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INTERNATIONAL FINANCIAL FLOWS AND THE RISK-TAKING CHANNEL

by Pietro Cova* and Filippo Natoli*

Abstract

During the 1990s, the higher propensity to save in emerging market economies triggered massive inflows towards safe assets in the United States; a few years later, a rising dollar funding by global banks was concurrent with increasing inflows to private-label US securities. While it is well documented that foreign financial flows have eased financing conditions in the US through the compression of long-term yields, in this paper we also find significant effects on the credit spread and the VIX, suggesting a substantial risk appetite channel. Moreover, flows into the US corporate bond market, partly linked to the previous savings glut in emerging economies, directly affected bank leverage, household indebtedness and the housing market. This evidence provides a new perspective on the global banking glut, complementary to the role of banks in the risk-taking channel of monetary policy.

JEL Classification: F32, F33, F34.
Keywords: saving glut, banking glut, capital flows, banking leverage, risk-taking channel.

Contents

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1. Introduction[1]

One of the main causes of the housing and financial bubble in the United States that preceded the global financial crisis has been identified as the availability of easy credit in the early 2000s. In the years between 1996 and 2003, following financial market crises in East Asia, Latin America and Russia, many developing and oil-producing economies decided to accumulate foreign reserves as a buffer against potential capital outflows, and achieved this in part by running current account surpluses. This increased propensity to save, coupled with a preference for investing reserves in low-risk assets, triggered substantial inflows to the US Government bond market. According to one prominent view, this has put downward pressure on real interest rates in the US, contributing along with other factors to a generalized asset bubble (the *Global Savings Glut* (GSG); see Bernanke (2005) and Warnock and Warnock (2009)).

More recently, the focus of the analysis concerning the overheating of US financial market conditions has shifted towards the role of the international banking sector, disregarded in previous studies. Many authors argue that the key driver of the ensuing financial crisis was not an excess of savings but the excess elasticity of the global financial system to expansionary monetary policy regimes, that allowed the build-up of unsustainable credit and asset price booms (the *Global Banking Glut* (GBG); see Borio and Disyatat (2011), Shin (2011), Brender and Pisani (2010) and Bernanke et al. (2011)). This evidence is related both to the activity of global banks, mostly European, which by raising dollar funding via their US branches participated in international "risk-taking chains" (Bruno and Shin, 2015b), and to the steady increase in foreign inflows to US corporate securities, mostly from European countries (Bertaut et al., 2012).

Testing the effect of foreign inflows on US long-term yields, Bertaut et al. (2012) find that, as inflows to public bonds (GSG flows henceforth) compressed their yields, so did flows targeting corporate bonds (GBG flows henceforth) with respect to AAA and ABS yields. Beyond this first step there is no investigation, as far as we know, of how this increased foreign demand has stimulated the risk-taking behavior in the US markets, and whether this has propagated to the credit and housing markets. Moreover, the possible connection between GSG (that preceded GBG and partly targeted Europe) and GBG flows has never been empirically explored.

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This paper addresses these issues by investigating the linkages between foreign demand pressures on US public and private bonds and the evolution of US financial market conditions during the periods in which GSG and GBG flows increased the most; notably, we focus on the phase in which the credit spread, i.e. the spread between private and public bond yields, as well as the VIX, steadily declined.[2] Focusing on this risk-taking phase that preceded the financial crisis, we then test possible direct effects of these flows on the leverage of US banks – the linchpin of global credit expansion according to Shin (2011) – as well as, by means of a Bayesian VAR (BVAR), the possible macroeconomic effects on households' indebtedness and the housing market.[3]

Throughout the analysis we show that foreign inflows had an autonomous role, with respect to US monetary policy, in affecting US financial and macroeconomic conditions. Indeed, we find that GBG flows were a relevant driver of the credit spread's and VIX's compressions, as well as a driver of the rise in banking leverage and household indebtedness, results that to our knowledge are completely new in the literature. Moreover, an analysis of the subcomponents of the credit spread and the VIX (i.e., expectations and risk premia) suggests that the effect of GBG was channeled via lower risk premia in bond and equity markets, uncovering a previously disregarded risk appetite channel.[4] We also find evidence that GSG and GBG influence each other; in particular, results on the effects of GSG on GBG support the triangular trade-in-financial assets view first proposed by Bertaut et al. (2012), according to which GSG flows to Europe may have been partly "recycled" to the US via the European banking system. Results on GBG since 1999 support the view that a regime change in the European regulatory environment – notably, the advent of the euro and the diffusion of more permissive risk management practices implied by the Basel II regulatory regime – had induced overseas diversification and higher risk-taking (Shin (2011) and Danielsson et al. (2011)); on the other hand,

Our results are complementary to those of Bertaut et al. (2012), who find effects of GBG flows on long-term rates. Moreover, our evidence also provides a new perspective on the GBG, complementary to the role of banks in the risk-taking channel of monetary policy highlighted by Bruno and Shin (2015a).

The rest of the paper is organized as follows. Section 2 describes financial inflows into

[2]The marked decrease in the credit spread between 2002 and 2007 has received much less attention in the literature than the so called Greenspan conundrum of long-term yields (Bernanke et al., 2011)

[3]Bruno and Shin (2015b) propose a model of the international banking system focusing on the leverage cycle of global banks and on the global and local factors that affect their balance sheets. Following Geneakoplos (2009), leverage is a collateral rate, distinct from the interest rate, which is given by the value of collateral that must be pledged to guarantee one dollar of loan. Huge moves in collateral rates define "leverage cycles".

[4]The expectations and risk premia components of the credit spread and the VIX used in our analysis are taken from Gilchrist and Zakrajsek (2012) and Bekaert and Hoerova (2014), respectively.

the US markets during the run-up to the crisis by their geographic origin, our procedure for the computation of monthly GSG and GBG flows and the empirical strategy followed in the rest of the paper. Section 3 and Section 4 focus respectively on our empirical results from monthly regressions and the impulse responses of a quarterly BVAR model. Section 5 concludes.

2. Data and empirical strategy

In this section we describe the main features of our analysis. Specifically, we present the data sets that are commonly used in the literature to measure GSG and GBG flows (Section 2.1). We then compare foreign inflows coming from different countries and regions in order to understand how these should be reflected in our benchmark measures for GSG and GBG flows (Section 2.2). We compute our measures of GSG and GBG flows and comment on their evolution between the 90s and the early 2000s (Section 2.3); finally, Section 2.4 describes and motivates the empirical approach adopted in the subsequent two sections.

2.1. Data sources

Following Warnock and Warnock (2009) and Bertaut et al. (2012), we construct monthly GSG and GBG flows by using data coming from two data sets published by the US Treasury. The first one is the "US Transactions with Foreigners in Long-term Domestic and Foreign Securities" (UST henceforth) that collects monthly gross purchases and sales made by foreign residents of domestic (US-issued) securities from January 1977; fixed-income securities are split into Treasury, Agency and corporate bonds. The second source is the survey named "Foreign portfolio holdings of US securities" (FPH henceforth), reporting holdings of foreign-owned US bonds for the same three categories; it has been conducted six times since 1974 (in 1974, 1978, 1984, 1989, 1994 and 2000), then on a yearly basis since 2002.

To obtain monthly holdings within each survey, one first needs to adjust the monthly net purchases computed from the UST in order to be coherent with the FPH. The method proposed by Warnock and Warnock (2009) has been refined and updated by Bertaut and Tryon (2007) and Bertaut and Judson (2014).[5] Monthly data (*benchmark-consistent holdings*, henceforth) are available from March 1994 to December 2014.[6]

We use these data to construct our indicators of GSG and GBG, relying respectively

[5]The estimation procedure involves (i) minimizing the gap between the holdings from the FPH data and the cumulated monthly net purchases from the UST and (ii) spread the needed adjustment evenly between two survey dates.

[6]See Bertaut and Judson (2014).

on flows (i.e., first differences of monthly holdings) into government bonds – Treasuries and Agencies – and private fixed-income securities – corporate bonds.[7] Before describing the computation of actual GSG and GBG flows, we first have a look at the evolution over time of foreign holdings during our period of interest, going from the 1990s to the early 2000s.

2.2. Capital inflows by region and country of origin

For each security, the benchmark-consistent holdings dataset reports the breakdown of foreign holders by country, as available in the original UST and FPH. While the GSG and GBG hypotheses refers to flows coming from emerging economies and from Europe through banks, respectively, an analysis of the evolution of net inflows to the US by security and country has never been reported, as far as we know. We analyze the time variation of net positions in public and private bonds separately: for both markets, we consider the level of foreign holdings on three survey dates (December 1994, March 2000 and June 2007) and we rank each source of flows (aggregated by region) by net change in holdings between 1994 and 2007. Then, we make a second ranking by country and pick the first ten countries which increased their portfolio holdings the most between these dates.

Table 1 displays the regional ranking for Treasury and Agency bonds. The block of Asian countries, is, on aggregate, not only the top foreign holder in 1994 (col. 1), but also the one that has increased its holdings the most between 1994 and 2007 (col. 4). Looking closer, while the pace of increase is close to the one of European countries during the '90s (i.e. between 1994 and 2000), in the first seven years of the 2000s Asia more than tripled its holdings, increasing its share of US public bonds owned by foreigners to up to two thirds (col. 3). Within Asia, Japan was the first holder of US bonds during the '90s – according to the survey in 2000, China's holdings were about a third of Japanese ones; in the 2000s, China increased its holdings more than any other country, replacing Japan as the first holder with 843 bn of US dollars as of June 2007 (Table 2). Following China and Japan, major buyers of public bonds are the group of Caribbean banking centers, Belgium plus Luxembourg, Russia, Brazil and Korea.

The investigation conducted above is repeated for US corporate bonds, leading to opposite results for European and Asian countries; holdings by region are reported in Table 3. In the overall market of private US bonds, Europe is by far the region with the strongest increase in total holdings during our sample period: since 1994, when European and Asian economies

[7] According to Bertaut et al. (2012), the majority of inflows into the broad category of corporate bonds between the late '90s and 2007 involved the purchase of asset-backed securities and other notes and structured products that were much less "safe" than conventional nonfinancial corporate bonds; we consider flows into this broader category because foreign holdings of ABS are only available since 2002. We have in mind the purchase of these types of fixed income securities by global banks when constructing our GBG indicator.

had a portfolio of US corporate bonds of similar size (55 and 43 bn USD, respectively), European countries started to accumulate private US securities reaching USD 250 billion in the year 2000; the pace of purchases increased substantially during the 2000s and total holdings reached more than 1600 bn in 2007 (11 percent of US GDP). The United Kingdom and some euro area countries, in particular Belgium plus Luxembourg, Ireland and Germany, are among the leading buyers (see Table 4).

The Caribbean banking centers have played a relevant role in both markets (third position in the ranking of net purchasers for both public and private bonds). Cayman Islands and Bermuda are two important business centers in the area: Cayman Islands are the main offshore centers for banking, hosting foreign branches of global banks, while Bermuda mainly hosts branches of insurance companies. According to the 2005 country report made by the International Monetary Fund (IMF), in 2003 Cayman Islands had 349 banks with total assets amounting to over one trillion dollars (see Table 5 for details). Almost one-third of these banks were foreign branches of European banks, holding 56 percent of the total assets. We thus speculate that a big portion of the purchases of US corporate bonds coming from the Cayman Islands might be traced back to European global banks.

