# The Global Financial Cycle*

Silvia Miranda-Agrippino†
Bank of England
CEPR and CfM(LSE)

Hélène Rey‡
London Business School
CEPR and NBER

September 22, 2021

**Abstract**

We review the literature on the empirical characteristics of the global financial cycle and associated stylized facts on international capital flows, asset prices, risk aversion and liquidity in the financial system. We analyse the co-movements of global factors in asset prices and capital flows with commodity prices, international trade and world output as well as the sensitivity of different parts of the world to the Global Financial Cycle. We present evidence of the causal effects of the monetary policies of the US Federal Reserve, the European Central Bank and of the People's Bank of China on the Global Financial Cycle. We then assess whether the 2008 financial crisis has altered the transmission channels of monetary policies on the Global Financial Cycle. Finally, we discuss the theoretical modelling of the Global Financial Cycle and avenues for future research.

*Key words: Monetary policy spillovers, Capital flows, Commodity cycles, Risk-taking, Systemic risk*
*JEL codes:* E5, F3

*This paper has been prepared for the Handbook of International Economics, Volume V, edited by Gita Gopinath, Elhanan Helpman and Kenneth Rogoff. We are grateful to the editors, to Şebnem Kalemli-Özcan and Livio Stracca (discussants) and to other participants at the International Macroeconomic Handbook Conference for helpful comments and discussions. Rey is grateful to the ERC for funding (Advanced Grant 695722).

†Monetary Analysis, Bank of England, Threadneedle Street, London EC2R 8AH, UK.
E: silvia.miranda-agrippino@bankofengland.co.uk W: www.silviamirandaagrippino.com
‡Department of Economics, London Business School, Regent's Park, London NW1 4SA, UK.
E: hrey@london.edu W: www.helenerey.eu

# 1 Introduction

Financial globalization has been rising in the last fifty years, at a time where financial deregulation has encouraged the development of global banking and capital markets. There is a growing literature documenting a high degree of co-movement in risky asset prices, capital flows, leverage and financial aggregates around the world, a phenomenon called the Global Financial Cycle (GFC) in Rey (2013). Since the GFC interacts with domestic monetary and financial conditions, it is important to understand better its drivers and its characteristics. Are there certain types of capital flows which are more correlated with the GFC than others? How are those flows related to leverage of intermediaries and liquidity creation in the private sector? How can we explain the important fluctuations in aggregate risk-taking in world markets, a phenomenon sometimes called *risk-on/risk-off* behaviour by market participants?

It is well documented that the United States and the US dollar play a major role in international investment, foreign exchange reserves and international banking, and as an anchor for pricing goods and financial assets (see for example Gourinchas, Rey and Sauzet, 2019; Ilzetzki, Reinhart and Rogoff, 2019; Gopinath, 2016). Does this imply that the monetary policy of the US Federal Reserve plays a key role in driving the GFC? What is the influence of the central banks of other large currency areas such as the European Central Bank, the People's Bank of China, the Bank of England, or the Bank of Japan on the GFC? The estimation of dynamic factor models and tests on the number of global factors that best describe the data lead us to uncover eight striking stylized facts: i) One global factor accounts for around a quarter of fluctuations in risky asset prices around the globe. It is highly correlated with measures of risk appetite such as the VIX or the VSTOXX. ii) Two global factors account for about thirty five percent of the variance of gross capital flows. The first global factor in capital flows is highly correlated with the global factor in asset prices. Hence, we interpret the global factor in risky asset prices and the first global factor in gross capital flows as reflecting *Global Financial Cycle* factors; they are linked in particular to global risk appetite. iii) Global factors in inflows and outflows are highly correlated with one another, and so are the flow factors disaggregated by asset classes: portfolio bond and equity flows and banking flows in particular co-move and drive the aggregate flow factors. FDI flows have a somewhat smoother dynamics. iv) The second global factor in capital flows is highly correlated with commodity indices, in particular the oil price, and with international trade and world output. v) One global factor accounts for about thirty percent of the variance of fluctuations in private liquidity worldwide. That factor is highly correlated with the second capital flow factor. We interpret the second capital flow factor and the private liquidity factor as reflecting a *Global Trade and Commodity Cycle*. vi) The US Federal Reserve plays an important role in driving the *Global Financial Cycle*, as measured by the global factor in asset prices, the first global factor in capital flows, measures of risk aversion, financial conditions, spreads, and credit. It also plays a role in driving the *Global Trade and Commodity Cycle*(see Miranda-Agrippino and Rey, 2020b; Kalemli-Ozcan, 2019; Degasperi, Hong and Ricco, 2021; Miranda-Agrippino and Nenova, 2021). vii) The European Central Bank (see Ca' Zorzi, Dedola, Georgiadis, Jarociński, Stracca and Strasser, 2020) plays a role in driving the *Global Financial Cycle* albeit a less important one than the Federal Reserve but the ECB monetary policy is an important driver of the *Global Trade and Commodity Cycle*. The People's Bank of China (see Miranda-Agrippino, Nenova and Rey, 2019) play an important role for international trade, output and commodity prices: it is a driver of the *Global Trade and Commodity Cycle*. viii) After the Lehman shock and the implementation of unconventional monetary policies, the asymmetry in international financial spillovers of the ECB and the Fed has decreased.

These stylized facts have been uncovered in macroeconomic data, but some have been reinforced and made more precise by the exploitation of very granular microeconomic data at the loan, bank and firm level. Recent papers using credit registry data (see di Giovanni, Kalemli-Ozcan, Ulu and Baskaya, 2017; Morais, Peydro and Ruiz, 2015, among others) can tell us a lot about the transmission of external financial conditions and domestic and foreign monetary policies on lending behaviour and risk taking. By matching data on financial intermediaries balance sheets and firm level data, it is possible to track the effect of the fluctuations in the GFC on the real economy, and to flesh out more explicitly the transmission channels for different economies with their specific institutional characteristics.

While empirical evidence on the GFC has been gathered from both macroeconomic and granular microeconomic data, theoretical models are still in their infancy. There are still few models able to generate correlations in gross capital inflows and outflows such as the ones we see in the data, let alone generate time-varying *risk-on* and *risk-off* behaviours with large asset pricing implications and fluctuations in capital flows around the globe. Yet, structural models will be necessary to understand the joint power of monetary policy, macroprudential policy and capital flow management. We have potentially many tools to tame the Global Financial Cycle and reinforce monetary policy independence and financial stability, provided we understand better the underlying mechanisms of the GFC. This is a fascinating area of research.

The paper is organized as follows. In Section 2 we review and update the macro empirical evidence on the Global Financial Cycle in asset prices, capital flows, and credit. We also discuss the Global Trade and Commodity Cycle. In Section 3 we review the evidence on the drivers of the global cycles, with a focus on the monetary policy of the largest central banks. We study how the GFC has evolved after the financial crisis of 2008 in Section 4 and discuss structural interpretations and models of the GFC in Section 5. We conclude by analysing the implications of the GFC for domestic financial stability and monetary policy in Section 6 and discussing avenues for future research.

# 2 Empirical Evidence on Global Factors

## 2.1 Global Factor in Risky Asset Prices

Kindleberger (1978) and Reinhart and Rogoff (2009) have documented important and recurring patterns of exuberance in asset markets and in lending across countries and across centuries. Asset valuations tend to boom, leverage tends to rise in parallel in many world economies and often, though not always, this leads to financial crises as described in Schularick and Taylor (2012). High indebtedness then translates in depressed aggregate demand during the bust as shown e.g. in Mian, Sufi and Verner (2017). In this Handbook, Amir Sufi and Alan Taylor provide a survey of our knowledge on financial crises and emphasize the importance of understanding better the boom phase that precedes them. The origin of these financial cycles has been the object of much attention in the literature.

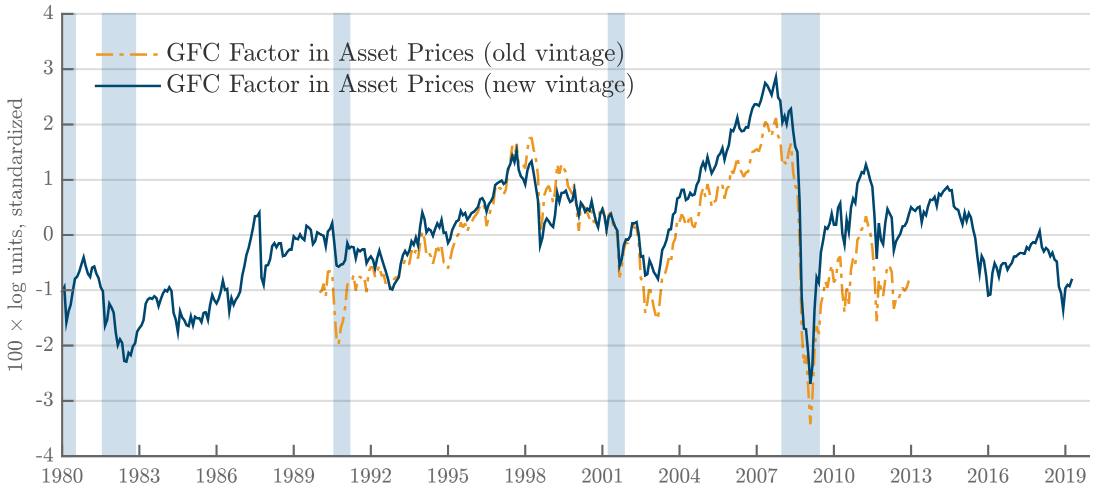
Calvo, Leiderman and Reinhart (1996) pointed out that capital inflows and outflows into emerging markets have an important global component: declines in world real rates encourage inflows, while US monetary policy tightenings lead to outflows. Lorenzoni (2014) emphasizes the importance of drops in asset valuations and movements in the real exchange rate as powerful amplifiers of the real effects of international crises. Miranda-Agrippino and Rey (2020b) have more generally shown the importance of global factors in the time series of financial variables of a large cross section of countries both during crisis times and in normal times. They identify one dimension of the global financial cycle in the high correlation across risky asset prices traded around the world, summarized using a common global factor. In their original setup, and in all the analysis that follows, the factors are estimated using Dynamic Factor Models (DFM) that allow for different global, regional and, in some specifications, sector-specific factors. The factors are estimated by postulating that the cross-section of data $x_t$ – whether asset prices, capital flows, or private credit –, can be represented as the sum of two orthogonal components, as in:

$$x_t = \Lambda f_t + \xi_t \ , \tag{1}$$

where $f_t$ is a vector collecting the common factors, and $\xi_t$ is an $n-$dimensional vector of idiosyncratic terms, specific to the $n$ entries of $x_t$. $\Lambda$ collects the factor loadings, that is, the extent to which each variable in $x_t$ loads on the common factors. The factors are assumed to evolve following a VAR process. Residual autocorrelation is soaked up by the idiosyncratic terms, that are assumed to follow univariate autoregressive processes. In order to distinguish between comovements at different levels of aggregation (e.g. at the regional level), block-specific factors can be estimated by imposing zero restrictions on some of the elements in $\Lambda$, such that e.g. only series that belong to a certain region are allowed to load on one or some of the factors. The factors are estimated using Maximum Likelihood on stationary and standardized data, and then cumulated.[1]

[1]The DFM can be cast in state-space form and estimated using Maximum Likelihood (see e.g. Doz, Giannone and Reichlin, 2011). The algorithm is initialized using principal components, that provide a good approximation of the common factors in large cross-sections. We set the number of lags in the factors VAR to 1, and the number of common factors following a number of criteria (see Table 1). The idiosyncratic terms are modelled as independent AR(1) processes. The block specification varies depending on the variables in $x_t$. For example, for asset prices we specify the blocks according to the geographical location of the markets in which they are traded, whereas for capital flows we specify them to

Figure 1: Global Factor in Risky Asset Prices

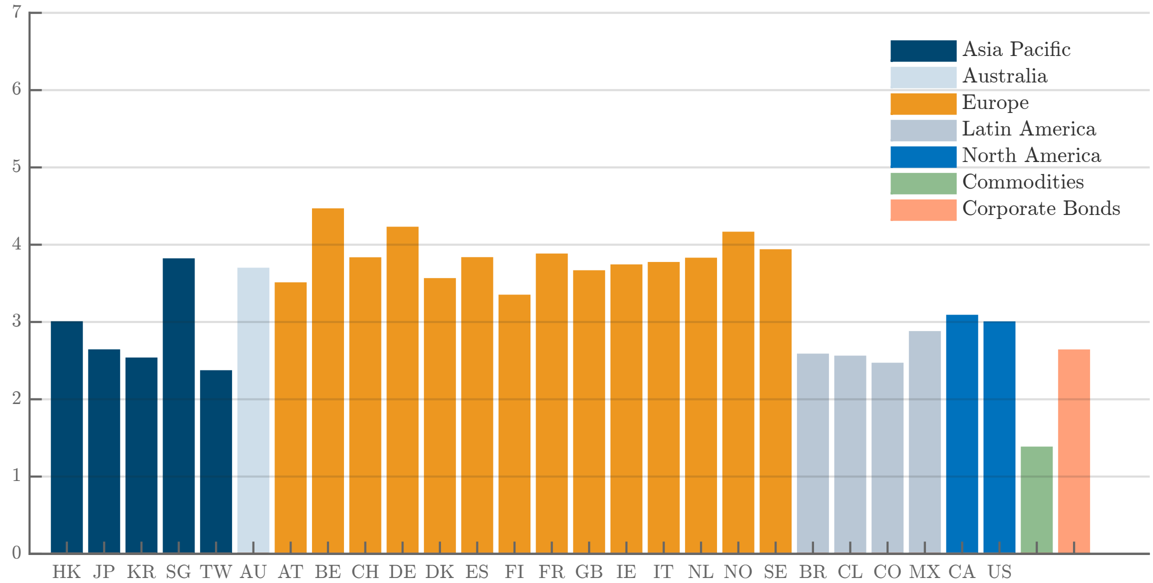



*Notes*: Common factor in world risky asset prices. Original vintage in Miranda-Agrippino and Rey (2020b), sample 1990:2012 (dashed line), updated vintage in Miranda-Agrippino, Nenova and Rey (2019), sample 1980:2019 (solid line).

In the original Miranda-Agrippino and Rey (2020b) sample, data covered the components of the equity indices traded in the largest markets worldwide, as well as commodity prices and corporate bonds, at monthly frequency from 1990 to 2010. The data supported the existence of *one* global factor, which was found to account for over a quarter of the common variation in all the 838 risky asset price series considered. Miranda-Agrippino, Nenova and Rey (2019) extend the analysis both over time, by considering a sample from 1980 to 2019, and along the cross section. The enlarged set of asset prices used for the factor extraction is assembled with the intention of being more representative of compositional changes in global markets, particularly through the inclusion of Asian stocks. The two factors are plotted in Figure 1. Despite the different composition, the two factors are very similar over the overlapping sample, with a correlation of 0.896. Since 2010, the factor picks up important global events such as the European sovereign debt crisis; the global equity sell-off of the beginning of 2016 triggered by fears that the Chinese growth slowdown may have spiralled out of control and by the dramatic plunge in oil prices; and the slowdown at the end of 2018, which some commentators attribute to the combined

capture different flows types (e.g. portfolio flows, or FDI). The block specification does not have material impact on the estimation of the global factors. For additional technical details see Miranda-Agrippino and Rey (2020b).

Figure 2: Global Factor in Risky Asset Prices: Factor Loadings




*Notes*: Average factor loadings (×100) across countries and asset classes. Estimation sample: 1980:2019.

effect of the withdrawal of some monetary stimuli, and to the escalation in the US-China trade conflict. Finally, and similar to the original estimates, the data support the existence of *one* global factor, which accounts for about a quarter of the overall common variation in this extended sample (Table 1).

Figure 2 reports the average factor loadings across countries and asset classes. Very interestingly, the loadings are remarkably homogeneous, and risky asset prices all load positively on the global factor, and to a very similar degree. There are however some interesting differences. Global commodity prices have the smallest loadings; this is consistent with the presence of a potentially different commodity cycle, something we elaborate on below. In relative terms, European stocks display the largest sensitivity to the common factor, whether in the euro area or outside, while Asian and Latin American markets tend to be relatively less exposed.[2]

As shown in Table 3 the global factor extracted from risky asset prices is highly correlated with the VIX, the VSTOXX, and measures of risk aversion taken from Bekaert

[2] Geographical regions include the following countries. Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom. North America: Canada, United States. Latin America: Brazil, Chile, Colombia, Mexico. Asia Pacific: Hong Kong SAR, Japan, Korea, Singapore, Taiwan. Australia: Australia.

