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The global capital flows cycle: structural drivers and transmission channels

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Abstract

In this paper, we study the effects of structural shocks that influence global risk – the main factor behind a "global capital flows cycle" – and how risk, in turn, is transmitted to capital flows. Our results show that not all the risk shocks driving the global financial cycle have the same effects on capital flows. Changes in global risk caused by pure financial shocks have the largest impact on the global configuration of capital flows, followed by US monetary policy shocks. As regards the transmission of risk to capital flows, we uncover a traditional "trilemma", as countries more financially open and adopting a strict peg are more sensitive to global risk. This "trilemma" is mainly driven by one category of cross-border flows, "other investment", confirming the importance of cross-border banking loans in the narrative of the global financial cycle.

JEL classification: E42, E52, F31, F36, F41

Keywords: Global financial cycle, capital flows, monetary policy, international spillover, global risk

Non-Technical Summary

According to leading scholars, increasing international financial integration has generated a global financial cycle, leading to increasing cross-country co-movement of financial variables, either flows or prices. This global financial cycle is, in turn, strongly influenced by the US monetary policy and related to both financial market volatility and to the degree of risk aversion of global investors. The existence of a global financial cycle has two crucial policy implications: first, a stronger co-movement of asset prices internationally would drastically limit the possibility of economic agents to diversify away idiosyncratic shocks through the acquisition of foreign assets; second, it would significantly reduce the ability of policymakers to steer domestic financial conditions away from global trends, for instance adopting flexible exchange rate regimes and running a monetary policy independent from that of the United States, which sets the pace of global monetary conditions. According to the classical "trilemma" in international macroeconomics, if the capital account is open, it is impossible to run an autonomous monetary policy – i.e. set the policy rate autonomously from that of the main centre economy, e.g. the United States – and, at the same time, have an exchange rate target. The global financial cycle would morph this trilemma into a "*dilemma*" as the policy choice is restricted between an independent monetary policy and capital account openness, whereas the exchange rate regime is irrelevant.

In this paper we study the structural drivers of the global financial cycle and the effects of such cycle on global capital flows. We offer three important contributions to the debate. First, we show that a measure of global risk that summarizes the co-movement of stock market returns in 63 economies (a Global Stock Market Factor) is tightly connected to a cycle in global capital flows, as measured by the sum of capital inflows across 50 emerging economies. Second, we investigate the structural drivers of this global risk measure and find that financial shocks, which can be interpreted as exogenous changes in the risk bearing capacity of the financial sector, matter more than US monetary policy shocks in driving global risk. Other shocks, such as those driven by geopolitical or economic policy uncertainty or by the US demand do not emerge as particularly relevant.

Third, we study how capital account openness and the exchange rate regime influence the transmission of global risk to different types of capital flows. Remarkably, we find confirmation of a "trilemma" in the transmission to capital flows, as countries more financially open and adopting a strict peg are more sensitive to global risk. This "trilemma" is largely driven by one category of cross-border flows, "other investment", to a large extent bank loans, therefore confirming the importance of global banks in the narrative of the global financial cycle. In particular, for emerging markets with open capital accounts and an exchange rate target, global risk shocks may impart a significant shift in capital flows compared to normal times.

Our findings offer two particularly interesting implications for the future analysis of international macroeconomic models and the international transmission of monetary and financial shocks. First, we claim that it is important to isolate the contribution of US monetary policy shocks to global risk to understand its international transmission. It may be difficult to establish a direct link between US monetary policy and capital flows, without "passing through" global risk. Nevertheless, global risk is also driven by other shocks, in particular financial shocks, and has a large idiosyncratic component, so that US monetary policy may be considered neither as the unique nor as the main factor behind the influence of the global financial cycle on capital flows. Second, we show that domestic monetary and exchange rate policies may influence the transmission of global risk to capital flows. This is especially true for loans, which are particularly sensitive to deviations in the uncovered interest parity and whose nominal value is not affected by risk shocks. On the contrary, portfolio flows appear to be less sensitive to global risk and completely "insensitive" to the prevailing exchange rate regime, because the adjustment to risk shocks, most likely, takes places through prices and not quantities. Since the role of market-based finance is on the rise – also among emerging markets – at the expenses of that of global banks, our results call for a careful assessment of the financial stability implications of global risk shocks. As the composition of global liquidity shifts away from bank loans to other sources of financing, such as equity and bonds, sudden shifts in investors' risk attitude can in fact propagate faster than in the past.

1 Introduction

According to leading scholars, increasing international financial integration led to the emergence of a global financial cycle, strongly influenced by US monetary policy (Miranda-Agrippino and Rey, 2015). This global financial cycle, in turn, is related to both financial market volatility and the degree of risk aversion of the market, and therefore provides a synthetic measure of global risk. The existence of a global financial cycle would have two crucial policy implications: first, a stronger co-movement of asset prices internationally would drastically limit the possibility of economic agents to diversify away idiosyncratic shocks through the acquisition of foreign assets; second, it would significantly reduce the ability of policymakers to steer domestic financial conditions away from global trends, for instance adopting flexible exchange rate regimes and running a monetary policy independent from that of the United States, which sets the pace of global monetary conditions. According to the classical "trilemma" in international macroeconomics, if the capital account is open, it is impossible to run an autonomous monetary policy and, at the same time, have an exchange rate target. The global financial cycle would morph this trilemma into a "dilemma" as the policy choice is restricted between an independent monetary policy and capital account openness, whereas the exchange rate regime is irrelevant, see Rey (2015) and Passari and Rey (2015).

In this paper we study the structural drivers of the global financial cycle and the effects of such cycle on global capital flows. We offer three important contributions to the debate. First, we show that a measure of global risk that summarizes the co-movement of stock market returns in 63 economies (a Global Stock Market Factor) is tightly connected to a cycle in global capital flows. In other words, there exists a *global "capital flows" cycle*, as measured by the sum of capital flows across 50 advanced and emerging economies, divided by the sum of their GDP in nominal US dollar (see Figure 1) that is strongly related to the concept of global financial cycle proposed by Miranda-Agrippino and Rey (2015).

(Figure 1 here)

Second, we investigate the structural drivers of this global risk measure and, crucially, find that financial shocks, which can be interpreted as exogenous changes in the risk bearing capacity of the financial sector, matter more than US monetary policy shocks in driving global risk. Other shocks, such as those driven by geopolitical or economic policy uncertainty or by the US demand are not particularly relevant.

Third, we study how capital account openness and the exchange rate regime influence the transmission of global risk to different types of capital flows. Remarkably, we find confirmation of a "trilemma" in the transmission to capital flows, as countries more financially open and adopting a strict peg are more sensitive to global risk. This "trilemma" is largely driven by one category of cross-border flows, "other investment", to a large extent bank loans, therefore confirming the importance of global banks in the narrative of the global financial cycle. In particular, for emerging markets with open capital accounts and an exchange rate target, global risk shocks may impart a significant shift in capital flows compared to normal times.

Our findings offer two particularly interesting implications for the future analysis of international macroeconomic models and the international transmission of monetary and financial shocks. First, we claim that it is important to isolate the contribution of US monetary policy shocks to global risk to understand its international transmission. It may be difficult to establish a direct link between US monetary policy and capital flows, without "passing through" global risk. Nevertheless, global risk is also driven by other shocks, in particular financial shocks, and has a large idiosyncratic component, so that US monetary policy may be considered neither as the unique nor as the main factor behind the global financial cycle, at least as regards capital flows. Second, we show that domestic monetary and exchange rate policies may influence the transmission of global risk to capital flows, in particular loans which are particularly sensitive to deviations in the uncovered interest parity and whose nominal value is not affected by risk shocks. On the contrary, portfolio flows appear to be less sensitive to global risk and completely "insensitive" to the prevailing exchange rate regime. This result provides empirical support to the claim that (under financial integration) international arbitrage leads to a rapid adjustment of prices and returns across internationally traded assets, equalising borrowing costs without the need to generate large adjustments in capital flows (Dedola and Lombardo, 2012).

The paper is structured as follows. In the next section, we discuss how our paper fits in the existing theoretical and empirical literature related to the global financial cycle. Section 3 describes the dataset. In section 4, we shall introduce our measure of global risk and analyse its structural drivers. In Section 5, we show how global capital flows are closely connected to global risk and only loosely related "directly" to US monetary policy. In Section 6, we test the sensitivity of different types of capital flows to the prevailing exchange rate regime (trilemma hypothesis). In Section 7 we discuss the results, providing an assessment of their economic significance. Section 8 concludes.

2 Relationship with the literature

Our work is related to a flourishing literature investigating the existence of a global financial cycle and its interaction with the US monetary policy (Rey, 2015; Miranda-Agrippino and Rey, 2015). This literature identifies a global factor – obtained as the common component of a large panel of returns on risky assets – that affects asset prices and capital flows in global markets and is closely related to conventional measures of investors risk aversion, such as the VIX or the Excess Bond Premium (EBP) of Gilchrist and Zakrajsek (2012).[1] The US monetary policy plays a key role in shaping the global financial cycle through the leverage of global banks and the international role of the dollar in credit markets (Bruno and Shin, 2015b,a). The effects of a US monetary policy tightening is transmitted to financial conditions in other economies outside the United States, including those with an inflation-targeting regime and flexible exchange rates (Passari and Rey, 2015). Eventually, this global financial cycle has a substantial impact on the real economy, as common international shocks to equity and house prices spill over to the business cycles of the G-7 economies (Kose, Ha, Otrok and Prasad, 2018).[2]

Fluctuations in the global risk, as proxied by the global financial cycle, affect not only financial asset prices but also capital flows. Global risk, in particular, is significantly associated with extreme capital flow episodes and the role of global factors in international liquidity flows overshadows that of domestic ones (Forbes and Warnock, 2012). Global factors, such as US interest rates or global investors' risk aversion act as "gatekeepers" determining surges of capital to emerging markets (Ghosh, Qureshi, Kim and Zalduendo, 2014). Unsurprisingly, the concept of a global financial cycle triggered a wider debate among economists. In particular the quantitative relevance of global risk for country level capital flows has been questioned by Cerutti, Claessens and Rose (2017), whose findings indicate that global factors do not explain more that 25 per cent of capital flows variation across countries. This would suggest that countries still have considerable sway over domestic financial conditions also through monetary policy (Arregui, Elekdag, Gelos, Lafarguette and Seneviratne, 2018).

Our contribution to this debate is twofold. First, we enlarge the perspective on

[1] The EBP measures the premium demanded by investors to hold risky corporate bonds, in excess to what is priced in by a simple linear model that relates default risk to observable firms characteristics.

[2] These studies generally focus on the last two to three decades. A longer historical perspective reveals that synchronization across asset prices is not only high, but it has also increased over time, over and above that implied by real economy integration, owing to increased global correlation of risk premia (Jordà, Schularick, Taylor and Ward, 2018).

the structural drivers of global risk, stressing the role of pure financial shocks in shaping the global financial cycle, which so far have been overshadowed by the role of US monetary policy shocks. Moreover, reinforcing the findings of the literature, we highlight an "extremely tight" connection between global risk and a global *aggregate* component in total capital flows.

Second, our paper also contributes to the literature on the classical trilemma in international economics. On the one hand, a number of papers, including Shambaugh (2004), Obstfeld, Shambaugh and Taylor (2005) and Klein and Shambaugh (2015), claim that floating exchange rates allow for a higher degree of monetary policy autonomy compared to pegs, even with an open capital account (*trilemma*).[3] Not only the domestic monetary policy in countries pegging their own currency is tied to the one of the centre economy, but also domestic financial conditions (credit, house prices, and banking sector leverage) among peggers are more sensitive to global risk shocks compared to floaters, at least for emerging market economies (Obstfeld, Ostry and Qureshi, 2018). On the other hand, Rey (2016) challenged the validity of the Mundellian trilemma, maintaining that even domestic financial conditions in inflation targeting economies with flexible exchange rates are affected by US monetary policy shocks. The exchange rate regime is therefore irrelevant (Rey, 2015). We contribute to this debate showing under which policy conditions risk shocks are transmitted to total capital flows. In particular, Avdjiev, Hardy, Kalemli-Ozcan and Servn (2017) highlighted the importance of distinguishing across different types of capital flows when studying their relationship with the global financial cycle. In a similar fashion, when studying the trilemma in capital flows, we shall isolate the impact across different categories of flows.

3 Data

Our database spans 50 countries, 18 advanced and 32 emerging economies, over a sample period of quarterly data from 1990Q1 to 2017Q4, see Table 1.[4] The empirical analysis is based on a dataset consisting of capital flows, in particular distinguishing gross capital "inflows" across four main categories: direct investment, portfolio equity, portfolio debt and other investment (such as bank loans, deposits and trade

[3]According to Han and Wei (2018) this trilemma is only partial. When the centre country loosens its monetary policy, countries with a flexible exchange rate regime do the same to avoid an exchange rate appreciation.

[4]A number of financial centres including Cyprus, Ireland, Hong Kong, Luxembourg, Malta, as well as Belgium and the Netherlands have been excluded as their cross-border capital flows record extremely large values with respect to GDP and are very volatile.

credits) from the *IMF Balance of Payments Statistics*.[5] The dataset also contains risky asset prices - stock market returns from *Global Financial Data*. We control for domestic pull factors, GDP growth and inflation, and push factors, world GDP growth, which were downloaded from *Haver*, based on *IMF International Financial Statistics*, *OECD* and national sources.

(Table 1 here)

Capital account liberalisation is measured through the updated *de jure* index of Chinn and Ito (2006) or through a *de facto* measure based on the stock of total external liabilities from the updated version of the dataset constructed by Lane and Milesi-Ferretti (2007) and further extended with the *IMF Balance of Payments Statistics*. In addition, we construct a measure of direct financial exposure to portfolio investment originating from the United States, using the bilateral dataset provided by the US Treasury International Capital (TIC) System. The latter two variables are scaled by domestic GDP in dollar terms, which was obtained from the IMF.

Exchange rate regime classification. In the paper, we distinguish strict pegs from soft pegs and from flexible exchange rate arrangements using the *de facto* exchange rate arrangement classification by Obstfeld, Shambaugh and Taylor (2010) and the classification by Ilzetzki, Reinhart and Rogoff (2017). As regards the latter, we use category 1 of the coarse index (including no separate legal tenders, currency boards, pegs and pre-announced bands narrower than or equal to +/- 2%) to identify strict pegs and category 2 and 3 (ranging from crawling pegs to managed floats) to identify soft pegs.[6]

Table 2A provides summary statistics for our dataset. It is important to highlight a few stylized facts. First, gross flows are large and very volatile, as noted by Broner, Didier, Erce and Schmukler (2013), in particular the category of "other investment". In some instances, usually financial centres, flows may peak to more than 100% of GDP in one quarter. To deal with these outliers, we winsorise our dependent variables at the 1% level. Moreover, we show also results excluding

[5]Similarly to other studies trying to capture a global financial cycle, the analysis focuses on "gross inflows" – i.e. net purchases by non-residents of securities issued by domestic residents of a country – to capture common trends across countries, not on "net" flows that can offset each other across countries.