This initial look at the data allows us to identify the key actors in our story. Indeed, we confirm that capital flows into the US markets originated mostly from Asian countries with high excess savings and from the cross-border lending activity of European global banks investing in US corporate bonds; however, the analysis also highlights the active role of Luxembourg in accumulating US public bonds and that of the Caribbean Banking centers as a source of inflows into private securities, usually disregarded in this literature. The data also shows that the bulk of inflows is concentrated between the 2000 and 2007. This is almost concurrent with the widening of the US current account deficit, which occurred between 1996 and 2003, as highlighted in Bernanke (2005); for the case of GBG flows, the strong increase since the early 2000s is in line with the hypothesis that the implementation of Basel II and the advent of the euro have put significant pressure on European banks to diversify their investments out of domestic markets (Shin, 2011).

2.3. GSG and GBG flows

We now move on to the construction of our proxies for GSG and GBG flows, by extending the original formulation of Warnock and Warnock (2009) to private as well as public bonds. While the definition of GSG flows as foreign net purchases of US government securities is common in the literature, GBG flows have been measured in different ways, depending on the aspect of the phenomenon one needs to focus on. During the run-up to the crisis, global

banks expanded their balance sheets by leveraging their funding in US dollars and increasing both investment in risky US assets (see Bernanke et al. (2011) and Bertaut et al. (2012)) and cross-border loans to regional banks (Bruno and Shin (2015b)). While investment in risky assets may have had direct effects on the US markets – via lower long-term rates and a compression of credit spreads –, cross border loans may have spilled back to the US markets only indirectly; for this reason, and in order to have flows that are comparable to GSG ones, we only focus on the first aspect and proxy GBG with net purchases of corporate US bonds.[8]

GSG and GBG are computed as the 12-month cumulated benchmark-consistent *flows* into Treasury and Agency bonds and corporate bonds respectively, both as a share of the (estimated) previous month's US GDP in annual terms.[9] Considering foreign investors from n countries and denoting by $\{T_{j,t}\}$, $\{A_{j,t}\}$ and $\{C_{j,t}\}$ the monthly series of benchmark-consistent holdings of country j of US Treasury, Agency and Corporate bonds, respectively. Let $\{\Delta T_{j,t}\}$, $\{\Delta A_{j,t}\}$ and $\{\Delta C_{j,t}\}$ be the benchmark-consistent flows obtained as first differences of holdings and $\{GDP_t\}$ the series of estimated monthly US GDP from quarterly data using the Chow-Lin algorithm (see Chow and Lin (1971)). GSG flows are defined as:

$$GSG_t = \frac{1}{12 * GDP_{t-12}} \sum_{j=1}^{n} \sum_{i=1}^{12} \left(\Delta T_{j,t-i+1} + \Delta A_{j,t-i+1} \right) \tag{1}$$

and GBG ones as

$$GBG_t = \frac{1}{12 * GDP_{t-12}} \sum_{j=1}^{n} \sum_{i=1}^{12} \Delta C_{j,t-i+1} \tag{2}$$

The evolution of GSG and GBG flows over time is reported in Figure 1. The upper panel reports GSG and GBG as total inflows into Treasury plus Agency bonds and corporate bonds, respectively; on the lower panel, the two series are constructed using inflows into US bonds coming from specific geographic regions, i.e. flows into US Treasuries and Agencies from all Asian countries for the GSG variable and those into corporate bonds from Europe and the Caribbean banking centers for the GBG measure. Capital inflows from abroad are substantial in two distinct phases (Figure 1, panel (a)): (i) during the early 90s, when inflows on private label securities were low and almost flat while purchases of public bonds increased a lot, then retrenching around the end of the decade during the Asian and Russian financial crises; (ii) between the end of the 90s and 2007, when both types of inflows rose substantially.

The dominance of one or the other type of flows during the second phase can be observed

[8] The indirect effect on US markets of an increase in cross border lending to regional banks (the *bank-to-bank* lending) is explained in Bruno and Shin (2015b).

[9] Focusing on flows rather than holdings is in line with the literature on the savings and banking glut. Intuitively, flow effects are considered to be more likely to have shaped the swings in financial variables than liquidity and portfolio effects induced by the increasing size of the stock of assets held abroad.

during the different subperiods: net purchases of corporate bonds are stronger between the end of the 90s and the beginning of the 2000s, while GSG overtake GBG flows later on in the 2000s; finally, corporate bond flows accelerate in 2005, and from there onwards, during the years running up to the 2008 crisis, exhibit a much more rapid pace than GSG flows. Instead, the series constructed using subsets of countries show a more comparable evolution during the entire period of interest (Figure 1, panel (b)), except during the later years of the sample period, when GBG flows rose much more rapidly. Focusing on the overall impact on the financing conditions in the US more than on the effects coming from specific regional inflows, we will use total inflows to identify GSG and GBG flows throughout the analysis.

2.4. Empirical strategy

The objective of this paper is to investigate the effects of foreign inflows on the US financial and economic conditions during the run-up to the financial crisis. Figure 2 summarizes the expected transmission channels, that we explore starting with a reduced form analysis targeting long-term yields and measures of quantity and price of risk.

First of all, we explore the impact of GSG and GBG on long-term interest rates in the US, considering 10-year Treasury yields and returns on AAA corporate bonds issued by the US non-financial sector to proxy private-label MBS.[10] We are interested not only in the effect on each market separately, but also on the credit spread, i.e. on the premium assigned by investors to corporate with respect to Government bonds. Indeed, during the run-up to the crisis, this spread steadily decreased due to the increased demand for MBS with respect to that of Treasuries: to investigate the possible contribution of GSG and GBG to the spread contraction, we regress the credit spread on our two financial flows measures. We employ the measure of credit spread by Gilchrist and Zakrajsek (2012), and an estimate of its two subcomponents – i.e., expectations and risk premium – proposed in the same paper: a negative impact of either type of flows on the credit spread, and in particular on its risk premium component, could signal foreign inflows as being partly responsible for eased financing conditions for consumers and investors.

Secondly, we investigate the excess elasticity of the global financial system claimed by Borio and Disyatat (2011) and at the heart of Bruno and Shin (2015b), according to which in periods of low risk aversion banks' leverage increases via an expansion of banks' balance sheets (i.e., higher lending). From this perspective, we regress separately a proxy for banking leverage and the VIX index on foreign inflows, with the aim of identifying a possible direct effect on leverage – banks increase their leverage when funding is abundant and rates are low.

[10] As shown by Bertaut et al. (2012), Jumbo MBS yields provided by JP Morgan and Bloomberg show a path that is very similar to that of AAA yields during the available sample.

At the same time, the idea is also to verify whether GSG and GBG exert some procyclical effects on risk aversion and countercyclical effects on market uncertainty, proxied by the two components of the VIX estimated by Bekaert and Hoerova (2014).

The analysis is then expanded by focusing on lower frequency data and estimating a BVAR that includes both financial and macroeconomic variables. The aim is to investigate whether, besides affecting banking leverage, GSG and GBG flows might also influence lending to households, housing prices and residential investment.

The BVAR setup also allows us to take on the question of how GSG and GBG flows might be interrelated, even if originating from different sources and underlying motivations; this is motivated by the fact that part of the GBG flows may be related to previous financial investments in Europe by GSG countries (the triangular trade-in-financial assets discussed by Bertaut et al. (2012)). A reverse causality between the two (GBG flows inducing more GSG inflows) is hardly plausible in the short-term, provided that the need of investing abroad by official investors in emerging economies is independent from big banks' strategies; for this reason, we consider GSG as more exogenous than GBG in the ordering of the variables. In the medium-term, however, we do not exclude that new GSG inflows could have been attracted by the availability of new and apparently safe products.

In the BVAR we also account for possible interactions between GBG flows, US monetary policy and dollar exchange rate changes. Before discussing impulse responses, we compare the identified GSG and GBG shocks with US monetary policy shocks taken from Gertler and Karadi (2015) to check the exogeneity of our estimates. Concerning the link with exchange rates, if foreign flows were following carry trade strategies during the expansion phase of the financial cycle, one would expect to see GBG increases leading to a US dollar (the target currency) appreciation. According to Hofmann et al. (2016) and Blanchard et al. (2015), currency appreciations may reflect, for a given monetary policy rate, the outcome of capital inflows associated to overall more expansionary financial and macroeconomic conditions.

We further investigate the effect of capital flows on private debt-to-income ratios and on the US housing sector. The aim is to understand which foreign flow, if any, may have contributed the most to the build-up of the housing bubble in the United States; moreover, we want to clarify the direction of causation between banking flows and house price developments: has the expansion of the housing sector been predetermined with respect to the increase of foreign investments into ABS and other private-label securities? According to this view, GBG flows would have followed, in the medium-term, internal developments in the US, with housing acting as a catalyst of foreign capital inflows.

3. Foreign inflows into US financial markets

Figure 3 shows the evolution of four risk taking indicators (long-term interest rates, credit spread, VIX and bank leverage) for the US markets during the run-up to the 2008 financial crisis. The yellow area marks the phase in which GSG inflows where predominant, while the green one identifies the rise in GBG inflows in addition to GSGs; a vertical dashed line marks the beginning of the synchronous decrease in the credit spread and the VIX from August 2002 inwards.

Long-term interest rates, on a downward trend since the early 1980s, showed substantial fluctuations during the whole 1994 – 2007 period (upper left panel); on the contrary, the credit spread, quite flat around 1% during the 90s, quadrupled between 1998 and 2002 before declining back to values just below two percent (upper right panel). Volatility in equity markets, as captured by the VIX, started to increase before the widening of the credit spread, staying at relatively high levels before declining, also from 2002 onwards (lower left panel); the leverage of US banks, on an upward trend since late 80s, exhibits relevant upswings during both the 90s and the 2000s and, again, in particular during the 2002-2007 sub-period (lower right panel).

In this section we present the results of our regression analysis: Section 3.1 focuses on the effects of GSG and GBG on long-term rates; Section 3.2 on their impact on the credit spread and on its subcomponents (the expected default component and excess bond premium); Section 3.3 on their effect on the VIX and on its expectation and premium components; finally, Section 3.4 on the relationship between both types of flows and banking leverage.

3.1. Long-term interest rates

To estimate the effects of foreign flows on long-term rates, we run univariate regressions of GSG and GBG on the 10-year Treasury rate and the AAA corporate yield, controlling for variations in the Federal Funds target rate, in 10-year inflation expectations (taken from the US Survey of Professional Forecasters), and in the log of the US real effective exchange rate. GSG and GBG are included both one at a time and together. All variables are taken in first differences, with the aim of capturing short-term effects on bond yields.[11]

Results are reported in Table 6. Both GBG and GSG flows have a significant and negative impact on the 10-year Treasury rate and the AAA yield, with comparable magnitudes for the two yields. This is evident both when they are included one at a time (cf. cols. 1,2

[11] Other papers investigate the effect on the level (instead of the first difference) of bond yields by running constrained regressions in which it is assumed that real interest rates are stationary (see Warnock and Warnock (2009), among others). We choose not to make this assumption and work on first differences.

and 4,5) and when they are included together (cf. cols. 3 and 6) though, in the latter case, the magnitude of the coefficients is somewhat lower. In both cases, the effect of GBG on long-term yields is stronger than that of GSG.

