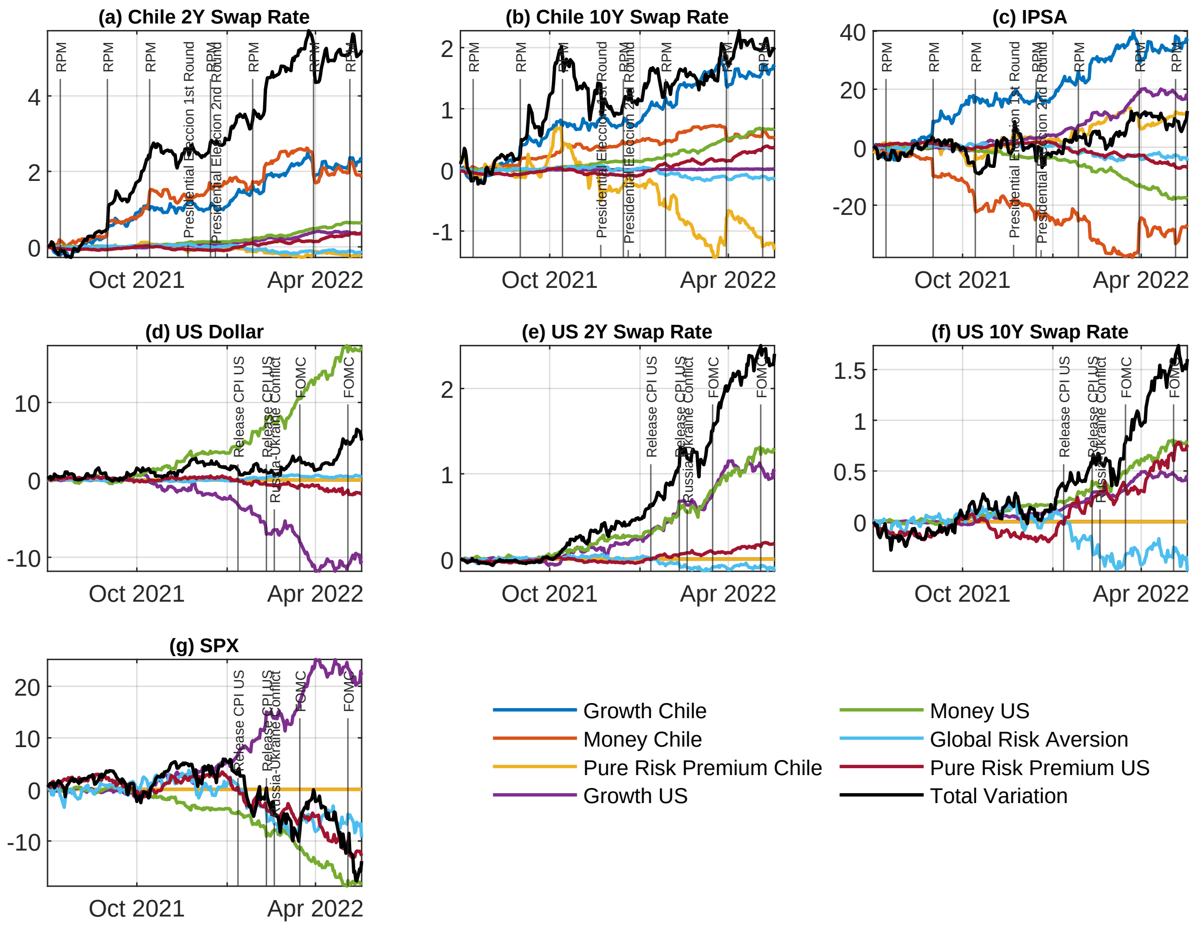
Note: Historical decompositions (henceforth, HD) for the sample (10/21/2019-02/28/2020). Vertical lines depict the next trading day after the social unrest of the 18th October 2019. The HD are demeaned and therefore are expressed as deviations from zero. US historical decompositions are omitted for ease of comparison and are available upon request.