[6]The policy variables controlling for capital account openness and the exchange rate regime are available on a yearly frequency and are interpolated with a cubic spline on a quarterly basis.

large financial centres, such as the United States, United Kingdom and Switzerland.[7] Second, in Table 2B, we report summary statistics for advanced and emerging economies, separately. Note that capital flows are generally larger and more volatile for advanced economies than for emerging markets, in turn a reflection of their higher capital account openness (see mean of policy indicators). Finally, we report the means of our dummies for the exchange rate regimes, which indicates the proportion of observations in each particular category. There are more strict pegs among advanced economies, largely due to the presence of euro area economies, which are classified as peggers. Therefore, when testing the trilemma, we shall also show results excluding euro area economies. In addition, it is worth noting that the Ilzetzki et al. (2017) classification includes a relatively low share of flexible exchange rates compared to the one by Obstfeld et al. (2010), 14% against 40% respectively.

(Tables 2A and 2B here)

4 Global risk and its structural drivers

We start our analysis by analyzing a measure of global risk extracted as the common latent factor that drives a large panel of stock returns. This latent Global Stock Market Factor (GSMF), which represents the global component of expected stock returns, turns out to co-move very closely with the measure of global financial cycle proposed by Miranda-Agrippino and Rey (2015) and is strongly related to the global common component of gross capital flows (Figure 1). An appealing feature of our approach is that the GSMF can be computed with a fraction of the data, around 60 time series, as opposed to the over eight hundred series used by Miranda-Agrippino and Rey (2015), and with a simpler econometric procedure (a simple principal component analysis as opposed to a hierarchical dynamic factor model).[8] Next, we provide a structural decomposition of our measure of global risk. Using a standard Vector Autoregression we analyze the relative merits of a rich set of shocks (monetary policy, financial, US demand and geopolitical uncertainty) in explaining fluctuations of global risk, also in relation to specific historical episodes.

[7] Nevertheless, we believe it is important to keep these large financial centres in the sample as their global banks have been the main conduit of the global financial cycle.

[8] Appendix A discusses more in depth the technical details related to the dataset and to the estimation procedure, and the relationship with the data structure and the econometric model employed by Miranda-Agrippino and Rey (2015)

4.1 Measuring Global Risk through a Global Stock Market Factor

We work with a dataset of country averages of stock market returns for 63 advanced and emerging market economies[9] and model co-movement across stock returns in the $j = 1, 2, ..., 63$ countries in our sample as follows:

$$r_{j,t} = \lambda_j f_t^{global} + \xi_{j,t} \tag{1}$$

Figure 2 shows our estimate of the global factor (the red line) and how it compares with (i) other indicators of the global financial cycle proposed in the literature as well as with indicators of (ii) financial risk and (iii) uncertainty and geopolitical risk. Grey bars indicate US recessions. The three global financial cycle measures are the ones by Miranda-Agrippino and Rey (2015), Bonciani and Ricci (2018) and Scheubel et al. (2018).[10] Financial risk is proxied by the Excess Bond Premium of Gilchrist and Zakrajsek (2012), by implied stock market volatility as measured by the VIX/VXO for the US and the VSTOXX for the euro area. Geopolitical risk is measured by the indicators of political uncertainty of Baker, Bloom and Davis (2016) and the Geopolitical Risk Index of Caldara and Iacoviello (2018).

(Figure 2 here)

First, our procedure behaves in line with alternative measures of the global financial cycle and documents two long periods of elevated risk-appetite, namely the second half of the Nineties and the period between the 2001 recession and the great financial crisis, both followed by large spikes in risk aversion. Second, common patterns between financial risk and the Global Stock Market Factor emerge in recession periods, indicating a clear link between swings in the global financial cycle and exogenous financial shocks. Third, a comparison between the Global Stock Market Factor and measures of uncertainty and geopolitical risk suggests

[9] Stock market returns are taken from Global Financial Data. The countries included are Mexico, Australia, Canada, Finland, Netherlands, Spain, France, United States, Hong Kong, Japan, United Kingdom, Argentina, India, Chile, Sri Lanka, Ireland, Italy, Pakistan, Malaysia, Austria, Mauritius, Philippines, Iran, Peru, Egypt, Bangladesh, Belgium, Slovak Republic, Republic Of Korea, Turkey, Czech Republic, Greece, Thailand, Iceland, China, Portugal, Venezuela, Indonesia, New Zealand, Switzerland, Croatia, Kuwait, Zambia, Hungary, Singapore, Israel, Europe, Russian Federation, Ukraine, Luxembourg, VietNam, Denmark, Norway, Colombia, Sweden, Brazil, Bulgaria, South Africa, Lebanon, Germany, Montenegro, Saudi Arabia, Slovenia.

[10] Bonciani and Ricci (2018) average through principal components a large international panel of over one thousand stocks returns. Scheubel et al. (2018) estimated a global financial factor from a large panel of real and financial variables, restricting the signs on the loadings to be consistent with a prior belief on how these variables should be affected by the global financial cycle.

that the latter is episodically (e.g. 9/11 or the 2003 Iraq war) related to turning points in global risk as well as with spikes in financial volatility.

How much of the observed swings in the financial cycle can be attributed to the US monetary policy, rather than to contractions and expansions in the risk bearing capacity of the financial sector? Do variations in uncertainty and geopolitical risk also matter? The next section sheds some light on these questions.

4.2 The structural drivers of Global Risk

The significant co-movement of the Global Stock Market Factor with other indicators of financial stress and geopolitical uncertainty suggests that, while monetary policy may indeed play a role in driving global risk, other shocks may have an equal, if not stronger, effect on the global financial cycle and, consequently, on the global capital flows cycle. We investigate the relative role of different structural shocks in a standard Vector Autoregression (VAR) framework. The information set is parsimonious, yet sufficiently large to investigate the effects of both US-based as well as global shocks. The model includes four US variables (the interest rate on the one-year Treasury bill, the log of the Consumer Price Index, the log of the S&P500 index and of the US dollar index) and three global variables (the yield of an US dollar High-Yield Corporate Bonds index, the log price of oil and the Global Stock Market Factor).[11] We identify four shocks that should be expected to impact global risk, namely: (i) a US monetary policy shock; (ii) a US aggregate demand shock; (iii) a global financial shock; and (iv) a geopolitical risk shock. The choice of these four shocks is directed by a large and growing literature on the international spillover of global liquidity conditions and US monetary policy (see for instance Choi, Kang, Kim and Lee, 2017; Buch, Bussiere, Goldberg and Hills, 2018) and by the literature on the impact of uncertainty and geopolitical risk on economic and financial conditions (Baker et al., 2016; Caldara and Iacoviello, 2018). The main assumptions behind the identification restrictions that we employ to identify these shocks are the following:

A monetary policy shock is identified through instrumental variable techniques. Following Jarociski and Karadi (2018) and Gertler and Karadi (2015) we assume that changes in short-term interest rates (so called *interest rate surprises*)

[11]One-year T-Bill rates and the US dollar index are from the Board of Governors of the Federal Reserve System. The Consumer Price Index is from the U.S. Bureau of Labor Statistics. The S&P500 index is from Bloomberg. The yield on US dollar High-Yield Corporate Bonds is the ICE Bank of America Merrill Lynch US Corporate & High Yield Index. The oil price is the US dollar Brent benchmark from the U.S. Energy Information Administration.

in a short window around US monetary policy announcements are correlated with monetary policy shocks but uncorrelated with other shocks. By instrumenting the residual of the interest rate equation with these interest rate surprises we are therefore able to recover a measure of monetary policy shocks.

For the remaining three shocks we rely on sign restrictions, following the method by Rubio-Ramirez, Waggoner and Arias (2016). A **US demand shock** is identified as a shock that decreases short-term interest rates and stock prices. The unexpected fall in demand also induces a decline in inflation, a reduction of the price of oil and weakening of the US dollar. As demand falls, global risk increases, led by higher volatility in financial markets and heightened risk aversion. To identify a **financial shock**, that is an exogenous tightening of financial conditions independent of monetary policy, we follow Cesa Bianchi and Sokol (2017). A deterioration in investors risk appetite leads to a re-balancing from stocks to bonds, inducing a fall in both short term interest rates (due to the increase in bond prices) and equity valuations. Weaker economic activity puts downward pressure on the the inflation rate as well as on oil prices. At the same time, investors turn away from risky bonds, whose yields increase, and flow towards a safe-haven currency, the US dollar, which appreciates. Lastly, we identify a **geopolitical risk shock**. We think of this shock as capturing episodes of geopolitical turmoil that could result in possible shortfalls of the supply of oil, like for instance the invasion of Kuwait or the terrorist attack to the Twin Towers. In response to such a shock, global risk rises, equity valuations and interest rates decline, and the dollar index appreciates due to a flight to safety effect. Oil prices (and as a consequence consumer prices) rise. This shock has therefore a stagflationary flavour that distinguishes it from both demand and financial shocks.[12] A summary of these restrictions is provided in Table 3. The interested reader can find a richer output as well as technical details on structural identification and model estimation in Appendix B.

(Table 3 here)

The structural identification of shocks in our model allows us to answer a crucial question: what is the importance of monetary policy shocks relative to that of other structural shocks, in explaining fluctuations in global risk? This question has gone so far unanswered in the literature. Papers that have taken a structural approach (Miranda-Agrippino and Rey, 2015; Rey, 2016; Bruno and Shin, 2015a)

[12]Notice that these signs are compatible with the effects of uncertainty shocks identified with a narrative approach (using as an instrument for uncertainty the changes in the price of gold in days of geopolitical tensions) by Piffer and Podstawski (2017).

have convincingly shown that US monetary policy is transmitted to the global economy also by affecting global risk, but they have stopped short of providing a quantification of how much monetary policy really matters for global risk when compared to other potential disturbances. In particular, to answer this question we look at two possible metrics that we obtain from the structural VAR analysis: the Forecast Error Variance Decomposition (FEVD) and the contribution of our identified shocks to observed fluctuations in global risk.

Variance decomposition analysis. The FEVD is a measure of the *relative* importance of a given structural shock in explaining the volatility of a variable of interest at some predetermined forecast horizon. Table 4 shows the FEVD at the 12 months forecast horizon.[13] As the estimation is performed with Bayesian methods we obtain not only a point estimate of the FEVD, but also a whole distribution of FEVDs. To summarise this information, Table 4 shows the mean as well as the 15_{th} and 85_{th} percentile of this distribution. Three interesting results emerge. First, around one fifth of the fluctuations in global risk at medium-term horizons are indeed due to US monetary policy. Hence, not only monetary policy is indeed relevant for global risk as the proponents of the global financial cycle have stressed, but its quantitative role is all but negligible. This, however, is only part of the story. The second result is that financial shocks actually matter more than US monetary policy for global risk fluctuations. This is all the more evident if one looks not only at the mean effect (23% as opposed to 19%) but properly takes into account model uncertainty and considers other percentiles as well. At the 85th percentile, financial shocks can account for up to around 70% of the forecast error variance of global risk, whereas US monetary policy cannot explain more than around 30%. Geopolitical risk shocks also explain a non-trivial fraction of global risk fluctuations, namely 13 percent on average, and up to 26 percent once we move to higher percentiles. Finally, unexpected shifts in US demand do not seem to contribute significantly to changes in global risk over time, as they explain less than 10% of its overall variance.

(Table 4 here)

Contribution of identified shocks to observed fluctuations in global risk. These contributions allows us to weigh the relative importance of our shocks for global risk. For instance, we would like to know how much of the decline in global risk before the Great Recession was actually due to US monetary policy being too

[13]Results for longer horizons are very similar.

lose, as some commentators have argued, or driven by a genuine appetite for risk, as measured by the risk-bearing capacity of the corporate sector. Similarly, we may understand to what extent the increase in global risk during the Great Recession can be related to financial disruptions, as suggested by Stock and Watson (2012), or by economic uncertainty. In Figure 3, we show the historical contribution of US monetary policy, financial and geopolitical-uncertainty shocks to the Global Stock Market Factor.

Quite strikingly, there are some instances in which movements in the Global Stock Market Factor are not happening *because* of US monetary policy shocks, but rather *despite* monetary policy pushing global risk in a different direction. Consider, for instance, the 2003-2008 period. After loosening the monetary policy stance in response to the brief recession that followed the collapse of the stock market bubble, the Fed embarked in a tightening cycle that was interrupted only by the inception of the Great Financial Crisis. During this period, despite tightening monetary policy, global risk fell (i.e. global appetite for risk increased) and capital flows actually surged. The fall in Global Risk before the crisis as well as its spike during the crisis, is accounted for in our framework by a financial shock, i.e. exogenous changes in the appetite for risk unrelated to monetary policy. After the crisis erupted, US monetary policy was quickly and substantially loosened, counteracting the spike in Global Risk triggered by the financial shock.

(Figure 3 here)

Summing up, a Global Stock Market Factor extracted from a global panel of stock market returns provides a meaningful measure of the global financial cycle. Moreover, peaks and troughs in this cycle tend to coincide with episodes of heightened financial risk, increased geopolitical risk as well as broad economic uncertainty. A structural analysis of the drivers of this Global Stock Market Factor, performed through a SVAR, reveals that exogenous swings in the appetite for risk (financial shocks) have a prominent role in explaining global risk fluctuations over time and, potentially, affect capital flows at the country level, the issue to which we now turn.

5 Global risk and capital flows

As mentioned in the introduction, global risk and global (aggregate) capital flows are tightly associated (Figure 1). In this section, we test the strength of this relationship through the panel analysis of the determinants of capital flows at the country level.

First, we analyse the impact of our Global Stock Market Factor, controlling for another important driver of the global financial cycle: US monetary policy. After having shown that global risk is the most robust *push factor* for capital flows, we test the significance of the drivers of global risk that have been identified in the previous section for capital flows.