Table 1: Number of Global Factors

| | Variance Share | $IC_{p1}$ | $IC_{p2}$ | $IC_{p3}$ | Onatski Test |
|---|---|---|---|---|---|
| Asset Prices (F1) | 24.1% | -0.184 | -0.183 | -0.189 | 0.049 |
| Capital Flows (F1) | 20.7% | -0.042 | -0.040 | -0.049 | 0.041 |
| Capital Flows (F2) | 14.5% | -0.051 | -0.047 | -0.065 | 0.007 |
| Capital Flows (F3) | 12.0% | -0.055 | -0.049 | -0.076 | 0.988 |
| Private Liquidity (F1) | 30.9% | -0.271 | -0.268 | -0.280 | 0.000 |
| Private Liquidity (F2) | 7.8% | -0.273 | -0.267 | -0.291 | 0.949 |
| Private Liquidity (F3) | 6.3% | -0.259 | -0.249 | -0.286 | 0.632 |

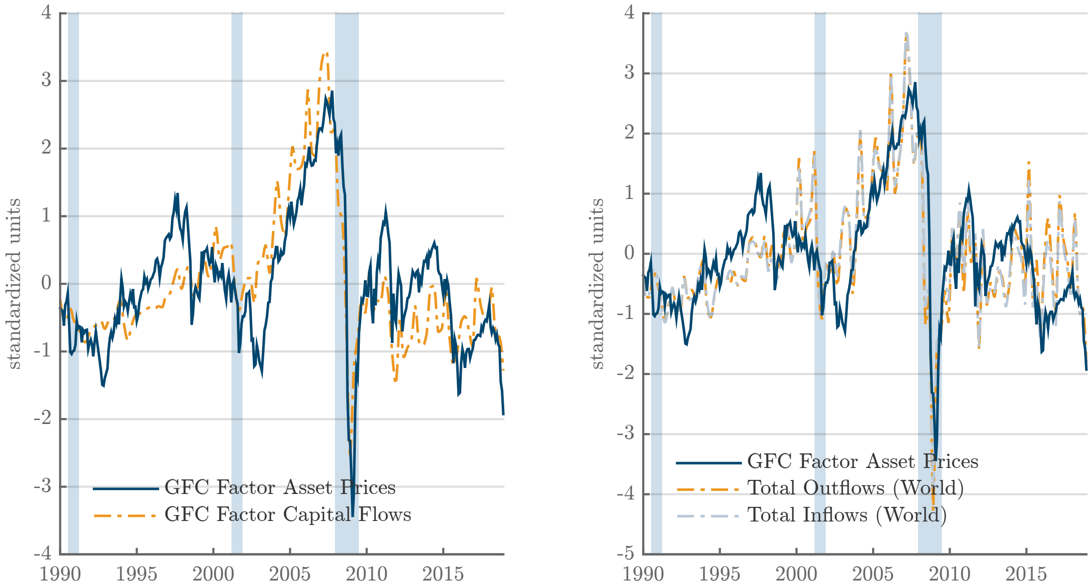
*Notes:* The first column of the table reports the share of variance explained by the estimated factors. The following three columns report the value of the ICp criteria in Bai and Ng (2002) and the last shows the p-value for the Onatski (2009) test where the null of $r-1$ common factors is tested against the alternative of $r$ common factors.

et al. (2019) (BEX), Bekaert et al. (2013) (BHD) and Cross Border Capital's data for risk appetite (CBC). Habib and Venditti (2019) also finds that a common component in global asset prices is closely related to the VIX and the risk premium on corporate bonds. We therefore report the following stylized fact:

**Stylized Fact 1.** *Global Financial Cycle*: One global factor in risky asset prices, correlated with global risk appetite, explains about a quarter of the variance of the data.

As noted in Rey (2013), however, asset prices are only one of the dimensions along which global financial cycles can be measured. Global capital flows also exhibit strong degrees of comovement. Barrot and Servén (2018) estimate global factors for annual gross capital inflows and outflows for a panel of 85 countries covering the years 1979-2015. They find that common factors, which include a global factor and a country group factor (advanced, emerging and developing economies), explain close to half of the overall variation of flows for all countries; but that there are important differences. In particular, global factors account for a larger share of the variance for advanced economies than for emerging markets (and developing economies). They also show that outflows across all countries tend to depend on global factors more than inflows do, suggesting that a significant share of the variation in global flows may be due to large outflows from a relatively large number of countries into a relatively smaller number of countries. A handful of global variables such as the VIX, the US interest rate, the US real exchange rate, US real GDP growth and a world commodity price index are found to explain much of the variance in the estimated factors. Cerutti, Claessens and Rose (2017) explores the importance of global drivers of international capital flows by focusing in particular on measures of goodness of fit. Unlike Barrot and Servén (2018), they estimate different global factors for different types of capital flows – i.e. foreign direct investment, portfolio equity and debt, and banking flows – for 85 countries over the period 1990-2015 at the quarterly frequency; they do not estimate country group specific factors. Their sample also differs from Barrot and Servén (2018) in that they include twenty former socialist economies but omit six emerging markets and twenty-four developing countries (mainly in Africa). The authors show significant degrees of heterogeneity across flow types and countries, and overall shares of explained variance that are lower than those reported in the literature. The existence of a Global Financial Cycle does not imply that all countries and flows be exposed to it in the same way and to the same extent, which is confirmed by the heterogeneity and time-variation in the factor loadings that emerges from most of the studies. Davis, Valente and van Wincoop (2019) explore the global determinants of both gross and net capital flows. Using annual data for 58 countries over the period 1996-2015, Davis et al. (2019) estimate a factor model for the joint dynamics of both inflows and outflows. This strategy allows them to analyse the characteristics of both gross flows (defined as inflows plus outflows) and net flows (defined as outflows minus inflows). They find evidence of two main factors characterising the dynamics of global gross flows, that are able to capture over 40% of their variation. Two findings stand out. First, the same factors also account for about 40% of the common variation in *net* flows in both advanced and emerging market economies. This is important because it suggests that the same factors that drive fluctuations in gross flows also induce variability in net flows, the latter being a more direct leading indicator of domestic business cycles. This is despite the fact that over time the correlation between inflows and outflows has increased, as noted in Forbes and Warnock (2012). Second, the first factor in global capital flows correlates strongly with the global factor in asset prices of Miranda-Agrippino and Rey (2020b) despite the two being extracted from completely different sets of data. This observation suggests that global financial prices and quantities share the same underlying

Figure 3: Global Factors in Asset Prices and Capital Flows




*Notes*: [Left Panel] Global factor in risky asset prices against first global factor in capital flows. [Right Panel] Global factor in risky asset prices against total inflows and outflows.

drivers to a large extent. This reinforces the notion of Global Financial Cycles being a comprehensive phenomenon that affect different types of financial variables.

## 2.2 Global Factors in Capital Flows and Private Sector Credit

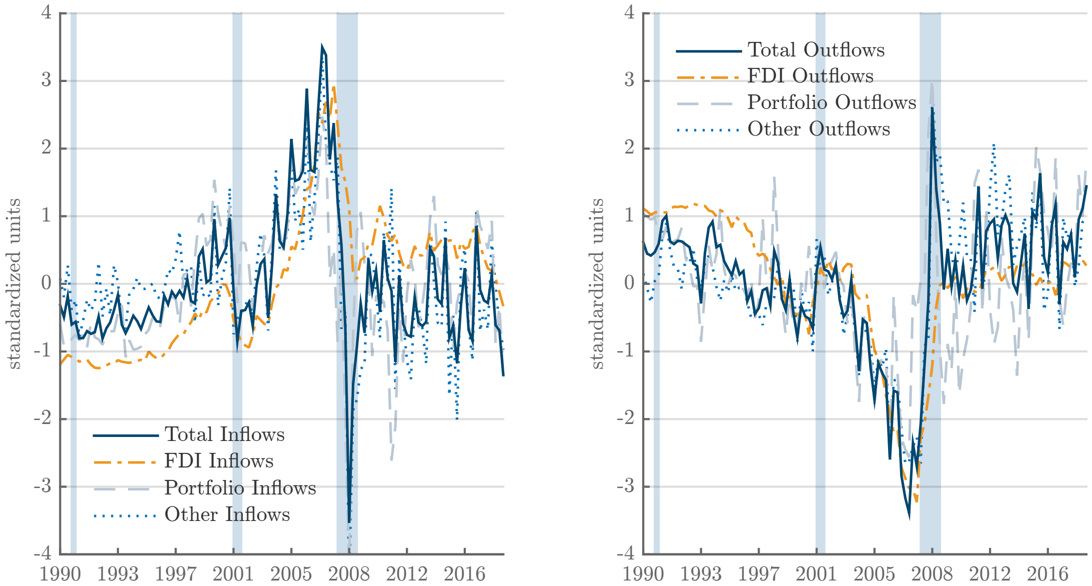
We explore common factors in capital flows and private sector credit in what follows using quarterly and monthly data (see Miranda-Agrippino, Nenova and Rey, 2019). We use quarterly data distributed by the IMF and consider both inflows and outflows across different types, namely, FDI, portfolio (equity and debt), and other (banking) flows. Our sample covers 81 countries from 1990 to 2018. All capital flows data are scaled by GDP. We estimate the common factors using a dynamic factor model similar to that employed for asset prices, that allows us to distinguish between global and group-specific factors, where groups are defined depending either on the type and direction of flows, or on the country classification as advanced or emerging market economy. The estimation of the common global factors is robust to these alternative group specifications.

Similar to Davis et al. (2019), we also find evidence of two global factors for capital flows (see Table 1 where we test for the number of factors). In annual data, Davis et al. (2019) found that those two factors capture over 40% of the variation. In quarterly data, we find that the two factors together account for over a third of the variation. This is natural as switching to quarterly observations somewhat reduces the share of explained common variance due to the higher volatility of the data. This is however the only difference relative to their findings. Importantly, we confirm that the first common factor in capital flows is strongly correlated with the global factor in asset prices, despite the two being estimated from completely different data. This is clearly visible in Figure 3 (left panel), and the correlation between the two factors is equal to 0.815 (Table 3). In Figure 3 (right panel) we estimate separately the first global factors in inflows and outflows and find that they are both highly correlated with the global factor in asset prices. This finding of co-movement between quantity and prices is of first-order importance for international finance models.

We explore in detail the degree of heterogeneity across inflows and outflows and across flow types by repeating the factor extraction on different cuts of the data and selecting each time the first common global factor. To highlight the different directions of flows, we rotate the outflow factors by pre-multiplying them by -1.[3] Figure 4 reports all the extracted global factors for different types of inflows (left panel) and different types of outflows (right panel) for all the countries in our sample. Pairwise correlation coefficients for all pairs are reported in Table 2. A few results stand out. First, global factors for gross inflows and gross outflows correlate almost perfectly (correlation equal to 0.952), which confirms results in both Forbes and Warnock (2012), Broner et al. (2013) and Davis et al. (2019). Second, there is strong evidence pointing to common sources of variation for all types of capital flows irrespective of the direction. Results in the table reveal that the only exception is represented by FDIs, for which the correlation with other flows tends to be lower, albeit significant. This is also visible in the subplots of Figure 4. FDI flows, depicted with orange dash-dotted lines, tend to be generally less volatile than other flows, and somewhat lagging. The different behaviour of FDIs is also highlighted in Cerutti, Claessens and Puy (2019), who note that banking, portfolio bond and equity inflows drive

[3]Factors are identified up to a scale, therefore the rotation does not affect their estimation. Rotating the factors also requires rotating the loadings, hence the outflows factors are negatively correlated with total outflows.

Figure 4: Global Factors across Types of Capital Flows




*Notes*: [Left Panel] Global factor for all inflows (solid line), all FDI inflows (dash-dotted line), all portfolio inflows (debt + equity, dashed line) and other inflows (dotted line). [Right Panel] On inverted scale, global factor for all outflows (solid line), all FDI outflows (dash-dotted line), all portfolio outflows (debt + equity, dashed line) and other outflows (dotted line).

most of the comovement in gross inflows, particularly for EMEs.

Table 2: Correlations among Capital Flows Factors

| | Total Inflows | Total Outflows | FDI Inflows | FDI Outflows | Portfolio Inflows | Portfolio Outflows | Other Inflows |
|---|---|---|---|---|---|---|---|
| Total Inflows | 1 | | | | | | |
| Total Outflows | -0.952 | 1 | | | | | |
| FDI Inflows | 0.568 | -0.530 | 1 | | | | |
| FDI Outflows | -0.710 | 0.738 | -0.883 | 1 | | | |
| Portfolio Inflows | 0.765 | -0.674 | 0.338 | -0.458 | 1 | | |
| Portfolio Outflows | -0.726 | 0.710 | -0.326 | 0.386 | -0.784 | 1 | |
| Other Inflows | 0.880 | -0.842 | 0.314 | -0.447 | 0.542 | -0.552 | 1 |
| Other Outflows | -0.852 | 0.908 | -0.332 | 0.578 | -0.481 | 0.452 | -0.900 |

*Notes:* Pairwise correlation coefficients. Outflows factors are rotated (i.e. premultiplied by -1) to highlight the different direction of flows. Sample 1990-2018.

**Stylized Fact 2.** Two global factors account for about thirty five percent of the variance of gross capital flows. The first global factor in capital flows is highly correlated with the global factor in asset prices. We interpret the global factor in risky asset prices and the first global factor in gross capital flows as reflecting *Global Financial Cycle factors*.

**Stylized Fact 3.** Global factors in inflows and outflows are highly correlated with one another and so are the flow factors disaggregated by asset classes: portfolio bond and equity flows and banking flows in particular co-move and drive the aggregate flow factors. FDI flows have a smoother dynamics.

Taken together, these results indicate that while there exists some degree of heterogeneity across different types of flows, world risky asset prices and international capital flows seem to share the same underlying global drivers. These common drivers, summarised by the global factors, also explain an important share of variation of the data, suggesting that Global Financial Cycles play a significant role in characterising fluctuations in these variables.

Finally, we explore common variation in private credit at the global level. We estimate common global factors from two different datasets. The first one is monthly, and distributed by Cross-Border Capital (CBC) Ltd. The variable we use is Private Sector Liquidity, defined as the net credit generation of all credit providers, traditional commercial banks and 'shadow banks'. The data are monthly and cover 72 countries over the period 1980-2019[4]. The second dataset is obtained from the International Financial Statistics dataset maintained by the IMF and it is quarterly. The variable used is Claims on Private Sector (IFS series code FOSAOP) from the Monetary, Other Depository Corporations Survey, extended back in time using the Monetary, Banking Institutions Survey (IFS line 22D). These data record domestic bank lending to the private non-financial sector, i.e. corporates and households. Relative to the CBC data, the IMF data do not include lending from shadow banks and long-term debt securities. We use the same set of countries and same time coverage[5].

As in the case of asset prices, we find evidence of one global factor for private credit variables across the different datasets. The two datasets largely capture the same type of

[4]For a detailed description of the data and additional stylized facts, see Howell (2020).

[5]The quarterly level data are interpolated using a shape-preserving piecewise cubic interpolation to compute monthly correlations.