Figure 7: **Historical Decompositions - COVID Crisis**



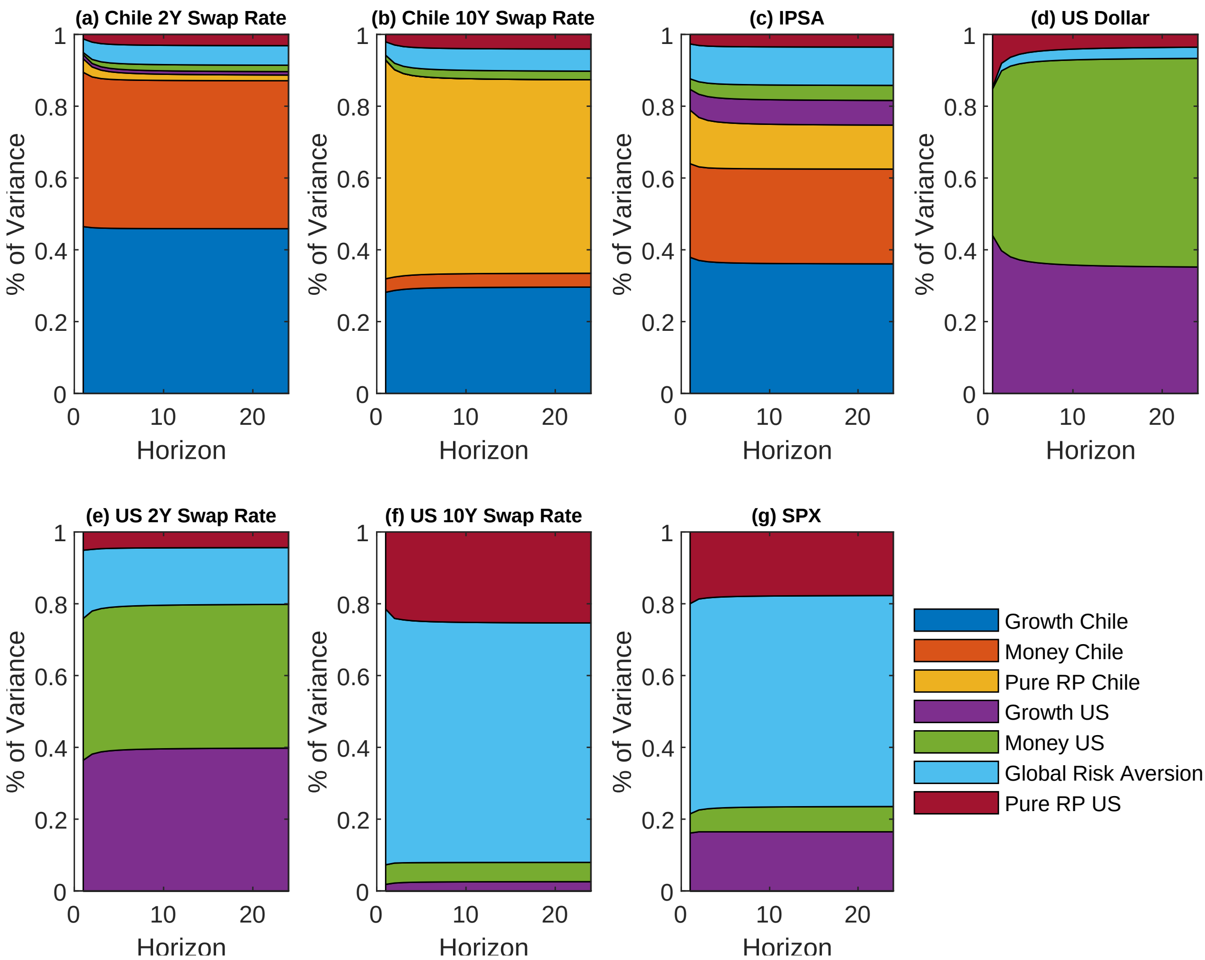
Note: Historical decompositions (henceforth, HD) for the sample (03/2/2020-7/31/2020). Vertical line from left to right depict the following events: (i) US declares National emergency; (ii) the first quarantine imposed on the 25th March 2020 in Chile; (iii) Emergency rate cut FOMC and (iv) Emergency rate cut Central Bank of Chile. The HD are demeaned and therefore are expressed as deviations from zero.

