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The risk-taking channel of international financial flows

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Abstract

From the second half of the 1990s, the high saving propensity in emerging economies triggered massive inflows towards safe assets in the United States; then, from the early 2000s, global banks also increased investment in US markets targeting riskier securities. We investigate to what extent the *global saving glut* and the *global banking glut* have stimulated risk taking, and find significant effects on credit spreads, market volatility and bank leverage. In a VAR framework, we also detect linkages between foreign inflows, US household indebtedness and house prices, suggesting a substantial risk-taking channel. Our findings provide evidence of the autonomous role of foreign financial flows during the run-up to the global financial crisis.

JEL classification: F32, F33, F34

Keywords: saving glut, banking glut, capital flows, banking leverage, risk-taking channel

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1 Introduction

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. Between 1996 and 2003, following financial crises in East Asia, Latin America and Russia, many developing and oil-producing economies accumulated foreign reserves as a buffer against potential capital outflows. This increased propensity to save, coupled with a preference for low-risk assets, triggered substantial inflows to the US bond market putting, according to one prominent view, downward pressure on real interest rates and upward pressure on asset prices (the *Global Saving Glut* or GSG; see Bernanke, 2005 and Warnock and Warnock, 2009). Another strand of the literature emphasizes the role of the international banking sector, arguing that a key driver of the crisis was the excess elasticity of banks' intermediation: according to it, banks' balance sheets expand in times of favorable regulation or expansionary monetary policy and, during the 2000s, allowed for the build-up of unsustainable credit (the *Global Banking Glut* or GBG; see Borio and Disyatat, 2011, Shin, 2011, Brender and Pisani, 2010 and Bernanke et al., 2011). The latter hypothesis is related to the activity of global banks, mostly European, which raised dollar funding via their US branches (Bruno and Shin, 2015b) and reinvested part of it in private-label US securities (Bertaut et al., 2012).

The two hypotheses have been separately explored by a number of authors. However, the investigation of the effects of financial flows on the US economy is limited to the analysis of foreign purchases of Treasuries, motivated by the Greenspan conundrum.[1] Indeed, on top of the decline in long rates, other trends characterized the US markets at that time: credit spreads decreased, market volatility shrunk and the leverage of US banks increased (see Figure 1.1). Related to these stylized facts, the relevance of the two hypotheses is still an open question. On one side, the saving glut effect could have been predominant, provided that total flows from Asia have been twice as large than those from European banks (Mc Cauley, 2018), and that current account imbalances (as those experienced by Asian countries) are known to drive changes in international investment positions (Gourinchas and Rey, 2014). On the other side, the dynamics of the spreads and the VIX seem to be more directly related to the search-for-yield behavior of banks: in particular, the fall in corporate spreads, maybe due to a stronger pressure on US corporate than Treasury bonds by foreign investors, can speak in favor of the banking glut hypoth-

[1] In 2005, the Federal Reserve Chairman Greenspan observed that long-term rates trended lower despite the 150-basis point rise in the Federal Funds rate. Empirically, Bertaut et al. (2012) find that foreign inflows to US bonds have significantly compressed bond yields.

esis. The extent to which these foreign developments may be partly responsible for this increase in risk-taking has received much less attention in the literature compared to the effects on US safe assets returns.