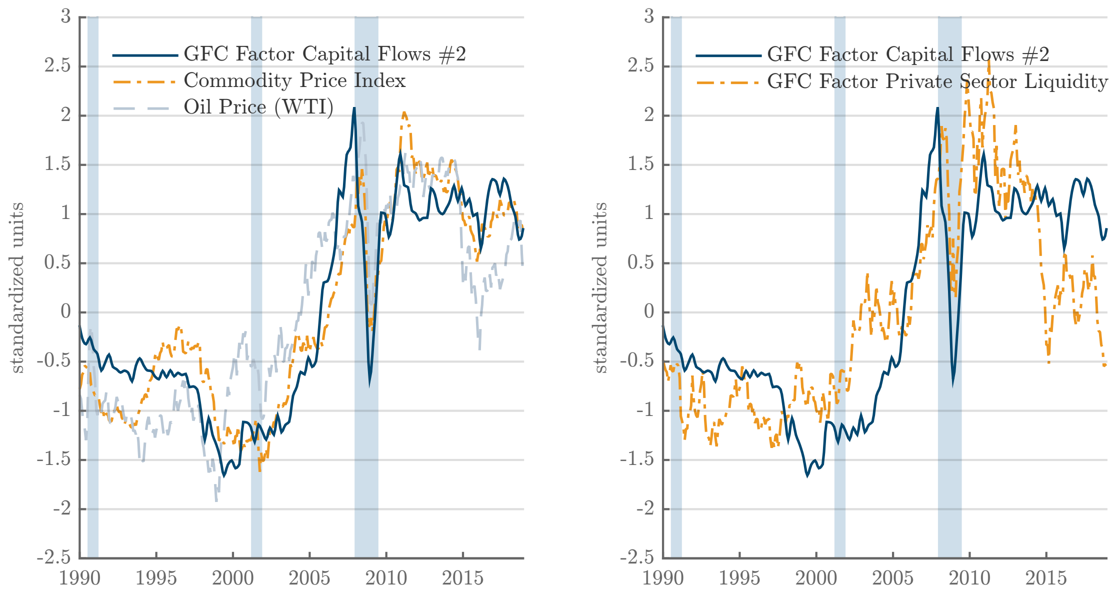
Table 3: Correlation among Global Factors

| | Asset Prices | Capital Flows (F1) | Capital Flows (F2) | Private Liquidity | Credit (IMF) |
|---|---|---|---|---|---|
| Asset Prices (F) | 1 | | | | |
| Capital Flows (F1) | 0.815 | 1 | | | |
| Capital Flows (F2) | 0.410 | 0.020$^{\dagger}$ | 1 | | |
| Private Liquidity (F) | *0.142* | -0.225 | 0.844 | 1 | |
| Total Credit (F IMF) | 0.424 | 0.472 | 0.366 | 0.419 | 1 |
| VIX Index | -0.649 | -0.476 | -0.261 | -0.063$^{\dagger}$ | -0.147 |
| VSTOXX Index | -0.695 | -0.496 | -0.284 | -0.052$^{\dagger}$ | -0.158 |
| Risk Aversion (BEX) | -0.653 | -0.472 | -0.189 | -0.023$^{\dagger}$ | -0.079$^{\dagger}$ |
| Risk Aversion (BHD) | -0.645 | -0.458 | -0.226 | -0.048$^{\dagger}$ | -0.119$^{\dagger}$ |
| Risk Appetite (CBC) | 0.748 | 0.706 | 0.011$^{\dagger}$ | -0.311 | 0.041$^{\dagger}$ |
| USD Exchange Rate | -0.413 | -0.019$^{\dagger}$ | -0.826 | -0.866 | -0.398 |
| EUR Exchange Rate | 0.231 | 0.020$^{\dagger}$ | 0.727 | 0.788 | 0.553 |
| RMB Exchange Rate | -0.400 | -0.729 | 0.430 | 0.379 | -0.447 |
| Oil Price | 0.335 | -0.088 | 0.913 | 0.854 | 0.313 |
| Commodity Price | 0.240 | -0.205 | 0.934 | 0.902 | 0.217 |
| World Output (BH) | 0.249 | -0.174 | 0.944 | 0.818 | 0.186 |
| World Output (NRB) | 0.229 | -0.201 | 0.922 | 0.779 | 0.122 |
| World Trade | 0.293 | -0.104$^{\dagger}$ | 0.945 | 0.804 | 0.250 |
| World FCI | -0.600 | -0.523 | -0.326 | 0.009$^{\dagger}$ | -0.264 |
| World Private Liq | 0.116$^{\dagger}$ | -0.268 | 0.909 | 0.890 | 0.267 |
| US 1-Year Rate | 0.456 | 0.681 | -0.439 | -0.654 | 0.020$^{\dagger}$ |
| US 10-Year Rate | 0.271 | 0.559 | -0.650 | -0.702 | -0.010$^{\dagger}$ |
| GER 1-Year Rate | 0.376 | 0.606 | -0.489 | -0.577 | 0.139 |
| GER 10-Year Rate | *0.125* | 0.447 | -0.686 | -0.597 | 0.121 |

*Notes:* Pairwise correlations, overlapping samples from 1990:01-2018-12. Variables in levels. Italic figures denote significance at 10% level, $^{\dagger}$ is for not-significant correlations, all remaining entries are significant at least at the 5% level. Measures of risk aversion are taken from Bekaert et al. (2019) (BEX), Bekaert et al. (2013) (BHD) and Cross Border Capital's data for risk appetite (CBC). Measures of world output are from Baumeister and Hamilton (2019) (BH) and from the CPB Netherlands Bureau for Economic Policy (NRB). The FCI is from Cross Border Capital.

information. At the quarterly frequency, we find that the global credit factor extracted from the IMF data correlates with the global factor in asset prices and the two capital flow factors though the correlations are not very strong. Once we aggregate the monthly private liquidity data to either quarterly average or end of quarter readings, we find that the extracted factor is very similar to that extracted from the IMF data. The global factor in private liquidity at the monthly frequency correlates strongly with the second factor in capital flows, and the *Global Commodity and Trade Cycle* (Table 3 and Figure 5). Davis et al. (2019) and Barrot and Servén (2018) also find that their second capital flow factor correlates strongly with commodity prices.

Figure 5: Capital Flows, Private Liquidity and Commodity Cycles




*Notes*: [Left Panel] Second global factor in capital flows (all directions, all types, solid line), commodity price index (dash-dotted line), oil price (dashed line). [Right Panel] Second global factor in capital flows (all directions, all types, solid line), global factor in world private liquidity (dash-dotted line).

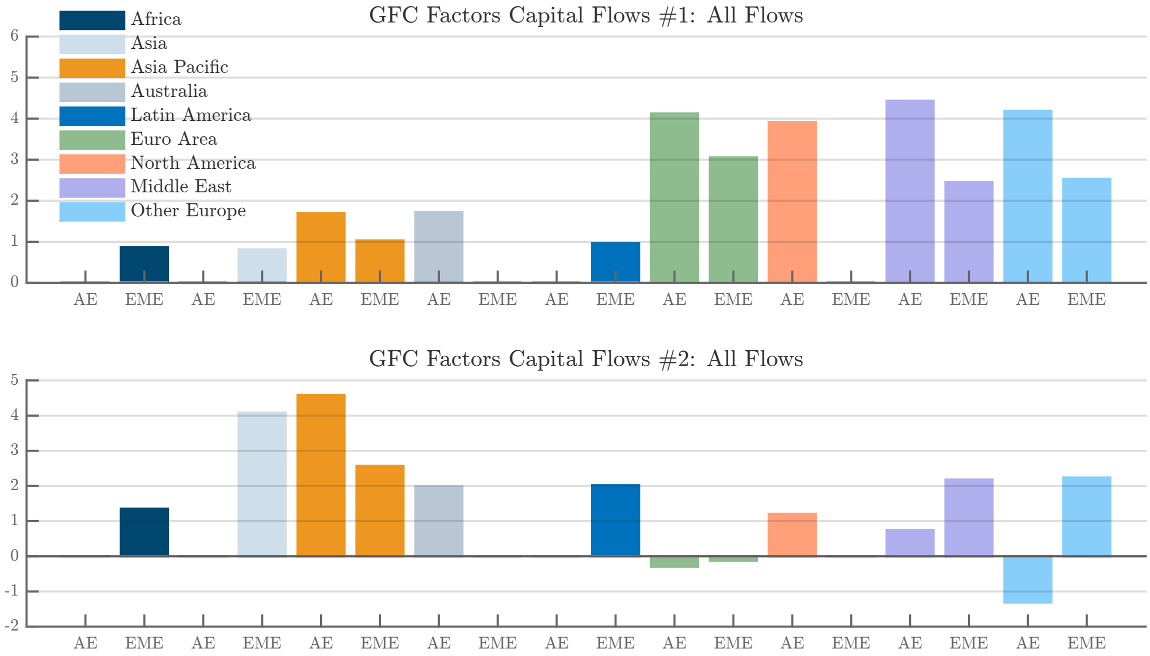
**Stylized Fact 4.** The second global factor in capital flows is highly correlated with commodity indices and with international trade and world output.

**Stylized Fact 5.** One global factor accounts for about 31 percent of the variance of fluctuations in private liquidity worldwide. That factor is highly correlated with the second capital flow factor. We interpret the second capital flow factor and the private liquidity factor as linked to the *Global Trade and Commodity Cycle*.

Figure 6 reports the average loadings across countries for the first and the second global factors in capital flows. The averages displayed are calculated across all flows, but we discuss below differences between inflows and outflows, or among flows types whenever relevant. In the figure we distinguish among broad geographical areas as well as between AE and EMEs, following the IMF classification.[6] Looking at the top panel of Figure 6 we

[6]Geographical areas include the following countries. Euro Area: Austria, Belgium, Croatia, Cyprus,

Figure 6: Global Factors Capital Flows: Loadings




*Notes*: Average loadings (×100) for the two factors in capital flows across countries. Distinction between Advanced and Developing/Emerging Market Economies. Sample 1990-2018.

see that capital flows in advanced economies of the Euro Area, other Europe and North America have the highest loadings on the first factor. This is also true for Israel, which is the only country classified as AE in the Middle East group. In general, AEs tend to have higher loadings on the first factor relative to EMEs, while flows to and from Asian and African economies have the lowest exposure to the GFC. The loadings on the GFC factor are always positive, irrespective of the type of flows, the geographical location, or the classification as AE/EME.

The picture is quite different for the second factor, which we have interpreted as capturing *Global Trade and Commodity Cycles* (GTCC). The bottom panel of the picture

Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain. North America: Canada, United States. Latin America: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru, Uruguay, Venezuela. Asia Pacific: Hong Kong SAR, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand. Australia: Australia, New Zealand. Asia: Bangladesh, China, India, Mongolia, Pakistan, Sri Lanka. Other Europe: Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Czech Republic, Denmark, FYR Macedonia, Hungary, Iceland, Montenegro, Norway, Poland, Russia, Serbia, Sweden, Switzerland, United Kingdom. Middle East: Armenia, Azerbaijan, Georgia, Israel, Jordan, Kazakhstan, Lebanon, Saudi Arabia, Turkey. Africa: Mauritius, Morocco, Namibia, South Africa.

shows that Asian countries have the highest loadings (EME Asia being dominated by China), moreover, with the exception of Asia Pacific, it is typically flows to and from EMEs that tend to have higher loadings relative to AEs. In fact, inflows to European AEs load negatively on this second factor. Equity flows to African economies also load strongly and negatively on the GTCC factor, while the pattern displayed in the picture is broadly representative of all other types of flows. Banking flows in AEs in Europe, North America and Australia do not load significantly on this second factor, while on the other hand FDI flows into Africa, Asia and for AEs in Asia Pacific and the Middle East load strongly and positively on the GTCC.

Table 3 shows that the global factor in risky asset prices and the first global factor in capital flows (F1) correlate highly with one another and with risk appetite and the world financial condition index (FCI). In contrast, the second global factor in capital flows (F2) correlates strongly with private liquidity, exchange rates and world output, trade and commodity prices, as is also clear from Figure 5. One possible interpretation of these results is that as commodity prices and international trade activity go up, EMs of Latin America and the Middle East which tend to be commodity exporters and Asian economies, which tend to engage heavily in international trade, are increasingly involved in international financial flows: due to scarce investment opportunities at home their excess savings are channeled abroad. This is accompanied by investment in a subset of countries where these excess savings migrate. This interpretation would be to a large extent reminiscent of the recycling of the petrodollars in the 1970s, which led to creation of liquidity in the US banking system and massive capital flows into Latin America. Since banking flows of AEs however do not seem to load much on this global factor, it seems that this time around (data are post 1990s), investment occurs mainly through FDI and portfolio flows into some EMs and some AEs. Nowadays, it is likely that China plays a key role in the commodity cycle and that episodes of high commodity prices coincide with strong growth in international trade and industrial output.

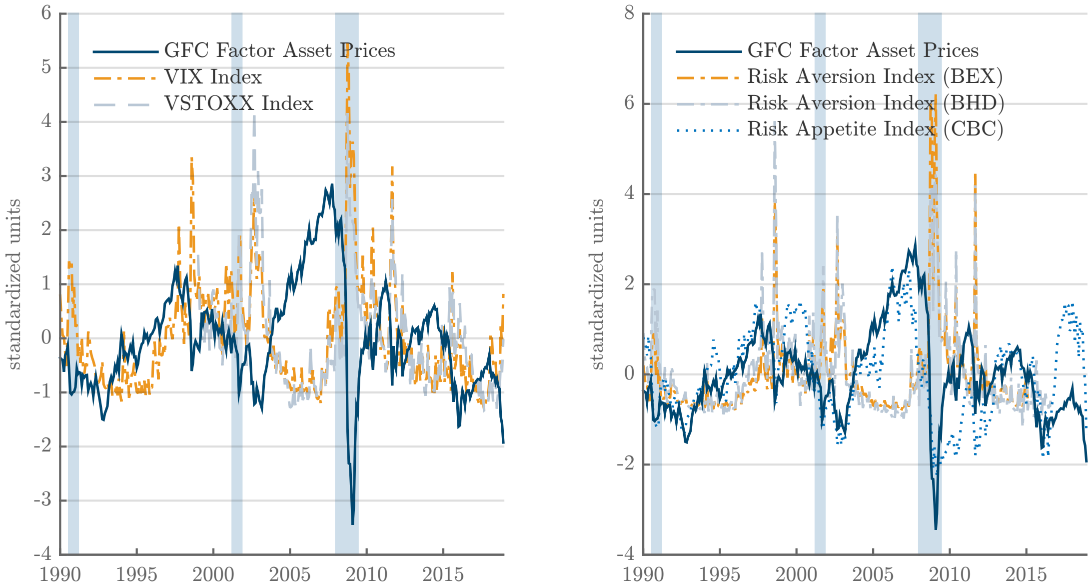
# 3 What is behind the Global Financial Cycle?

## 3.1 Capital flows & Risk

The importance of international monetary spillovers and of the world interest rate in driving capital flows and credit booms and busts has been pointed out in the classic work of Calvo, Leiderman and Reinhart (1996). This literature typically relies on panel regressions at the country level to investigate the relative contribution of global (push) and country-specific (pull) factors in driving capital flows. Fratzscher (2012) shows that common factors, such as global risk (proxied by the VIX), dominated the dynamics of net capital flows up until the 2008 financial crisis, with heterogenous effects across different countries. Similarly, Forbes and Warnock (2012) show that global factors, especially global risk, are significantly associated with extreme capital flow episodes. Financial contagion, whether through trade, banking, or geography, is also associated with sharp decreases in both gross capital inflows and outflows, while local factors are generally less important. These results align with those in Barrot and Servén (2018), who find that a handful of global variables, including the VIX, the US interest rate and real exchange rate, drive most of the common variation in gross capital inflows and outflows. Miranda-Agrippino and Rey (2020b) shows that the global factor in risky asset prices and the VIX and other measures of risk aversion are highly correlated (see Figure 7). Asset prices boom when risk aversion and volatility is low and vice versa (see Passari and Rey, 2015). Cesa-Bianchi, Pesaran and Rebucci (2020) show that time variations in country-specific volatility are explained largely by shocks to a global financial factor and explore in detail the correlations between volatility and growth. Caggiano and Castelnuovo (2021) presents evidence that global financial uncertainty shocks have a stronger effect on world output when global financial conditions deteriorate.

Kalemli-Ozcan (2019) finds strong evidence that US monetary policy affects global investors's risk perceptions thereby transmitting itself to domestic credit costs. These risk spillovers are higher for emerging markets than for advanced economies; they interact with country risk. She finds that capital flows in and out of emerging market economies are particularly sensitive to fluctuations in global risk perceptions and have a direct effect on local credit spreads. One of the core empirical results of her paper is that an increase

Figure 7: Global Factors in Asset Prices and Risk Measures




*Notes*: [Left Panel] Global factor in risky asset prices (solid line), CBOE VIX index (dash-dotted line), VSTOXX index (dashed line). [Right Panel] Global factor in risky asset prices (solid line), Bekaert, Engstrom and Xu (2019) risk aversion index BEX (dash-dotted line), Bekaert, Hoerova and Lo Duca (2013) risk aversion index BHD (dashed line), Cross-Border Capital world risk appetite index CBC (dotted line).

in the U.S. policy rate leads to an asymmetric response of interest rate differentials for advanced economies and for emerging markets. In advanced economies, a 100 basis points tightening leads to a 50 basis points decrease in interest-rate differentials, but it leads to a 230 basis points increase in interest rate differentials for emerging markets. Some emerging markets attempt to stabilize their exchange rates vis-à-vis their anchor currency (often the \$) and therefore tighten when the Fed tightens: this is the fear of floating (see Calvo and Reinhart, 2002). Others attempt to counteract a Fed tightening by loosening their policy stance but do not manage to control local credit spreads. In the case of Chile for example, Gourinchas (2017) shows that the Central Bank tries to offset the tightening of financial conditions due to the GFC by lowering the policy rate. Importantly, Kalemli-Ozcan (2019) shows that flexible exchange rates help absorb partly risk premia shocks. But she emphasizes that domestic monetary policy is partly ineffective in mitigating the spillovers as the pass-through of policy rates into short-term interest rates is imperfect. For advanced economies, Rey (2016) shows that US monetary policy transmits to financial conditions in Sweden, UK and Canada, which are all inflation targeters. Chari et al. (2020) show that changes in global risk aversion have large impacts on capital flows to emerging markets and on emerging markets stock and bond valuations. Bai et al. (2019) provide evidence that the GFC is driven by a long run risk component which accounts for the co-movement of sovereign spreads. The co-movement of sovereign spreads is also analysed in Gilchrist et al. (2021). Boehm and Kroner (2020) show that US macroeconomic news releases have large and significant effects on global risky asset prices. Their results are consistent with a direct effect on investors' risk-taking capacity: news about the US business cycle has large effects on global financial conditions possibly due to the US central position in the global financial system. Jorda, Schularick, Taylor and Ward (2018) document a sharp increase in the co-movement of global equity markets in the recent period. They demonstrate that fluctuations in risk premia, and not risk-free rates and dividends, account for a large part of the observed equity price synchronization after 1990, and that U.S. monetary policy plays an important role as a source of fluctuations in risk appetite. They find that these fluctuations transmit across both fixed and floating exchange rate regimes, though the effects are more muted in floating rate regimes.