Figure 8: **Historical Decompositions - Hiking Cycles in Chile and US and the war between Russia and Ukraine**



Note: Historical decompositions (henceforth, HD) for the sample (7/2/2021-5/18/2022). The HD are demeaned and therefore are expressed as deviations from zero.

Figure 9: **Forecast Error Variance Decomposition (FEVD)**



Note: Forecast Error Variance Decomposition (henceforth, FEVD) for the whole sample (1/4/2010-05/18/2022).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	of which:						
Variable	2y	ϵ^g_{cl}	ϵ^m_{cl}	ϵ^c_{cl}	ϵ^g_{us}	ϵ^m_{us}	ϵ^h_{us}	ϵ^c_{us}
RPM	-0.11	-0.06	0.27	-0.13*	0.02	-0.01	-0.22**	0.02
	(-0.24)	(-0.19)	(0.90)	(-1.64)	(0.47)	(-0.16)	(-2.18)	(0.25)
RPM*IPoM	5.08***	2.92***	2.40***	-0.60***	0.11	0.05	0.19	0.01
	(4.11)	(3.31)	(2.94)	(-2.69)	(0.88)	(0.46)	(0.69)	(0.06)
Minutes RPM	-0.58	-0.09	-0.36	-0.08	0.04	-0.03	0.00	-0.05
	(-1.36)	(-0.28)	(-1.28)	(-1.05)	(0.84)	(-0.77)	(-0.05)	(-0.84)
FOMC	-0.45	-0.25	0.21	-0.03	-0.04	-0.09**	-0.17*	-0.08
	(-0.93)	(-0.72)	(0.66)	(-0.29)	(-0.95)	(-1.96)	(-1.60)	(-1.15)
FOMC Minutes	-0.28	-0.15	-0.02	0.05	-0.11***	-0.05	0.15	-0.15***
	(-0.57)	(-0.44)	(-0.06)	(0.55)	(-2.26)	(-0.95)	(1.34)	(-2.04)
	Overall	of which:						
Variable	10y	ϵ^g_{cl}	ϵ^m_{cl}	ϵ^c_{cl}	ϵ^g_{us}	ϵ^m_{us}	ϵ^h_{us}	ϵ^c_{us}
RPM	-0.84**	-0.02	0.08	-0.69**	-0.02	0.01	-0.22***	0.01
	(-1.77)	(-0.08)	(0.90)	(-1.93)	(-1.14)	(0.19)	(-2.20)	(0.14)
RPM*IPoM	0.67	2.23***	0.75***	-2.62***	0.04	0.07	0.18	0.03
	(0.52)	(3.27)	(2.96)	(-2.70)	(0.81)	(0.46)	(0.69)	(0.12)
Minutes RPM	-0.67	-0.07	-0.11	-0.38	-0.01	-0.03	0.00	-0.07
	(-1.49)	(-0.29)	(-1.25)	(-1.12)	(-0.54)	(-0.60)	(-0.05)	(-0.91)
FOMC	-0.57	-0.19	0.07	-0.05	-0.03	-0.11**	-0.17	-0.09
	(-1.13)	(-0.70)	(0.72)	(-0.13)	(-1.64)	(-1.84)	(-1.61)	(-1.13)
FOMC Minutes	0.04	-0.12	-0.01	0.28	-0.04***	-0.04	0.14	-0.16**
	(0.09)	(-0.46)	(-0.11)	(0.74)	(-2.09)	(-0.68)	(1.32)	(-1.96)
	Overall	of which:						
Variable	IPSA	ϵ^g_{cl}	ϵ^m_{cl}	ϵ^c_{cl}	ϵ^g_{us}	ϵ^m_{us}	ϵ^h_{us}	ϵ^c_{us}
RPM	0.02	0.03	-0.05	0.07**	0.03	-0.01	-0.05	0.00
	(0.23)	(0.49)	(-0.89)	(1.81)	(1.03)	(-0.45)	(-1.56)	(0.11)
RPM*IPoM	0.44	0.51***	-0.42***	0.29***	0.05	-0.02	0.04	-0.01
	(1.51)	(3.03)	(-2.98)	(2.69)	(0.73)	(-0.41)	(0.45)	(-0.25)
Minutes RPM	0.13	-0.02	0.06	0.04	0.03	0.01	0.00	0.02
	(1.27)	(-0.35)	(1.19)	(1.13)	(1.08)	(0.46)	(-0.08)	(0.97)
FOMC	-0.08	-0.04	-0.04	0.01	-0.01	0.03	-0.04	0.02
	(-0.70)	(-0.61)	(-0.81)	(0.19)	(-0.43)	(1.64)	(-1.21)	(1.07)
FOMC Minutes	-0.01	-0.04	0.01	-0.03	-0.06***	0.01	0.06**	0.03
	(-0.10)	(-0.56)	(0.21)	(-0.64)	(-2.14)	(0.45)	(1.69)	(1.64)