5.1 Global risk, US monetary policy and capital flows

To begin, we estimate a fixed-effects pooled panel model:

$$y_{it} = \alpha_i + \beta(L)y_i + \gamma\bar{x}^D_{it-1} + \delta\bar{w}^G_{t,t-1} + \varepsilon_{it} \tag{2}$$

where y_{it} is the dependent variable, total capital inflows or one of the main four categories of capital flows – direct investment, portfolio equity, portfolio debt or other investment – in country i at time t, $\bar{x}^D_{it-1}$ is a vector of domestic "pull" factors influencing capital flows, such as real GDP growth or inflation, and $\bar{w}^G_{t,t-1}$ is a vector of global "push" factors for capital flows, which are invariant across countries, including world GDP growth at time $t-1$, global risk and the US monetary policy at time t. Global risk is proxied by our Global Stock Market Factor; whereas the US monetary policy is gauged by a series of US monetary policy surprises, as measured by Gertler and Karadi (2015).[14] The model includes country-fixed effects (α_i) and four lags of the dependent variable, $(L)y_i$.[15] Finally, ε_{it} is an error term. The model is estimated with the Driscoll-Kraay estimator accounting for any remaining cross-sectional and temporal dependence of the residuals.

The first five columns of Table 5 report the results of the estimation of equation (2). It is evident that our proxy of risk, the Global Stock Market Factor, has a negative impact on capital flows and, remarkably, the impact is statistically significant for *all types* of flows. When we replace our Global Stock Market Factor with the VIX, we find that it has a statistically significant impact only in the case

[14] We have tested a number a number of different measures of US monetary policy, including the level of and the change in the effective Fed Funds Rate – extended with the Wu and Xia (2016) shadow rate during the zero-lower bound period – and a measure of US monetary policy uncertainty, the sub-index of the popular economic policy uncertainty index of Baker et al. (2016). However, monetary policy surprises proved to be the most robust regressor for capital flows among these different measures. In particular, we did not find a robust connection between the level or the change in the US Fed Funds Rate and capital flows. Possibly, interest rates, even in the United States, are endogenously determined by global financial conditions and it is therefore necessary to isolate exogenous monetary policy shocks. Monetary policy surprises have the additional advantage of being clearly exogenous.

[15] Time (quarter/year) fixed-effects are not included, since they would preclude the identification of push factors, in particular our proxy of global risk, which do no not vary across groups.

of portfolio (equity and debt) flows, not on other categories or total capital flows (results are not reported for brevity).[16]

(Table 5 here)

Global risk shocks lead to a decline in capital inflows across many countries, nevertheless their economic significance is rather modest for the dynamic of capital flows in each country. For one standard deviation shock in global risk, the decline in gross inflows ranges from 0.1% of GDP in the case of equity to 0.8% of GDP in the case of other investment. Overall, gross capital inflows decline by 1.7% of GDP on average across our panel of countries against a global risk shock. These numbers are rather small when compared to the volatility (14%) of capital flows (see Table 2).[17] This is naturally the average impact across a number of economies with different characteristics that may influence the transmission of risk shocks, such as capital account openness or the exchange rate regime. Therefore, we shall postpone a complete discussion of the economic significance of the coefficients associated with global risk at later stage in Section 7.

Turning to the direct impact of US monetary policy on global capital flows, US monetary policy surprises have a negative impact on total capital flows, in particular statistically significant for portfolio flows, as one would expect from the theoretical literature on the global financial cycle (see columns 2 and 3 of Table 5). However, we do not find a statistically significant impact of US monetary policy surprises on "other investment", which includes cross-border loans, to a large channeled through banks, and on "total flows". This is only apparently in contrast with the findings of Bruno and Shin (2015a). As shown in the next subsection, US monetary policy surprises may still influence cross-border loans through their impact on global risk.

Robustness. One may contest that our measure of global risk is endogenous with respect to capital flows. For this reason, we replicate our regressions with a different model, using the two-step system Generalised Method of Moments (GMM) estimator, treating the Global Stock Market Factor as endogenous (instrumented

[16] We have also tried other popular alternative proxies of global risk, such as the Excess Bond Premium calculated by Gilchrist and Zakrajsek (2012) or the Geopolitical Risk Index of Caldara and Iacoviello (2018), finding patterns similar to that of the impact of the VIX. These results are omitted for reasons of space and available from the authors upon request. Our Global Stock Market Factor or similar global factors such as the one by Miranda-Agrippino and Rey (2015) or Bonciani and Ricci (2018) are the only proxies of risk impacting all categories of capital flows.

[17] To have an idea of the size of a one standard deviation risk shock, this corresponds broadly to the change in our Global Stock Market Factor during the Russian sovereign debt crisis and the ensuing collapse of Long-Term Capital Management in 1998Q3, the trough of the US bear stock market in 2002Q3, the Bear Stearns bail-out in 2008Q1, the global financial crisis in 2008Q3 and Q4 and the euro area sovereign debt crisis in 2011Q3.

with the second lag level in the first differences equation) and the control variables as predetermined (instrumented with the first lag level) with the exception of the US monetary policy surprise that is treated as exogenous. The results are reported in the last five columns of Table 5 and are very similar to our benchmark fixed-effects estimates. Actually, the estimated impact of a standard deviation shock in global risk on total capital flows using the system-GMM estimator is much larger (2.9% of GDP) compared to the one obtained from the fixed-effects model. In addition, in the next sub-section, we replace the Global Stock Market Factor with the underlying structural shocks (see section 4), which, by construction, capture exogenous shifts in monetary policy or in the investors' risk attitude due to financial shocks and geopolitical events.

Is the relationship between global risk and capital flows stemming from a particular sample of countries? Generally, it is not. In Table 6 we replicate the regressions for the model including US monetary policy surprises and splitting the sample between advanced and emerging economies. Our Global Stock Market Factor is again associated with a decline in capital flows in both groups of countries. Perhaps surprisingly, the impact of global risk on *portfolio* flows is absent among emerging economies compared with advanced ones. First, as shown by Avdjiev et al. (2017), emerging markets' debt is mainly accounted for by *sovereigns'* external borrowing, which moves counter-cyclically with risk. Second, the next section will show that the lower sensitivity of emerging markets' flows to risk is simply the outcome of the lower degree of capital account openness among emerging markets.

(Table 6 here)

In Table 7, we perform two additional checks. First, we exclude the remaining large financial centres in our sample of countries, the United States, Switzerland and the United Kingdom (columns 1-5), finding broadly similar results compared to the full sample. Second, we control if the impact of global risk on capital flows is driven by the largest shock in our sample, the global financial crisis, excluding the 2008-09 period from the regressions (columns 6-10). The size and statistical significance of the coefficients associated with our Global Stock Market Factor are again very similar to that in the full sample, with the exception of the category of portfolio debt flows.

(Table 7 here)

5.2 The structural drivers of global risk and capital flows

Which particular driver of global risk is behind the global capital flows cycle? We replace the vector of global push factors with a vector including the three structural shocks that have been identified in the previous section as the main drivers of global risk: US monetary policy, financial and geopolitical-uncertainty shocks. Formally, equation (2) becomes:

$$y_{it} = \alpha_i + \beta(L)y_i + \gamma\bar{x}^D_{it-1} + \delta\bar{w}^G_{t-1} + \phi\hat{S}_t + \varepsilon_{it} \tag{3}$$

where $\bar{w}^G_{t-1}$ now includes only world GDP growth and $\hat{S}_t = [\hat{S}^{monpol}_t, \hat{S}^{financ}_t, \hat{S}^{geo-unc}_t]$ is our vector of estimated structural shocks. Table 8 show the results where alternatively, we use either the structural shocks obtained from our structural VAR (columns 1-5) or their contributions to observed fluctuations in global risk (columns 6-10). It is worth remarking that shocks and their historical contributions are closely related, as the latter can be seen as the linear projection of an observable variable (in our case the Global Stock Market Factor) on the shocks. Not surprisingly, considering the findings in section 4 on the drivers of global risk, we find that financial shocks have the strongest impact on capital flows, in general robust across different categories of flows. The coefficient associated with US monetary policy shocks are also statistically significant, in particular for portfolio flows (see columns 2 and 3). This is broadly consistent with the results shown in Table 7 when monetary policy surprises are plugged directly in the regression. On the other hand, when we consider the historical contribution of US monetary policy to global risk, we find that it becomes relevant for direct investment and total capital flows (columns 6 and 10). In other words, US monetary policy can affect these flows only to the extent that it induces significant shifts in global risk.

(Table 8 here)

6 The transmission of global risk to capital flows: dilemma or trilemma?

So far, we have shown that global risk is tightly linked to aggregate capital flows and, on average, across our panel of countries. However, as noted by Goldberg and Krogstrup (2018), countries' capital flow response to global risk is country specific. Which particular country features can absorb or magnify the impact of global risk shocks on gross capital flows? The natural candidates are two policy variables: the degree of capital account openness and the exchange rate regime. Standard international macroeconomic models would predict that a shock that changes financial conditions in the centre country (say the United States) with respect to the rest of the world – e.g. a relative change in risk premia between the US dollar and other currencies or a monetary policy shock in the United States – would force those countries with an open capital account and a fixed exchange rate regime to follow the monetary and financial conditions of the centre economy, otherwise capital flows would force a readjustment. Instead, flexible exchange rate regimes would be shielded as the exchange rate would absorb the divergence in interest rates or risk premia between the centre economy and the domestic one, without triggering an adjustment through capital flows.

6.1 Testing the policy trilemma

In order to provide an insight in the ability of flexible exchange rate regimes to absorb global risk shocks or US monetary policy shocks, similarly to Passari and Rey (2015) and Obstfeld et al. (2018), the model in equation [2] is augmented with a vector of policy variables accounting for the classical trilemma in international macroeconomics:

$$\bar{z}_{it} = \left[KO_{it-4}, D_{it}^{peg}, D_{it}^{softpeg}\right]$$

where KO_{it} is a measure of capital account liberalisation, the *de jure* index of Chinn and Ito (2006) or a *de facto* measure as detailed in Section 3, D_{it}^{peg} is a dummy equal to 1 for countries with a rigidly fixed exchange rate regime and $D_{it}^{softpeg}$ a dummy for those with an interemediate exchange rate regime, according to the classification of Obstfeld et al. (2010) or Ilzetzki et al. (2017). This vector of policy variables is interacted with the two push factors that have been identified in the previous sections as potential determinants of the global capital flows cycle: our Global Stock Markt Factor ($GSMF_t$); and US monetary policy surprises (MPS_t).

$$\bar{p}_t = [GSMF_t, MPS_t]$$

To test the policy trilemma in the transmission of global risk to capital flows, we therefore extend the model in equation (2) as follows:

$$y_{it} = \alpha_i + \beta(L)y_i + \gamma\bar{x}_{it}^D + \delta\bar{x}_t^G + \eta\bar{z}_{it} + \theta\bar{p}_t * \bar{z}_{it} + \varepsilon_{it} \qquad (4)$$

where y_{it} is again total capital flows or one of the four types of capital flows (direct investment, portfolio equity, portfolio debt, other investment) to country i a time t. The key parameter to test the policy trilemma is the set of coefficients θ associated with the interaction terms between push factors and policy variables. In particular, a negative θ coefficient would signal that those economies with that particular feature, i.e. capital account openness or a rigid exchange rate, are more sensitive to risk or monetary policy shocks compared to the rest of the sample (*trilemma*). If, instead, the coefficient θ is negative for capital account openness, but not statistically different from zero for the exchange rate regime, this means that the latter does not matter for the transmission of shocks (*dilemma* between capital account openness and monetary autonomy).[18] There is an issue of potential endogeneity of the policy variables with respect to monetary policy and risk shocks, which may force an adjustment in the prevailing policy regime. To deal with these endogeneity concerns, following Obstfeld et al. (2018), we take the measures of capital account openness lagged by four quarters (as the data are available on a yearly frequency) and we exclude from the sample all the episodes of currency, banking and sovereign debt crises, as classified by Laeven and Valencia (2013) and extended using their methodology, when changes in the policy regime are more likely to happen.

Table 9 reports the results of the estimation of the extended model in equation (7), using the *de jure* Chinn and Ito (2006) index to control for capital account openness. The first five columns report the results of the model including the Obstfeld et al. (2010) classification of exchange rate arrangements, whereas the last five columns the results using the classification by Ilzetzki et al. (2017). Control variables are omitted for reasons of space. Table 9 provides two clear policy messages. First, capital account openness and the exchange rate regime *do* matter for the transmission of global risk shocks to capital flows, but *do not* matter for the transmission of US monetary policy shocks. The interaction terms between our global risk factor and the policy variables are negative and statistically significant (see columns 5 and 10).[19] This is not the case for the interaction terms between US

[18] Again, time (quarter/year) fixed-effects are not included, since they would preclude the identification of push factors. However, in this case, our interest is in the interaction terms between push factors and policy variables that vary across countries and time. Therefore, in a robustness test, we include time-dummies to account for any possible omitted global factor. Including time-dummies, the coefficient associated with time-invariant variables will not be identified, but those associated with the interaction terms will be correctly identified.

[19] Note that the coefficient associated with the Global Stock Market Factor is sometimes positive and significant, suggesting that for sufficiently low values of the Chinn-Ito index (when close to zero) and flexible exchange rate regimes (when the dummy for pegged regimes is equal to zero) risk shocks may be even associated with a "rise" in capital flows. However, when re-estimating the baseline model in equation (5) within subsamples including only countries with low values of the

monetary policy surprises and policy variables. Second, more rigid exchange rate regimes, in particular "strict pegs" are associated with a stronger transmission of risk shocks to "other investment" and "direct investment", not necessarily to portfolio flows. The absolute value of the coefficient of the interaction term between risk shocks and the dummy controlling for strict pegs is particularly large in the case of "other investment", suggesting that this particular category, which includes cross-border bank loans, is behind the trilemma. In a nutshell, there is classical trilemma in the transmission of risk shocks to capital flows that is largely driven by one category of capital flows: other investment.

(Table 9 here)

6.2 Robustness of the policy trilemma

The evidence regarding the trilemma for capital flows is not driven by the particular measure of capital account openness that we have used. In Table 10 we substituted the *de jure* Chinn-Ito index with a *de facto* measure of financial openness: total external liabilities as a ratio to GDP. The results are virtually identical to those reported in Table 9. In addition, we control if the direct exposure to portfolio investment from the United States, the likely source of major shocks and the largest holder of external assets, can amplify the transmission of risk shocks. The impact of this particular control policy variable is not statistically different from zero, suggesting that it is financial openness *per se* and not the particular exposure to the United States that matters for the transmission of risk shocks (see Table 11).