These empirical results on the transmission mechanism of monetary policy via its impact on risk premia, spreads, and volatility, are related to those of Gertler and Karadi (2015) and Bekaert, Hoerova and Lo Duca (2013) obtained in the domestic US context.[7] A small number of papers have analyzed the effect of US monetary policy on leverage and on the VIX (see e.g. Passari and Rey, 2015; Bruno and Shin, 2015a). Adrian, Stackman and Vogt (2016) estimate the price of risk as a function of the VIX and show that countries' exposure to the global price of risk is related to macroeconomic risks and financial crises. Consistent with the findings of Bekaert, Hoerova and Lo Duca (2013), they find significant interactions between the short rate and the global price of risk, pointing towards a risk-taking channel of monetary policy.

## 3.2 Transmission of US Monetary Policy across borders

The situation of the US at the centre of the international monetary and financial systems (see Farhi and Maggiori, 2018; Ilzetzki et al., 2019; Gourinchas et al., 2019; Gopinath,

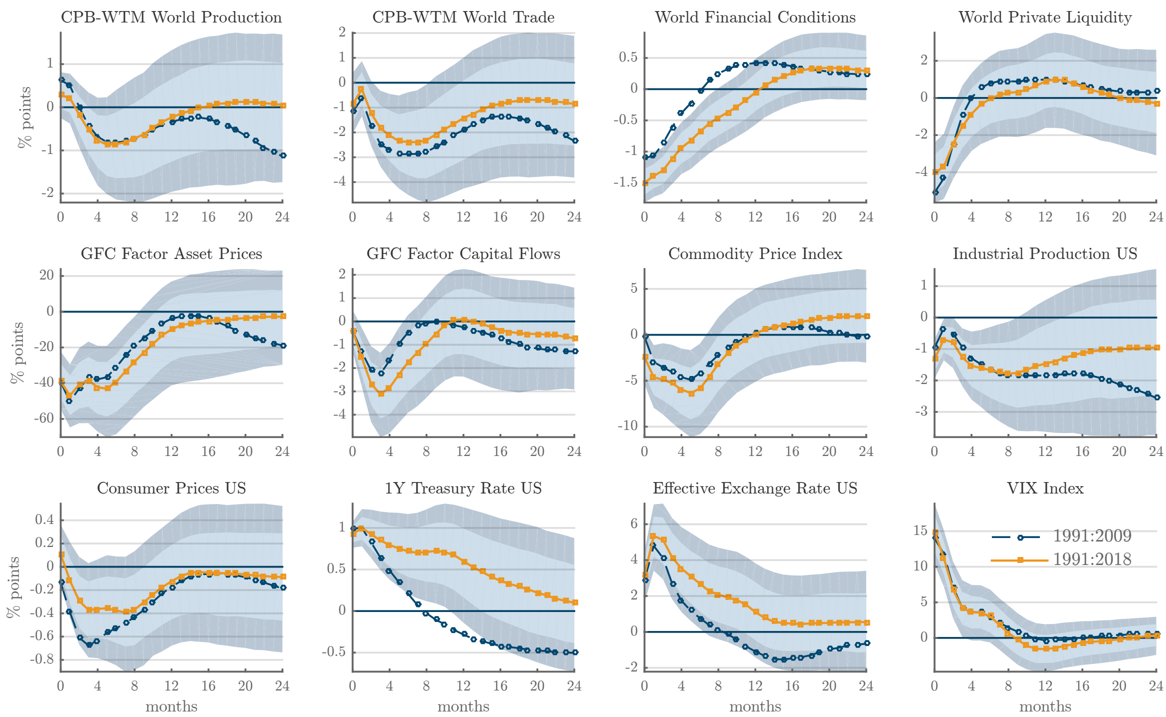
[7]For a discussion on the transmission of unconventional US monetary policy on global risk premia see Rogers, Scotti and Wright (2018).

2016) makes it likely that US monetary policy can transmit itself internationally via multiple channels. We estimate a proxy VAR which includes real economy as well as financial variables in order to understand their joint dynamics. We summarize the global landscape with the following variables: world production and world trade (from the CPB World Trade Monitor); world financial conditions and world private liquidity (from CrossBorder Capital Ltd.); the global factors in asset prices and capital flows; exchange rates and a commodity price index. We report median responses and posterior credible sets at the 68% and 90% level to a monetary policy shock identified using high-frequency movements in the price of Federal Funds Futures around FOMC announcements as external instrument (Stock and Watson, 2018). The IRFs are normalized such that the impact response of the policy rate (1-year rate) is equal to 100 bps. The VAR is estimated at monthly frequency over the sample 1991:01-2018:12 with 12 lags and standard macroeconomic priors (Giannone, Lenza and Primiceri, 2015).

Results are reported in Figure 8. They extend and confirm findings in Miranda-Agrippino and Rey (2020b). Following a US monetary policy tightening global financial conditions deteriorate materially. Private liquidity, measured as net credit generated by all credit providers, contracts. World financial conditions tighten and the USD appreciates. Global asset prices and global capital flows, summarized by the two factors, contract on impact, and the VIX spikes up. Commodity prices go down. Global growth does not seem to be materially affected, while world trade contracts slightly at medium horizons. All this happens against a backdrop of cooling domestic conditions, with prices and production decreasing in the US. Hence, the Federal Reserve monetary policy has important spillovers on global financial markets and liquidity conditions worldwide. It is a driver of the Global Financial Cycle.

We further explore the response of capital flows. In our VAR, we replace the global factor with four variables: capital flows in and out of the US; and capital flows in and out of EMEs. We find that US inflows and outflows move largely in tandem, pointing to a general weakening of financial activity. This is not the case for EMEs, which are hit by a double whammy of smaller inflows and larger outflows (see Figure 9 top panel). This vulnerability of EMEs to US monetary policy has been noted on several occasions, and culminated with the Taper Tantrum episode of 2013, when hints that the monetary

Figure 8: US Monetary Policy and the Global Financial Cycle

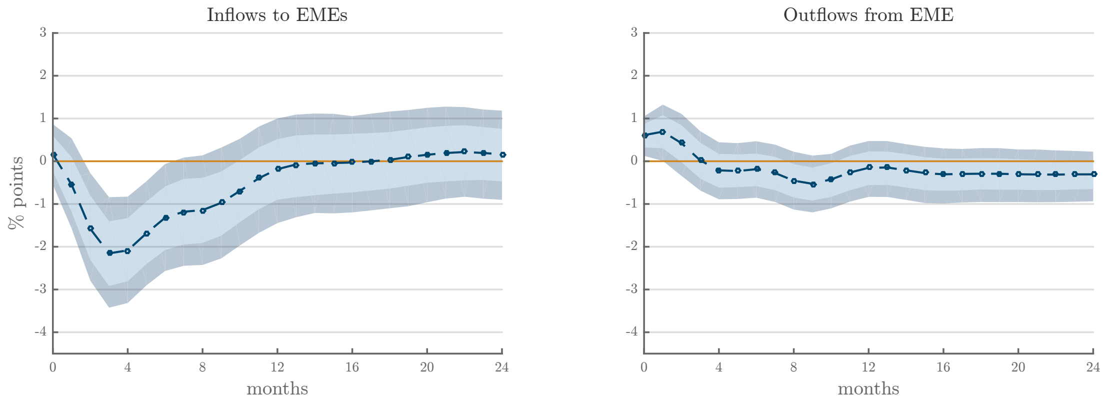



*Note*: Median impulse response functions with 68% and 90% posterior credible sets. BVAR(12).

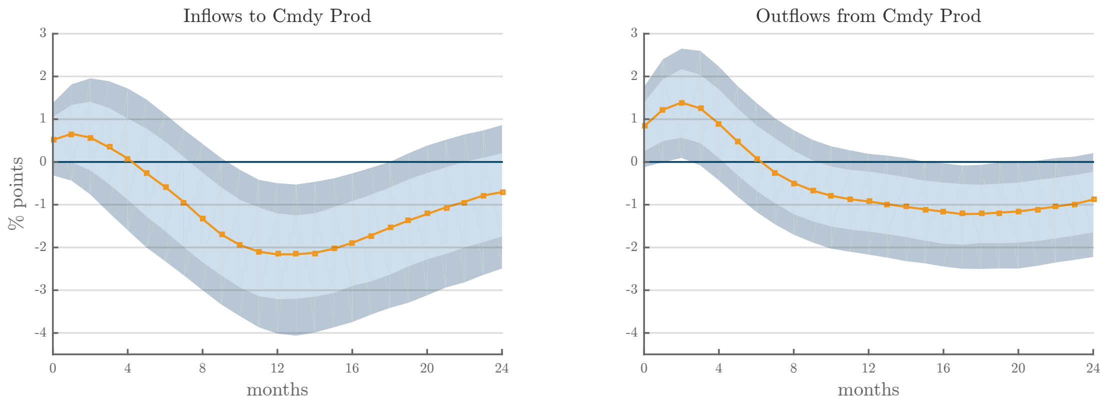
stimulus may start to be withdrawn threw investors into a panic that quickly transformed into excess volatility and sell-off, particularly in EMEs.

Other papers in the literature have shown the potency of US monetary policy spillovers. Dedola, Rivolta and Stracca (2017) find that in their panel of 36 advanced and emerging economies, a surprise US monetary tightening leads industrial production and real GDP to fall, and unemployment to rise. Inflation declines especially in advanced economies and the US $ appreciates. They find evidence of significant heterogeneity across countries in the response of asset prices, and portfolio and banking cross-border flows. Degasperi, Hong and Ricco (2021) use a large country panel of 30 economies to investigate the effect of US monetary policy using high frequency identification. They find that a US monetary policy tightening has large contractionary effects on both advanced and emerging economies. They show that flexible exchange rates cannot fully insulate domestic economies, due to movements in risk premia that limit central banks' ability to control the yield curve. Interestingly, Degasperi et al. (2021) also find that financial channels

Figure 9: Responses of Capital Flows to Different Monetary Policies




(a) *Note*: Responses to a US monetary policy shock that raises the 1-year rate by 1% on impact. Median impulse response functions with 68% and 90% posterior credible sets. BVAR(12). 1991:01-2018:12.




(b) *Note*: Responses to a Chinese monetary policy contraction that raises the policy indicator by 1% on impact. Median impulse response functions with 68% and 90% posterior credible sets. BVAR(12). 1999:01-2018:12.

dominate over demand and exchange rate channels in the transmission to real variables, while the transmission via oil and commodity prices is important for nominal spillovers. They show that even large advanced economies such as the euro area are affected by the recessionary effects of a US monetary policy tightening despite using their own monetary policy to counteract the effect of a US tightening.

Another strand of the literature has used more granular data to study in detail the role of financial intermediaries in channeling spillovers. Cetorelli and Goldberg (2012) use balance sheet data to study the role of global banks in transmitting liquidity conditions across borders. Using firm-bank loan data, Morais, Peydro and Ruiz (2015) find that a softening of foreign monetary policy increases the supply of credit of foreign banks to

Mexican firms. Using credit registry data combining firm-bank level loans and interest rates data for Turkey, di Giovanni, Kalemli-Ozcan, Ulu and Baskaya (2017) show that increased capital inflows lead to a large decline in real borrowing rates, and to a sizeable expansion in credit supply. They find that the increase in credit creation goes mainly through a subset of the local biggest banks. Thus, by matching credit registry data and balance sheet of Turkish companies they are able to document in a very precise way the large direct effect of external flows on lending and on real economic activity. They find that 43% of cyclical loan growth can be explained by the Global Financial Cycle. They are also able to provide evidence regarding the evolution of financing costs and lending constraints (collateral for example) with external conditions. Baskaya, di Giovanni, Kalemli-Özcan, Peydro and Ulu (2017) further explore the link between capital inflows, particular banking flows, and local credit creation. Elliott, Meisenzahl and Peydró (2021) use international loan-level data to show that non-bank lenders behave differently from banks, and can act as partial absorber of foreign monetary policy spillovers. When US monetary policy tightens, non-bank lenders increase the supply of dollar funds to non US borrowers relative to banks, which partially attenuates the total contraction of US dollar credit. This literature establishes using granular data that one of the channels through which US monetary policy affects real activity in emerging markets is by affecting local credit conditions[8].

## 3.3 Transmission of the European Central Bank monetary policy across borders

Ca' Zorzi, Dedola, Georgiadis, Jarociński, Stracca and Strasser (2020) compares the effects of the Fed and ECB monetary policy shocks on a variety of variables over the common sample 1999-2018. The identification is based on high-frequency surprises making use of the Jarociński (2020) methodology to clean the data for information effects. First they analyse the effect of ECB and Fed policy on Euro Area (EA) and US variables. They find that local output and inflation respond in a 'textbook way', but while the ECB policy has no effect on US variables, the Fed policy has a large effect on the EA real

[8]Epure, Mihai, Minoiu, Peydró et al. (2021) shows that macroprudential policies dampen the effect of the Global Financial Cycle on local credit conditions using granular data from Romania.

activity and financial markets (not as much on inflation). These asymmetries are also confirmed in Jarociński (2020). On trade, Ca' Zorzi et al. (2020) find that the responses are consistent with DCP for the US whose trade variables (imports, exports and terms of trade) are not responsive to ECB policy. But for the ECB they find that terms of trade improve strongly after tightening/EUR appreciation: responses are consistent with either PCP, or a combination of PCP for exports (which decline) and DCP for imports (which do not move at all). Fed policy influences financial conditions in the EA but the reverse is not true. This is particularly true for corporate bond spreads. Fed influences global borrowing, measured as $-denominated debt issuance (both financial and private non-financial), portfolio investments, syndicated loans and global asset prices, while the ECB policy does not move these variables. Interestingly, they find the ECB strongly affects commodity prices but the Fed does not. Fed policy strongly affects EMEs stock markets and GDP, but not much their export volumes while, in contrast, the ECB affects export volumes but not GDP or stock market. Ca' Zorzi, Dedola, Georgiadis, Jarociński, Stracca and Strasser (2020) conclude that "Overall, a hierarchy of monetary policy spillovers emerges, which places the Federal Reserve ahead of the ECB in terms of the global impact of its policies. Financial spillovers emanating from Federal Reserve monetary policy spread to the euro area and other countries. Trade spillovers emanating from ECB monetary policy barely affect the United States, but do spread to other countries."

Importantly, this asymmetry in the international financial spillovers of ECB and Fed monetary policies is typical of conventional interest-rate-based interventions, but was greatly reduced following the financial crisis of 2008 and the implementation of unconventional monetary policy tools. Miranda-Agrippino and Nenova (2021) shows that ECB's unconventional monetary policy produces qualitatively the same effects on international financial conditions as Fed unconventional policies, albeit with smaller magnitudes. We explore the evolution of the GFC drivers after the Lehman crisis and the zero lower bound in detail in Section 4.

## 3.4 Transmission of the Bank of England monetary policy across borders

Gerko and Rey (2017) uses a proxy VAR and high frequency identification based on Fed Funds Futures for the US and on Short-term Sterling Futures for the United Kingdom. They find that US monetary policy stance transmits itself to UK financial conditions measured by mortgage and corporate spreads. They do not find however that UK monetary policy affects US financial conditions. International spillovers are therefore asymmetric. It would be very interesting to investigate along the same lines the potential spillovers of the monetary policy of the Bank of Japan.