3.2. Credit spreads

As shown by Gilchrist and Zakrajsek (2012) (GZ henceforth), credit spreads capture both the expected default rate of the riskier bond and cyclical movements in investors' risk appetite. The authors propose a measure of these two components, named the expected default component and the excess bond premium.[12] While the former is related to the financial health of the issuer, it is not as strongly related to investors' moods. To investigate the effect of foreign flows on the credit spread, we run univariate regressions on the aggregate GZ measure – that, differently than the AAA-minus-10year spread, is free from duration and liquidity mismatches – and, separately, on its two subcomponents. The credit spread series is stationary, so we can assess the short-term impact of GSG and GBG flows on its level; as in the previous estimation, regressors are all in first differences.

Results are reported in Table 7. Panel A, in which the GZ spread is the dependent variable, shows that GBG has a negative effect on the credit spread, while GSG is almost never significant throughout the sample. Estimates in Panel B and Panel C (in which the dependent variables are the expected default component and the excess default premium, respectively) confirm that, as expected, the fall in the credit spread induced by GBG flows is driven by a compression in the excess bond premium, not in the default component. Concerning the expected default component, we do not find any statistical significance spanning the entire sample period chosen, neither for GSG nor for GBG (Panel B); for the excess bond premium, we find negative effects of GBG flows, that are preserved even when GSG and GBG are included jointly (Panel C).

Interestingly, contrary to GBG, GSG flows have a positive effect on the excess bond premium. This joint, and distinct in sign, effect of the two types of flows is consistent with a standard portfolio balance model with imperfect substitution across safer (Treasuries and Agency debt) and riskier (corporate bonds) assets. Note that the effects on the excess bond premium become even stronger from 1999 onwards (Panel C, results for subperiod 1999-2007), after the formal introduction of the euro when, as argued by Shin (2011), the expansion of global banking markedly accelerated (Figure 1).[13]

[12] In Gilchrist and Zakrajsek (2012), the excess bond premium is obtained as the residual after subtracting from the credit spread the expected default component; the latter is in turn obtained in a separate regression by regressing the credit spread on firm-specific measures of expected default and a vector of bond-specific characteristics.

[13] The third phase of the Economic and Monetary Union (EMU) started formally on January 1, 1999, with

Overall, results on credit spreads confirms our prior that GSG and GBG flows induced variations in the subjective investor-led pricing of default risk rather than variations in the risk of default of the underlying bond issuer per se; also, they highlight that these effects are concentrated in 1999-2007.

3.3. Risk aversion and uncertainty

In this section we turn to the analysis of the US equity market, investigating possible effects of GSG and GBG flows on expected equity price fluctuations proxied by the VIX. A VIX index significantly reacting to GSG and GBG could be interpreted as international financial flows having effect on investors' uncertainty or risk aversion in equity markets, complementing the evidence found for the bond market.

Results for regressions of GBG and GSG flows are shown in Table 8. During the entire sample period (1994-2007), the coefficients of both GBG and GSG flows are negative and significant (Panel A, first three columns), meaning that an increase in these flows is negatively correlated to the VIX index. Controlling for the US effective Federal Funds' target rate in real terms does not invalidate this result. Note also that, while both GBG and GSG flows are significant if included one at a time, only the effect of GBG flows remains statistically significant once both variables are included together.

The VIX being a risk-neutral measure, variations could reflect changes in the expected volatility (i.e., uncertainty about future prices) or variations in the price attached by investors to future fluctuations (i.e., risk aversion). In order to disentangle the effects on the two components, we re-run the last set of regressions by substituting the VIX with the conditional variance of the stock market and the variance premium estimated by Bekaert and Hoerova (2014) – which sum up to the square of the VIX. Results show that, differently than the case of the credit spread, there is also a significant effect of inflows on uncertainty; however, in line with the previous results, the effect of GBG flows is stronger in terms of reducing equity investors' risk aversion (Table 8, Panels B and C). Finally, note that the effects of GBG flows on risk aversion are strongest in the 1999-2007 subperiod.

3.4. Bank leverage

Results in Sections 3.2 and 3.3 suggest that both GBG and GSG flows acted as push factors on US financial markets, leading to lower US long-term rates and a reduction in risk

the gradual introduction of the euro – first as a scriptural money at fixed conversion rates, and from January 1, 2002, with the introduction of euro coins and banknotes – and implementation of a single monetary policy under the responsibility of the European Central Bank (ECB) within the Eurosystem.

aversion in both bond and equity markets. Do these flows also directly account for an increase in banks' lending, i.e. do they also positively affect credit supply? We take up this question by testing the effect of foreign inflows on banks' leverage, proxied, as in Bruno and Shin (2015b), with the ratio of US broker-dealers' total liabilities including equity, over equity.[14]

Results are reported in Table 9, suggesting two interesting facts. First of all, GBG (and not GSG) flows are significant in explaining the observed variations in bank leverage during the entire sample period (1994 –2007). While the significance vanishes in the 1999 – 2007 subperiod, the all-sample result is confirmed in the narrower 2002–2007 sample, that is the focus of our analysis. This evidence confirms Shin (2011)'s claim that European global banks were relevant drivers of the GBG flows and, hence, also in influencing financial conditions in the US, particularly after the euro changeover in 2002.[15]

Secondly, the lagged VIX index also significantly affects banking leverage: banks' leverage decreases when expected stock market volatility increases.[16] The first to highlight this important result have been Bruno and Shin (2015a), who also find evidence that the decrease in the VIX may be induced by changes in monetary policy, thereby supporting the view of a so-called "risk-taking channel" of monetary policy. According to our results, the impact of GBG flows on banking leverage is independent from the corresponding effect of the VIX regressor.[17] We will return to this result in the next section.

All in all the results reported in Table 9 point to the fact that GBG flows act as a rather different and stand-alone conduit of the leverage cycle than the VIX index. Thus, beyond the explanatory power of foreign capital flows on the VIX index (Table 8) – a result that has been emphasized by a number of authors[18] – GBG flows exert an autonomous pro-cyclical effect on banking leverage (both on the credit demand and supply side). The introduction of

[14] Shin (2011) shows that a large fraction of the US dollar intermediation activity that takes place outside the United States is accounted for by European global banks. Moreover, as explained in Bruno and Shin (2015b), proxying the leverage of European global banks with the one of US broker-dealers is based on two considerations: (i) first of all, the only available balance sheet data for European global banks are consolidated, so it is impossible to separate between commercial banking and wholesale investment banking activities, which are the only ones that matter for measuring banking leverage ratios; (ii) secondly, US broker dealers' behavior is most likely aligned to that of their European counterparts.

[15] This increased linkage between GBG flows and banks' leverage after 2002 is consistent with the balance sheet capacity channel advocated by Shin and co-authors (see, Danielsson et al. (2011)): according to this view, in periods of low perceived risk, leverage builds up thanks to additional debt piled up by banks to finance asset purchases. Such a period of markedly low volatility was indeed observed in 2002-2007 (see Figure 3).

[16] Note that, in line with many other authors, we are considering the lagged VIX index, as the VIX captures the one-month expected volatility. As such, an increase in today's uncertainty about the future should affect a bank's investment decisions - and hence its leverage - in due time.

[17] Including an interaction between between the VIX and either type of international financial flows does not alter this finding.

[18] Bruno and Shin (2015b) confirm this important linkage, highlighted also by Adrian and Shin (2010) and Forbes and Warnock (2012).

the euro seems to define a structural break in terms of investment decisions, both in terms of geographic destination of funds and of size of financial investments (i.e., triggering a marked acceleration of GBG inflows, cf. Figure 1). To our knowledge, these results have not been emphasized in the literature so far.

4. BVAR analysis

4.1. Motivation

The empirical estimates presented so far have highlighted sound linkages between GBG, GSG flows and US financial variables – looking both at asset prices and quantities. Overall, the analysis indicates an autonomous role of these flows in affecting the US financial markets during the run-up to the crisis.

We now use our GBG and GSG measures to identify two distinct shocks in a BVAR framework. The two shocks can be viewed as external portfolio preference shocks, i.e. preference shocks which origin from non-US agents. The aim of this analysis is to evaluate the timing and persistence of the responses in US financial variables to inflows shocks and to extend the investigation to other macroeconomic and financial variables.

In particular, we focus on four topics. First, we explore the extent of the linkages between GSG and GBG flows. While GSG flows are the outcome of deliberate policy decisions undertaken since the first half of the nineties, GBG flows have assumed particular relevance later in that decade, possibly also in reaction to GSG flows, as highlighted in Bertaut et al. (2012). In particular if, as suggested by these authors, GBG flows have been largely driven by the part of GSG flows previously invested in European assets (the triangular trade-in-financial assets view), then we should find that the effects of GBG on US markets may not hold in the BVAR; this fact might challenge the view according to which GBG flows contributed *per se* to an easing of financial conditions in the US, which is at least as important as that attributable to GSG ones (Shin, 2011).

Second, we make a broader investigation of the role of risk aversion. Our previous results have highlighted the relevance of both GBG and GSG in bringing about a risk-on investment environment of low credit spreads and volatility. The BVAR framework should help to clarify whether the reduction in riskiness which stimulates an expansion in banks' balance sheets is only the outcome of an underlying transmission channel of monetary policy (the "risk-taking channel of monetary policy" view documented by Bruno and Shin (2015b)) or, as we have shown in the previous section, if it also reflects the autonomous transmission mechanism of GBG and GSG flows.

Third, by including in the BVAR both the US real effective exchange rate and the real Fed Funds target rate, we want to investigate the possible direct effects induced by GSG and GBG flows on the dollar, controlling for the US monetary policy stance. In other words, we look at whether international financial inflows exert appreciation pressures on the US dollar, thus conforming to the view exposed by Hofmann et al. (2016) according to which a currency appreciation may be the outcome of more permissive financial conditions.[19]

Finally, we extend the analysis beyond the effects on US financial markets. As affirmed by Justiniano et al. (2014), only a few papers have addressed quantitatively the impact of GSG and GBG on the US economy in general, and on the credit and house-price boom of the 2000s more specifically. To investigate this issue we thus include in our BVAR two alternative measures, one for credit (household debt) and one for housing demand (house prices).

4.2. Setup

We define a BVAR specification that we take as a benchmark and which includes variables in the following order (from the most exogenous to the most endogenous): (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate, and (7) the real Federal Funds target rate. We then augment this benchmark specification by adding, alternatively, a measure of household debt and house prices (BVAR #2 and #3).