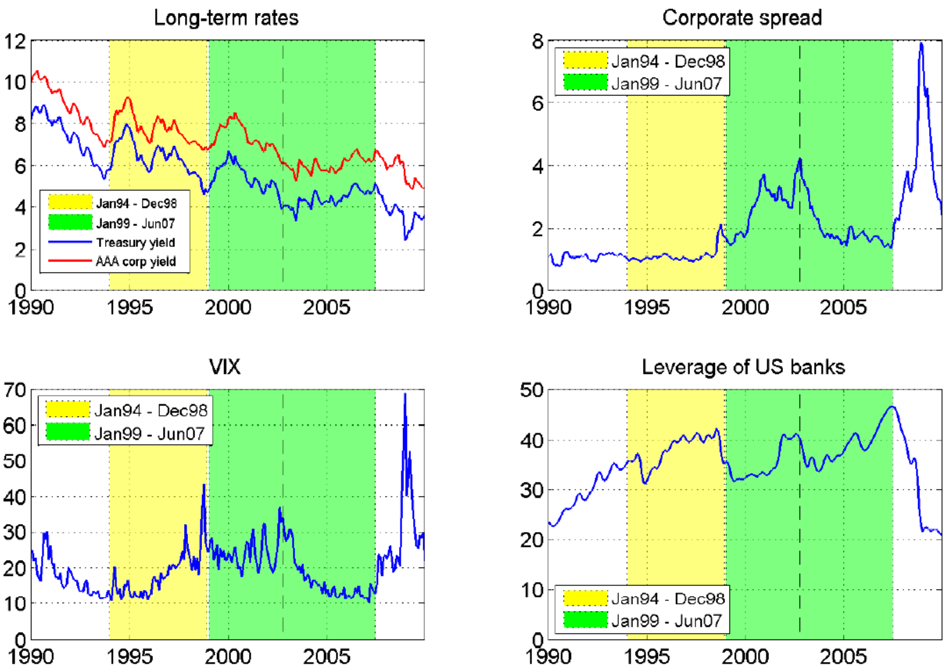

Figure 1.1: Long-term interest rates, credit spread, VIX and US bank leverage during the run-up to the crisis. The vertical dashed line in August 2002 marks the beginning of the credit spread's and VIX's decreasing phases; the yellow area marks the phase in which GSG inflows where predominant, while the green one the period when both GSG and and GBG inflows were present.

We re-investigate the role of foreign financial flows into the US markets during the run-up to the great financial crisis. The analysis is divided into two parts. First, we test the effects of foreign US bonds purchases on risk-taking: aggregate portfolio flows, separating between those coming from emerging Asia and those from European countries, are included in a regression analysis to identify their effects on the VIX, the corporate credit spread and US broker-dealer leverage. Within the same framework, we further disentangle their impact on the risk premium component, as opposed to the expectations component, of the VIX and the credit spread, using some of the proxies available in the literature (Gilchrist and Zakrajsek, 2012 and Bekaert and Hoerova, 2014). Second, we construct "saving glut flows" and "banking glut flows" by selecting investments in US bonds coming from emerging Asia (for the former type of flows) and by some European countries selected by crossing inward and outward portfolio flows (for the latter one); finally, we evaluate the financial and real effects of the two global financial gluts in an identified VAR framework.

Our results show that both types of inflows had autonomous roles in affecting US financial and macroeconomic conditions. In particular, GBG flows were a relevant driver behind the compression of the credit spread and the VIX and the expansion of household debt-to-income ratio, whereas both types of flows contributed to the rise in bank leverage and house prices. The decomposition of the credit spread and the VIX in their expectations and risk premia components also suggests that the effect of foreign inflows was channeled via lower risk premia both in bond and equity markets. We also find evidence that the global saving and banking glut had reinforcing effects. Last, to address the issue of possible endogeneity with respect to US monetary policy, we conduct a test between our identified shocks and popular measures of US monetary policy surprises, finding no significant correlations: this suggests an autonomous risk-taking channel of foreign financial flows towards US markets.

We contribute to the literature on global financial flows in three ways. First, we improve understanding of the international drivers of risk appetite and credit booms. To our knowledge, while the effect of US monetary policy on foreign investment and on synchronized capital flows has been extensively investigated (see Rey, 2015 and Miranda-Agrippino and Rey, 2015, among others), here we document an episode in which foreign financial flows had independent effects *on* the US economy. Second, concerning the analysis of the pre-crisis period, we highlight the joint and autonomous role of the saving and banking gluts, which have never been extensively explored from an empirical point of view. In this perspective, our analysis informs the broader literature on the connections between US markets and the global financial cycle. Third, from a more methodological point of view, our work proposes a simple strategy to identify two types of (almost concomitant) capital flow shocks using data on bilateral portfolio flows among countries from which these two flows originated. This allows us to address the potential endogeneity affecting GBG flows, which could arise from the fact that, especially during the pre-crisis period, GBG flows may have been partly "recycled" from GSG flows targeting Europe, as suggested by Bertaut et al. (2012).