Table 2: The Effects of Central Bank Communication. The table reports regressions of for the daily changes of the 10y, 2y yields and daily log exchange rate and stock market returns during the day after monetary policy meeting. Starting with a dummy that takes the value of 1 the day before, during and after the monetary policy announcement. Regressions are also complemented with dummy variables for the release of the Monetary Policy Report (IPOM) and the minutes of monetary policy meetings. All coefficients are in basis points. Regressions are estimated with a constant, which is suppressed in the output for brevity. In column (1), the dependent variable is the overall stock/FX return or yield change. In columns (2)–(8), the dependent variables are the historical decompositions of stock/FX returns and yields changes into contributions of structural shocks. Regressions are estimated over the 2010–2021 sample, covering 125 scheduled monetary policy meetings. t-statistics robust to heteroscedasticity are reported in parentheses. */**/*** indicates significance at the 10% /5%/ 1% level.

References

S. Ahmed, B. Coulibaly, and A. Zlate. International financial spillovers to emerging market economies: How important are economic fundamentals? *Journal of International Money and Finance*, 76:133–152, 2017.

S. Ahmed, O. Akinci, and A. Queralto. Us monetary policy spillovers to emerging markets: Both shocks and vulnerabilities matter. *FRB of New York Staff Report*, (972), 2021.

E. Albagli, L. Ceballos, S. Claro, and D. Romero. Channels of us monetary policy spillovers to international bond markets. *Journal of Financial Economics*, 134(2):447–473, 2019. ISSN 0304-405X. doi: https://doi.org/10.1016/j.jfineco.2019.04.007. URL `https://www.sciencedirect.com/science/article/pii/S0304405X19301072`.

P. Andrade and F. Ferroni. Delphic and odyssean monetary policy shocks: Evidence from the euro area. *Journal of Monetary Economics*, 117:816–832, 2021. ISSN 0304-3932. doi: https://doi.org/10.1016/j.jmoneco.2020.06.002. URL `https://www.sciencedirect.com/science/article/pii/S0304393220300787`.

J. E. Arias, J. F. Rubio-Ramirez, and D. F. Waggoner. Inference based on svars identified with sign and zero restrictions: Theory and applications. 2014.

S. Avdjiev, V. Bruno, C. Koch, and H. S. Shin. The dollar exchange rate as a global risk factor: evidence from investment. *IMF Economic Review*, 67(1):151–173, 2019.

N. F. Azad and A. Serletis. Monetary policy spillovers in emerging economies. *International Journal of Finance & Economics*, 25(4):664–683, 2020.

B. S. Bernanke and K. N. Kuttner. What explains the stock market's reaction to federal reserve policy? *The Journal of Finance*, 60(3):1221–1257, 2005. doi: https://doi.org/10.1111/j.1540-6261.2005.00760.x. URL `https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.2005.00760.x`.

O. Blanchard, J. D. Ostry, A. R. Ghosh, and M. Chamon. Capital flows: expansionary or contractionary? *American Economic Review*, 106(5):565–69, 2016.