Following Bruno and Shin (2015b), fast moving financial variables are ordered after variables involving slower decision processes – such as foreign inflows and banking leverage –. As discussed in the previous subsection we order GSG before GBG flows. With respect to the five variables that follow GSG and GBG, the main identifying assumption implied by this ordering is that only the policy rate can react contemporaneously to financial disturbances (the recursiveness assumption made by Christiano et al. (1999), among others). This is consistent with the view that monetary policy can respond immediately to any financial misalignment that arises and that poses a threat to its target.[20]

The BVARs are estimated with four lags using a Gibbs sampling algorithm with 1000 replications and identified recursively, with Minnesota priors calibrated as in Banbura et al.

[19] According to this "risk-taking channel" view, exchange rate appreciations are not necessarily contractionary as in the standard Mundell-Fleming model, where an appreciation is associated with lower net exports and output. A similar argument has been recently advanced also by Blanchard et al. (2015), who argue that capital inflows by reducing financial intermediation costs may offset the contractionary impact of appreciations.

[20] This assumption has been adopted, for example, in Gilchrist and Zakrajsek (2012). Alternatively, one could assume that monetary policy does only respond with some lags to shocks channeled by the VIX and the real exchange rate, which are faster moving variables, as in Bruno and Shin (2015b). Our results are robust to this alternative ordering assumption.

(2010). Quarterly variables are averages of daily (for financial variables) or monthly (for GBG, GSG and bank leverage) values. The estimation is done from 1990 Q1 to 2010 Q3, i.e. stopping our sample period due to data availability.[21]

4.3. Structural shocks testing

Results coming from the analysis carried out in Section 3 do not a priori rule out the possibility that foreign inflows were endogenous to the accommodative monetary policy stance in the US. Before discussing the impulse responses we test whether, under our identification assumptions, GSG and GBG shocks are correlated to US monetary policy shocks.

Shocks from our identified BVAR are computed as follows. From the reduced-form representation

$$x_t = Fx_{t-1} + u_t \tag{3}$$

where x_t and u_t are $[N * T]$ matrices, one can identify the parameters of the structural form

$$Ax_t = Bx_{t-1} + e_t \tag{4}$$

where $F = A^{-1}B$ and $B = AF$. Structural shocks can be computed as

$$e_t = Au_t \tag{5}$$

Provided that the Gibbs sampling procedure identifies one A^{-1} matrix at each iteration, we retain the one yielding median impulse responses and construct structural shocks according to Equation 5. This procedure is repeated for our three BVAR specifications.

As proxies for monetary policy shocks, we consider the set of instruments used in Gertler and Karadi (2015) to assess the effect of monetary shocks on interest rates: (1) the surprise in the current month's Fed Funds futures (FF1); (2) the surprise in the three-month ahead Fed Funds futures (FF4); and (3) in the six-month, (4) nine-month and (5) one-year ahead futures on three-month Eurodollar deposits (ED2, ED3, ED4), as in Gurkaynak et al. (2005). We compute quarterly measures of these instruments by averaging monthly values.[22]

Results of linear correlations with bootstrapped confidence intervals are reported in Table

[21] GZ spreads are only available until 2010 Q3. The estimation periods are extended backwards compared to the regression analysis in Section 3 given the fairly large number of variables entering our BVARs. Our main constraints in extending the length of the estimation period further backwards are twofold. First, it is widely accepted that both types of flows have started to play a major quantitative role no earlier than in the 1990s (see Figure 1). Second, the VIX Index is not available prior to 1990.

[22] This is coherent with monthly surprises constructed in Gertler and Karadi (2015) by averaging daily surprises.

10, and the dynamics of GSG and GBG shocks along with that of the FF4 proxy (the preferred instrument in Gertler and Karadi (2015)) are shown in Figure 5. Correlations are not significant for any of the five instruments with both GSG and GBG shocks; the same outcomes show up when extracting structural GSG and GBG shocks from the other two BVAR specifications.

The above results confirm, under our identification assumptions, the absence of endogeneity between foreign flows and US monetary policy, adding evidence to our claim of an autonomous role of GSG and GBG flows on US financial conditions.

4.4. Impulse responses

Figures 5 and 6 present the main impulse response functions of the benchmark specification; Figure 7 and 8 present selected impulse responses from BVAR #2 and #3, respectively. Each panel in the figure graphs the impulse responses over 20 quarters (five years) to a one-standard-deviation shock.

The effects of GSG and GBG on US financial variables The main results on the effects of GSG and GBG flows on US financial conditions can be summarized as follows. First, both GSG and GBG flows lead to a significant increase in banking leverage: a positive shock to GSG leads, on impact, to an increase in leverage that lasts about three quarters, while the reaction to a GBG shock is more persistent – lasting up to five quarters – and, at its peak, almost double in size (Figure 5 rows 1 and 2, col. 1). This result confirms the predominant role of GBG with respect of GSG and highlights the autonomous impact of the two types of flows on US banks' leverage ratios.

Second, the effects of GBG and GSG shocks on bond and equity markets are quite differentiated. Both shocks compress the excess bond premium, even though the effect of GSG is more persistent; on the contrary, GBG shocks significantly reduce the VIX while the GSG shocks are not significant. Again, this result confirms the role of GBG as the main factor inducing higher risk appetite in US markets.

Third, the US dollar real effective exchange rate depreciates persistently in response to a positive GBG shock and for approximately two years in response to an unexpected increase in GSG flows (rows 1 and 2, col. 4). This result is consistent with capital inflows being associated not only with overall more expansionary financial conditions, but also with easier monetary conditions. This can be clearly seen from the fact that GBG shocks exert a negative impact on the Federal funds real rate. This is a slightly different result than the findings in Hofmann et al. (2016) and Blanchard et al. (2015) according to which currency appreciations may reflect, for a given monetary policy rate, the outcome of capital inflows,

such as GBG ones, associated to overall more expansionary financial and macroeconomic conditions. Also according to our findings capital inflows are conducive to more expansionary financial conditions, but in addition to that they also lead to easier monetary conditions and an exchange rate depreciation as opposed to an appreciation.

Fourth, both types of flows seem to affect each other over the first year (rows 1 and 2, col. 5). The effect of GSG flows on GBG ones speaks in favor of the view advanced by Bertaut et al. (2012) according to which part of the GBG flows may have been "recycled" from previous financial investments in Europe by GSG countries. Alternatively, the impact of GSG shocks on GBG flows could simply reflect the degree of substitutability between safer (Treasuries and Agency debt) and riskier (corporate bonds) assets.

All in all, our results confirm that GSG and, in particular, GBG are conducive to generally looser financial conditions via higher banking leverage, with both types of flows tending to reinforce each other. According to our findings both GSG and GBG flows are conduits for risk-on/risk-off periods: inflows (outflows) are not simply driven by risk-on (risk-off) periods, as usually documented for emerging market economies, but they actively concur to the determination of these periods.[23] Moreover, both types of flows are conducive to international spillover effects, as they lead to a persistent real effective depreciation of the US dollar vis-à-vis its trading partners.

The risk-taking channel of monetary policy Our impulse responses are in line with the results documented by Bruno and Shin (2015b) and Rey (2015) on the so-called risk-taking channel of monetary policy. As in Bruno and Shin (2015b), we do find that (see Figure 6): (1) a positive shock to the real Fed funds target rate induces after some time a persistent rise in the VIX index and a decline in banking leverage after a fairly long lag (around 10 quarters); (2) the pro-cyclical effect of monetary policy on risk-taking holds also with respect to the GZ excess bond premium measure; (3) an increase in the VIX lowers banks' leverage.

In addition, we also find significant negative effects of a monetary tightening on GSG and especially GBG flows from the second half of year two onwards (row 1, cols. 1 and 2). However, both the responses of GBG flows and banking leverage to a monetary policy shock are positive during the first year, suggesting that a turning in financial conditions, i.e. a reduction in GBG flows and banking leverage in response to a monetary tightening, is not immediate.

The effects of GSG and GBG on US macroeconomic conditions We may now explore whether GSG and GBG flows have also any direct macroeconomic effects on house-

[23] See for example, by Miranda-Agrippino and Rey (2015).

hold debt and housing market developments. BVAR #2 and BVAR #3 include the following variables: (i) the US households' debt-to-disposable-income ratio, taken from the FRED database (BVAR #2), and (ii) the S&P/Case-Shiller 10-City Composite Home Price Index (average price for 10 cities in the United States), deflated by the CPI (BVAR #3).

In BVAR #2, households' debt as a percentage of disposable income is assumed to respond to changes in banks' lending decisions with a lag, so it is placed between GBG and bank leverage. The variable ordering becomes: (1) GSG, (2) GBG, (3) household debt-to-income, (4) banking leverage, (5) the GZ excess bond premium, (6) the VIX index, (7) the US dollar real effective exchange rate, and (8) the real Federal Funds target rate. Results are shown in Figure 7. As expected, GBG flows positively affect households' debt dynamics in a very persistent way; on the contrary, GSG do not have any significant effect on it (row 1 col 1).[24]

The ordering of BVAR #3 is the following: (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate, (7) the real house price index and (8) the real Federal Funds target rate. Results (in Figure 8) support the view according to which positive shocks to both GBG and, after a fairly long lag, GSG flows significantly affect the US housing market by contributing to a rise in real house prices. This finding is in line with the results of Punzi and Kauko (2015).

The above figures point also to another interesting evidence: expansions in households' debt-to-income ratios and increases in house prices are conducive to higher GBG flows. Thus, according to our BVAR, there is evidence of households' indebtedness and housing market developments acting also as a catalyst for GBG flows. Overall, while both GSG and, especially, GBG flows may have contributed significantly to U.S. macroeconomic imbalances prior to the onset of the Great Recession, it appears from our results that increasingly favorable developments in the U.S. economy have also been important determinants in attracting GBG flows towards U.S. financial markets.

5. Conclusions

This paper has explored the effects of official and private international financial flows – our GSG and GBG measures – on US financial conditions. We have further focused on the nexus between GSG and GBG flows and the broader US economy, in particular the dynamics of households' debt and of the housing market.

Our results confirm the existence of an autonomous channel whereby both types of flows have contributed to looser financial market conditions in the United States through lowered

[24]Including household debt-to-GDP instead of debt-to-disposable-income yields identical results.

risk aversion and higher banking leverage. Moreover, during the period of strongest global financial expansion, both types of flows are complementary in that they tend to reinforce each other. Finally, both GSG, and to a greater extent, GBG flows exert a positive impact on households' debt-to-income ratios, and housing market developments. However it is also the case that ebullient macroeconomic conditions, in terms of higher house prices and more leveraged households, have significant effects on GBG flows.

The above findings suggest that international capital inflows can have significant autonomous effects on financial and macroeconomic stability in the US. Relying on this important evidence, our results could inform the development of more general quantitative open economy models, in the spirit of Justiniano et al. (2014): this can help to further investigate the broader macroeconomic consequences of foreign inflows on the US economy, to assess whether particular counter-cyclical policy measures on international financial flows are desirable in terms of welfare outcomes both for the recipient and the originator countries. We leave these very interesting extensions for future research.