The rest of the paper is organized as follows. Section 2 describes in detail the evolution of financial inflows into the US markets during the run-up to the crisis, the way we compute monthly GSG and GBG flows and the empirical strategy followed in the rest of the paper. Section 3 and Section 4 focus, respectively, on the results from monthly regressions and on the impulse responses of quarterly BVAR models. Section 5 concludes.

2 Data and empirical strategy

In this section we describe the main features of our analysis. First, we describe the dataset (Section 2.1). Then, we compute our measures of inflows into the US public and private bond markets and comment on their evolution between the 90s and the early 2000s (Section 2.2); finally, Section 2.3 describes and motivates our empirical approach.

2.1 Data sources

Following Warnock and Warnock (2009) and Bertaut et al. (2012), we construct monthly foreign inflows into US securities 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 from 2002.

To obtain monthly holdings within each survey, one first needs to adjust the monthly net purchases (i.e., gross purchases less sales of US bonds by foreigners) computed from UST in order to be coherent with FPH. The method proposed by Warnock and Warnock (2009) has been refined and updated by Bertaut and Tryon (2007) and Bertaut and Judson (2014).[2] Monthly data (*benchmark-consistent holdings*, henceforth) are available from March 1994 to December 2014.[3]

To construct our indicators, we rely on flows (i.e., first differences of monthly holdings) into government bonds – Treasuries and Agencies – and private fixed-income securities – corporate bonds.[4] The evolution over time of foreign holdings of US securities during the 1990s and early 2000s reveals two interesting stylized facts: first, between 2000

[2] 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.

[3] See Bertaut and Judson (2014).

[4] 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.

and 2007, Asia (and particularly China) more than tripled its holdings of US safe assets; second, in the same period, European countries massively increased their holdings of US private-label bonds. A more detailed analysis at both regional and country level is provided in Appendix A.

2.2 Indicators of financial inflows

Our indicators of foreign inflows into public and private US bonds are constructed following the original formulation of Warnock and Warnock (2009) for public bonds. Foreign financial inflows 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.[5] Consider foreign investors in Treasury and Agency bonds from n countries, and investors in US corporate bonds from m countries. Denote by $\{T_{j,t}\}$, $\{A_{j,t}\}$ and $\{C_{k,t}\}$ the monthly series of benchmark-consistent holdings of country j (k) of US Treasury and Agency (corporate) bonds, respectively. Let $\{\Delta T_{j,t}\}$, $\{\Delta A_{j,t}\}$ and $\{\Delta C_{k,t}\}$ be the benchmark-consistent flows obtained as first differences of holdings and $\{GDP_t^{US}\}$ the series of estimated monthly US GDP from quarterly data using the Chow-Lin algorithm (see Chow and Lin, 1971). Twelve-month cumulated inflows in Treasury and Agency bonds are defined as:

$$\text{TAinflows}_t = \frac{1}{12 * GDP_{t-12}^{US}} \sum_{j=1}^{n} \sum_{i=1}^{12} \left(\Delta T_{j,t-i+1} + \Delta A_{j,t-i+1} \right) \tag{2.1}$$

and those in corporate bonds as:

$$\text{Cinflows}_t = \frac{1}{12 * GDP_{t-12}^{US}} \sum_{k=1}^{m} \sum_{i=1}^{12} \Delta C_{k,t-i+1} \tag{2.2}$$

The evolution of those inflows over time is reported in Figure 2.1. The left panel reports inflows into Treasury plus Agency bonds (red line) and corporate bonds (blue line) from all foreign countries (i.e., $m = n =$ all foreign countries); the right panel shows inflows into US Treasuries and Agencies from all Asian countries (red line) and into corporate bonds from Europe and the Caribbean banking centers (blue line). Financial inflows from abroad are substantial in two distinct phases (Figure 2.1, left panel): (i) during the early 90s, when inflows on private label securities were low and almost flat while pur-

[5]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.

chases 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.