## 3.5 Transmission of the People's bank of China monetary policy across borders

The Chinese monetary policy framework is very different from the Fed and the ECB. It uses many tools, both quantities and (repo) interest rates and for some time intermediate quantity targets. Kim and Chen (2019) however shows that effects are similar across tools. Particularly in recent years, the analysis of the conduct of monetary policy of the People's Bank of China has gained increasing attention (see e.g. Jones and Bowman, 2019). The objective of the prudent monetary policy of the Chinese monetary authority, initiated in 1989, is that of maintaining prices and the value of the Renminbi stable, while contributing to and promoting economic growth (Zhou, 2015). Over the years, the policy has moved from being predominantly quantity-based to interest-rate-based (Chen, Chen and Gerlach, 2011; Kim and Chen, 2019). And much like for other major central banks, communication has become increasingly important and studied (McMahon, Schipke and Li, 2018). To measure the Chinese monetary policy stance, Miranda-Agrippino et al. (2019) make use of the monetary policy indicator constructed in Xu and Jia (2019) to summarize information in a variety of interest rates. They identify Chinese monetary policy shocks by postulating a Taylor-type rule for the monetary authority, as an innovation of the monetary policy index in a recursively identified VAR. Together with domestic prices and output, they assume that world variables do not react within a month. The VARs are monthly, estimated with 12 lags from 1999:01 to 2018:12, and IRFs are normalized to yield a 1% increase in the monetary policy index on impact. The sample standard deviation of the index is 0.5. The normalization can thus be thought of as a two standard deviations shock, hence quite large.

Miranda-Agrippino et al. (2019) find that Chinese production, measured as gross value added, declines with delay, reaching a peak negative response after one year. Similar dynamics characterize the price adjustment and the reaction of the RMB. Prices eventually decline, while the currency slowly appreciates. The domestic response is very much in line with the standard textbook transmission mechanism documented for other countries, apart from the slow exchange rate adjustment. The channels of global transmission are instead very different from those documented for the US. Global financial variables are largely unaffected: world financial conditions, the VIX, and the global factors in asset prices and capital flows do not respond in any significant way, at least at short-medium horizons. Conversely, world production slows down, presumably dragged by the contraction in Chinese domestic demand that in turn pulls down world trade and commodity prices.The sluggish response of the exchange rate is very different from the US one, and deserves further investigation (see also Richmond, 2019).

The effects that fluctuations in the Chinese economy elicit on global quantities seem to go mainly through commodity prices, and the compression of global demand. We explore this further in Figure 9 where we look more in detail at how commodity producers react to the shock. Financial conditions tighten significantly for this pool of countries; in particular, they witness both a contraction in inflows and a surge of capital outflows. Hence, an important channel of the international transmission of Chinese monetary shocks seems to reside in its large relative weight in world production. Weak Chinese demand has the potential to disrupt global production because of the crucial role it plays in the global markets for both raw materials, and intermediate production goods. Hence the Chinese and ECB monetary policies both seem to affect mainly international trade and commodity markets but not so much the GFC[9].

The analysis of the international spillovers of the three largest currency areas monetary

[9]Though ECB's monetary policy also has an effect on global financial variables, especially after Lehman's bankruptcy, as we show in the next section.

policies lead us therefore to state the following two important stylized facts:

**Stylized Fact 6.** The US Federal Reserve plays an important role in driving the *Global Financial Cycle* measured by the global factor in asset prices, the first global factor in capital flows, measures of risk aversion, financial conditions, spreads and credit.

**Stylized Fact 7.** The European Central Bank and the People's Bank of China play an important role for international trade, output and commodity prices. They are drivers of the *Global Trade and Commodity Cycle*. The People's Bank of China does not play a major role in driving the Global Financial Cycle.

# 4 Has the Global Financial Cycle changed after Lehman?

Forbes and Warnock (2020) extend their previous work and show that while the occurrence of extreme capital flow movements has not changed since the 2008 financial crisis, these phenomena tend to be less correlated with changes in global risk (VIX), and more difficult to explain with standard mechanisms based on global, regional and domestic factors. Similarly, Avdjiev, Gambacorta, Goldberg and Schiaffi (2017) note that, since the crisis, the sensitivity of global liquidity (international bank lending and bond issuance) to global risk has decreased significantly, as a result of the regulatory changes which have led to better capitalized banking systems. Conversely, the sensitivity to US monetary policy increased and peaked around the time of the taper tantrum of 2013. Avdjiev et al. (2017) also finds that after the crisis the impact of global risk has increased for international bonds flows and declined for cross-border loan flows. McCauley, McGuire and Sushko (2015), focusing on credit denominated in US dollars, finds that unconventional monetary policy helped the partial shift from borrowing away from global bank loans and towards bonds. Cerutti et al. (2017) shows that changes in banking system conditions since Lehman have affected the importance of US and European drivers of bank flows. Avdjiev, Du, Koch and Shin (2019) and Erik, Lombardi, Mihaljek and Shin (2020) show that a stronger dollar goes hand in hand with larger deviations from covered interest parity (CIP) and contractions of cross-border bank lending in dollars. They argue that the role of the dollar as a key barometer of risk-taking capacity in global capital markets has increased after Lehman.

## 4.1 Fed Unconventional Monetary Policy & Global Financial Cycle

After 2009, with short-term policy rates at or close to the zero lower bound (ZLB), the Federal Reserve, the ECB and other major central banks have conducted monetary policy using unconventional tools, primarily aimed at managing expectations and easing stress in financial markets. Prominent tools include communication about the near-term course of actions (forward guidance), and large-scale asset purchases (quantitative easing, or QE).

Because of their multidimensional nature, identifying and estimating the effects of such unconventional policies has proven to be challenging. A convenient way of characterizing unconventional monetary policy tools is introduced by Swanson (2021) that uses a variety of asset prices that cover the entire maturity spectrum to capture the information content of each FOMC announcement through the lens of financial markets, that act as an information aggregator. Extending the approach of Gürkaynak et al. (2005), Swanson (2021) identifies three dimensions of monetary policy: i) a federal funds rate factor, that loads predominantly on the overnight rate, and is equivalent to the high-frequency instruments used in Section 3; ii) a communication/forward guidance factor that loads mostly on 1 to 2-year maturity rates; and iii) an LSAP factor that mostly captures the variation at the long end of the curve (10-year Treasury rates) and is constrained to be negligible in the pre-ZLB sample by construction.[10]

Miranda-Agrippino and Rey (2020a) use the forward guidance and LSAP factors as external instruments to evaluate the international transmission of US policies to the GFC in the post-Lehman world. They note that while most of the results in Miranda-Agrippino and Rey (2020b) carry through to the post crisis sample, central bank information effects

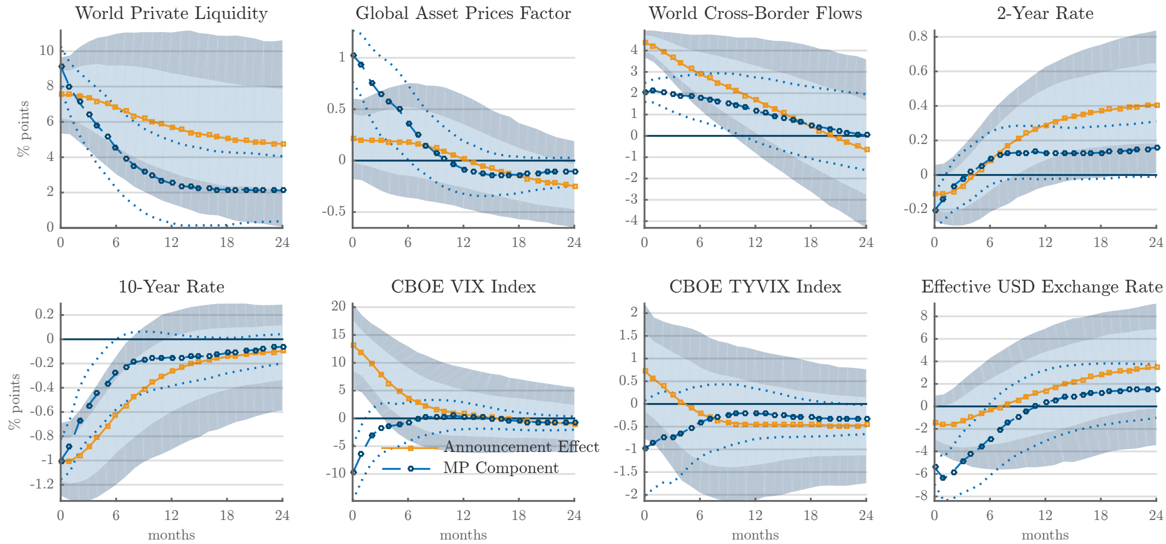
[10] The asset prices from which the factors are extracted include federal funds rate futures (the current-month contract rate and the contract rates for each of the next six months), Eurodollar futures (the current-quarter contract rate and the contract rates for each of the next eight quarters), Treasury bond yields (3-month, 6-month, and 2-, 5-, 10-, and 30-year maturities), the stock market (S&P 500), and exchange rates (yen/dollar and dollar/euro).

become an important confounding factor, particularly when evaluating the effects of monetary policy at the long end of the curve. Central bank information effects denote the implicit transfer of information about the macroeconomic outlook that is revealed to the public at monetary policy announcements. Accordingly, a monetary policy easing may be interpreted as signalling deteriorating conditions ahead, and this affects expectations and macroeconomic and financial aggregates in the opposite direction relative to a monetary policy shock. Stavrakeva and Tang (2019) provide a thorough analysis of this effect in the post 2009 sample, while Miranda-Agrippino and Ricco (2021) discuss information effects in FOMC announcements in the pre-ZLB sample.

Following Miranda-Agrippino and Nenova (2021), we repeat the analysis in Miranda-Agrippino and Rey (2020a) and isolate the monetary policy component of FOMC announcements as in Jarociński and Karadi (2020). The VAR includes a core set of US variables: domestic output and prices, and the 2-year and 10-year interest rates. The international financial variables that summarize fluctuations in the GFC are a measure of global private liquidity and global cross-border flows, the dollar effective exchange rate, two implied volatility indices intended to capture risk in the stock (VIX) and bond (TYVIX) markets respectively, and the global factor in world risky asset prices. The VAR is estimated with 6 lags from 2009:01 - 2019:04. We report median IRFs together with 68% and 90% posterior coverage bands. The two term-structure shocks are normalized to reduce the 10-year interest rate by 100 bps on impact. In the figures that follow, the yellow lines refer to the whole announcement effect, and replicate results in Miranda-Agrippino and Rey (2020a), whereas the blue lines trace the responses to the pure monetary policy component.

**Shocks to the short end of the US yield curve** Figure 10 collects the responses to a shock identified using the forward guidance (FG) factor. Given that the typical time horizon of forward guidance announcements roughly matches the maturity of the interest rates that mostly load on this factor, it quite naturally lends itself to being interpreted as identifying the effects of forward guidance. Technically, however, this shock effectively combines the effects of explicit policy communication with those of the 'signalling channel' of the QE transmission mechanism (see Krishnamurthy and Vissing-Jorgensen, 2011). As

Figure 10: GFC After Lehman: Shocks at the Short End




*Note*: Median impulse response functions. Shock normalized to induce a 1% decline in the 10-year rate. VAR(6). Sample 2008:01-2019:04.

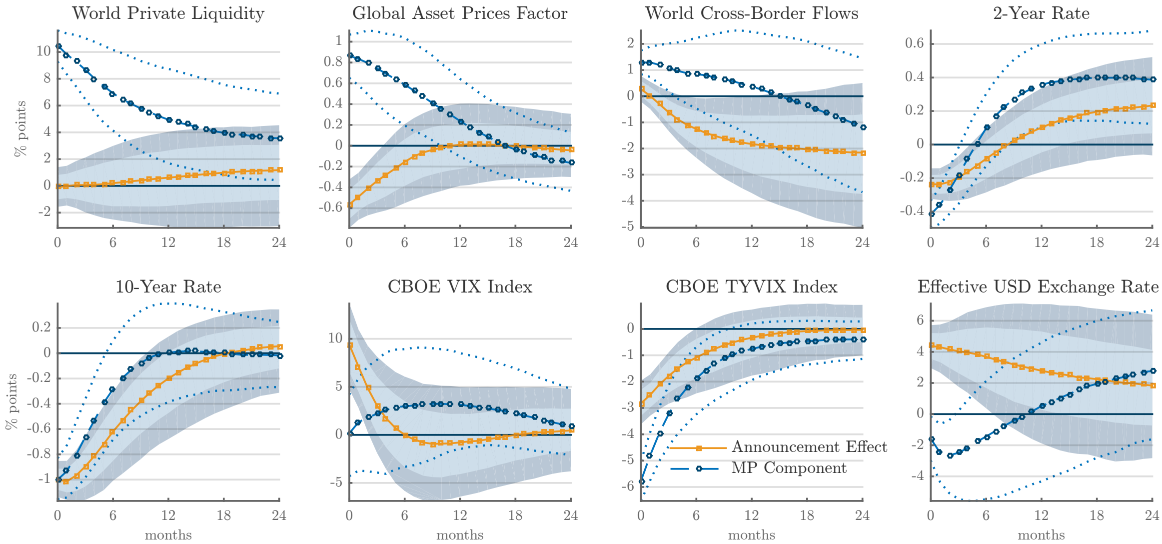
a consequence, the factor approximates all the monetary policy events that have had an effect on interest rates up to the 2-year maturity.

Shocks that lower the short-end of the term structure impact the domestic and GFC variables in a way that is mostly similar to the pre-2009 conventional monetary policy. Expansionary monetary policy stimulates domestic inflation (not reported), but also increases world private liquidity and global cross-border flows. It depreciates the US dollar against foreign currencies, and does not have significant effects on bond market volatility, as measured by the TYVIX index.[11]

Miranda-Agrippino and Rey (2020a) noted that, relative to their previous results over the pre-ZLB sample, shocks at the short end of the curve had opposite effects on the VIX. Moreover, while the shocks led to a general increase in the global factor in asset prices, the magnitude of the effect was significantly smaller than in their previous results. These responses represented an important departure point relative to their previous findings but were consistent with findings in Forbes and Warnock (2020), who show that extreme capital flows movements seem to be less correlated with global risk (as measured by VIX) since the crisis. Similarly, Avdjiev et al. (2017) note that the responsiveness of

[11]The TYVIX index is an estimate of the expected 30-day implied volatility of 10-year Treasury futures; it is distributed by the CBOE and is available since 2003.

Figure 11: GFC After Lehman: Shocks at the Long End




*Note*: Median impulse response functions. Shock normalized to induce a 1% decline in the 10-year rate. VAR(6). Sample 2009:01-2019:04.

international bank lending to global risk conditions, again measured by the VIX, has declined steadily since 2009. Figure 10 shows that these puzzling responses are explained by the information effects that are present in FOMC announcements since the crisis. The blue lines in the figure show that once the pure monetary policy component is isolated, both the VIX index and global asset prices move strongly, and in line with what we discussed in Section 3.[12]

**Shocks to the long end of the US yield curve** Figure 11 reports the responses of the same variables to a shock that is instead identified using the LSAP factor and loads predominantly on the long end of the term structure. This is a factor that is not active pre-2009 by construction. Similar to the FG case, this is a combination of primitive shocks that leads market participants to revise their expectations about future long-term rates in the narrow window of FOMC announcements. Importantly, this factor is orthogonal to both changes in the overnight rate and in the FG factor. Hence, it can be thought of as capturing residual ways in which FOMC announcements alter markets' expectations about long-term rates beyond those that result from direct transmission from changes in shorter-maturity interest rates.

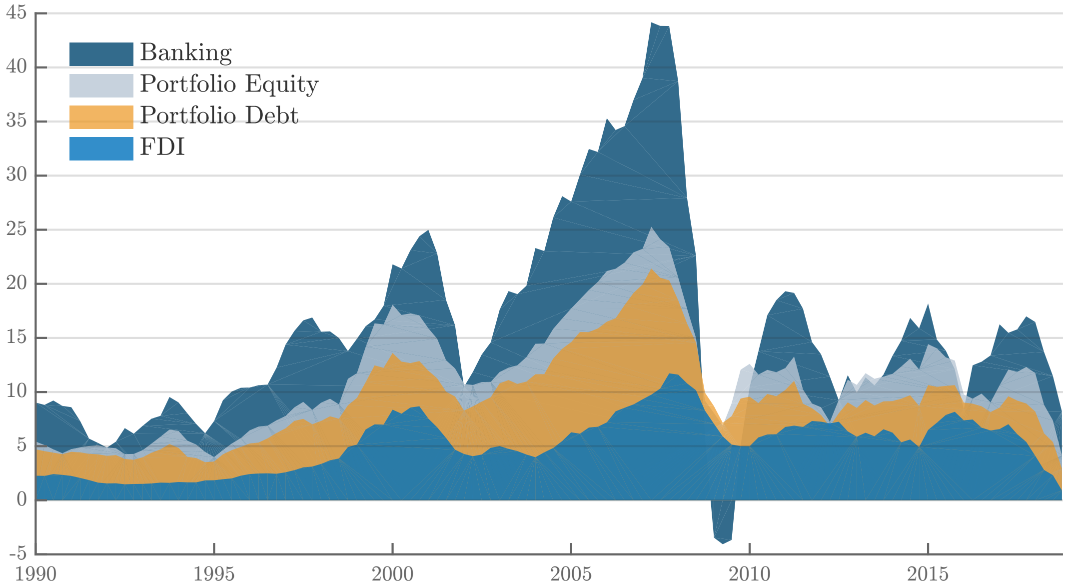
[12]In the figure, the blue lines are estimated over the sample 2009-2019.