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#	Region	1994	2000	2007	1994–2007	2000–2007
1	Total Asia	302.2	596.1	2144.0	1841.8	1547.9
	of which:					
	China	*17.7*	*90.7*	*842.9*	*825.1*	*752.2*
	Japan	*166.4*	*263.9*	*781.4*	*615.0*	*517.5*
	Middle Eastern Oil Exporters	*19.9*	*24.4*	*108.3*	*88.4*	*83.9*
2	Total Europe	188.5	390.3	656.8	468.2	266.4
	of which:					
	Euro Area Countries	*105.5*	*191.0*	*325.8*	*220.3*	*134.8*
	United Kingdom	*58.1*	*112.0*	*73.5*	*15.4*	*-38.5*
3	Total Latin America	12.6	44.0	196.6	184.0	152.6
4	Total Caribbean	33.8	64.2	163.9	130.1	99.7
5	Australia and New Zealand	2.9	8.0	44.8	40.1	36.8
6	Total Africa	1.2	5.4	14.6	13.3	9.1
	total	570.7	1145.6	3268.2	2697.6	2122.7

Table 1: Foreign portfolio holdings of US Treasury and Agency bonds by region on three surveyed dates (December 1994, March 2000 and June 2007) and changes in holdings between two surveys (Jun2007-Dec1994 and Jun2007-Mar2000), in bn USD. Regions are sorted by net change in holdings between 2007 ad 1994 (col. 4). Net positions for the United Kingdom also comprises Channels Islands and the Isle of Man.

#	Country	1994	2000	2007	1994–2007	2000–2007
1	China	17.7	90.7	842.9	825.1	752.2
2	Japan	166.4	263.9	781.4	615.0	517.5
3	Caribbean Banking Centers	33.2	56.0	157.8	124.6	101.8
4	Belgium and Luxembourg	14.5	28.9	131.5	117.0	102.6
5	Russia	0.1	6.8	108.8	108.6	102.0
6	Brazil	0.2	7.6	102.0	101.9	94.5
7	Korea	5.4	38.4	105.9	100.5	67.5
8	Middle Eastern Oil Exporters	19.9	24.4	108.3	88.4	83.9
9	Taiwan	33.3	45.1	97.9	64.6	52.9
10	Hong Kong	13.9	55.9	76.2	62.3	20.3
	total	570.7	1145.6	3268.2	2697.6	2122.7

Table 2: Top 10 portfolio holdings of US Treasury and Agency bonds by foreign country on three surveyed dates (December 1994, March 2000 and June 2007) and changes in holdings between two surveys (Jun2007-Dec1994 and Jun2007-Mar2000), in bn USD. Countries are sorted by net change in holdings between 2007 ad 1994 (col. 4).

#	Region	1994	2000	2007	1994–2007	2000–2007
1	Total Europe	55.0	250.6	1677.0	1622.0	1426.5
	of which:					
	Euro Area Countries	*23.0*	*115.3*	*1062.9*	*1040.0*	*947.6*
	United Kingdom	*24.2*	*114.1*	*460.8*	*436.5*	*346.6*
2	Total Caribbean	21.8	114.2	454.5	432.7	340.3
3	Total Asia	42.7	37.8	239.3	196.6	201.6
	of which:					
	China	*0.3*	*0.2*	*27.6*	*27.3*	*27.5*
	Japan	*29.9*	*22.2*	*119.2*	*89.2*	*96.9*
	Middle Eastern Oil Exporters	*5.8*	*4.4*	*16.7*	*10.9*	*12.3*
4	Total Latin America	2.9	4.2	30.9	28.0	26.7
5	Australia and New Zealand	0.5	2.4	28.5	26.4	26.0
6	Total Africa	0.8	1.0	1.5	0.7	0.4
	total	275.5	703.5	2737.6	2462.1	2034.1

Table 3: Foreign portfolio holdings of US Corporate bonds by region on three surveyed dates (December 1994, March 2000 and June 2007) and changes in holdings between two surveys (Jun2007-Dec1994 and Jun2007-Mar2000), in bn USD. Regions are sorted by net change in holdings between 2007 ad 1994 (col. 4). Net positions for the United Kingdom also comprises Channels Islands and the Isle of Man.

#	Country	1994	2000	2007	1994–2007	2000–2007
1	Belgium and Luxembourg	6.6	43.0	661.7	655.1	618.7
2	United Kingdom	24.2	114.1	460.8	436.5	346.6
3	Caribbean Banking Centers	22.4	109.0	451.0	428.6	342.0
4	Ireland	0.9	8.9	136.0	135.1	127.1
5	Germany	4.5	34.6	98.5	93.9	63.8
6	Japan	29.9	22.2	119.2	89.2	96.9
7	Switzerland	7.0	17.3	89.2	82.2	71.9
8	Netherlands	3.8	11.0	84.2	80.3	73.2
9	Canada	3.6	12.9	83.6	80.1	70.7
10	France	3.8	10.1	58.5	54.7	48.4
	total	570.7	1145.6	3268.2	2697.6	2122.7

Table 4: Top 10 portfolio holdings of US Corporate bonds by foreign country on three surveyed dates (December 1994, March 2000 and June 2007) and changes in holdings between two surveys (Jun2007-Dec1994 and Jun2007-Mar2000), in bn USD. Countries are sorted by net change in holdings between 2007 ad 1994 (col. 4). Net positions for the United Kingdom also comprises Channels Islands and the Isle of Man.

	2002		2003		
Country	#	tot asset	#	tot asset	% of assets
Africa	1	0.1	1	0.2	0
Asia	41	38.2	34	29.7	3
Caribbean	14	5.7	12	11.4	1
Canada	10	29.2	8	21.2	2
Cayman Islands	5	1.0	5	1.2	0
Central and South America	82	59.1	73	67.1	6
Europe	110	501.0	101	580.1	56
Middle East	17	3.2	13	2.8	0
United Kingdom	16	12.8	16	10.5	1
United States	87	317.2	86	321.0	31
Total	383	967.5	349	1045.2	

Table 5: Cayman Islands - Geographical distribution of banks in 2002 and 2003 (total assets are in bn USD).

	D.10-year	D.10-year	D.10-year	D.AAAyield	D.AAAyield	D.AAAyield
D.FFtarget	0.37***	0.37***	0.37***	0.20**	0.20**	0.20**
	(0.10)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)
D.exp infl	−0.09	−0.11	−0.12	−0.02	−0.03	−0.04
	(0.08)	(0.09)	(0.08)	(0.06)	(0.06)	(0.06)
D.logREER	−0.73	−0.24	−0.98	−1.12	−0.61	−1.28
	(1.47)	(1.52)	(1.47)	(1.07)	(1.12)	(1.10)
D.GBG	−0.40***		−0.28***	−0.33***		−0.25***
	(0.09)		(0.10)	(0.07)		(0.08)
D.GSG		−0.29***	−0.23***		−0.21***	−0.15**
		(0.07)	(0.08)		(0.06)	(0.06)
Constant	0.00	−0.00	0.00	−0.00	−0.01	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	162	162	162	162	162	162
Adjusted R^2	0.15	0.17	0.20	0.12	0.11	0.15

Standard errors in parentheses. Sample: Jan 1994 – Jun 2007.
* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Regressions on US long rates (10-year Treasury yield) and Moody's AAA corporate bond yield. Regressors are: nominal Fed Funds target rate (*FFtarget*), expected inflation proxied by lagged core US CPI inflation (*exp infl*), US real effective exchange rate in natural logs (*logREER*), GSG and GBG. Sample is January 1994 – June 2007 (162 obs.). The *D.* indicates that variables are taken in first differences.

Panel A: Credit spread

	1994 – 2007			1999 – 2007		
D.FFtarget	-2.18^{***}	-2.14^{***}	-2.16^{***}	-2.34^{***}	-2.27^{***}	-2.28^{***}
	(0.26)	(0.26)	(0.26)	(0.24)	(0.25)	(0.24)
D.exp infl	0.65	0.54	0.54	0.42	0.20	0.21
	(0.49)	(0.50)	(0.48)	(0.49)	(0.53)	(0.51)
D.logreer	−6.88	−5.05	−6.45	−1.81	1.66	−1.65
	(5.22)	(5.26)	(5.29)	(5.37)	(5.50)	(5.37)
D.GBG	−0.36		−0.53	-0.55^{**}		-0.82^{***}
	(0.34)		(0.37)	(0.28)		(0.29)
D.GSG		0.20	0.34		0.37	0.63^{**}
		(0.23)	(0.26)		(0.25)	(0.27)
Constant	1.87^{***}	1.86^{***}	1.87^{***}	2.28^{***}	2.25^{***}	2.27^{***}
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Adjusted R^2	0.19	0.19	0.20	0.33	0.32	0.36

Panel B: Expected default component

	1994 – 2007			1999 – 2007		
D.FFtarget	-0.71^{***}	-0.71^{***}	-0.72^{***}	-0.48^{***}	-0.48^{***}	-0.49^{***}
	(0.19)	(0.19)	(0.19)	(0.16)	(0.16)	(0.16)
D.exp infl	0.27	0.30	0.30	−0.02	−0.02	−0.01
	(0.25)	(0.26)	(0.26)	(0.22)	(0.24)	(0.24)
D.logreer	-6.22^{*}	-6.16^{*}	-6.31^{*}	−3.31	−2.38	−3.31
	(3.71)	(3.61)	(3.67)	(3.28)	(3.14)	(3.27)
D.GBG	−0.09		−0.06	−0.23		−0.23
	(0.23)		(0.25)	(0.15)		(0.16)
D.GSG		−0.08	−0.07		−0.08	−0.00
		(0.20)	(0.22)		(0.22)	(0.24)
Constant	2.01^{***}	2.01^{***}	2.01^{***}	2.34^{***}	2.33^{***}	2.34^{***}
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Adjusted R^2	0.04	0.04	0.04	0.04	0.03	0.03

Panel C: Excess bond premium

	1994 – 2007			1999 – 2007		
D.FFtarget	-1.47^{***}	-1.43^{***}	-1.44^{***}	-1.85^{***}	-1.79^{***}	-1.80^{***}
	(0.19)	(0.19)	(0.19)	(0.21)	(0.20)	(0.20)
D.exp infl	0.37	0.24	0.24	0.44	0.21	0.22
	(0.29)	(0.30)	(0.28)	(0.33)	(0.35)	(0.34)
D.logREER	−0.66	1.10	−0.14	1.49	4.05	1.66
	(2.98)	(2.98)	(2.92)	(5.14)	(4.97)	(4.85)
D.GBG	−0.27		-0.48^{*}	−0.32		-0.59^{**}
	(0.23)		(0.24)	(0.25)		(0.26)
D.GSG		0.28^{*}	0.40^{**}		0.45^{*}	0.63^{**}
		(0.15)	(0.17)		(0.25)	(0.27)
Constant	-0.14^{***}	-0.16^{***}	-0.14^{***}	−0.05	−0.08	−0.06
	(0.04)	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)
Adjusted R^2	0.22	0.23	0.24	0.27	0.29	0.32

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Regressions on the US credit spread and on its two subcomponents estimated in Gilchrist and Zakrajsek (2012). Regressors are: nominal Fed Funds target rate (*FFtarget*), expected inflation proxied by lagged core US CPI inflation (*exp infl*), US real effective exchange rate in natural logs (*logREER*), GSG and GBG. Samples are January 1994 – June 2007 (162 obs.), January 1999 – June 2007 (102 obs.). The *D.* symbol indicates that variables are taken in first differences.