L. Brandt, A. Saint-Guilhem, M. Schröder, and I. Van Robays. What drives euro area financial market developments? the role of us spillovers and global risk. *ECB Working Paper*, (2560), 2021.

M. Breitenlechner, D. Gründler, and J. Scharler. Unconventional monetary policy announcements and information shocks in the us. *Journal of Macroeconomics*, 67:103283, 2021.

M. Bussière, C. Lopez, and C. Tille. Do real exchange rate appreciations matter for growth? *Economic Policy*, 30 (81):5–45, 2015.

C. Caceres, Y. Carrière-Swallow, and B. Gruss. Global financial conditions and monetary policy autonomy. 2016.

J. Campbell, C. Evans, J. Fisher, and A. Justiniano. Macroeconomic effects of federal reserve forward guidance. *Brookings Papers on Economic Activity*, 43(1 (Spring)):1–80, 2012. URL `https://EconPapers.repec.org/RePEc:bin:bpeajo:v:43:y:2012:i:2012-01:p:1-80`.

A. Carstens and H. S. Shin. Emerging markets aren't out of the woods yet. *Foreign Affairs*, 2019.

R. Cerda, A. Silva, and J. T. Valente. Impact of economic uncertainty in a small open economy: the case of chile. *Applied Economics*, 50(26):2894–2908, 2018.

A. Cieslak and H. Pang. Common shocks in stocks and bonds. *SSRN Electron. J.*, 2019.

A. Cieslak and H. Pang. Common shocks in stocks and bonds. *Journal of Financial Economics*, 2021.

A. Cieslak and A. Schrimpf. Non-monetary news in central bank communication. *Journal of International Economics*, 118:293–315, 2019. ISSN 0022-1996. doi: https://doi.org/10.1016/j.jinteco.2019.01.012. URL `https://www.sciencedirect.com/science/article/pii/S002219961830268X`.

J. H. Cochrane and M. Piazzesi. The fed and interest rates - a high-frequency identification. *American Economic Review*, 92(2):90–95, May 2002. doi: 10.1257/000282802320189069. URL `https://www.aeaweb.org/articles?id=10.1257/000282802320189069`.

L. Dedola, G. Rivolta, and L. Stracca. If the fed sneezes, who catches a cold? *Journal of International Economics*, 108:S23–S41, 2017.

P. Druck, N. E. Magud, and R. Mariscal. Collateral damage: Dollar strength and emerging markets' growth. *The North American Journal of Economics and Finance*, 43:97–117, 2018.

S. Edwards and E. L. Yeyati. Flexible exchange rates as shock absorbers. *European Economic Review*, 49(8):2079–2105, 2005.

M. Ehrmann, M. Fratzscher, and R. Rigobon. Stocks, bonds, money markets and exchange rates: measuring international financial transmission. *Journal of Applied Econometrics*, 26(6):948–974, 2011. doi: https://doi.org/10.1002/jae.1173. URL https://onlinelibrary.wiley.com/doi/abs/10.1002/jae.1173.

D. Eterovic, C. Sweet, and N. Eterovic. Asymmetric spillovers in emerging market monetary policy. *International Review of Economics & Finance*, 82:650–662, 2022. ISSN 1059-0560. doi: https://doi.org/10.1016/j.iref.2022.08.005. URL https://www.sciencedirect.com/science/article/pii/S1059056022002040.

M. Fratzscher, M. Lo Duca, and R. Straub. On the international spillovers of us quantitative easing. *The Economic Journal*, 128(608):330–377, 2018.

R. Fry and A. Pagan. Some Issues In Using Vars For Macroeconometric Research. CAMA Working Papers 2005-19, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University, Aug. 2005. URL https://ideas.repec.org/p/een/camaaa/2005-19.html.

R. Fry and A. Pagan. Sign restrictions in structural vector autoregressions: A critical review. *Journal of Economic Literature*, 49(4):938–60, 2011.

R. S. Gürkaynak, B. Sack, and E. Swanson. The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models. *American Economic Review*, 95(1):425–436, March 2005. doi: 10.1257/0002828053828446. URL https://www.aeaweb.org/articles?id=10.1257/0002828053828446.