The responses *to the full announcement* are dominated by a strong central bank information effect: the monetary policy announcement mostly signals to market participants deteriorating economic conditions ahead, which leads them to flee into the 10-year US Treasuries, considered to be a safe haven (see **?**). Once changes at the shorter end and their transmission along the curve have been controlled for, longer term interest rates seem to move during FOMC announcements mostly because of the news about the economy that are disclosed by the announcements themselves.

At the domestic level, the shock translates into a severe contraction of real activity, and a relatively muted response of inflation (not shown). Bad news travel fast internationally: world private liquidity decreases, and so do global risky asset prices and cross-border flows. Perceived risk (VIX) rises, and the US dollar appreciates sharply (flight to quality). The monetary policy information channel is specific to the exceptionally bad news conveyed by the Fed during the financial crisis. Controlling for the central bank information effect becomes crucial when evaluating the effects of monetary policy at the long end. As shown in Figure 11, once the pure monetary policy component is isolated, much of the effects estimated over the pre-crisis sample are restored, and the monetary policy loosening is associated with a widespread easing of financial conditions at the global level. Interestingly, there is no significant response of the VIX.

To summarize, the transmission of US monetary policy to the variables that characterize the Global Financial Cycle – cross-border flows, global factor in asset prices, world liquidity –, has remained relatively similar before and after 2009, though they are confounded by an important information effect. Looser policy leads to an increase in all the GFC variables. This with the exception of the VIX index. A loosening of US monetary policy led to a decrease in the VIX pre-2009, and this result is confirmed post-2009 for monetary policy that affects the short end of the yield curve. However, the VIX seems to be largely unresponsive to US monetary policy shocks at the long end after Lehman. More research is needed to confirm this result as the sample size post crisis is still small, and to understand it. It would be interesting to investigate for example if it is linked to changes in the international structure of capital flows, the decline of global banks and the rise of asset managers post Lehman, which is apparent in Figure 12 .

Figure 12: International Financial Flows

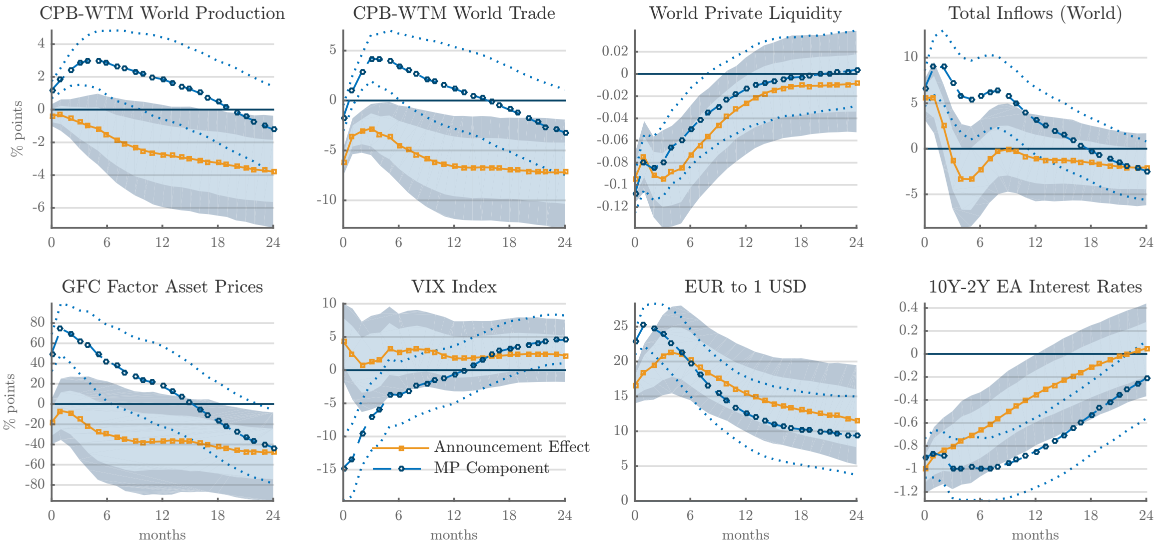



*Note*: International Flows by asset class as a percentage of world GDP. Annual moving averages. Source IFS. Sample 1990-2018.

## 4.2 ECB Unconventional Monetary Policy & Global Financial Cycle

Since the financial crisis, and also in response to the European sovereign debt crisis that followed, the European Central Bank has intervened vigorously to stabilise the euro area economies, particularly through large asset purchase programmes. A natural question is whether these policies changed the relative weight of the ECB in the international financial system. Miranda-Agrippino and Nenova (2021) study the financial spillovers of ECB unconventional monetary policies and compare them with those of the Fed. Their setup is similar to what was discussed earlier for the Fed where, following the same logic as in Swanson (2021), the different dimensions of policy are summarized using factors extracted from the high-frequency surprises from asset prices at different maturities collected in the database of Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019). First, they look at bilateral spillovers in financial markets in the days that follow ECB and Fed policy announcements. They find that ECB policies at the long end have sizeable effects on the stock market (EUROSTOXX and S&P 500), on risk measures (the

Figure 13: GFC After Lehman: ECB Shocks at the Long End




*Note*: Median impulse response functions. Shock normalized to induce a 1% decline in the EA slope. VAR(6). Sample 2000:01-2018:12.

VIX and the VSTOXX), and on corporate spreads (both \$ and € denominated debt). Second, they look at the spillovers through the GFC, summarized using the global factor in risky asset prices, the VIX, world inflows and world private liquidity both expressed in percentage of world output. Their VAR also includes global production and trade (both distributed by the CBP World Trade Monitor), and bilateral exchange rates. The VAR is estimated with six lags over the sample 2000-01:2018:12. We reproduce their results below.

Figure 13 reports the responses to an easing of the ECB monetary policy stance through a shock that mainly impacts long term rates, and is normalized such that the slope of the EA yield curve, calculated as the spread between 10 and 2 year rates, declines by 100 bps on impact. As was done earlier for the Fed shocks, we separate the pure monetary policy component from the full announcement effect as in Jarociński and Karadi (2020). A number of results are worth discussing. First, central bank information effects are a powerful confounding factor when studying the effects of ECB monetary policy, just as for the Fed. Second, ECB monetary policy shocks at the long end elicit essentially the same type of responses in the GFC variables as for the Fed. Following an ECB monetary policy easing global asset prices rise, the VIX falls strongly and significantly, and global inflows rise. The euro depreciates strongly against the USD. Moreover, global production and trade both rise. The only difference relative to the effects of Fed monetary policy shocks is the response of private liquidity. This could be due to the fact that private credit is largely denominated in USD. Particularly interesting when compared to the results in Section 4.1 is the response of the VIX. Contrary to the case of the US where the response of the VIX is muted for long maturity policies, ECB unconventional policies have a powerful effect in compressing global risk premia. Finally, while the sign of the responses are largely equivalent to those elicited by Fed shocks, the magnitude of the effects is typically smaller.

Miranda-Agrippino and Nenova (2021) further note that the use of the euro as a pricing currency for international trade and financial assets seems to be linked to the magnitude of the effects. Countries that invoice large shares of their trade in euros tend to experience larger spillovers compared to countries that do not. As also noted in Boz, Casas, Georgiadis, Gopinath, Mezo, Mehl and Nguyen (2020), however, these are also the countries that tend to have the euro area as their largest trade partner, therefore, disentangling the marginal role that euro invoicing plays relative to the strength of the trade linkages remains a question for future research. Results do however suggest that currency usage in international transactions could be one important channel for the international transmission of monetary policy shocks.

In sum, since the global financial crisis of 2008, the role of the ECB as a driver of the GFC has become more prominent. While the magnitude of the spillovers is smaller than that of the Fed, if the euro were to be used more widely in the international monetary and financial system, we could expect the size of these spillovers to become even stronger.

**Stylized Fact 8.** After the Lehman shock and the implementation of unconventional monetary policies, the asymmetry in international financial spillovers of the ECB and the Fed has decreased. In particular, the ECB monetary policy has become a driver of the *Global Financial Cycle*, albeit a less important one than the Federal Reserve.

## 5 Models of the Global Financial Cycle

Before even modelling global financial cycles, one should recognize how challenging it is for the finance literature to model quantity and prices jointly. This is a headache for finance in general, and in international finance it translates into the broad inability of the literature to jointly model international capital flows, asset prices and exchange rates in a way that reproduces key characteristics of the data[13]. According to our stylized facts, a fully successful model of the Global Financial Cycle would have to be able to account for: 1) the existence of a global factor in risky asset prices highly correlated with a global factor in capital flows and co-moving with aggregate measures of risk appetite; 2) the important effect of US monetary policy on global risk appetite and the GFC in general; the Fed policy affecting local financial and monetary conditions around the world; 3) the high correlation between capital inflows and outflows and among flows of different assets (except maybe FDI); 4) The asymmetric effects of US monetary policy tightening on advanced economies versus emerging market flows and interest rate differentials. It should also be compatible with other well known stylized facts linked to the hegemonic role of the US in the international monetary and financial system such as 5) *the exorbitant privilege* (Gourinchas and Rey (2007b) and Gourinchas and Rey (2007a)): the US is a world banker, who is long risk, short safe and earns an excess returns on its net foreign asset position. This eases its international adjustment process in the long run; 6) *the exorbitant duty* (Gourinchas, Rey and Govillot (2010)): as a world insurer issuing the reserve currency – external liability which appreciates in bad times while external risky assets plummet –, the US makes a large wealth transfer to the rest of the world during global crises (see Gourinchas et al. (2019)); and 7) the existence of a dollar risk factor as shown by (Lustig, Roussanov and Verdelhan, 2014) and Verdelhan (2018). This is a tall order. We outline here the ingredients of a few models that may put us on the right track.

**Models where dollar safe assets are special** Du, Im and Schreger (2018) and Jiang, Krishnamurthy and Lustig (2018) show the existence of a dollar *convenience yield* (safe

[13] Caballero and Simsek (2020) provides a model of gross capital flows based on liquidity shocks and fire sales.

dollars have low returns). Stavrakeva and Tang (2020) provide a general equilibrium model of foreign exchange markets with deviation from FIRE and use survey data on exchange rate expectations to test it. Bianchi, Bigio and Engel (2020) propose a theory of exchange rate fluctuations arising from financial institutions' demand for liquid dollar assets, which gives rise to a convenience yield. Gopinath and Stein (2017) develop a theory linking demand for dollars for trade purposes and dollarisation of banking deposits. Caballero and Krishnamurthy (2009) shows the link between demand for US safe assets, global imbalances and financial fragility. Jiang, Krishnamurthy and Lustig (2020) builds a model in which there is a special demand for dollar safe assets, which trade at a premium. Firms around the world choose dollars to issue debt as this is cheaper. As a consequence, however, they often face a currency mismatch in their balance sheet. The authors assume a downward sloping world convenience demand curve for safe dollars bonds. A decrease in safe dollar bonds supply will therefore increase the convenience yield. A US monetary policy tightening decreases the dollar bond supply and hence increases the convenience yield and appreciates the dollar via uncovered interest rate parity. Because many firms around the world have a currency mismatch and dollar debt, this is contractionary, and the effects are reminiscent of some aspects of the Global Financial Cycle such as the contractionary effect of a Fed tightening on global credit. Furthermore US monetary policy has strong asymmetric spillovers on foreign output. In addition, in their model the US pockets an exorbitant privilege due to the convenience yield and doing a carry trade. The US however also increases the net present value of its profits in crisis times, since a high convenience yield in bad time means high expected future carry trade returns. Interestingly, the model can generate contagion (dollar risk factor) since a bad shock in a country reduces the total supply of safe dollar claims and appreciates the dollar which transmits the shock to other economies. Finally, the authors argue that the increased issuance of dollar debt by firms around the world to take advantage of the convenience yield will lead to increasing financial spillovers and a strengthening of the Global Financial Cycle. This model is therefore able to reproduce a large number of the characteristics of the GFC building on the assumption of 'specialness' of safe dollar assets. It remains silent on risk premia, gross capital flows and global risk appetite fluctuations and leaves open the question of which characteristics of the US explain the 'specialness' of US dollar assets.

**Models with a US hegemon** Several authors present general equilibrium models of the international monetary system where the US, as a hegemon of the international monetary system, has special characteristics. Allowing for heterogeneity in risk aversion (the US is more risk tolerant as in Gourinchas, Rey and Govillot (2010) and Kekre and Lenel (2021)) or for weaker financial frictions in the US as in Maggiori (2017)[14]) enables to account for an important set of stylized facts relating to the *exorbitant privilege* and the *exorbitant duty*. It remains challenging however to model gross capital flow dynamics and to endogenize fluctuations in global risk appetite together with the role of US monetary policy. Farhi and Maggiori (2018) model the US hegemon as a monopolistic issuer of US safe assets and interpret the *exorbitant privilege* as a rent. Gourinchas et al. (2019) provides a more complete overview of this literature.

**Models with time variation in global risk appetite** A recent strand of the literature has shown the importance of financial intermediaries in asset pricing. Strikingly, Muir (2017) shows in a historical comparison of financial crises, wars and recessions that risk premia increase substantially in financial crises but not in other episodes. This strongly suggests that theories where asset prices are related to financial intermediation are promising. Fostel and Geanakoplos (2008) have underlined the importance of investor heterogeneity in beliefs to understand leverage cycles and risk premia while Gourinchas, Rey and Govillot (2010) and Kekre and Lenel (2021) emphasize heterogeneity in risk aversion. Kekre and Lenel (2021) also introduce a time varying convenience yield in their open economy new keynesian model of the international monetary system. They are able to generate a phenomenon of flight to safety following an exogenous shock to the convenience yield and a dollar appreciation as well as a decline in world output. Koijen and Yogo (2019) have shown that elasticities of demand for different assets classes are heterogeneous, and that this is of first order importance for asset pricing. One natural interpretation of the fluctuations in the global time varying risk aversion and in global lending is therefore that the financial system is made of a collection of financial intermedi-

[14] Mendoza et al. (2009) is an early example of a model of global imbalances where financial frictions are weaker in the US than in the rest of the world.

aries which have different degrees of risk aversion or different institutional constraints. As their wealth fluctuates, they become more or less important in financial flows and in the pricing of financial assets in international markets as apparent in Figure 12 where global banks lose market shares to asset managers after Lehman. In that view of the world, it is therefore changes in the composition of the financial intermediation sector which are are responsible for fluctuations in risk taking and in risk premia. The underlying drivers of the relative importance of different intermediaries in the world financial system may be linked to monetary policy, as it affects their funding costs, the Fed playing an especially important role since the US dollar is the main currency in international banking. They may also be linked to changes in regulation (increasing importance of non-bank financial intermediaries after Basel 3) or in technology. Of course the state of aggregate demand also plays a role. The cost of funds is influenced by fluctuations in savings versus investment at the world level, and changes in the cost of funds may lead to different risk taking behaviour depending on institutional constraints faced by different intermediaries: some face leverage caps and regulatory liquidity and capital adequacy ratios, many have value-at-risk constraints etc... Furthermore different supervisory bodies may exert different degree of tightness of controls on intermediaries balance sheets.

We present here a very stylized model of intermediaries to illustrate the link between heterogeneity in risk taking and the Global Financial Cycle. First we analyse the effect of heterogeneity in risk aversion among asset managers and then introduce two types of intermediaries, global banks and asset managers, with different regulatory constraints.

### A stylized model of heterogeneous risk-taking intermediaries: Two types of asset managers

Asset managers are standard mean-variance investors with a constant degree of risk aversion equal to $\sigma_1$ and $\sigma_2$ with $\sigma_1 < \sigma_2$. We call $\mathbf{x}_t^1$ and $\mathbf{x}_t^2$ the vector of portfolio weights of the asset managers in tradable risky assets. We call $w_t^1$ and $w_t^2$ the equity of asset managers. We denote by $\mathbf{R}_t$ the vector of excess returns of all traded risky assets in the world (in dollars). An asset manager chooses his portfolio of risky assets by maximizing:

$$\max_{x_t^i} \mathbb{E}_t\left(\mathbf{x}_t^{i\prime}\mathbf{R}_{t+1}\right) - \frac{\sigma_i}{2}\mathbb{V}ar_t\left(\mathbf{x}_t^{I\prime}\mathbf{R}_{t+1}\right).$$

The optimal portfolio choice in risky tradable securities for asset manager $i$ is given by:

$$\mathbf{x}_t^i = \frac{1}{\sigma_i}\left[\mathbb{V}ar_t(\mathbf{R}_{t+1})\right]^{-1}\left[\mathbb{E}_t(\mathbf{R}_{t+1})\right]. \tag{2}$$

The market clearing condition for risky traded securities is $\mathbf{x}_t^1 \frac{w_t^1}{w_t^1+w_t^2} + \mathbf{x}_t^2 \frac{w_t^2}{w_t^1+w_t^2} = \mathbf{s}_t$ where $\mathbf{s}_t$ is a world vector of net asset supplies for traded assets.