(Tables 10 and 11 here)

One may wonder whether the evidence of the trilemma is confined to a particular group of countries or affected by the presence of the global financial crisis in 2008-09. Table 12 shows a number of robustness tests for total capital flows including the *de jure* Chinn and Ito (2006) index to control for capital account openness and the Obstfeld et al. (2010) classification for the exchange rate regime. Splitting the sample between advanced and emerging economies does not weaken the support for the policy trilemma (columns 2 and 3). Our *de facto* measures of exchange rate regimes classify euro area economies as pegged and this could potentially influence the results. Our evidence, however, shows that excluding euro area economies the

Chinn-Ito index and flexible exchange rate arrangements, the coefficient associated with global risk is not statistically different from zero or, again, negative.

trilemma is still present (column 4). Similarly, excluding large financial centres, such as the United States, the United Kingdom and Switzerland (column 5) or eliminating from the sample the global financial crisis (column 6) does not affect the main conclusions. Reintroducing the observations for banking, currency and sovereign debt crisis in the sample brings no substantial changes (column 7). Finally, we exclude all the push factors that are invariant across countries and include time-dummies to control for any possible global factor that could have not been captured by our push factors. This model still allows to estimate the interaction terms that are varying across countries. The coefficients of the interaction terms between risk and capital account openness and between risk and strict pegs are again negative and statistically significant, supporting the presence of a trilemma in the transmission of risk shocks to capital flows (column 8). We obtain the same results using the exchange rate classification of Ilzetzki et al. (2017), instead of Obstfeld et al. (2010), showing that the trilemma is robust to the choice of this particular classification (Table 13).[20] To conclude, the presence of a trilemma in the transmission of risk shocks to capital flows, in particular to other investment, is remarkably robust.

(Tables 12 and 13 here)

7 Interpreting the results and their economic significance

We found convincing evidence of a global capital flows cycle connected to global risk. This connection is tighter among countries more financially open and adopting a rigid exchange rate arrangements. In particular, the sensitivity to global risk and its dependence to the policy arrangements is clearly visible for one category of flows: other investment.

The importance of the category "other investment" for the trilemma and the global capital flows cycle is not surprising. This category largely reflects foreign bank lending (Levy Yeyati and Zúñiga, 2016). As mentioned, to a large extent, the narrative of a global financial cycle is intimately linked to the role of global banks that has been highlighted by Bruno and Shin (2015b) and Bruno and Shin (2015a). In addition, Basso, Calvo-Gonzalez and Jurgilas (2011) note that interest

[20] Similar robustness tests for the two categories of capital flows where we found a trilemma, direct and other investment, produce similar results, which have been omitted for space reasons and available upon request from the authors.

(lending) rate differentials and access to foreign funding play a key role in explaining "loan" dollarisation. In particular, they show that lending rates between two different currencies may diverge even for countries with hard exchange rate pegs, in violation of the uncovered interest parity. In this case, domestic residents may underestimate the implicit exchange rate risk of borrowing in foreign currency in tranquil times, leading to credit booms that turn into busts and capital flows reversals when volatility rises. In turn, this is confirmed by Ghosh et al. (2014), who find that liability-flow surges are more likely in emerging economies with less flexible exchange rate regimes.

Portfolio flows appear to be less sensitive to the global financial cycle compared to "other investment". This is not a novel result, as Broner et al. (2013) show that, around crises, other investments are the flows that experience the sharpest drops among high-income countries, whereas direct investment and other investments are the flows posting the largest decline among upper-middle-income countries. Banking flows were the hardest hit following the great retrenchment in international capital flows during the 2008-09 global financial crisis (Milesi-Ferretti and Tille, 2011). Moreover, as regards portfolio debt, this includes sovereigns' external liabilities, which move acyclically in advanced economies and countercyclically in emerging markets (Avdjiev et al., 2017).

A number of considerations may explain why, in addition, the sensitivity to risk of portfolio flows is not affected by the exchange rate regime. For an equity investor, the volatility of the exchange rate is a factor of second-order importance compared to the volatility of equity prices, therefore it is not surprising that the exchange rate regime would not matter. For a foreign bond investor investing in local currency bonds, exchange rate volatility does matter. This is however a typical investment for sophisticated portfolio investors, who may recur to derivative instruments to hedge the currency risk. In general, global bond investors dislike "currency risk" to the extent that their holdings are biased toward their own currencies: the "home-currency bias" identified by Maggiori, Neiman and Schreger (2018). Finally, under financial integration, international arbitrage leads to a rapid adjustment of prices and returns across internationally traded assets, equalising borrowing costs without the need to generate large adjustments in capital flows (Dedola and Lombardo, 2012),

The relevance of a global financial cycle for capital flows has been challenged, for instance by Cerutti et al. (2017). Indeed, we noted that the estimated average impact of one standard deviation global risk shock is rather modest compared to the size and volatility of capital flows. However, this average effect masks important differences across economies that come to the surface once we identify the channels of transmission and isolate the policy trilemma.

Table 14 summarises the impact (absolute value) of one standard deviation shock to our Global Stock Market Factor for the type of flows that are influenced by the policy trilemma: direct and other investment, as well as total capital flows.[21] Starting from the top panel, showing the impact across the full sample, it may be appreciated how controlling for capital account openness the average impact of risk shocks on total capital inflows (last column) increases by one percentage point of GDP from 1.7% to 2.8% of GDP. For those economies that have liberalised the capital account and adopt an exchange rate target, the impact augments by more than one percentage point, up to 4.0% of GDP. This impact becomes economically significant, when compared to the volatility of capital inflows in the sample (13.8% of GDP). The finer classification of capital flows shows that "other investment" is the category explaining the quantitative impact of the trilemma.

The trilemma in the transmission of risk shocks is particularly relevant for emerging markets, as shown in the lowest panel of Table 14. In emerging markets that are open and fixing the exchange rate, a one standard deviation risk shock leads to a *decline* in total gross capital inflows by more than 4% of GDP, four times larger than the average impact across all emerging markets (1% of GDP). Considering that an emerging market would typically receive an inflow of almost 7% of GDP on average (the sample mean), a risk shock would lead to a "sudden stop" by foreign investors in emerging markets (Forbes and Warnock, 2012), much larger for those countries that are open and peg their currency compared with those more closed and adopting a flexible exchange rate. Again, "other investment" is the category most sensitive to risk shocks and the one being affected by the policy trilemma.

Finally, one may wonder whether there is a contradiction between the tight link between our Global Stock Market Factor and gross capital inflows, lending support to the presence of a policy dilemma (Rey, 2015), and the results from the analysis in Section 7, finding evidence of a classical trilemma. Not necessarily, as the policy regimes may change through time, reinforcing or weakening the link between global risk and capital flows. Figure 4 reports the average level of *de jure* capital account liberalisation and the share of countries adopting a strict peg in our sample in three different periods: the 1990s, the 2000s and since 2010. Both measures tend

[21] To have an idea of the size and relevance of this shock, one standard deviation corresponds to the rise in our measure of global risk in the following episodes: the Russian default and LTCM collapse in 1998-Q3, the trough of US bear stock market in 2002-Q3, the Bear Stearns bail-out in 2008-Q1, the global financial crisis in 2008-Q3 and -Q4, and the euro area sovereign debt crisis in 2011-Q3.

to increase over time. The higher these two measures, the stronger the expected sensitivity of capital flows to global risk according to the trilemma. Indeed, this is exactly what we find once we re-estimate our model across these three different periods. The last three columns in Figure 4 show that the impact of global risk on capital flows since 2010 is three times as large as the impact back in the 1990s.

(Table 14 and Figure 4 here)

8 Conclusions

In this paper, we show that there is a tight link between a measure of global risk that summarizes the co-movement of stock market returns in 63 economies – a Global Stock Market Factor, akin to the global financial cycle measure by Miranda-Agrippino and Rey (2015) – and a *global capital flows cycle*. An analysis of the structural drivers of global risk reveals that exogenous changes in the appetite for risk in the financial sector – *financial* shocks – have a greater role than the US monetary policy in shaping global risk dynamics. The direct link between the US monetary policy and capital flows may be elusive. It is therefore important to isolate the contribution of US monetary policy shocks to global risk to understand its international transmission to capital flows. The transmission of global risk to capital flows is consistent with a "trilemma", as countries that are more financially integrated and have lower exchange rate flexibility are more sensitive to global risk. Drilling deeper into the behaviour of different types of capital flows, we find that this "trilemma" is mainly driven by cross-border loans by banks and other financial institutions, confirming the prominent role of global banks in the transmission of global shocks. Portfolio flows appear to be less sensitive to global risk compared to cross-border loans because the adjustment to risk shocks, most likely, takes places through prices and not quantities. Moreover, the sensitivity of portfolio flows to risk is not attenuated by greater exchange rate flexibility. Since the role of market-based finance is on the rise – also among emerging markets – at the expenses of that of global banks, our results call for a careful assessment of the financial stability implications of global risk shocks. As the composition of global liquidity shifts away from bank loans to other sources of financing, such as equity and bonds, sudden shifts in investors' risk attitude can in fact propagate faster than in the past.

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Table 1: Country sample

Advanced economies	United States, United Kingdom, Austria, Denmark, France, Germany, Italy, Norway, Sweden, Switzerland, Canada, Japan, Finland, Greece, Portugal, Spain, Australia, New Zealand
Emerging economies	Turkey, South Africa, Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Uruguay, Israel, Saudi Arabia, India, Indonesia, Korea, Republic of Malaysia, Pakistan, Philippines, Thailand, Bulgaria, Russian Federation, China, Czech Republic, Slovakia, Estonia, Latvia, Hungary, Lithuania, Croatia, Slovenia, Poland, Romania

Table 2.A: Summary statistics. Full sample

	(1) Mean	(2) SD	(3) Min	(4) Max	(5) Obs.
Gross capital inflows:					
Direct investment (% of GDP)	3.0	6.2	-52.1	231.3	5,251
Portfolio equity (% of GDP)	0.5	2.0	-26.6	29.3	4,998
Portfolio debt (% of GDP)	1.9	5.2	-47.4	39.6	5,017
Other investment (% of GDP)	2.4	10.9	-124.8	205.5	5,212
Total (% of GDP)	7.8	13.8	-113.6	229.4	5,163
Push factors:					
Global Stock Market Factor	0.0	1.0	-2.5	1.6	5,600
VIX	19.4	7.3	10.3	58.7	5,600
US Fed funds rate & Wu-Xia shadow rate (%)	2.9	3.1	-2.9	9.7	5,800
Bloom US monetary policy uncertainty (index)	88.9	58.0	16.6	407.9	5,750
Gertler-Karadi US monetary policy surprise (%)	0.0	0.5	-1.2	2.0	5,600
World GDP growth, annualised (%)	3.4	1.3	-1.8	5.7	5,800
Policy and control variables:					
Chinn-Ito capital account liberalisation (index)	0.68	0.34	0.00	1.00	5,528
External liabilities (ratio to GDP)	1.14	0.91	0.09	6.69	5,516
US exposure to domestic equity and debt (% of GDP)	32.1	39.0	0.0	263.6	4,690
Strict peg, Obstfeld, Shambaugh and Taylor (dummy)	0.30	0.46	0.00	1.00	5,800
Soft peg, Obstfeld, Shambaugh and Taylor (dummy)	0.30	0.46	0.00	1.00	5,684
Strict peg, Ilzetzki, Reinhart and Rogoff (dummy)	0.30	0.46	0.00	1.00	5,800
Soft peg, Ilzetzki, Reinhart and Rogoff (dummy)	0.56	0.50	0.00	1.00	5,800
Inflation, year-on-year (%)	10.4	33.2	-3.82	495.2	5,325
Domestic GDP growth, year-on-year (%)	3.2	4.8	-19.7	73.0	5,261

Table 2.B: Summary statistics. Advanced vs. emerging economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Advanced economies					Emerging economies				
	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	Obs.
Gross capital inflows:										
Direct investment (% of GDP)	2.4	5.1	-31.5	94.5	2,036	3.4	6.7	-52.1	231.3	3,215
Portfolio equity (% of GDP)	0.8	2.5	-17.0	29.3	1,946	0.4	1.5	-26.6	17.2	3,052
Portfolio debt (% of GDP)	3.0	6.5	-47.4	39.6	2,002	1.1	3.8	-23.9	38.5	3,015
Other investment (% of GDP)	3.4	15.0	-124.8	205.5	2,036	1.8	6.9	-47.9	85.9	3,176
Total (% of GDP)	9.6	17.4	-113.6	214.0	2,035	6.6	10.6	-57.1	229.4	3,128
Policy and control variables:										
Chinn-Ito capital account liberalisation (index)	0.94	0.15	0.17	1.00	2,060	0.53	0.34	0.00	1.00	3,468
External liabilities (ratio to GDP)	1.71	1.15	0.32	6.69	2,080	0.79	0.45	0.09	3.81	3,436
US exposure to domestic equity and debt (% of GDP)	56.5	51.5	2.3	263.6	1,632	19.2	20.8	0.00	137.1	3,058
Strict peg, Obstfeld, Shambaugh and Taylor (dummy)	0.39	0.49	0.00	1.00	2,088	0.25	0.43	0.00	1.00	3,712
Soft peg, Obstfeld, Shambaugh and Taylor (dummy)	0.28	0.45	0.00	1.00	2,088	0.31	0.46	0.00	1.00	3,596
Strict peg, Ilzetzki, Reinhart and Rogoff (dummy)	0.42	0.49	0.00	1.00	2,088	0.23	0.42	0.00	1.00	3,712
Soft peg, Ilzetzki, Reinhart and Rogoff (dummy)	0.37	0.48	0.00	1.00	2,088	0.66	0.47	0.00	1.00	3,712
Inflation, year-on-year (%)	2.26	2.24	-2.41	21.0	1,944	15.1	41.0	-3.82	495.2	3,381
Domestic GDP growth, year-on-year (%)	1.8	2.4	-10.9	8.7	1,944	4.1	5.6	-19.7	73.0	3,317

Table 3: Summary of the identification assumptions

Shock	*Monetary Policy* *(signs implied by external instrument)*	US Demand	Financial	Geopolitical Uncertainty
US Treasury Rate (one-year)	+	-	-	-
SP500 (log)	-	-	-	-
US Consumer Price Index (log)	-	-	-	+
High Yield USD Corporate Bonds (yield)	+	-	+	
Trade Weighted US Dollar index (log)	+	-	+	+
Oil Price (Brent Quality, log)		-	-	+
Global Stock Market Factor	+	+	+	+

Table 4: Forecast Error Variance Decomposition (12 steps ahead)

	15th percentile	mean	85th percentile
MP	0.11	0.19	0.28
Financial Shock	0.00	0.23	0.68
Geopol. Uncertainty	0.01	0.13	0.26
US demand	0.01	0.07	0.13