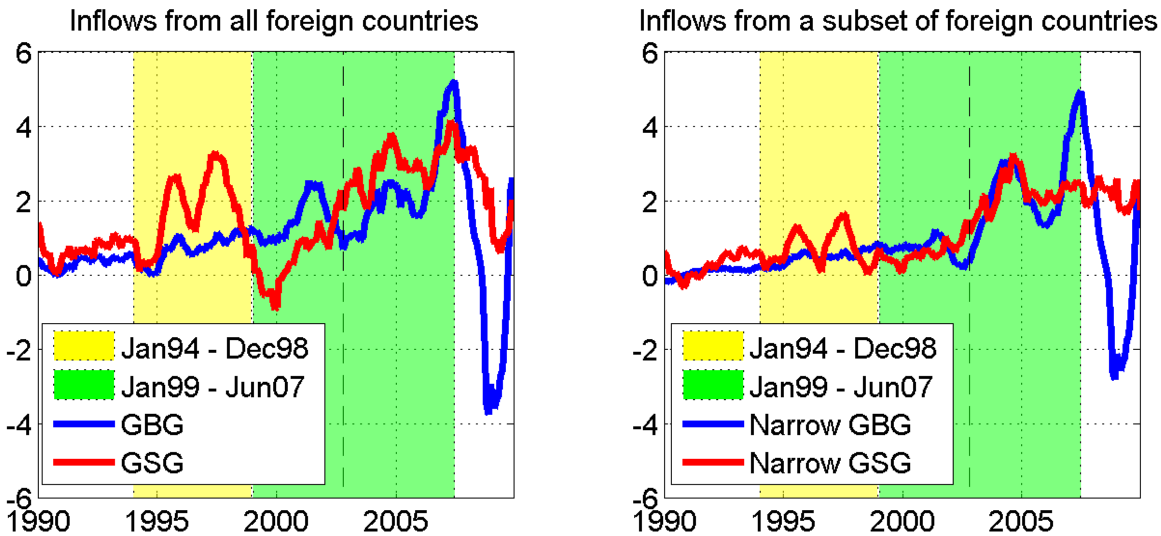

Figure 2.1: Inflows to Treasuries and Agency bonds (red line) and inflows to corporate bonds (blue line), in % of US GDP. Left panel: inflows from all countries; right panel: inflows from Europe plus Caribbean banking centers (corporate inflows) and from Asian countries (Treasury and Agency inflows). Yellow area: beginning of the global savings glut; green area: concomitant phase of savings and banking glut. Vertical dashed line: beginning of the synchronous decrease in the credit spread and the VIX (August 2002).

The dominance of one or the other type of flows during the second phase can be observed during the different subperiods: net purchases of corporate bonds are stronger than those of public bonds between the end of the 90s and the beginning of the 2000s, while the evidence is reversed later on in the 2000s; finally, between 2005 and 2008, private bond inflows exhibit again a much more rapid pace. Instead, the series constructed using subsets of countries show a more comparable evolution during the entire period of interest (Figure 2.1, right panel), except during the later years of the sample, when foreign banking flows accumulation clearly dominates.

2.3 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. We start with a reduced-form analysis focusing on long-term yields, credit spreads, the VIX and bank leverage, and then we proceed by identifying GSG and GBG shocks in a BVAR model.

The reduced-form analysis is conducted as follows. We first explore the impact of foreign inflows on US long-term rates, namely 10-year Treasury yields and returns on AAA corporate bonds issued by the US non-financial sector (a proxy for private-label MBS).[6] Then, we focus more closely on the credit spread, i.e. the premium assigned by investors to corporate with respect to government bonds which steadily decreased during the run-up to the crisis, between the second half of 2002 and the first half of 2008. In particular, we employ both the measure of the credit spread and of its two subcomponents – the expectations and risk premium components – computed by Gilchrist and Zakrajsek (2012): a negative impact of either type of flows on the credit spread, and in particular on its risk premium component, should signal foreign inflows as being partly responsible for increased risk-taking behavior.

We further investigate 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 whether both the reduction in riskiness and the expansion in banks' balance sheets also reflect the autonomous transmission mechanism of GBG and GSG flows. For this purpose, while controlling for the monetary policy stance, we regress separately a proxy for banking leverage and the VIX index on foreign inflows. The aim is to capture a possible direct effect of international financial flows on US leverage, and also to test whether inflows exert pro- or counter-cyclical effects on risk aversion and market uncertainty, proxied by the two components of the VIX estimated by Bekaert and Hoerova (2014).