Using Eq. (2) and the market clearing conditions, the expected excess returns on tradable risky assets can be rewritten as one global factor:

$$\mathbb{E}_t\left(\mathbf{R}_{t+1}\right) = \Gamma_t \mathbb{V}ar_t(\mathbf{R}_{t+1})\mathbf{s}_t \tag{3}$$

where $\Gamma_t \equiv \left[\frac{w_t^1}{\sigma_1} + \frac{w_t^2}{\sigma_2}\right]^{-1}(w_t^1 + w_t^2)$. The global component of risky asset prices is equal to the aggregate variance scaled by the aggregate degree of effective risk aversion $\Gamma_t$. If the asset manager 1, who is the more risk tolerant concentrates a lot of the assets ($w_t^1 >> w_t^2$) then the aggregate effective risk aversion will be close to $\sigma_1$ and risk premia will be low. But if asset manager 2 who is more risk averse dominates the market, global risk appetite will go down. The same logic applies if we now consider heterogeneous types of intermediaries.

**Asset Managers and Global Banks**

Global banks intermediate international capital allocations subject to Value-at-Risk (VaR) constraints, which establishes a link between their balance sheet constraints and the VIX (Adrian and Shin, 2014).[15] Global banks maximize the expected return of their portfolio of world risky assets subject to a VaR constraint. The VaR imposes an upper limit on the amount a bank is predicted to lose on a portfolio with a certain probability. We denote by $\mathbf{x}_t^B$ the portfolio shares of a global bank, and by $w_t^B$ the equity of the bank.

[15] VaR constraints have been used internally for the risk management of large banks for a long time and have entered the regulatory sphere with Basel II and III. For a microfoundation of VaR constraints, see Adrian and Shin (2014).

The maximization problem of a global bank is

$$\max_{\mathbf{x}_t^B} \mathbb{E}_t \left( \mathbf{x}_t^{B\prime} \mathbf{R}_{t+1} \right)$$
$$\text{subject to } \mathrm{VaR}_t \leq w_t^B,$$

where $\mathrm{VaR}_t$ is defined as a multiple $\alpha$ of the standard deviation of the bank portfolio $\mathrm{VaR}_t = \alpha w_t^B \left[ \mathbb{V}ar_t \left( \mathbf{x}_t^{B\prime} \mathbf{R}_{t+1} \right) \right]^{\frac{1}{2}}$ ($\alpha$ can thus be interpreted as a regulatory parameter).

Taking the first order condition, and using the fact that the constraint is binding (since banks are risk neutral) gives the following solution for the vector of asset demands:

$$\mathbf{x}_t^B = \frac{1}{\alpha \lambda_t} \left[ \mathbb{V}ar_t(\mathbf{R}_{t+1}) \right]^{-1} \mathbb{E}_t(\mathbf{R}_{t+1}), \tag{4}$$

where we use $\mathbb{V}ar$ to denote the variance. This is formally similar to the portfolio allocation of a mean-variance investor. In Eq.(4), $\lambda_t$ is the Lagrange multiplier: the VaR constraint plays the same role as risk aversion.[16]

We denote by $w_t^I$ the wealth of the asset manager. The market clearing condition for risky traded securities is $\mathbf{x}_t^B \frac{w_t^B}{w_t^B + w_t^I} + \mathbf{x}_t^I \frac{w_t^I}{w_t^B + w_t^I} = \mathbf{s}_t$ where $\mathbf{s}_t$ is a world vector of net asset supplies for traded assets.

Using Eq. (4) and (2) and the market clearing conditions, the expected excess returns on tradable risky assets can be rewritten as one global factor:

$$\mathbb{E}_t \left( \mathbf{R}_{t+1} \right) = \Gamma_t \mathbb{V}ar_t(\mathbf{R}_{t+1}) \mathbf{s}_t \tag{5}$$

where $\Gamma_t \equiv \left[ \frac{w_t^B}{\alpha \lambda_t} + \frac{w_t^I}{\sigma} \right]^{-1} \left( w_t^B + w_t^I \right)$.

$\Gamma_t$ is now the wealth-weighted average of the 'risk aversions' of the asset managers and the global banks. It can be interpreted as the aggregate degree of effective risk aversion of the market. If all the wealth were in the hands of asset managers, for example, aggregate risk aversion would be equal to $\sigma$. If the global banks dominate the market then aggregate risk aversion will be shaped by the interaction of economic conditions,

[16] It is possible to solve out for the Lagrange multiplier using the binding VaR constraint (see Zigrand et al., 2010).

monetary policy and value-at-risk constraints. In such a world, loose monetary policy or low fundamental volatility is associated with higher leverage and lower risk premia (see Coimbra and Rey (2017)). More intermediation by global banks is associated with more international banking flows. Hence a world where international finance is dominated by global banks, where funding costs are low and value-at-risk constraints are loose has common characteristics with the 2000-2007 period (see Figure 12) with its high leverage, high valuations and high cross border credit flows. The post Lehman period, characterised by a tighter regulation of the banking sector, sees in contrast an increasing role of asset managers. This narrative, while informative, is partial equilibrium and has nothing to say on the dynamics of the wealth distribution of intermediaries and its determinants. It is also silent on the dynamics of the joint determination of asset prices, exchange rate and capital flows in equilibrium. (Bruno and Shin, 2015b) develop a partial equilibrium model in which financial conditions around the world are due to global banks transferring their constraints to local ones via their lending relationships. Interestingly the exchange rate plays a key role in relaxing or tightening value-at-risk contraints in their model. Gabaix and Maggiori (2015) presents a model of financial intermediation in general equilibrium that links currency demand stemming from trade flows and movements in the exchange rate but without endogenous capital flows. Gourinchas et al. (2021) and Greenwood et al. (2019) present partial equilibrium models of the term structure where exchange rates and yields are jointly determined and quantities play a role while Camanho et al. (2018) and Hau and Rey (2006) present models of financial intermediation where capital flows, exchange rate and equity prices are jointly determined but where the real side of the economy is reduced form. Sauzet (2021b) and Sauzet (2021a) solve a very general two-tree two-good model of the open economy with incomplete financial integration and derives interesting results linking the endogenous time varying wealth distribution, asset valuations and the real exchange rate.

A dynamic stochastic general equilibrium model of financial cycles is presented in Coimbra and Rey (2017). They develop a model with a continuum of financial intermediaries heterogeneous in their VaR constraints. Coimbra, Kim and Rey (2021) performs a structural estimation of the distribution of the tightness of the value at risk constraints, using a large panel of banks balance sheets and links empirically fluctuations in the distribution of risk taking across intermediaries to monetary policy and regulatory conditions. Heterogeneous VaRs may reflect different risk attitudes by the boards of financial intermediaries or different implementations of regulatory constraints across institutions and supervisors. In the model of Coimbra and Rey (2017), the dynamics of the distribution of leverage across intermediaries is a key determinant of financial conditions. When high risk-taking intermediaries are dominant, they increase the price of risky assets and concentrate most of the aggregate risk on their balance sheets. This tends to happen when financing costs are low, which may be due to deregulation, a savings glut, expansionary monetary policy or when volatility is low, in a way that is consistent with the empirical characteristics of the global financial cycle discussed above. Their model embeds an endogenous risk-taking channel of monetary policy in general equilibrium and allows to study the usual expansionary effect of monetary policy jointly with its effect on financial stability. Monetary policy affects the cost of funds and who is dominant in intermediation, which affects the distribution of leverage, lending and the risk premium. This model is therefore consistent with some of the key characteristics of the financial cycle: it generates bad booms (large credit expansion, low risk premia, low volatility) during which financial fragility builds up, as well as good booms (expansion of economic activity with no noticeable increase in financial fragility). It can therefore speak to the stylized facts also discussed in Sufi and Taylor (2022) but needs to be extended to an open economy setting. Davis and Van Wincoop (2021) builds a model of the Global Financial Cycle with a continuum of investors heterogeneous in risk aversion, in home bias and in expected dividends. The authors analyse the effects of shocks to global risk aversion and show that in order to fit stylized facts of the Global Financial Cycle on gross and net capital flows, the model needs cross-country as well as within-country heterogeneity. Within country heterogeneity is key in particular to account for fluctuations in gross capital flows along the GFC while heterogeneity across countries is important to account for the different vulnerabilities of countries to shocks to risk aversion. Interestingly the paper links net foreign asset positions of countries in safe assets (leverage) to the dynamic responses of their gross capital flows and of their asset valuations to a shock in global risk aversion. So far their framework does not have a role for monetary policy nor a special status for the dollar.

# 6 Global Financial Cycle, monetary and macroprudential policies: a research agenda

The world is interconnected and the channels of interconnection are diverse. The US Federal Reserve's monetary policy affects the Global Financial Cycle. So does the ECB's monetary policy post Lehman, albeit to a lesser extent. The People's Bank of China and the ECB have an important effect on the Global Trade and Commodity Cycle. A US monetary tightening is followed by a significant deleveraging of global financial intermediaries, a rise in aggregate risk aversion, a contraction in the global factor in asset prices and a decline in global credit, a widening of corporate bond spreads and retrenchments of gross capital flows. These results also hold for countries with floating exchange rates, though some of the spillovers may be attenuated in that case. This set of results shows that here is a limit to the degree of monetary policy sovereignty of open economies, and echoes the claim of Rey (2013) that the trilemma may have morphed into a dilemma: as long as capital flows across borders are free, and macroprudential tools or capital controls are not used, monetary conditions in any country, even those with flexible exchange rates, are partly dictated by the monetary policy of the hegemon (the US)[17]. This of course does not mean that exchange rate regimes do not matter, as Klein and Shambaugh (2013) and Obstfeld (2015) rightly point out. However, as noted in Corsetti, Kuester, Müller and Schmidt (2021), the degree of insulation provided by flexible exchange rates may be smaller than typically assumed. Farhi and Werning (2012) models the challenges to the trilemma in standard neo-Keynesian models. The international transmission mechanism of monetary policy to fluctuations in global risk aversion is a priori consistent with models where financial market imperfections play an important role, e.g. models with imperfect asset substitutability and models with heterogeneous financial intermediaries. There is a vibrant and promising literature attempting to model the Global Financial Cycle and an equally vibrant empirical one documenting its drivers and channels using macroeconomic as well as granular data. Needless to say that understanding more precisely the interactions of monetary policy with financial stability and the risk-taking channel of monetary

[17] Portes et al. (2020) and Forbes (2021) analyse the international dimensions of macroprudential policies.

policy in an international context, would be not only intellectually very rewarding and exciting but highly desirable. This would allow for a better assessment of the use of macro prudential policies and capital flow management tools and of their interactions with interest rate and quantitative easing policies[18].

[18] IMF (2020) and Basu et al. (2020) provide useful milestones for the policy implications of that research agenda.

# References


Adrian, Tobias and Hyun Song Shin (2014) "Procyclical Leverage and Value-at-Risk," *Review of Financial Studies*, Vol. 27, No. 2, pp. 373–403.

Adrian, Tobias, Daniel Stackman, and Erik Vogt (2016) "Global price of risk and stabilization policies," Staff Reports 786, Federal Reserve Bank of New York.

Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Ragusa (2019) "Measuring euro area monetary policy," *Journal of Monetary Economics*, Vol. 108, pp. 162–179.

Avdjiev, Stefan, Wenxin Du, Catherine Koch, and Hyun Song Shin (2019) "The dollar, bank leverage, and deviations from covered interest parity," *American Economic Review: Insights*, Vol. 1, No. 2, pp. 193–208.

Avdjiev, Stefan, Leonardo Gambacorta, Linda S. Goldberg, and Stefano Schiaffi (2017) "The Shifting Drivers of Global Liquidity," NBER Working Papers 23565, National Bureau of Economic Research, Inc.

Bai, Jushan and Serena Ng (2002) "Determining the Number of Factors in Approximate Factor Models," *Econometrica*, Vol. 70, No. 1, pp. 191–221.

Bai, Yan, Patrick J Kehoe, and Fabrizio Perri (2019) "World financial cycles," in *2019 Meeting Papers*, Vol. 1545, Society for Economic Dynamics.

Barrot, Luis-Diego and Luis Servén (2018) "Gross capital flows, common factors, and the global financial cycle," Policy Research Working Papers 8354, The World Bank.

Baskaya, Yusuf Soner, Julian di Giovanni, Şebnem Kalemli-Özcan, José-Luis Peydro, and Mehmet Fatih Ulu (2017) "Capital flows and the international credit channel," *Journal of International Economics*, Vol. 108, pp. S15–S22. 39th Annual NBER International Seminar on Macroeconomics.

Basu, Suman, Emine Boz, Gita Gopinath, Francisco Roch, and Filiz Unsal (2020) "A Conceptual Model for the Integrated Policy Framework," *IMF Working Paper*.

Baumeister, Christiane and James D. Hamilton (2019) "Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks," *American Economic Review*, Vol. 109, No. 5, pp. 1873–1910, May.

Bekaert, Geert, Eric C Engstrom, and Nancy R Xu (2019) "The Time Variation in Risk Appetite and Uncertainty," Working Paper 25673, National Bureau of Economic Research.

Bekaert, Geert, Marie Hoerova, and Marco Lo Duca (2013) "Risk, uncertainty and monetary policy," *Journal of Monetary Economics*, Vol. 60, No. 7, pp. 771 – 788.

Bianchi, Javier, Saki Bigio, and Charles Engel (2020) "Banks, Dollar Liquidity, and Exchange Rates."

Boehm, Christoph and Niklas Kroner (2020) "The US, economic news, and the global financial cycle," *Economic News, and the Global Financial Cycle (January 10, 2020).*

Boz, Emine, Camila Casas, Georgios Georgiadis, Gita Gopinath, Helena Le Mezo, Arnaud Mehl, and Tra Nguyen (2020) "Patterns in Invoicing Currency in Global Trade," IMF Working Papers 2020/126, International Monetary Fund.

Broner, Fernando, Tatiana Didier, Aitor Erce, and Sergio L. Schmukler (2013) "Gross capital flows: Dynamics and crises," *Journal of Monetary Economics*, Vol. 60, No. 1, pp. 113–133. Carnegie-NYU-Rochester Conference.

Bruno, Valentina and Hyun Song Shin (2015a) "Capital flows and the risk-taking channel of monetary policy," *Journal of Monetary Economics*, Vol. 71, pp. 119–132.

——— (2015b) "Cross-Border Banking and Global Liquidity," *Review of Economic Studies*, Vol. 82, No. 2, pp. 535–564.

Ca' Zorzi, Michele, Luca Dedola, Georgios Georgiadis, Marek Jarociński, Livio Stracca, and Georg Strasser (2020) "Monetary policy and its transmission in a globalised world," Working Paper Series 2407, European Central Bank.

Caballero, Ricardo J and Arvind Krishnamurthy (2009) "Global imbalances and financial fragility," *American Economic Review*, Vol. 99, No. 2, pp. 584–88.

Caballero, Ricardo J and Alp Simsek (2020) "A model of fickle capital flows and retrenchment," *Journal of Political Economy*, Vol. 128, No. 6, pp. 2288–2328.

Caggiano, Giovanni and Efrem Castelnuovo (2021) "Global uncertainty."

Calvo, Guillermo A. and Carmen M. Reinhart (2002) "Fear Of Floating," *The Quarterly Journal of Economics*, Vol. 117, No. 2, pp. 379–408, May.

Calvo, Guillermo A., Leonardo Leiderman, and Carmen M. Reinhart (1996) "Inflows of Capital to Developing Countries in the 1990s," *Journal of Economic Perspectives*, Vol. 10, No. 2, pp. 123–139.

Camanho, Nelson, Harald Hau, and Hélene Rey (2018) "Global portfolio rebalancing and exchange rates,"Technical report, National Bureau of Economic Research.

Cerutti, Eugenio, Stijn Claessens, and Damien Puy (2019) "Push factors and capital flows to emerging markets: why knowing your lender matters more than fundamentals," *Journal of International Economics*, Vol. 119, No. C, pp. 133–149.

Cerutti, Eugenio, Stijn Claessens, and Andrew K Rose (2017) "How Important is the Global Financial Cycle? Evidence from Capital Flows," Working Paper 23699, National Bureau of Economic Research.

Cesa-Bianchi, Ambrogio, M Hashem Pesaran, and Alessandro Rebucci (2020) "Uncertainty and economic activity: A multicountry perspective," *The Review of Financial Studies*, Vol. 33, No. 8, pp. 3393–3445.