Panel A: logVIX

	1994 – 2007			1999 – 2007		
D.real FF target	-0.53^{***}	-0.55^{***}	-0.55^{***}	-0.61^{***}	-0.60^{***}	-0.60^{***}
	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)	(0.11)
D.logREER	0.31	0.81	0.14	-1.32	0.35	-1.32
	(2.52)	(2.41)	(2.44)	(3.16)	(3.24)	(3.18)
D.GBG	-0.33^{**}		-0.25^{*}	-0.40^{***}		-0.42^{***}
	(0.15)		(0.15)	(0.15)		(0.16)
D.GSG		-0.21^{*}	-0.15		-0.10	0.03
		(0.11)	(0.11)		(0.12)	(0.12)
Constant	2.92^{***}	2.92^{***}	2.93^{***}	2.95^{***}	2.94^{***}	2.95^{***}
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Adjusted R^2	0.13	0.12	0.13	0.19	0.14	0.18

Panel B: Conditional variance (in logs)

	1994 – 2007			1999 – 2007		
D.real FF target	-0.99^{***}	-0.99^{***}	-1.00^{***}	-0.93^{***}	-0.88^{***}	-0.88^{***}
	(0.18)	(0.19)	(0.19)	(0.21)	(0.22)	(0.23)
D.logREER	-0.49	1.04	-0.59	1.19	4.54	1.21
	(4.51)	(4.62)	(4.55)	(5.92)	(6.31)	(5.99)
D.GBG	-0.66^{**}		-0.62^{**}	-0.72^{**}		-0.83^{***}
	(0.27)		(0.29)	(0.29)		(0.31)
D.GSG		-0.24	-0.08		-0.03	0.23
		(0.20)	(0.20)		(0.25)	(0.24)
Constant	2.79^{***}	2.77^{***}	2.79^{***}	2.91^{***}	2.88^{***}	2.90^{***}
	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)	(0.06)
Adjusted R^2	0.15	0.12	0.14	0.17	0.11	0.17

Panel C: Variance premium (in logs)

	1994 – 2007			1999 – 2007		
D.real FF target	-1.40^{***}	-1.44^{***}	-1.45^{***}	-1.68^{***}	-1.65^{***}	-1.66^{***}
	(0.25)	(0.26)	(0.26)	(0.30)	(0.31)	(0.30)
D.logREER	1.20	2.78	0.82	-5.89	-1.48	-5.88
	(6.09)	(5.78)	(5.89)	(7.41)	(7.44)	(7.48)
D.GBG	-0.91^{**}		-0.75^{*}	-1.04^{**}		-1.09^{**}
	(0.40)		(0.45)	(0.42)		(0.47)
D.GSG		-0.51^{**}	-0.32		-0.22	0.12
		(0.25)	(0.28)		(0.34)	(0.36)
Constant	2.51^{***}	2.49^{***}	2.51^{***}	2.47^{***}	2.44^{***}	2.47^{***}
	(0.07)	(0.06)	(0.06)	(0.09)	(0.09)	(0.09)
Adjusted R^2	0.13	0.12	0.13	0.18	0.13	0.17

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Regressions on logVIX and on its subcomponents taken from Bekaert and Hoerova (2014). Samples are January 1994 – June 2007 (162 obs.), January 1999 – June 2007 (102 obs.). Regressors are: real Fed Funds target rate proxied by nominal Fed Funds target rate minus expected inflation (*real FFtarget*), US real effective exchange rate in natural logs (*logREER*), GSG and GBG. The *D.* indicates that variables are taken in first differences.

Bank leverage (first difference)

	1994 – 2007				1999 – 2007				2002 – 2007			
D.real FF target	−0.63	−0.50	−0.51	−0.44	−0.76*	−0.67	−0.66	−0.61	−0.09	0.06	0.20	0.20
	(0.40)	(0.42)	(0.42)	(0.44)	(0.44)	(0.48)	(0.45)	(0.49)	(0.49)	(0.48)	(0.45)	(0.44)
L(3).logVIX	−0.61***	−0.52***	−0.56***	−0.50**	−0.76***	−0.65**	−0.72***	−0.64**	−0.96***	−0.81**	−0.94**	−0.80**
	(0.18)	(0.20)	(0.20)	(0.20)	(0.22)	(0.26)	(0.24)	(0.27)	(0.36)	(0.38)	(0.37)	(0.39)
L.D.GBG		0.55*		0.52*		0.39		0.44		0.69**		0.87***
		(0.29)		(0.29)		(0.33)		(0.31)		(0.31)		(0.31)
D.GBG		0.55*		0.40		0.31		0.16		0.62**		0.42
		(0.31)		(0.29)		(0.30)		(0.32)		(0.30)		(0.33)
L.D.GSG			0.18	0.06			0.06	−0.07			−0.04	−0.35
			(0.22)	(0.22)			(0.25)	(0.23)			(0.30)	(0.30)
D.GSG			0.42	0.30			0.37	0.32			0.59*	0.35
			(0.29)	(0.30)			(0.26)	(0.27)			(0.35)	(0.39)
Constant	1.86***	1.55***	1.69***	1.50**	2.37***	2.01**	2.23***	1.98**	2.78***	2.26**	2.68**	2.23**
	(0.53)	(0.58)	(0.57)	(0.60)	(0.66)	(0.78)	(0.70)	(0.81)	(0.98)	(1.07)	(1.03)	(1.08)
Adjusted R^2	0.07	0.09	0.08	0.09	0.14	0.14	0.14	0.14	0.17	0.25	0.18	0.24

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Regressions on bank leverage, proxied, as in Bruno and Shin (2015b), with the ratio of US broker-dealers' total liabilities including equity, over equity. Regressors are: real Fed Funds target rate proxied by nominal Fed Funds target rate minus expected inflation (*real FFtarget*), the VIX index in natural logs (*logVIX*), GSG and GBG. Samples are January 1994 – June 2007 (162 obs.), January 1999 – June 2007 (102 obs.), September 2002 – June 2007 (58 obs.). The *D.* symbol indicates that variables are taken in first differences; the *L.* symbol indicates one-period lag, and *L(3).* symbol indicates a 3-period lag.

		GSG			GBG		
		correlation	conf int lowb	conf int ub	correlation	conf int lowb	conf int ub
BVAR #1	FF1	- 0.090	- 0.308	0.112	- 0.077	- 0.279	0.107
	FF4	- 0.120	- 0.308	0.076	- 0.010	- 0.239	0.174
	ED2	- 0.038	- 0.239	0.154	- 0.007	- 0.245	0.213
	ED3	- 0.021	- 0.234	0.183	0.012	- 0.248	0.239
	ED4	- 0.001	- 0.217	0.231	0.021	- 0.224	0.247
BVAR #2	FF1	- 0.080	- 0.294	0.121	- 0.010	- 0.250	0.186
	FF4	- 0.118	- 0.298	0.072	0.033	- 0.251	0.221
	ED2	- 0.037	- 0.242	0.152	0.048	- 0.221	0.251
	ED3	- 0.025	- 0.248	0.197	0.047	- 0.232	0.256
	ED4	- 0.006	- 0.231	0.240	0.048	- 0.220	0.256
BVAR #3	FF1	- 0.071	- 0.299	0.144	- 0.048	- 0.242	0.130
	FF4	- 0.109	- 0.314	0.115	- 0.012	- 0.219	0.170
	ED2	- 0.020	- 0.239	0.179	0.015	- 0.214	0.212
	ED3	- 0.003	- 0.239	0.211	0.034	- 0.204	0.235
	ED4	0.017	- 0.218	0.251	0.048	- 0.186	0.244

Table 10: Correlations between the structural GSG/GBG shocks (left/right block) extracted from the three BVAR specifications and the five instrument for monetary policy shocks taken from Gertler and Karadi (2015). For each block, column 1 reports Pearson's correlations coefficients and columns 2 and 3 the confidence interval's lower and upper bound, respectively. Bootstrapped confidence intervals are computed with 1000 replications.

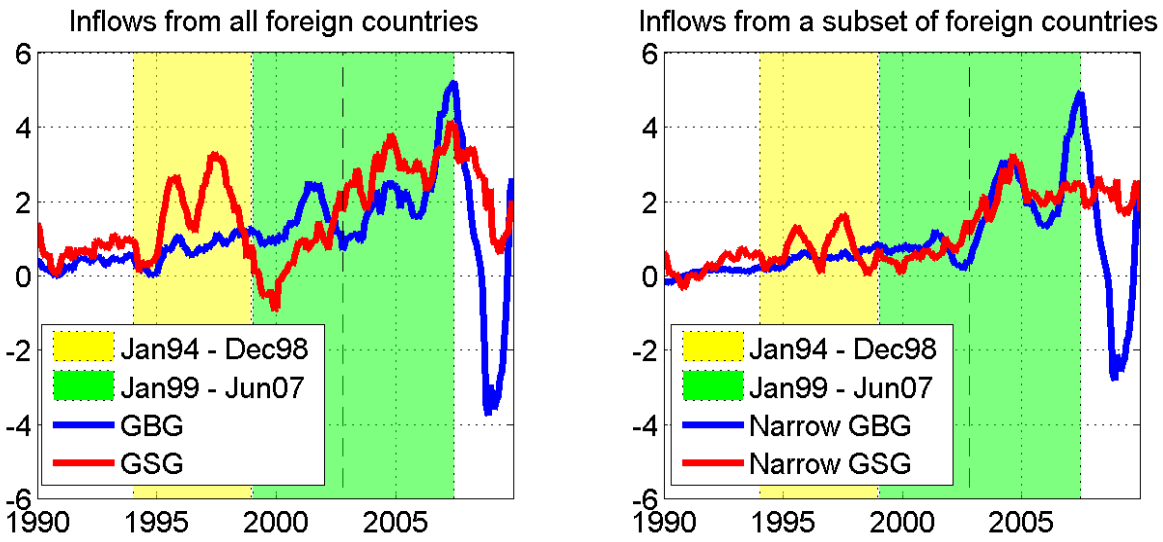

Figure 1. Monthly GSG (red line) and GBG (blue line) computed for total foreign countries (Panel (a)) and for a restricted sample of countries (Panel (b)), in % of US GDP. The restricted sample is formed by European countries plus Caribbean banking centers (banking glut) and by the group of Asian countries (savings glut). Values for month t are computed as the sum of the 12 month flows ending in month t, standardized by the monthly value of US GDP for month $t-12$, as Warnock and Warnock (2009). The vertical dashed line in August 2002 marks the beginning of the credit spread's and VIX's decreasing phases; the yellow area (Jan94-Dec98) marks the phase in which, according to the literature, GSG inflows where predominant; the green area (Jan99-Jun07) marks the rise in GBG inflows. The temporal disaggregation of US quarterly GDP is done using a Chow-Lin type algorithm. Data are from January 1990 to January 2008.