Table 5: Capital flows, global risk and US monetary policy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Fixed effects					System GMM				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Lag 1 dep. variable	0.136***	0.175***	0.123***	0.044	0.089***	0.184***	0.207***	0.144***	0.046	0.071
	(0.023)	(0.028)	(0.026)	(0.032)	(0.029)	(0.028)	(0.053)	(0.039)	(0.054)	(0.047)
Lag 2 dep. variable	0.114***	0.107***	0.143***	0.115***	0.129***	0.128***	0.153**	0.135***	0.095**	0.081
	(0.023)	(0.024)	(0.023)	(0.028)	(0.025)	(0.018)	(0.074)	(0.043)	(0.045)	(0.052)
Lag 3 dep. variable	0.076***	-0.009	0.089***	0.055*	0.051	0.119***	0.003	0.125***	0.047	0.028
	(0.023)	(0.030)	(0.027)	(0.032)	(0.039)	(0.031)	(0.046)	(0.028)	(0.034)	(0.036)
Lag 4 dep. variable	0.172***	0.100***	0.167***	0.202***	0.242***	0.191***	0.144*	0.191***	0.181***	0.184***
	(0.020)	(0.029)	(0.035)	(0.039)	(0.035)	(0.033)	(0.079)	(0.043)	(0.054)	(0.060)
Inflation (t-1)	-0.003**	0.001	0.001	0.007*	0.004	-0.003	-0.000	-0.006*	0.007	-0.006
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.002)	(0.000)	(0.003)	(0.007)	(0.007)
GDP growth (t-1)	0.021	0.008	-0.005	0.102**	0.123**	0.020	0.009	-0.071	-0.098	-0.025
	(0.013)	(0.005)	(0.017)	(0.050)	(0.054)	(0.035)	(0.010)	(0.070)	(0.072)	(0.107)
World GDP growth (t-1)	0.088**	-0.061*	-0.161	0.419***	0.265	0.018	-0.051	0.129	1.124***	1.485***
	(0.040)	(0.032)	(0.117)	(0.149)	(0.284)	(0.095)	(0.078)	(0.230)	(0.386)	(0.500)
Global Stock Market Factor	**-0.469*** **	**-0.136*** **	**-0.354** **	**-0.809*** **	**-1.718*** **	**-0.334** **	-0.161	**-1.015*** **	**-1.151** **	**-2.889*** **
	(0.063)	(0.050)	(0.139)	(0.265)	(0.374)	(0.144)	(0.113)	(0.271)	(0.479)	(0.565)
US monetary policy surprise, Gertler-Karadi	0.024	**-0.192*** **	**-0.477* **	-0.432	-1.278	-0.077	**-0.172** **	**-0.501*** **	0.195	-0.679
	(0.074)	(0.066)	(0.270)	(0.494)	(0.783)	(0.078)	(0.067)	(0.158)	(0.370)	(0.460)
Observations	4,852	4,604	4,613	4,820	4,772	4,852	4,604	4,613	4,820	4,772
Countries	50	49	49	50	50	50	49	49	50	50
R^2	0.180	0.083	0.120	0.116	0.207					
Instruments						18	18	18	18	18
J test (p-value)						0.692	0.0895	0.432	0.195	0.136

Notes: The first five columns report the results of the model including country-specific fixed effects. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The last five columns report the two-step system-GMM estimates with the Windmeijer (2004) small sample correction, treating the Global Stock Market Factor as endogenous (instrumented with the second lag level in the first differences equation) and the control variables as predetermined (instrumented with the first lag level) with the exception of the US monetary policy surprise that is treated as exogenous. The J test is the Hansen test for the validity of the instruments, testing over-identifying restrictions under the null hypothesis that the instrumental variables are uncorrelated with the error term. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 6: Capital flows, global risk and US monetary policy
Advanced vs. emerging economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	Advanced economies					Emerging economies				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Inflation (t-1)	-0.028	-0.027	0.013	-0.068	-0.182	-0.002*	0.000	-0.000	0.005*	0.003
	(0.034)	(0.032)	(0.072)	(0.142)	(0.189)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
GDP growth (t-1)	0.037	0.015	0.022	0.038	0.167	0.015	0.007*	-0.018	0.090**	0.094*
	(0.033)	(0.025)	(0.095)	(0.208)	(0.166)	(0.012)	(0.004)	(0.015)	(0.044)	(0.050)
World GDP growth (t-1)	0.078	-0.081*	-0.365*	1.125***	0.613*	0.088**	-0.046	0.010	0.109	0.071
	(0.071)	(0.046)	(0.205)	(0.291)	(0.345)	(0.044)	(0.028)	(0.097)	(0.151)	(0.264)
Global Stock Market Factor	**-0.575***	**-0.206**	**-0.769***	**-1.196***	**-2.839***	**-0.397***	**-0.084**	-0.033	**-0.561**	**-1.027***
	(0.107)	(0.090)	(0.231)	(0.362)	(0.536)	(0.069)	(0.041)	(0.119)	(0.269)	(0.388)
US monetary policy surprise	-0.020	**-0.162***	**-0.675***	-0.435	-1.589	0.024	**-0.210***	-0.385	-0.454	**-1.042***
	(0.134)	(0.089)	(0.330)	(0.849)	(1.162)	(0.071)	(0.067)	(0.324)	(0.353)	(0.585)
Observations	1,885	1,793	1,844	1,885	1,885	2,967	2,811	2,769	2,935	2,887
Countries	18	18	18	18	18	32	31	31	32	32
R^2	0.114	0.0773	0.176	0.0969	0.203	0.242	0.111	0.0477	0.211	0.259

Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Capital flows, global risk and US monetary policy
Excluding large financial centres and the global financial crisis in 2008-09

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	Excluding large financial centres (US, UK, CH)					Excluding global financial crisis (2008-09)				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Inflation (t-1)	-0.003**	0.000	0.001	0.007*	0.004	-0.003**	0.001	0.001	0.007*	0.006
	(0.001)	(0.001)	(0.002)	(0.004)	(0.003)	(0.001)	(0.001)	(0.002)	(0.004)	(0.004)
GDP growth (t-1)	0.019	0.007	-0.003	0.103**	0.123**	0.012	0.010*	0.007	0.085	0.106**
	(0.013)	(0.005)	(0.017)	(0.050)	(0.053)	(0.011)	(0.006)	(0.018)	(0.053)	(0.053)
World GDP growth (t-1)	0.098***	-0.059*	-0.169	0.315**	0.165	0.086	-0.023	-0.015	0.473***	0.443
	(0.036)	(0.034)	(0.119)	(0.146)	(0.282)	(0.062)	(0.037)	(0.116)	(0.162)	(0.282)
Global Stock Market Factor	**-0.450***	**-0.130**	**-0.341**	**-0.793***	**-1.650***	**-0.488***	**-0.152***	**-0.259***	**-0.620**	**-1.429***
	(0.057)	(0.056)	(0.135)	(0.272)	(0.376)	(0.065)	(0.036)	(0.132)	(0.257)	(0.325)
US monetary policy surprise	0.007	**-0.215***	**-0.500***	-0.101	-0.939	-0.007	**-0.159***	-0.171	0.146	-0.254
	(0.070)	(0.077)	(0.277)	(0.430)	(0.723)	(0.074)	(0.082)	(0.214)	(0.331)	(0.440)
Observations	4,567	4,319	4,328	4,535	4,487	4,452	4,212	4,225	4,420	4,376
Countries	47	46	46	47	47	50	49	49	50	50
R^2	0.191	0.0904	0.114	0.122	0.223	0.178	0.0812	0.124	0.116	0.215

Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 8: The structural drivers of the global capital flows cycle

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	Shocks					Contributions				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Inflation (t-1)	-0.003**	0.001	0.001	0.005*	0.003	-0.004***	0.000	-0.000	0.004	-0.001
	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)
GDP growth (t-1)	0.023*	0.010*	0.002	0.110**	0.134**	0.020	0.008	-0.009	0.098*	0.116**
	(0.013)	(0.005)	(0.017)	(0.052)	(0.057)	(0.013)	(0.006)	(0.018)	(0.050)	(0.055)
World GDP growth (t-1)	0.227***	-0.018	-0.084	0.592***	0.638**	0.089**	-0.068**	-0.201	0.370***	0.167
	(0.061)	(0.018)	(0.080)	(0.150)	(0.264)	(0.042)	(0.028)	(0.127)	(0.131)	(0.260)
Monetary policy shock	-0.152	**-0.202***	**-0.431**	-0.369	**-1.224**	**-0.408**	-0.033	-0.282	-0.781	**-1.486***
	(0.099)	(0.065)	(0.168)	(0.431)	(0.515)	(0.200)	(0.165)	(0.324)	(0.489)	(0.759)
Financial shock	-0.279	**-0.308***	**-1.195***	**-1.352***	**-3.174***	**-0.609***	-0.076	**-0.722***	**-1.549***	**-2.821***
	(0.198)	(0.052)	(0.209)	(0.401)	(0.544)	(0.172)	(0.121)	(0.266)	(0.413)	(0.619)
Geopolitical-uncertainty shock	**-0.252**	**-0.333***	-0.070	0.628**	0.133	**-0.894**	**-0.493***	-0.589	-1.188	-3.275
	(0.112)	(0.067)	(0.217)	(0.301)	(0.429)	(0.368)	(0.143)	(0.612)	(1.280)	(2.067)
Observations	4,852	4,604	4,613	4,820	4,772	4,852	4,604	4,613	4,820	4,772
Countries	50	49	49	50	50	50	49	49	50	50
R^2	0.169	0.101	0.129	0.115	0.206	0.176	0.0802	0.119	0.116	0.204

Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 9: The trilemma in the transmission of global risk and US monetary policy to capital flows (*de jure* capital account openness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate regime classification	Obstfeld, Shambaugh and Taylor					Ilzetzki, Reinhart and Rogoff				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Inflation (t-1)	-0.003*	0.001	-0.003	0.009***	0.002	-0.001	0.002*	-0.004	0.016***	0.010*
	(0.002)	(0.001)	(0.002)	(0.003)	(0.005)	(0.002)	(0.001)	(0.003)	(0.004)	(0.006)
GDP growth (t-1)	0.030**	0.010	-0.034*	0.189***	0.188***	0.028**	0.013*	-0.032*	0.194***	0.197***
	(0.013)	(0.006)	(0.020)	(0.057)	(0.057)	(0.013)	(0.007)	(0.019)	(0.059)	(0.060)
World GDP growth (t-1)	0.074*	-0.071**	-0.161	0.294**	0.126	0.069*	-0.070**	-0.155	0.304**	0.137
	(0.039)	(0.034)	(0.108)	(0.142)	(0.256)	(0.038)	(0.034)	(0.109)	(0.143)	(0.259)
De jure capital account openness (KAOPEN)	0.421	0.042	0.316	0.186	0.903	0.323	0.003	0.331	-0.008	0.654
	(0.262)	(0.096)	(0.401)	(0.642)	(0.835)	(0.287)	(0.100)	(0.403)	(0.642)	(0.878)
Strict peg	-0.188	0.156*	0.252	0.707	1.028	0.695**	0.410***	0.043	2.601***	3.544***
	(0.155)	(0.085)	(0.269)	(0.506)	(0.682)	(0.298)	(0.133)	(0.435)	(0.665)	(0.929)
Soft peg	-0.103	0.036	-0.053	0.419	0.268	0.888***	0.147	-0.278	2.366***	2.646**
	(0.120)	(0.072)	(0.164)	(0.351)	(0.490)	(0.237)	(0.128)	(0.430)	(0.847)	(1.068)
Global Stock Market Factor (GSMF)	-0.123	-0.147	0.045	0.872***	0.615*	0.208	**-0.289****	-0.106	1.248***	0.973**
	(0.114)	(0.091)	(0.160)	(0.261)	(0.336)	(0.132)	(0.133)	(0.201)	(0.337)	(0.414)
GSMF * KAOPEN	**-0.367****	0.006	**-0.561****	**-1.750*****	**-2.734*****	**-0.482*****	0.061	**-0.443****	**-1.952*****	**-2.786*****
	(0.149)	(0.093)	(0.220)	(0.404)	(0.497)	(0.152)	(0.115)	(0.203)	(0.422)	(0.491)
GSMF * Strict peg	**-0.304*****	**-0.079***	-0.011	**-1.380*****	**-1.818*****	**-0.485*****	0.005	-0.087	**-1.389*****	**-2.104*****
	(0.098)	(0.047)	(0.264)	(0.329)	(0.396)	(0.127)	(0.077)	(0.322)	(0.505)	(0.533)
GSMF * Soft peg	-0.070	0.027	0.055	-0.331	-0.177	**-0.362*****	0.146*	0.168	**-0.523****	-0.495
	(0.095)	(0.087)	(0.119)	(0.270)	(0.336)	(0.098)	(0.083)	(0.156)	(0.221)	(0.319)
US Monetary Policy Surprises	-0.019	-0.165	**-0.580***	-0.498	-1.125	-0.075	-0.062	-0.231	-0.855	-0.972
	(0.152)	(0.170)	(0.342)	(0.479)	(0.849)	(0.175)	(0.145)	(0.412)	(0.626)	(0.826)
MPS * KAOPEN	0.063	0.052	-0.433	-0.212	-0.983	0.057	0.010	-0.336	-0.152	-0.803
	(0.278)	(0.167)	(0.373)	(0.692)	(0.882)	(0.281)	(0.171)	(0.385)	(0.724)	(0.918)
MPS * Strict peg	-0.000	**-0.243****	0.885	1.368**	1.853*	0.070	**-0.262****	0.313	1.801**	1.631*
	(0.174)	(0.098)	(0.645)	(0.596)	(1.011)	(0.191)	(0.118)	(0.567)	(0.772)	(0.955)
MPS * Soft peg	-0.035	-0.037	0.475	0.296	1.056	0.068	-0.132	-0.246	0.418	0.059
	(0.163)	(0.105)	(0.300)	(0.591)	(0.862)	(0.127)	(0.125)	(0.259)	(0.486)	(0.586)
Observations	4,395	4,202	4,208	4,363	4,346	4,395	4,202	4,208	4,363	4,346
Countries	50	49	49	50	50	50	49	49	50	50
R^2	0.165	0.0871	0.120	0.139	0.226	0.166	0.0896	0.119	0.139	0.227

Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). The *de jure* capital account openness (KAOPEN) is measured with the normalised Chinn-Ito(2006) index. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 10: The trilemma in the transmission of global risk and US monetary policy to capital flows (*de facto* financial openness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate regime classification	Obstfeld, Shambaugh and Taylor					Ilzetzki, Reinhart and Rogoff				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
De facto financial openness (FINOPEN)	0.132	-0.096	-0.140	-0.757*	-0.907	0.151	-0.105	-0.143	-0.756*	-0.933
	(0.106)	(0.067)	(0.247)	(0.429)	(0.577)	(0.112)	(0.068)	(0.243)	(0.427)	(0.588)
Strict peg	-0.090	0.195**	0.389	0.762	1.465*	0.790***	0.426***	0.073	1.539*	2.894***
	(0.172)	(0.088)	(0.279)	(0.537)	(0.796)	(0.276)	(0.119)	(0.401)	(0.892)	(0.984)
Soft peg	-0.090	0.026	-0.087	0.258	0.063	0.876***	0.119	-0.525	0.905	0.992
	(0.120)	(0.066)	(0.170)	(0.344)	(0.486)	(0.221)	(0.122)	(0.337)	(0.799)	(0.884)
US monetary policy surprise	0.006	-0.191**	-0.489**	-0.164	-0.918	0.009	-0.193**	-0.483**	-0.170	-0.915
	(0.082)	(0.075)	(0.234)	(0.379)	(0.560)	(0.083)	(0.075)	(0.237)	(0.387)	(0.568)
Global Stock Market Factor (GSMF)	**-0.183****	**-0.189*****	-0.052	0.554	0.053	-0.009	**-0.294*****	-0.224	0.471	-0.143
	(0.091)	(0.070)	(0.193)	(0.436)	(0.517)	(0.092)	(0.082)	(0.202)	(0.358)	(0.479)
GSMF * FINOPEN	**-0.182****	0.049	-0.256	**-0.780****	**-1.209*****	**-0.179***	0.053	-0.251	**-0.799***	**-1.200*****
	(0.090)	(0.038)	(0.189)	(0.388)	(0.432)	(0.092)	(0.042)	(0.186)	(0.403)	(0.450)
GSMF * Strict peg	**-0.316*****	-0.076	-0.052	**-1.461*****	**-1.976*****	**-0.457*****	0.009	-0.025	**-1.183****	**-1.821*****
	(0.110)	(0.057)	(0.237)	(0.325)	(0.394)	(0.139)	(0.082)	(0.285)	(0.529)	(0.536)
GSMF * Soft peg	-0.062	0.020	0.055	-0.288	-0.135	**-0.256*****	0.135*	0.280	-0.094	0.146
	(0.110)	(0.089)	(0.133)	(0.241)	(0.333)	(0.088)	(0.071)	(0.190)	(0.244)	(0.344)
Observations	4,413	4,219	4,225	4,376	4,364	4,413	4,219	4,225	4,376	4,364
Countries	50	49	49	50	50	50	49	49	50	50
R^2	0.170	0.0879	0.119	0.139	0.226	0.171	0.0905	0.120	0.138	0.226

Notes: The model includes country-specific fixed effects, four lags of the dependent variable and a vector of domestic (inflation and GDP growth) and global (GDP growth) control variables that can affect capital flows (omitted for space reasons). The *de facto* financial openness (FINOPEN) is the ratio of total external liabilities to GDP. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 11: The trilemma in the transmission of global risk and US monetary policy to capital flows (financial exposure to the United States)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate regime classification	Obstfeld, Shambaugh and Taylor					Ilzetzki, Reinhart and Rogoff				
Dependent variable	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total	Direct investm.	Portfolio equity	Portfolio debt	Other investm.	Total
Financial exposure to US (FINEX)	0.009**	-0.004*	-0.003	-0.004	-0.001	0.009**	-0.004*	-0.003	-0.003	-0.000
	(0.004)	(0.002)	(0.005)	(0.011)	(0.012)	(0.004)	(0.002)	(0.005)	(0.011)	(0.012)
Strict peg	-0.305	0.156*	0.345	0.387	0.802	0.758*	0.231	0.172	2.642**	3.490**
	(0.238)	(0.085)	(0.340)	(0.707)	(1.014)	(0.435)	(0.155)	(0.560)	(1.144)	(1.426)
Soft peg	-0.187	0.045	-0.059	0.525	0.306	0.997***	-0.039	-0.089	3.268**	3.288**
	(0.149)	(0.062)	(0.200)	(0.421)	(0.587)	(0.360)	(0.143)	(0.551)	(1.317)	(1.599)
US monetary policy surprise	0.058	-0.261***	-0.506	-0.256	-1.103	0.060	-0.262***	-0.501	-0.320	-1.147
	(0.111)	(0.084)	(0.306)	(0.515)	(0.770)	(0.115)	(0.084)	(0.312)	(0.531)	(0.779)
Global Stock Market Factor (GSMF)	**-0.213****	-0.117	**-0.282***	-0.245	-0.925	-0.035	-0.193	-0.390	-0.569	**-1.224****
	(0.107)	(0.083)	(0.155)	(0.388)	(0.598)	(0.145)	(0.146)	(0.240)	(0.453)	(0.612)
GSMF * FINEX	-0.003	0.000	-0.000	-0.002	-0.004	-0.002	0.000	-0.001	-0.001	-0.003
	(0.002)	(0.001)	(0.002)	(0.006)	(0.007)	(0.002)	(0.001)	(0.002)	(0.006)	(0.008)
GSMF * Strict peg	**-0.539*****	-0.101	-0.218	**-1.887*****	**-2.731*****	**-0.679*****	-0.038	-0.251	**-1.425****	**-2.501*****
	(0.108)	(0.072)	(0.340)	(0.465)	(0.619)	(0.175)	(0.123)	(0.396)	(0.638)	(0.740)
GSMF * Soft peg	-0.161	-0.003	0.012	-0.275	-0.308	**-0.323****	0.083	0.222	0.112	0.142
	(0.123)	(0.099)	(0.135)	(0.306)	(0.423)	(0.132)	(0.123)	(0.255)	(0.375)	(0.433)
Observations	3,800	3,651	3,639	3,763	3,757	3,800	3,651	3,639	3,763	3,757
Countries	49	48	48	49	49	49	48	48	49	49
R^2	0.147	0.076	0.113	0.135	0.216	0.148	0.077	0.114	0.135	0.217

Notes: The model includes country-specific fixed effects, four lags of the dependent variable and a vector of domestic (inflation and GDP growth) and global (GDP growth) control variables that can affect capital flows (omitted for space reasons). The financial exposure to the United States (FINEX) is the bilateral portfolio investment by US residents to the recipient country divided by recipient country's GDP. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 12: The trilemma in the transmission of global risk to capital flows. Robustness

Policy controls: *De jure* capital account openness and Obstfeld, Shambaugh, Taylor (OST) exchange rate regime classification.

Dependent variable: Total Capital Flows

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Benchmark	Advanced economies	Emerging economies	Excl. euro area	Excl. financial centres	Excl. global fin. crisis	Including crises	Including time dummies
Inflation (t-1)	0.002	-0.102	0.003	-0.000	0.003	0.001	0.000	0.003
	(0.005)	(0.193)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.007)
GDP growth (t-1)	0.185***	0.193	0.152***	0.160***	0.178***	0.096	0.120**	0.197**
	(0.055)	(0.182)	(0.051)	(0.051)	(0.052)	(0.063)	(0.058)	(0.074)
World GDP growth (t-1)	0.139	0.463	-0.062	0.270	0.040	0.372	0.235	
	(0.259)	(0.333)	(0.247)	(0.241)	(0.260)	(0.289)	(0.274)	
De jure capital account	0.920	4.699	0.377	0.355	0.651	0.419	1.009	0.833
openness (KAOPEN)	(0.824)	(3.080)	(0.860)	(0.806)	(0.804)	(0.873)	(0.876)	(0.684)
Strict peg, OST	0.982	0.499	1.110	0.638	1.168*	0.518	1.370**	0.478
	(0.698)	(1.740)	(0.708)	(0.647)	(0.605)	(0.537)	(0.656)	(0.559)
Soft peg, OST	0.250	0.613	0.259	0.308	0.113	-0.215	0.383	-0.084
	(0.512)	(1.331)	(0.315)	(0.478)	(0.385)	(0.332)	(0.472)	(0.380)
US monetary policy	-1.050*	-1.071	-1.015*	-1.201**	-0.702	-0.238	-1.203	
surprise	(0.625)	(0.881)	(0.586)	(0.594)	(0.577)	(0.470)	(0.753)	
Global Stock Market	0.612*	3.945	0.332	0.712**	0.413	0.654	0.640**	
Factor (GSMF)	(0.342)	(2.535)	(0.210)	(0.318)	(0.280)	(0.400)	(0.318)	
GSMF * KAOPEN	**-2.679*** **	**-5.747** **	**-2.608*** **	**-2.598*** **	**-2.497*** **	**-2.416*** **	**-2.670*** **	**-2.241*** **
	(0.504)	(2.674)	(0.663)	(0.506)	(0.456)	(0.505)	(0.503)	(0.608)
GSMF * Strict peg, OST	**-1.917*** **	**-2.137*** **	**-1.629*** **	**-1.868*** **	**-1.792*** **	**-1.879*** **	**-1.967*** **	**-1.793*** **
	(0.403)	(0.801)	(0.458)	(0.441)	(0.403)	(0.439)	(0.395)	(0.525)
GSMF * Soft peg, OST	-0.218	**-1.701** **	0.455	-0.218	0.122	-0.198	-0.214	-0.256
	(0.333)	(0.744)	(0.279)	(0.342)	(0.261)	(0.332)	(0.335)	(0.389)
Observations	4,346	1,785	2,561	3,705	4,077	4,110	4,717	4,346
Countries	50	18	32	50	47	50	50	50
R^2	0.225	0.199	0.304	0.204	0.247	0.231	0.225	0.287

Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). The *de jure* capital account openness (KAOPEN) is measured with the normalised Chinn-Ito(2006) index. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 13: The trilemma in the transmission of global risk to capital flows. Robustness

Policy controls: *De jure* capital account openness and Ilzetzki, Reinhart, and Rogoff (IRR) exchange rate regime classification.

Dependent variable: Total Capital Flows

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Benchmark	Advanced economies	Emerging economies	Excl. euro area	Excl. financial centres	Excl. global fin. crisis	Including crises	Including time dummies
Inflation (t-1)	0.009	-0.067	0.007	0.010*	0.005	0.008	0.006	0.010
	(0.006)	(0.189)	(0.005)	(0.006)	(0.005)	(0.006)	(0.004)	(0.007)
GDP growth (t-1)	0.193***	0.188	0.168***	0.168***	0.190***	0.103	0.120*	0.204***
	(0.058)	(0.184)	(0.055)	(0.055)	(0.055)	(0.065)	(0.061)	(0.073)
World GDP growth (t-1)	0.144	0.482	-0.057	0.281	0.036	0.372	0.251	
	(0.259)	(0.321)	(0.256)	(0.247)	(0.261)	(0.291)	(0.271)	
De jure capital account openness (KAOPEN)	0.690	6.153*	0.106	-0.227	0.495	0.159	0.851	0.466
	(0.872)	(3.409)	(0.852)	(0.831)	(0.826)	(0.898)	(0.918)	(0.740)
Strict peg, IRR	3.383***	3.731**	3.175***	4.865***	2.394***	3.083***	3.513***	3.424**
	(0.950)	(1.636)	(1.134)	(1.399)	(0.837)	(0.999)	(0.701)	(1.550)
Soft peg, IRR	2.574**	5.289**	1.540**	3.589***	1.133	2.552**	2.555***	2.484*
	(1.061)	(2.331)	(0.727)	(1.231)	(0.727)	(1.090)	(0.869)	(1.334)
US monetary policy surprise	-1.055	-1.071	-1.013*	-1.173*	-0.714	-0.231	-1.236	
	(0.640)	(0.881)	(0.605)	(0.607)	(0.585)	(0.466)	(0.767)	
Global Stock Market Factor (GSMF)	0.947**	4.006	0.097	1.127***	0.968***	0.999**	1.016**	
	(0.419)	(2.547)	(0.572)	(0.383)	(0.346)	(0.474)	(0.414)	
GSMF * KAOPEN	**-2.700*** **	**-5.885** **	**-2.525*** **	**-2.794*** **	**-2.407*** **	**-2.478*** **	**-2.684*** **	**-2.138*** **
	(0.490)	(2.609)	(0.606)	(0.497)	(0.410)	(0.511)	(0.480)	(0.645)
GSMF * Strict peg, IRR	**-2.204*** **	**-2.235*** **	**-1.386**	**-2.085*** **	**-2.344*** **	**-2.170*** **	**-2.295*** **	**-1.836** **
	(0.546)	(0.841)	(0.888)	(0.642)	(0.574)	(0.621)	(0.507)	(0.688)
GSMF * Soft peg, IRR	-0.499	-0.747	0.293	-0.531	**-0.687** **	-0.472	**-0.555* **	-0.089
	(0.315)	(0.495)	(0.667)	(0.323)	(0.345)	(0.351)	(0.328)	(0.600)
Observations	4,346	1,785	2,561	3,705	4,077	4,110	4,717	4,346
Countries	50	18	32	50	47	50	50	50
R^2	0.226	0.201	0.303	0.206	0.247	0.232	0.226	0.288

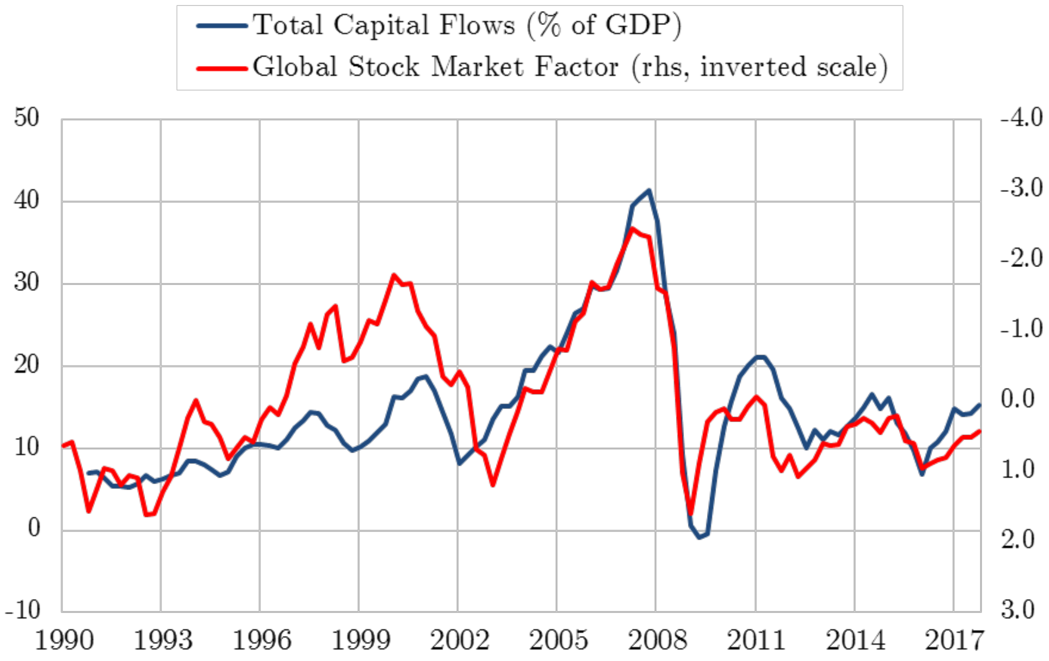
Notes: The model includes country-specific fixed effects and four lags of the dependent variable (omitted for space reasons). The *de jure* capital account openness (KAOPEN) is measured with the normalised Chinn-Ito(2006) index. Driscoll-Kraay standard errors, accounting for cross-sectional and temporal dependence of the residuals, are reported in parentheses. The asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 14: Impact of global risk shock on capital flows (absolute value) as % of GDP