Cetorelli, Nicola and Linda S. Goldberg (2012) "Banking Globalization and Monetary Transmission," *The Journal of Finance*, Vol. 67, No. 5, pp. 1811–1843.

Chari, Anusha, Karlye Dilts Stedman, and Christian Lundblad (2020) "Capital flows in risky times: Risk-on/risk-off and emerging market tail risk,"Technical report, National Bureau of Economic Research.

Chen, Hongyi, Qianying Chen, and Stefan Gerlach (2011) “The Implementation of Monetary Policy in China: The Interbank Market and Bank Lending,” Working Papers 262011, Hong Kong Institute for Monetary Research.

Coimbra, Nuno and Hélène Rey (2017) “Financial Cycles with Heterogeneous Intermediaries,” NBER Working Papers 23245, National Bureau of Economic Research, Inc.

Coimbra, Nuno, Daisoon Kim, and Hélène Rey (2021) “Central Bank Policy and the concentration of risk: Empirical estimates,” *Journal of Monetary Economics*.

Corsetti, Giancarlo, Keith Kuester, Gernot Müller, and Sebastian Schmidt (2021) “The Exchange Rate Insulation Puzzle,” CEPR Discussion Papers 15689, C.E.P.R. Discussion Papers.

Davis, J Scott and Eric Van Wincoop (2021) “A Theory of the Global Financial Cycle,”Technical report, National Bureau of Economic Research.

Davis, J. Scott, Giorgio Valente, and Eric van Wincoop (2019) “Global Capital Flows Cycle: Impact on Gross and Net Flows,” Working Paper 25721, National Bureau of Economic Research.

Dedola, Luca, Giulia Rivolta, and Livio Stracca (2017) “If the Fed sneezes, who catches a cold?” *Journal of International Economics*, Vol. 108, pp. S23–S41.

Degasperi, Riccardo, Seokki Hong, and Giovanni Ricco (2021) “The Global Transmission of US Monetary Policy,”Technical report, Working Paper, University of Warwick.

di Giovanni, Julian, Sebnem Kalemli-Ozcan, Mehmet Fatih Ulu, and Yusuf Soner Baskaya (2017) “International Spillovers and Local Credit Cycles,” Working Paper 23149, National Bureau of Economic Research.

Doz, Catherine, Domenico Giannone, and Lucrezia Reichlin (2011) “A Quasi–Maximum Likelihood Approach for Large, Approximate Dynamic Factor Models,” *Review of Economics and Statistics*, Vol. 94, No. 4, pp. 1014–1024.

Du, Wenxin, Joanne Im, and Jesse Schreger (2018) “The U.S. Treasury Premium,” *Journal of International Economics*, Vol. 112, pp. 167–181.

Elliott, David, Ralf Meisenzahl, and José-Luis Peydró (2021) “Nonbank Lenders as Global Shock Absorbers: Evidence from US Monetary Policy Spillovers,” working paper, Imperial College London.

Epure, Mircea, Irina Mihai, Camelia Minoiu, José-Luis Peydró et al. (2021) “Global financial cycle, household credit, and macroprudential policies,”Technical report.

Erik, Burcu, Marco J Lombardi, Dubravko Mihaljek, and Hyun Song Shin (2020) “The dollar, bank leverage, and real economic activity: An evolving relationship,” in *AEA Papers and Proceedings*, Vol. 110, pp. 529–34.

Farhi, Emmanuel and Matteo Maggiori (2018) “A Model of the International Monetary System,” *The Quarterly Journal of Economics*, Vol. 133, No. 1, pp. 295–355.

Farhi, Emmanuel and Ivan Werning (2012) “Dealing with the Trilemma: Optimal Capital Controls with Fixed Exchange Rates,” Working Paper 18199, National Bureau of Economic Research.

Forbes, Kristin J (2021) “The International Aspects of Macroprudential Policy,” *Annual Review of Economics*, Vol. 13.

Forbes, Kristin J. and Francis E. Warnock (2012) “Capital flow waves: Surges, stops, flight, and retrenchment,” *Journal of International Economics*, Vol. 88, No. 2, pp. 235–251.

Forbes, Kristin J and Francis E Warnock (2020) “Capital Flow Waves—or Ripples? Extreme Capital Flow Movements Since the Crisis,” Working Paper 26851, National Bureau of Economic Research.

Fostel, Ana and John Geanakoplos (2008) “Leverage Cycles and the Anxious Economy,” *American Economic Review*, Vol. 98, No. 4, pp. 1211–44.

Fratzscher, Marcel (2012) “Capital flows, push versus pull factors and the global financial crisis,” *Journal of International Economics*, Vol. 88, No. 2, pp. 341–356.

Gabaix, Xavier and Matteo Maggiori (2015) “ International Liquidity and Exchange Rate Dynamics *,” *The Quarterly Journal of Economics*, Vol. 130, No. 3, pp. 1369–1420, 03.

Gerko, Elena and Hélène Rey (2017) “Monetary Policy in the Capitals of Capital,” *Journal of the European Economic Association*, Vol. 15, No. 4, pp. 721–745, 08.

Gertler, Mark and Peter Karadi (2015) “Monetary Policy Surprises, Credit Costs, and Economic Activity,” *American Economic Journal: Macroeconomics*, Vol. 7, No. 1, pp. 44–76.

Giannone, Domenico, Michele Lenza, and Giorgio E. Primiceri (2015) “Prior Selection for Vector Autoregressions,” *Review of Economics and Statistics*, Vol. 97, No. 2, pp. 436–451.

Gilchrist, Simon, Wei Bin, Vivian Yue, and Egon Zakrajsek (2021) “Sovereign Risk and Financial risk,” *NBER International Seminar on Macroeconomics.*

Gopinath, Gita (2016) “The International Price System,”Technical report, Jackson Hole Symposium Proceedings.

Gopinath, Gita and Jeremy Stein (2017) “Banking, Trade and the Making of a Dominant Currency,” *Quarterly Journal of Economics.*

Gourinchas, Pierre-Olivier (2017) “Monetary policy transmission in emerging markets: an application to Chile,” *Monetary policy and global spillovers: mechanisms, effects and policy measures*, p. 279.

Gourinchas, Pierre-Olivier and Helene Rey (2007a) *1 From World Banker to World Venture Capitalist*: University of Chicago Press.

——— (2007b) “International Financial Adjustment,” *Journal of Political Economy*, Vol. 115, No. 4.

Gourinchas, Pierre-Olivier, Walker Ray, and Dimitri Vayanos (2021) “A Preferred-Habitat Model of Term Premia, Exchange Rates and Monetary Policy Spillovers,”Technical report, Financial Market Group, LSE.

Gourinchas, Pierre-Olivier, Hélène Rey, and Nicolas Govillot (2010) "Exorbitant privilege and exorbitant duty,"Technical report, Institute for Monetary and Economic Studies, Bank of Japan Tokyo.

Gourinchas, Pierre-Olivier, Hélène Rey, and Maxime Sauzet (2019) "The International Monetary and Financial System," *Annual Review of Economics*, Vol. 11, No. 1, pp. 859–893.

Greenwood, Robin, Samuel G Hanson, Jeremy C Stein, and Adi Sunderam (2019) "A quantity-driven theory of term premiums and exchange rates,"Technical report, Working paper, Harvard Business School.

Gürkaynak, Refet S., Brian Sack, and Eric Swanson (2005) "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking*, Vol. 1, No. 1, May.

Habib, Maurizio Michael and Fabrizio Venditti (2019) "The global capital flows cycle: structural drivers and transmission channels."

Hau, Harald and Hélène Rey (2006) "Exchange rates, equity prices, and capital flows," *The Review of Financial Studies*, Vol. 19, No. 1, pp. 273–317.

Howell, Michael (2020) *Capital Wars*: Palgrave Macmillan.

Ilzetzki, Ethan, Carmen M Reinhart, and Kenneth S Rogoff (2019) "Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?*," *The Quarterly Journal of Economics*, Vol. 134, No. 2, pp. 599–646, 01.

IMF (2020) "Toward an Integrated Policy Framework," *IMF Policy Paper No. 2020/46.*

Jarociński, Marek (2020) "Central bank information effects and transatlantic spillovers," Working Paper Series 2482, European Central Bank.

Jarociński, Marek and Peter Karadi (2020) "Deconstructing Monetary Policy Surprises—The Role of Information Shocks," *American Economic Journal: Macroeconomics*, Vol. 12, No. 2, pp. 1–43, April.

Jiang, Zhengyang, Arvind Krishnamurthy, and Hanno Lustig (2018) "Foreign safe asset demand and the dollar exchange rate,"Technical report, National Bureau of Economic Research.

——— (2020) "Dollar Safety and the Global Financial Cycle," Working Paper 27682, National Bureau of Economic Research.

Jones, Bradley and Joel Bowman (2019) "China's Evolving Monetary Policy Framework in International Context," RBA Research Discussion Papers rdp2019-11, Reserve Bank of Australia.

Jorda, Oscar, Moritz Schularick, Alan M Taylor, and Felix Ward (2018) "Global Financial Cycles and Risk Premiums," Working Paper 24677, National Bureau of Economic Research.

Kalemli-Ozcan, Şebnem (2019) "U.S. Monetary Policy and International Risk Spillovers," Working Paper 26297, National Bureau of Economic Research.

Kekre, Rohan and Moritz Lenel (2021) "The Flight to Safety and International Risk Sharing." Chicago Booth and Princeton.

Kim, Soyoung and Hongyi Chen (2019) "From Quantity- to Interest Rate-Based Framework: Multiple Monetary Policy Instruments and their Effects in China," Working Paper 1, Hong Kong Institute for Monetary Research.

Kindleberger, Charles (1978) "Manias, Panic and Crashes,"Technical report, New York basic books.

Klein, Michael W. and Jay C. Shambaugh (2013) "Rounding the Corners of the Policy Trilemma: Sources of Monetary Policy Autonomy," NBER Working Papers 19461, National Bureau of Economic Research, Inc.

Koijen, Ralph S.J. and Motohiro Yogo (2019) "A Demand System Approach to Asset Pricing," *Journal of Political Economy*, Vol. 127, No. 4.

Krishnamurthy, Arvind and Annette Vissing-Jorgensen (2011) "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity*, Vol. 43, No. 2 (Fall), pp. 215–287.

Lorenzoni, Guido (2014) "International Financial Crises," in Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff eds. *Handbook of International Economics*, Vol. 4 of Handbook of International Economics: Elsevier, pp. 689–740.

Lustig, Hanno, Nikolai Roussanov, and Adrien Verdelhan (2014) "Countercyclical currency risk premia," *Journal of Financial Economics*, Vol. 111, No. 3, pp. 527–553.

Maggiori, Matteo (2017) "Financial Intermediation, International Risk Sharing, and Reserve Currencies," *American Economic Review*, Vol. 107, No. 10, pp. 3038–71.

McCauley, Robert N., Patrick McGuire, and Vladyslav Sushko (2015) "Global dollar credit: links to US monetary policy and leverage," *Economic Policy*, Vol. 30, No. 82, pp. 187–229, 03.

McMahon, Michael, Alfred Schipke, and Xiang Li (2018) "China's Monetary Policy Communication: Frameworks, Impact, and Recommendations," IMF Working Papers 18/244, International Monetary Fund.

Mendoza, Enrique G, Vincenzo Quadrini, and Jose-Victor Rios-Rull (2009) "Financial integration, financial development, and global imbalances," *Journal of Political economy*, Vol. 117, No. 3, pp. 371–416.

Mian, Atif, Amir Sufi, and Emil Verner (2017) "Household Debt and Business Cycles Worldwide*," *The Quarterly Journal of Economics*, Vol. 132, No. 4, pp. 1755–1817, 05.

Miranda-Agrippino, Silvia and Tsvetelina Nenova (2021) "A Tale of Two Global Monetary Policies," CEPR Discussion Papers 16485, C.E.P.R. Discussion Papers.

Miranda-Agrippino, Silvia and Hélène Rey (2020a) "The global financial cycle after Lehman," in *AEA Papers and Proceedings*, Vol. 110, pp. 523–28.

——— (2020b) "US Monetary Policy and the Global Financial Cycle," *The Review of Economic Studies*, Vol. 87, No. 6, pp. 2754–2776. rdaa019.

Miranda-Agrippino, Silvia and Giovanni Ricco (2021) "The Transmission of Monetary Policy Shocks," *American Economic Journal: Macroeconomics*, Vol. 13, No. 3, pp. 74–107, July.

Miranda-Agrippino, Silvia, Tsvetelina Nenova, and Hélène Rey (2019) "Global Footprints of Monetary Policies," discussion paper series, Centre for Macroeconomics (CFM).

Morais, Bernardo, Jose Luis Peydro, and Claudia Ruiz (2015) "The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects," International Finance Discussion Papers 1137, Board of Governors of the Federal Reserve System (U.S.).

Muir, Tyler (2017) "Financial crises and risk premia," *The Quarterly Journal of Economics*, Vol. 132, No. 2, pp. 765–809.

Obstfeld, Maurice (2015) "Trilemmas and Tradeoffs: Living with Financial Globalization," in Claudio Raddatz, Diego Saravia, and Jaume Ventura eds. *Global Liquidity, Spillovers to Emerging Markets and Policy Responses*, Vol. 20 of Central Banking, Analysis, and Economic Policies Book Series: Central Bank of Chile, Chap. 2, pp. 013–078.

Onatski, Alexei (2009) "Testing Hypotheses About the Number of Factors in Large Factor Models," *Econometrica*, Vol. 77, No. 5, pp. 1447–1479.

Passari, Evgenia and Hélène Rey (2015) "Financial Flows and the International Monetary System," *The Economic Journal*, Vol. 125, No. 584, pp. 675–698.

Portes, Richard, Thorsten Beck, Willem H Buiter, Kathryn ME Dominguez, Daniel Gros, Christian Gross, ?ebnem Kalemli-Özcan, Tuomas A Peltonen, and Antonio Sánchez Serrano (2020) "The global dimensions of macroprudential policy," *Advisory Scientific Committee Reports*, No. 10.

Reinhart, Carmen M. and Kenneth S. Rogoff (2009) *This Time Is Different: Eight Centuries of Financial Folly*, Princeton, New Jersey: Princeton University Press.

Rey, Hélène (2013) "Dilemma not trilemma: the global financial cycle and monetary policy independence,"Technical report, Proceedings - Economic Policy Symposium - Jackson Hole.

——— (2016) "International Channels of Transmission of Monetary Policy and the Mundellian Trilemma," *IMF Economic Review*, Vol. 64, No. 1, pp. 6–35, May.

Richmond, Robert J (2019) "Trade network centrality and currency risk premia," *The Journal of Finance*, Vol. 74, No. 3, pp. 1315–1361.

Rogers, John H., Chiara Scotti, and Jonathan H. Wright (2018) "Unconventional Monetary Policy and International Risk Premia," *Journal of Money, Credit and Banking*, Vol. 50, No. 8, pp. 1827–1850.

Sauzet, Maxime (2021a) "Asset prices, global portfolios, and the international financial system," *Boston University.*

——— (2021b) "Two investors, two trees, two goods," *Boston University.*

Schularick, Moritz and Alan M. Taylor (2012) "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870-2008," *American Economic Review*, Vol. 102, No. 2, pp. 1029–61.

Stavrakeva, Vania and Jenny Tang (2019) "The Dollar During the Great Recession: US Monetary Policy Signaling and The Flight To Safety," working paper, London Business School.

——— (2020) "Deviations from fire and exchange rates: a GE theory of supply and demand,"Technical report, Working Paper, London Business School.

Stock, James H. and Mark W. Watson (2018) "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments," *The Economic Journal*, Vol. 128, No. 610, pp. 917–948.

Sufi, Amir and Alan Taylor (2022) "Financial Crises: A Survey," in Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff eds. *Handbook of International Economics*, Vol. 5 of Handbook of International Economics: Elsevier.

Swanson, Eric T. (2021) "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets,"Technical report, Journal of Monetary Economics (forthcoming).

Verdelhan, Adrien (2018) "The share of systematic variation in bilateral exchange rates," *The Journal of Finance*, Vol. 73, No. 1, pp. 375–418.

Xu, Zhong and Yandong Jia (2019) "Natural Interest Rate and Choice of the Macro Policies in China,"Technical report, Economic Research Journal, Beijing, China.

Zhou, Xiaochuan (2015) *China's Monetary Policy Since the Turn of the Century*, Chap. 4, pp. 63 – 82, Leiden, The Netherlands: Brill.

Zigrand, Jean-Pierre, Hyun Song Shin, and Jon Danielsson (2010) "Risk Appetite and Endogenous Risk," FMG Discussion Papers dp647, Financial Markets Group.