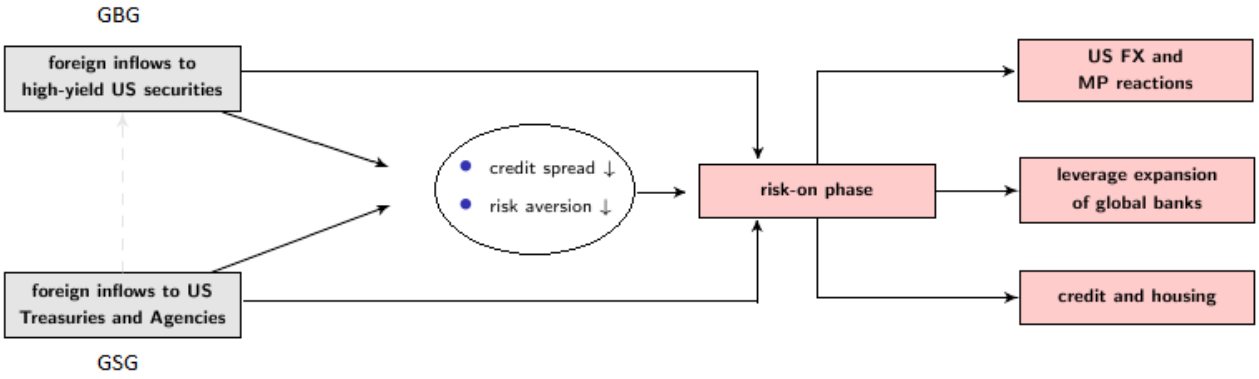

Figure 2. Diagram of the effect of foreign inflows on the US financial and macroeconomic conditions.

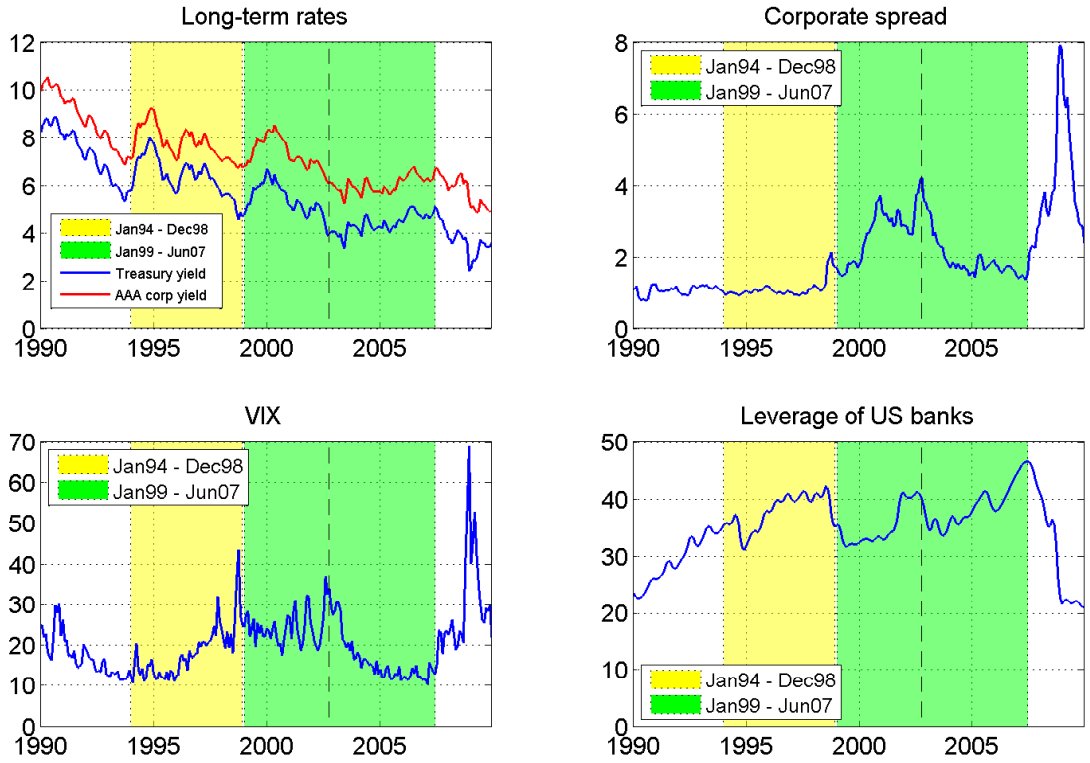

Figure 3. Long-term rates, credit spread by Gilchrist and Zakrajsek (2012), VIX and US bank leverage during the run up to the crisis. The vertical dashed line in August 2002 marks the beginning of the credit spread's and VIX's decreasing phases; the yellow area marks the phase in which GSG inflows where predominant, while the green one marks the rise in GBG inflows..

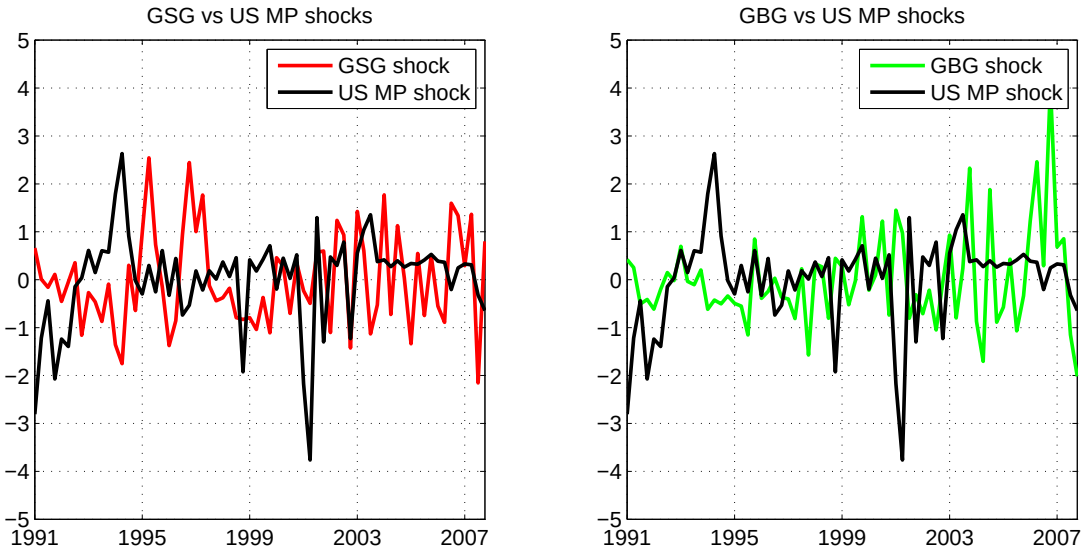

Figure 4. Comparison between BVAR-estimated structural shocks and US monetary policy shocks. Structural GSG and GBG shocks are computed from the benchmark BVAR. The proxy for monetary policy shock is the three-month ahead funds rate surprise (FF4), chosen by Gertler and Karadi (2015) for their baseline estimation. Shocks are standardized in mean and variance..

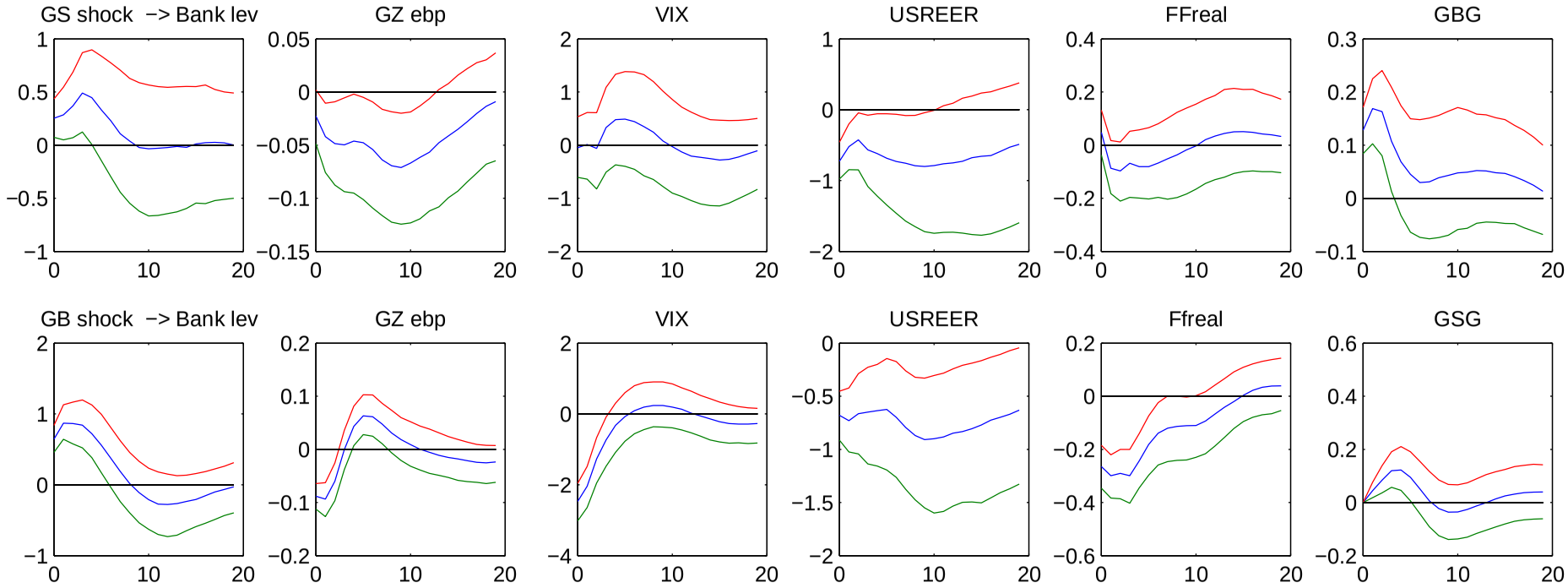

Figure 5. Impulse response functions from GSG and GBG shocks, taken from the benchmark BVAR. The order of the variables is (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate (REER), and (7) the real Federal Funds target rate. The bootstrapped 90% confidence bands are computed with 1000 replications; the sample period is 1990Q1-2010Q3.