	Direct investment	Other investment	Total
Full sample			
Average impact	0.5	0.8	1.7
Fully open economies*	0.6	1.5	2.8
Open and strict peg	0.7	2.3	4.0
Memo: Sample Mean	*3.0*	*2.4*	*7.8*
Standard Deviation	*(6.2)*	*(10.9)*	*(13.8)*
Advanced economies			
Average impact	0.6	1.2	2.8
Fully open economies*	1.4	1.4	3.2
Open and strict peg	1.3	1.7	3.9
Memo: Sample Mean	*2.4*	*3.4*	*9.6*
Standard Deviation	*(5.1)*	*(15.0)*	*(17.4)*
Emerging markets			
Average impact	0.4	0.6	1.0
Fully open economies*	0.5	1.5	2.3
Open and strict peg	0.9	2.7	4.2
Memo: Sample Mean	*3.4*	*1.8*	*6.6*
Standard Deviation	*(6.7)*	*(6.9)*	*(10.6)*

Notes: the table reports the impact of one-standard deviation change in the Global Stock Market Factor on capital flows (absolute value) as % of GDP according to the benchmark model, including US monetary policy surprises and the Global Stock Market Factor interacted with the Chinn-Ito (2006) *de jure* index of capital account openness and dummies for strict pegs according to the Obstfeld, Shambaugh, Taylor (2010) exchange rate regime classification. *Fully open economies correspond to those observations for which the Chinn-Ito index (normalized) takes the value of 1.

Figure 1: Global capital flows and global risk



Notes: Total capital flows aggregated across 50 economies as share of total GDP. The Global Stock Market Factor is constructed from stock returns for 63 countries.
Sources: IMF Balance of Payments Statistics, Global Financial Data and authors' calculations

Figure 2: Global Stock Market Factor and alternative risk indicators

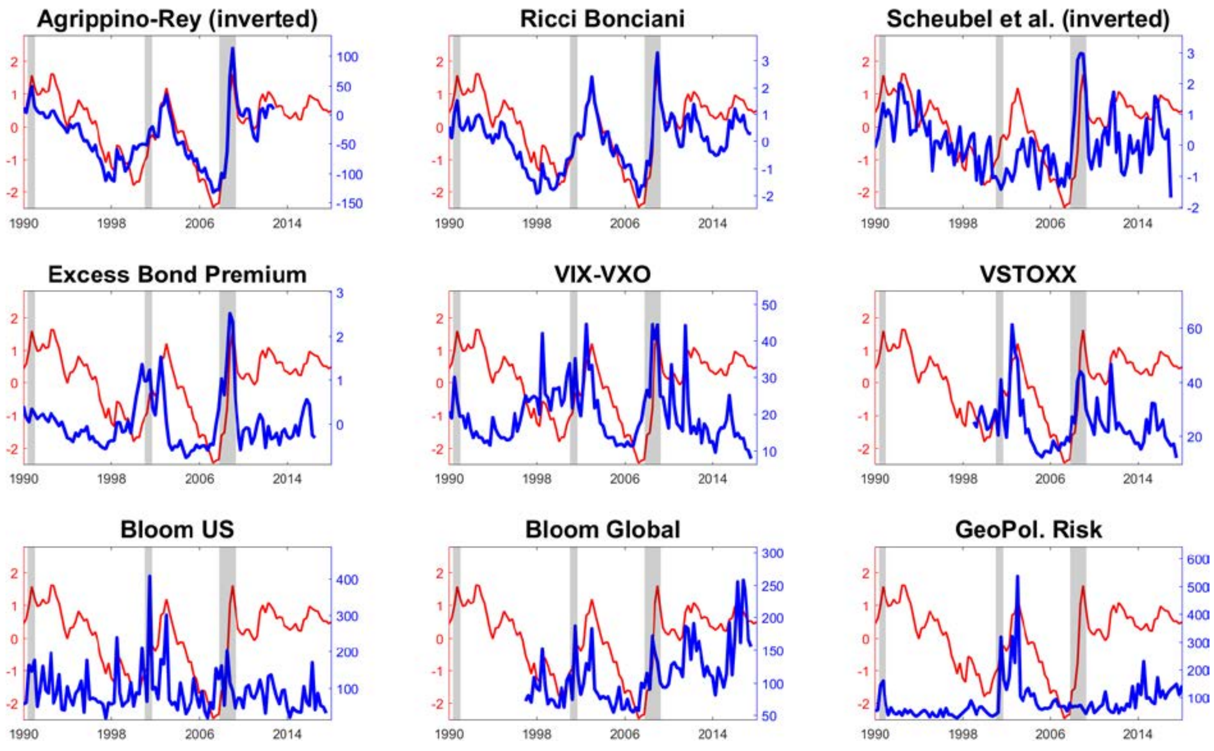


Figure 3: Historical contribution of identified shocks to global risk

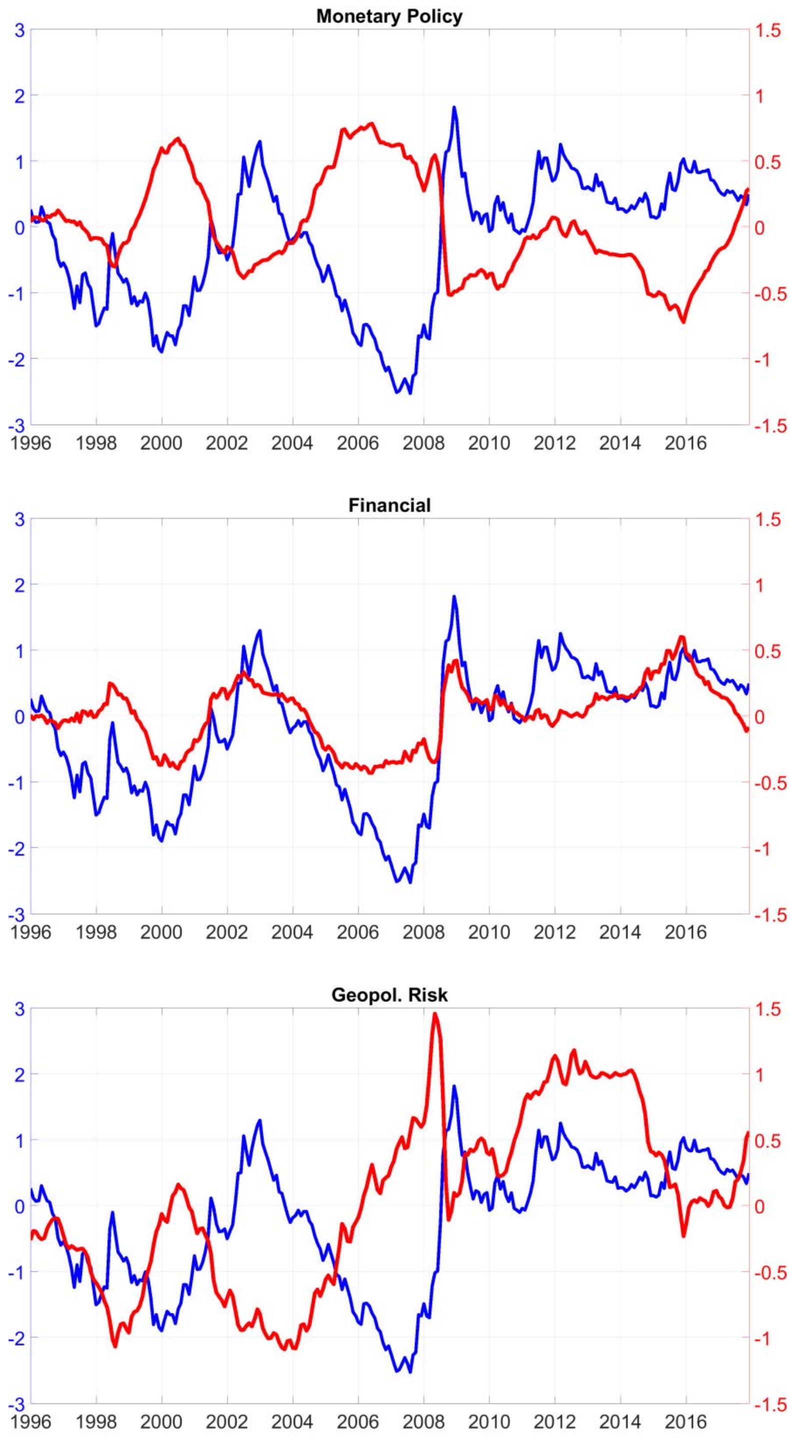
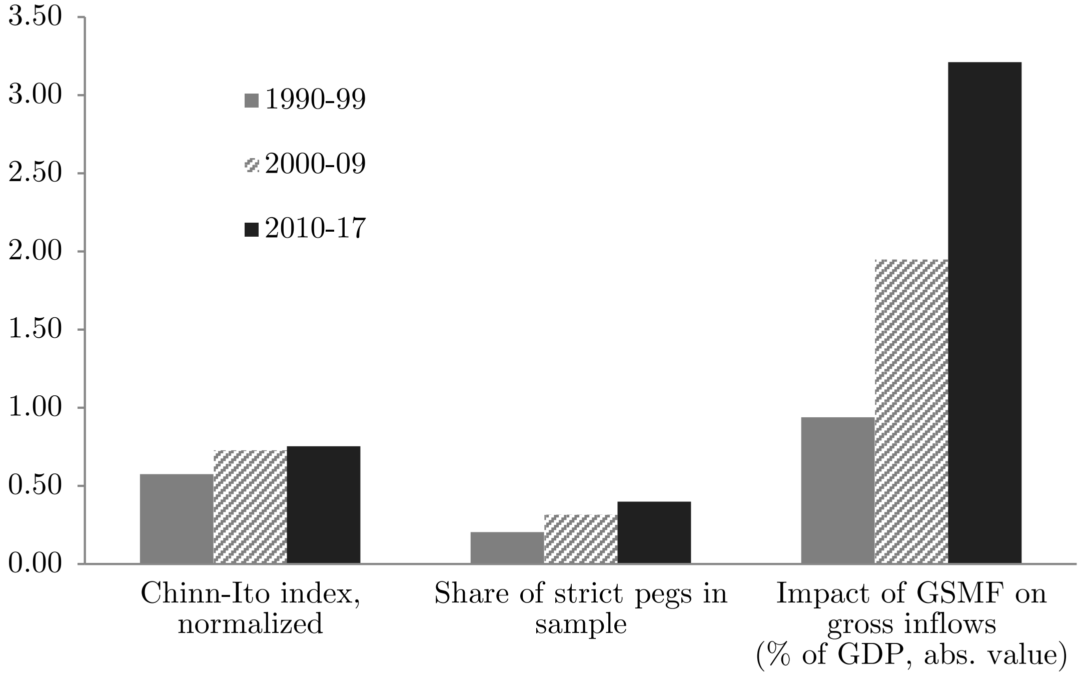


Figure 4: Evolution of policy regimes and sensitivity of total gross capital inflows to the Global Stock Market Factor (GSMF) since the 1990s



Notes: The normalised Chinn-Ito(2006) index is a measure of *de jure* capital account openness ranging between 0 (completely closed) and 1 (fully open). Strict pegs are defined according to the *de facto* exchange rate arrangement classification by Obstfeld, Shambaugh and Taylor (2010). The last three columns report the absolute value of the coefficient associated with the Global Stock Market Factor (GSMF) in the benchmark fixed-effects model for total capital inflows in equation (2), estimated across the three sub-samples: 1990-99; 2000-09 and 2010-2017.

A The Global Stock Market Factor

In this Appendix we offer an intuition of why our Global Stock Market Factor obtains, with a simpler model structure and a fraction of the data, the same results as those by Miranda-Agrippino and Rey (2015). Let us start from a short description of their model. Their dataset includes over eight hundred time series of stock as well as corporate bond returns. Each return for asset i, in market j, at time t is then decomposed into the contribution of three parts, one that is common across all stock returns (f_t^{global}), one that is common across all stock returns in the same market ($f_{j,t}$) and an idiosyncratic element ($\xi_{i,j,t}$). Formally:

$$r_{i,j,t} = \lambda_i f_t^{global} + \lambda_{i,j} f_{j,t} + \xi_{i,j,t} \tag{1}$$

where the global factor (f_t^{global}) and the regional factors ($f_{j,t}$) are orthogonal to each other. The regional factors account for the correlation across asset prices within the same region that is not accounted for by the global factor. Our model, instead, operates directly on regional averages of stock market returns, i.e. we model co-movement across stock returns in the $j = 1, 2, ..., 63$ countries in our sample as follows:

$$r_{j,t} = \lambda_j f_t^{global} + \xi_{j,t} \tag{2}$$

What is the relationship between the original model in equation (1) and our simplified version in equation (2)? It is easy to see that if one averages equation (1) over units i within each region j, one obtains:

$$\overline{r}_{j,t} = \overline{\lambda}_j f_t^{global} + \epsilon_{j,t} \tag{3}$$

which is equivalent to (2).[1] Crucially, the regional averages in equation (3) load exactly on the same global factor f_t^{global} as the individual returns in (1), so that a consistent estimate of this factor can be obtained modeling regional means as well as individual returns. If one is interested in the behaviour of the individual global factor f_t^{global} (and not in the behaviour of the individual regional factors) a model of regional averages like the one in (2) is a valid alternative to (1).[2]

[1]Formally, $\overline{r}_{j,t} = \frac{1}{N_j}\sum_{i \in N_j} r_{i,j,t}$, $\overline{\lambda}_j = \lambda_j$ and $\epsilon_{j,t} = \frac{1}{N_j}\sum_{i \in N_j}(\lambda_{i,j} f_{j,t} + \xi_{i,j,t})$.