X. Han and S.-J. Wei. International transmissions of monetary shocks: Between a trilemma and a dilemma. *Journal of International Economics*, 110:205–219, 2018.

J. Hoek, S. Kamin, and E. Yoldas. Are higher u.s. interest rates always bad news for emerging markets? *Journal of International Economics*, 137:103585, 2022. ISSN 0022-1996. doi: https://doi.org/10.1016/j.jinteco.2022.103585. URL https://www.sciencedirect.com/science/article/pii/S0022199622000174.

B. Hofmann, I. Shin, and H. S. Shin. Bond risk premia and the exchange rate. *Journal of Money, Credit and Banking*, 52(S2):497–520, 2020. doi: https://doi.org/10.1111/jmcb.12760. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/jmcb.12760.

M. Jarociński and P. Karadi. Deconstructing monetary policy surprises—the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2):1–43, April 2020. doi: 10.1257/mac.20180090. URL https://www.aeaweb.org/articles?id=10.1257/mac.20180090.

s. Jordà. Estimation and inference of impulse responses by local projections. *American Economic Review*, 95(1):161–182, March 2005. doi: 10.1257/0002828053828518. URL https://www.aeaweb.org/articles?id=10.1257/0002828053828518.

G. Koop and D. Korobilis. *Bayesian multivariate time series methods for empirical macroeconomics*. Now Publishers Inc, 2010.

K. N. Kuttner. Monetary policy surprises and interest rates: Evidence from the fed funds futures market. *Journal of Monetary Economics*, 47(3):523–544, 2001. ISSN 0304-3932. doi: https://doi.org/10.1016/S0304-3932(01)00055-1. URL https://www.sciencedirect.com/science/article/pii/S0304393201000551.

D. Lodge and A.-S. Manu. Eme financial conditions: Which global shocks matter? *Journal of International Money and Finance*, 120:102479, 2022. ISSN 0261-5606. doi: https://doi.org/10.1016/j.jimonfin.2021.102479. URL https://www.sciencedirect.com/science/article/pii/S0261560621001303.

T. Matheson and E. Stavrev. News and monetary shocks at a high frequency: a simple approach. *Economics Letters*, 125(2):282–286, 2014.

R. A. Mundell. Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science/Revue canadienne de economiques et science politique*, 29(4):475–485, 1963.

E. Nakamura and J. Steinsson. High-frequency identification of monetary non-neutrality: the information effect. *The Quarterly Journal of Economics*, 133(3):1283–1330, 2018.

M. Obstfeld. Global dimensions of us monetary policy. *International Journal of Central Banking*, 16(1):73, 2020.

M. Obstfeld, J. D. Ostry, and M. S. Qureshi. Global financial cycles and the exchange rate regime: A perspective from emerging markets. In *AEA Papers and Proceedings*, volume 108, pages 499–504, 2018.

H. Rey. Dilemma not trilemma: the global financial cycle and monetary policy independence. Technical report, National Bureau of Economic Research, 2015.

R. Rigobon. Identification through heteroskedasticity. *The Review of Economics and Statistics*, 85(4):777–792, 2003. ISSN 00346535, 15309142. URL http://www.jstor.org/stable/3211805.

R. Rigobon and B. Sack. Measuring the reaction of monetary policy to the stock market. *The Quarterly Journal of Economics*, 118(2):639–669, 2003. ISSN 00335533, 15314650. URL http://www.jstor.org/stable/25053916.

J. F. Rubio-Ramirez, D. F. Waggoner, and T. Zha. Structural vector autoregressions: Theory of identification and algorithms for inference. *The Review of Economic Studies*, 77(2):665–696, 2010.

S. Shousha. The dollar and emerging market economies: financial vulnerabilities meet the international trade system. 2019.

F. Smets and R. Wouters. Shocks and frictions in us business cycles: A bayesian dsge approach. *American economic review*, 97(3):586–606, 2007.

P. Tillmann. Unconventional monetary policy and the spillovers to emerging markets. *Journal of International Money and Finance*, 66:136–156, 2016.

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