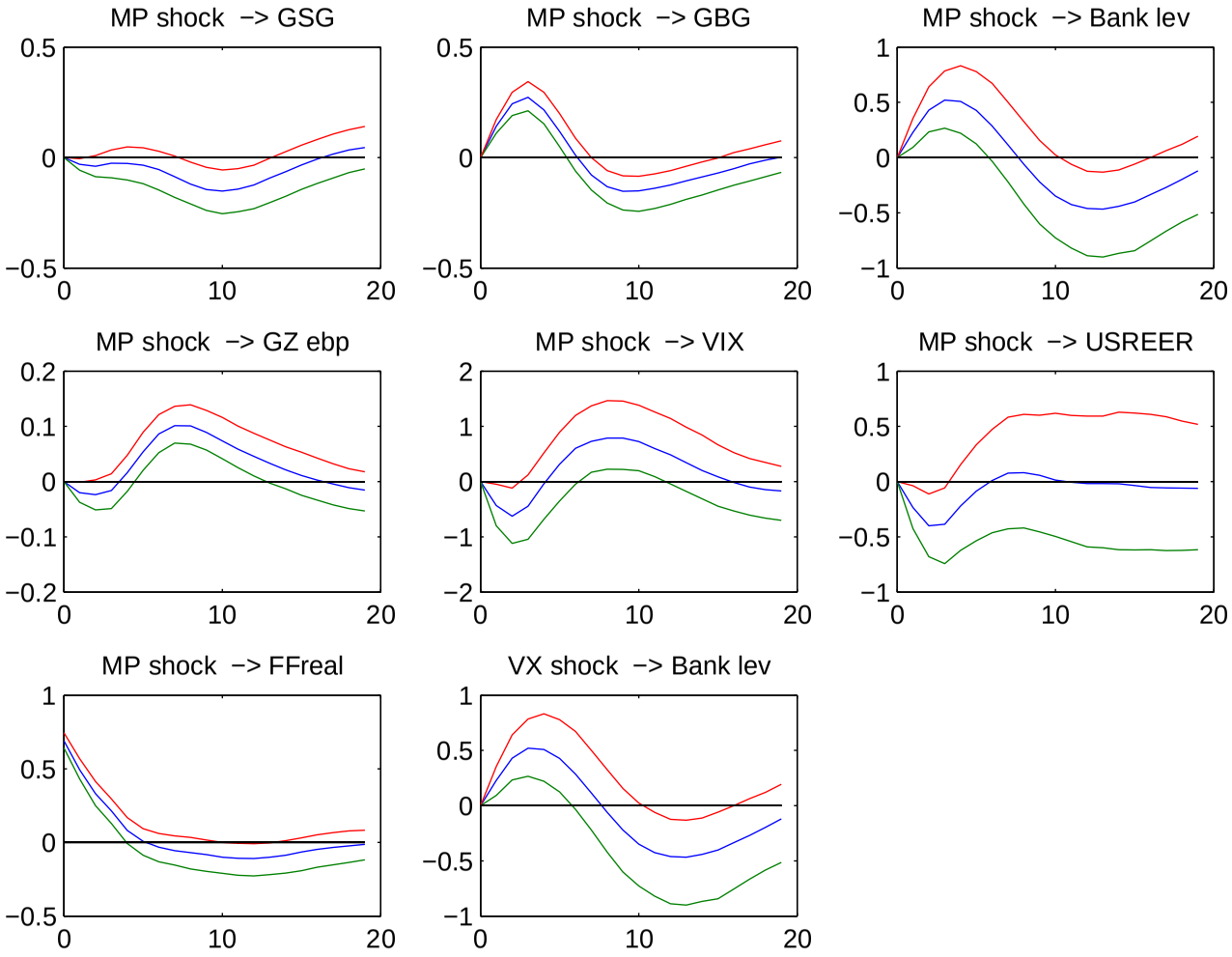

Figure 6. Impulse response functions from selected shocks, taken from the benchmark BVAR. The order of the variables is (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate (REER), and (7) the real Federal Funds target rate. The bootstrapped 90% confidence bands are computed with 1000 replications; the sample period is 1990Q1-2010Q3.

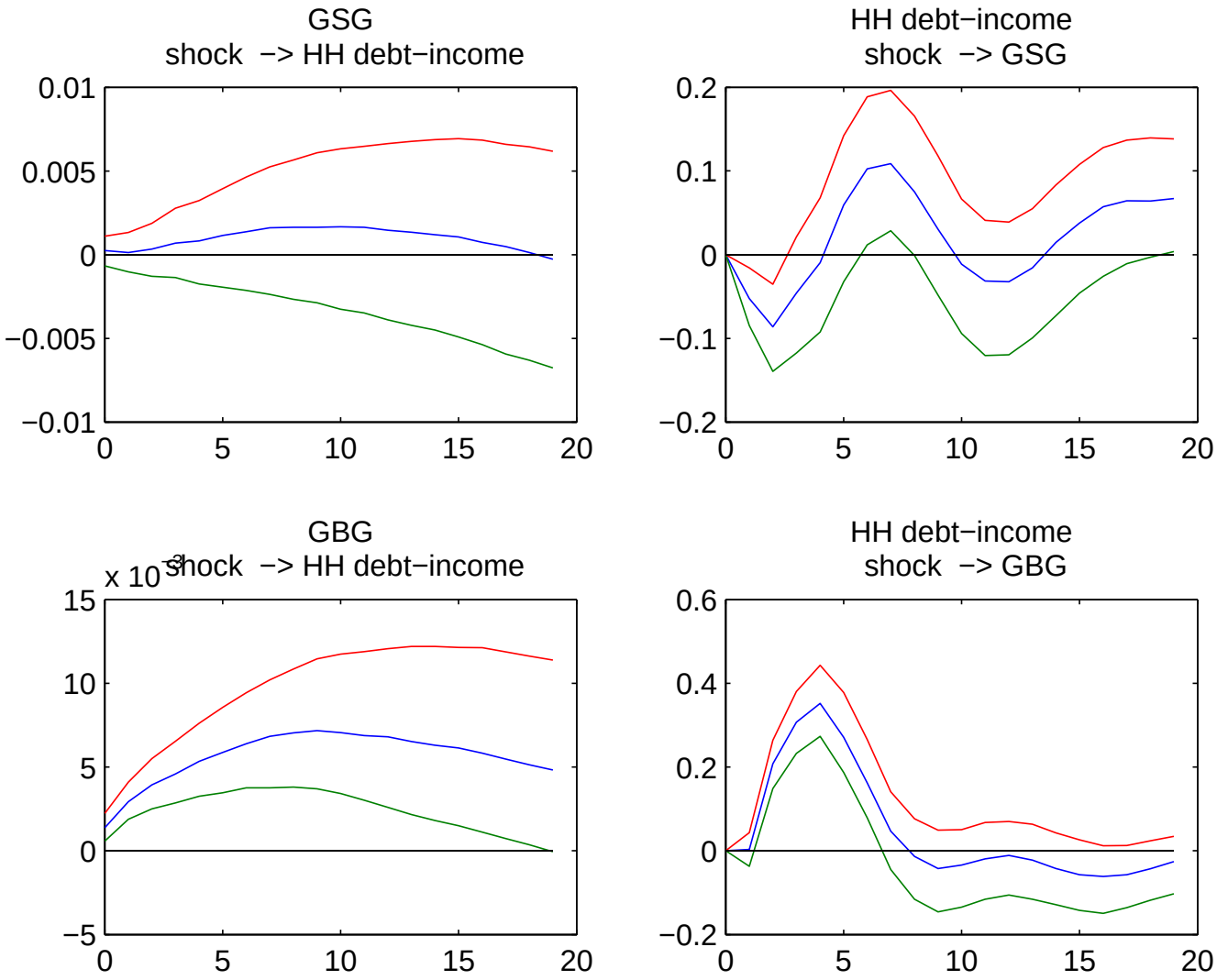

Figure 7. Impulse response functions from selected shocks, taken from BVAR #2. BVAR #2 is (1) GSG flows, (2) GBG flows, (3) household debt, (4) banking leverage, (5) the GZ excess bond premium, (6) the VIX index, (7) the US dollar real effective exchange rate (REER), and (8) the real Federal Funds target rate. The bootstrapped 90% confidence bands are computed with 1000 replications; the sample period is 1990Q1-2010Q3.

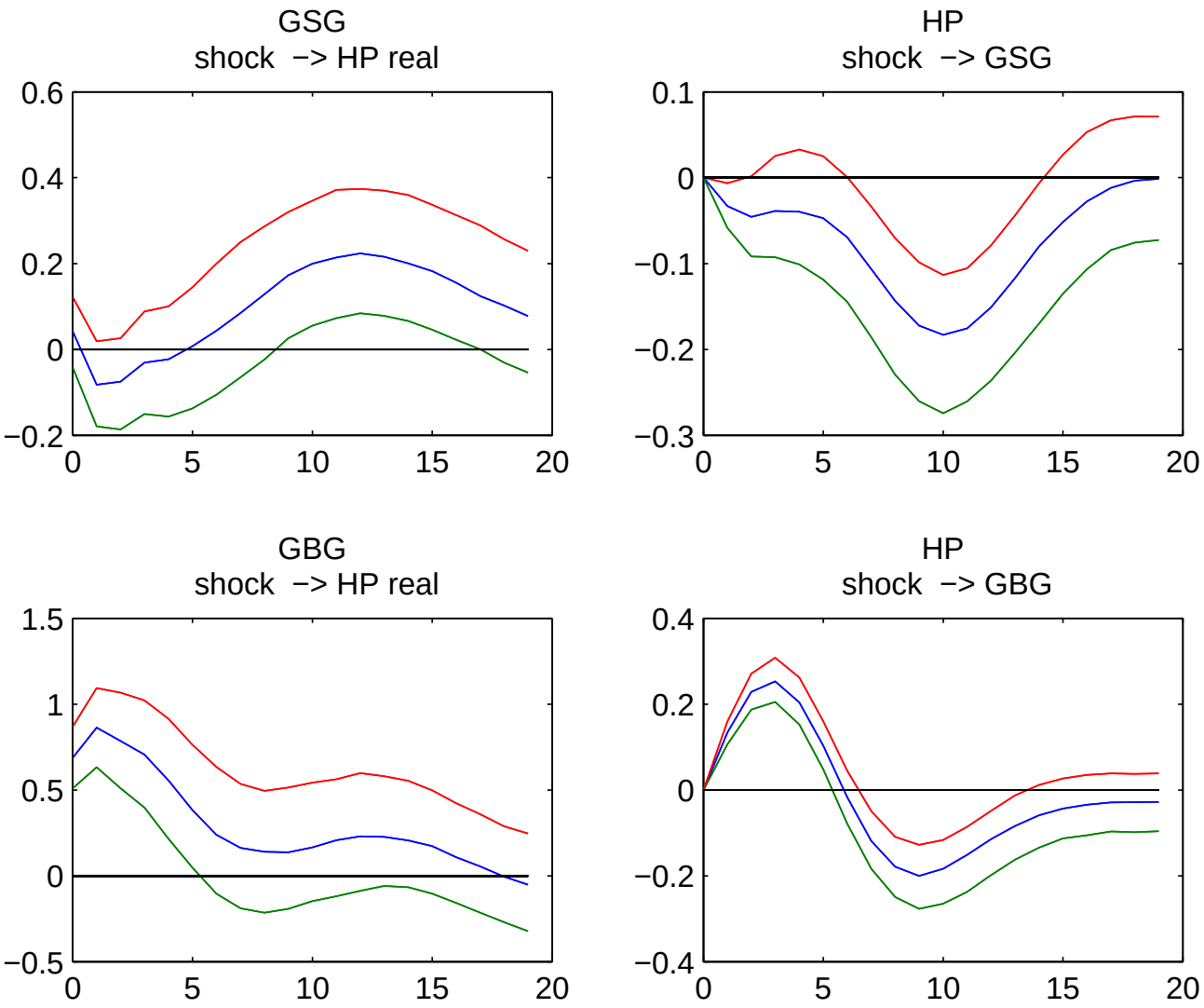

Figure 8. Impulse response functions from selected shocks, taken from BVAR #3. BVAR #3 is (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate (REER), (7) the real house price index and (8) the real Federal Funds target rate. The bootstrapped 90% confidence bands are computed with 1000 replications; the sample period is 1990Q1-2010Q3.

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