[2]This proposition holds as long as long as the number of regions is sufficiently large so that the global factor can be consistently estimated.

B Structural VAR: identification and estimation

Our VAR model includes four US variables (the interest rate on the one-year Treasury bill, the log of the Consumer Price Index, the log of the S&P500 index and of the US dollar index) and three global variables (the yield of an US dollar High-Yield Corporate Bonds index, the log price of oil and the Global Stock Market Factor). Collecting these variables in the vector y_t, the structural representation of the model, which allows for contemporaneous interaction of the variables, is the following:

$$A_0 y_t = A_1 y_{t-1} + A_2 y_{t-1} + ... + A_1 y_{t-p} + c + e_t \qquad u_t \sim i.i.d.\ N(0, I), \tag{4}$$

where A_0 is an $n \times n$ matrix of contemporaneous interactions, the p matrices A_j, $j = 1, 2, ..., p$ of dimension $n \times n$ collect the autoregressive coefficients, e_t is a n dimensional vector of structural shocks and c is an intercept term. The model can be written in compact form as follows:

$$A_0 y_t = A_+ x_t + e_t \qquad e_t \sim i.i.d.\ N(0, I), \tag{5}$$

where $A_+ = [A_1, A_2, ..., A_p]$ and $x_t = [y'_{t-1}, y'_{t-1}, ..., y'_{t-p}, 1]'$. The reduced form model, which does not contain contemporaneous interaction terms, is the following

$$y_t = \Phi_1 y_{t-1} + \Phi_2 y_{t-1} + ... + \Phi_p y_{t-p} + u_t \qquad u_t \sim i.i.d.\ N(0, \Sigma),$$

where the generic j^{th} matrix $\Phi_j = {A_0}^{-1} A_j$. The relationship between reduced form and structural shocks is the following:

$$u_t = A_0^{-1} e_t = B e_t, \tag{6}$$
$$\Sigma = (A'_0 A_0)^{-1}. \tag{7}$$

where the matrix B, the structural impact matrix, is the key element of interest in the structural identification. A compact representation of the reduced form model is the following:

$$y_t = \Phi_+ x_t + u_t \qquad u_t \sim i.i.d.\ N(0, \Sigma),$$

where $\Phi_+ = {A_0}^{-1} A_+$. Structural identification implies estimation of the structural impact matrix B starting from the reduced form coefficients Φ and Σ. We approach both the estimation and the identification problem using a Bayesian approach. Equation 6 shows that $B = A_0^{-1}$ allows us to define a mapping from reduced form residuals to structural shocks. Together with the reduced form parameters Φ_+ and Σ, the matrix B allows us to compute Impulse Response Functions (IRFs) and other quantities of interest. Let us partition the $n \times 4$ structural impact matrix B in columns, $B = [b_1, b_2, b_3, b_4]$. In our identification strategy, we estimate the elements of the first columns b_1 using an external instrument (monetary policy surprises); whereas the elements of the remaining three columns b_2 to b_4 are only *set-identified*, i.e. they need to fulfil the sign restrictions in Table 3 in the main text.

B.1 Estimating Φ_+, Σ and b_1

Our first step consists of estimating Φ_+, Σ and the first column of B, that is b_1, using the Bayesian procedure proposed by Caldara and Herbst (2019). To understand how the method works, let us consider the relationship between the external instrument z_t and the shock that we want to identify using this instrument (without loss of generality let us assume that this is the first shock, i.e. e_1). If z_t is a *valid* and *relevant* instrument[3] then the relationship between the shock and the instrument can be consistently estimated with the following regression:

$$z_t = \beta e_{1,t} + \sigma_\nu \nu_t, \quad \nu_t \sim N(0,1) \tag{8}$$

Equation (8) shows that if we had available an estimate of β and σ_ν, then we could recover the first shock $e_{1,t}$ and, consequently, estimate its effect on the variables in the VAR, i.e. the column b_1. Caldara and Herbst (2019) develop a sampler that delivers a joint posterior distribution for Φ_+, Σ, β and σ_ν, and therefore provides an estimate of b_1.

B.2 Estimating b_2 to b_4

Next, we need to *set identify* b_2, b_3 and b_4. In practical terms this means obtaining values for these vectors that respect the sign restrictions in Table 3 and that are conditional on the values for b_1, Φ_+ and Σ estimated in the previous step. Method that tackle this problem have been developed by Cesa Bianchi and Sokol (2017), Braun and Brggemann (2017) and Arias, Rubio-Ramirez and Waggoner (2019). We briefly describe how we adapt the procedure by Cesa Bianchi and Sokol (2017) to the Bayesian framework of Caldara and Herbst (2019).

[3] Validity implies that the instrument is correlated with the shock of interest but uncorrelated with the remaining shocks. Relevance implies that the correlation between the instrument and the shock of interest is significantly different from zero.

Identification via sign restriction consists of finding an orthonormal matrix Ω (i.e. a matrix such that $\Omega^{-1} = \Omega'$) that rotates the reduced form residuals and makes them consistent with structural shocks that have the desired economic interpretation. In other words given the Choleski factor Σ_{tr} of Σ such that $\Sigma_{tr}\Sigma_{tr}' = \Sigma$ the problem consists of finding a particular Ω such that:

$$\begin{aligned} B &= [b_1, b_2, .., b_n] \\ &= \Sigma_{tr}\Omega \\ &= \Sigma_{tr}[\omega_1, \omega_2, ..., \omega_n] \\ &= [\Sigma_{tr}\omega_1, \Sigma_{tr}\omega_2, ..., \Sigma_{tr}\omega_n] \end{aligned} \tag{9}$$

Equation (9) shows that conditioning on b_1 implies a restriction on the first column of Ω $\omega_1 = \Sigma_{tr}^{-1}b_1$.[4] Then, in order to find a rotation matrix Ω such that the remaining columns satisfy the sign restrictions, we implement the following algorithm:

1. Draw Φ_+, Σ and b_1 using the method in Caldara and Herbst (2019)
2. Compute $\hat{\omega}_1 = \Sigma_{tr}^{-1}b_1$
3. Draw a candidate $n \times n$ orthonormal Ω matrix using the algorithm in Rubio-Ramirez, Waggoner and Arias (2016).
4. Replace ω_1 in Ω with $\hat{\omega}_1$.
5. Orthogonalize columns from 2 to n of Ω with respect to $\hat{\omega}_1$.[5] Call this matrix $\Omega^\star$
6. Compute $B = \Sigma_{tr}\Omega^\star$. If columns b_2, b_3 and b_4 satisfy the sign restrictions retain this draw, otherwise discard it and return to step 1.

Monetary policy shock. There is now a long and established tradition of using interest rate surprises around policy announcements as an instrument for monetary policy shocks. The validity of this High Frequency Identification approach (HFI), rests on the premise that changes in the prices of futures interest rates before and after a monetary policy decision mainly reflect a shift in the monetary policy stance rather than other macroeconomic shocks. In this spirit, Gertler and Karadi (2015) use it in the context of Vector Autoregressions (VAR) and study the transmission of monetary policy to credit costs. An issue with this methodology arises as central banks' announcements convey information not only about monetary policy (the monetary policy shock) but also about the assessment of the central bank on the state of the economy (an information shock). Jarocinski and Karadi (2018) suggest

[4] The intuition is that since the orthonormal matrix Ω spans $\boldsymbol{R}^n$ the first vector can be picked up arbitrarily.

[5] This is done using the Grahm-Schmidt procedure.

a relatively easy way to disentangle these two components by looking at the contemporaneous co-movement between equity prices and interest rate futures. Such co-movement should be negative in the case of monetary policy shocks and positive in the case of information shocks. Only interest rates surprises that trigger a stock price reaction of the opposite sign provide an estimate of the monetary policy component embedded in interest rates surprises. We follow their approach and use such surprises “clean” of information shocks to estimate monetary policy shocks.[6]

Demand Shocks. Negative US demand shocks are identified as shocks that generate a fall in interest rates, a drop in stock prices, and a concomitant reduction in oil and consumer prices. The global stock market factor rises, as the appetite for risk falls due to worsened economic conditions. Notably, we assume that the yield on High Yields Corporate bonds decreases, corresponding to a *loosening* in financing conditions for risky borrowers. Recessionary headwinds drive risk premia higher, but the increase in risk premia is more than offset by the reduction in the safe leg of the interest rate. Finally, the US dollar depreciates.

Financial shocks. A financial shock, i.e. an exogenous decrease in the risk bearing capacity of the financial system, is also identified using sign restrictions. Such shock looks like a negative demand shock except for two differences. First, following Cesa Bianchi and Sokol (2017), we assume that the financing costs for risky borrowers *worsen* following a financial shock. In this case, the increase in compensation required to bear the additional default risk associated with worse economic conditions more than offsets the fall in safe interest rates, which follows an expected monetary policy accommodation. Second, the US dollar appreciates as flight to safety characterises this shock.

Geopolitical uncertainty. A geopolitical uncertainty shock is similar to a financial shock, apart from its effects on the price of oil, and as a consequence, on consumer prices. In particular, increased geopolitical uncertainty has recessionary effects, as equity prices fall. Short term interest rates fall, as investors rotate from risky assets and shift their portfolio exposure to short term bills, causing their yields to fall. A similar rationale leads to an appreciation of the US dollar. The peculiar features of such a shock is that it raises pressure on the price of oil and as a consequence on the inflation rate. It is this stagflationary effect that it identifies such a shock from a financial and a demand shock. The signs used for this identification are obtained by running an exercise similar to the one used by Piffer and Podstawski (2017). In particular, we instrument the unexpected change in our global risk measure with the change in the price of gold in given dates identified with a

[6]We thank Marek Jarocinski for making these estimates available to us.

narrative approach by Piffer and Podstawski (2017) but restricted to days also related to terrorist attacks and related concerns on the supply of oil (e.g. the invasion of Kuwait in 1990 or the 9/11 terrorist attack). The signs of the resulting IRFs are then used to identify geopolitical risk shocks. Notice that, since we already use an external instrument to identify a monetary policy shock, we avoid using directly in the VAR a second one for the geopolitical risk. This, in fact, would require us to impose a timing restriction in the identification of the two shocks (see for instance Mertens and Ravn, 2013) that is hardly tenable at monthly frequency.

B.3 Reduced Form Estimation

The VAR is estimated using Bayesian methods. We use the same prior values as Caldara and Herbst (2019). Results are based on 15,000 draws from the posterior distribution of the structural parameters, with the first 5,000 draws used as a burn-in period. The VAR is estimated in levels using 6 lags. Figure A1 shows the related Impulse Response Functions.

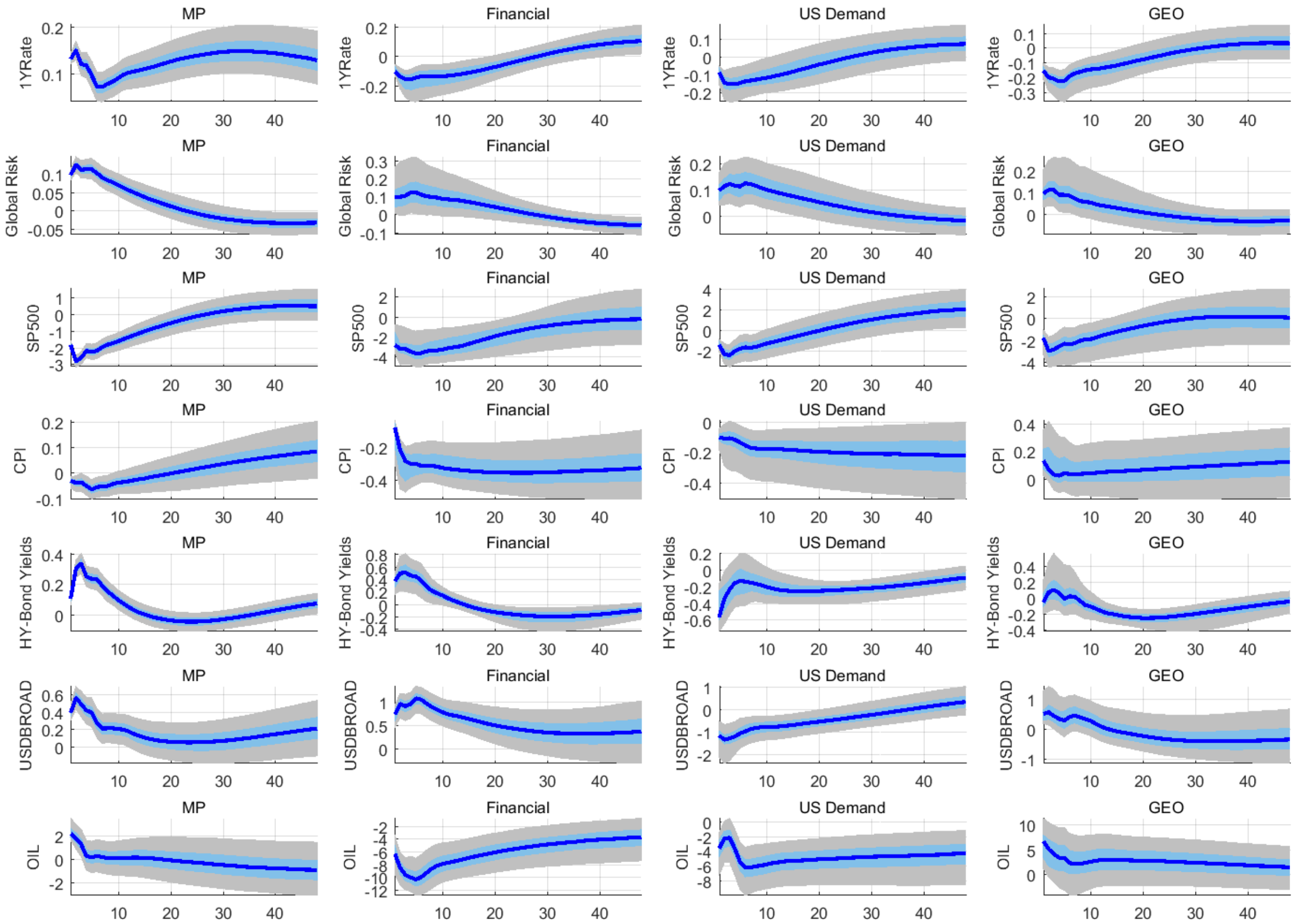


Figure A1: Impulse Response Functions

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