The structural analysis is implemented in a BVAR framework including both financial and macroeconomic variables.[7] The GSG variable included in the BVAR is computed by retaining inflows to US public bonds coming from emerging Asian economies only, in line with the original definition by Bernanke (2005); the GBG one is instead computed using corporate bond flows from those European economies in which portfolio investments from emerging Asia *decreased* during the same years, to exclude inflows to the US that could have been recycled from the Asian saving glut (see Section 4). The shocks are recovered through a recursive procedure, after their exogeneity with respect to US monetary shocks has been established by assessing their correlation with the monetary policy shocks identified by Gertler and Karadi (2015). These GSG and GBG shocks are then used

[6] As shown by Bertaut et al. (2012), Jumbo MBS yields provided by JP Morgan and Bloomberg show a very similar evolution over time to that of the larger set of AAA yields during the available sample.

[7] The choice of Bayesian estimation techniques is dictated by the fairly short sample period and relatively high dimensionality of the VAR model.

to investigate whether GSG and GBG flows have effects not only on financial conditions, but also on bank lending, house prices and residential investment.

3 Foreign inflows into US financial markets

In this section we present the results of our regression analysis. The regressions are specified as follows:

$$y_t = \alpha + \beta_1 \text{ Cinflows}_t + \beta_2 \text{ TAinflows}_t + \gamma \textbf{ Controls}_t + \epsilon_t \tag{3.1}$$

where y is the target variable: 10-year or AAA corporate yields (Section 3.1), Gilchrist and Zakrajsek (2012)'s credit spread and its subcomponents (Section 3.2), the VIX and its expectation and risk premium components taken from Bekaert and Hoerova (2014) (Section 3.3), and a measure of US bank leverage (Section 3.4). Control variables (**Controls**) aim at capturing the stance of US monetary policy as well as movements in the exchange rate of the dollar. We thus include in the set of controls the Federal Funds target rate, 10-year US CPI inflation expectations (taken from the US Survey of Professional Forecasters) and the log of the US narrow real effective exchange rate (taken from the BIS).

3.1 Long-term interest rates

To estimate the effects of foreign flows on long-term rates, we run univariate regressions of foreign financial inflows on the 10-year Treasury rate and the AAA corporate yield. Inflows in Treasury and Agency bonds (TAinflows) and those on US corporate bonds (Cinflows) 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.[8]

Results are reported in Table 1. Both flow variables 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 and 4,5) and when they are included together (cf. cols. 3 and 6), although in this latter case the magnitude of the coefficients is somewhat lower. In both cases, the effect of corporate bond inflows on long-term yields is stronger than that of public bond flows.

[8]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 with first differences.

	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.Cinflows	−0.40***		−0.28***	−0.33***		−0.25***
	(0.09)		(0.10)	(0.07)		(0.08)
D.TAinflows		−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 1: 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*), Cinflows and TAinflows. Sample is January 1994 – June 2007 (162 obs.). The *D.* indicates that variables are in first differences.

3.2 Credit spreads

As shown by Gilchrist and Zakrajsek (2012) (GZ henceforth), credit spreads capture both the expected default rate of corporate bonds and cyclical movements in investors' risk appetite. The authors compute measures of these two components, i.e. the expected default component and the excess bond premium.[9] While the former is related to the financial health of the issuers, 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 inflows on its level; as in the previous estimation, regressors are all in first differences.

Results are reported in Table 2. Panel A, in which the GZ spread is the dependent variable, shows that corporate flows have a negative effect on the credit spread, while public bond inflows are 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

[9]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.

the credit spread induced by corporate bond flows is driven by a compression in the excess bond premium, and 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 corporate nor for public inflows (Panel B); for the excess bond premium, we find negative effects of corporate inflows, that are preserved even when both flow variables are included jointly (Panel C).

Interestingly, contrary to corporate inflows, flows on public US securities 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 flows markedly accelerated (Figure 2.1).[10] Overall, results on credit spreads confirm our prior that financial inflows 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

We next turn to the analysis of the US equity market, investigating possible effects of foreign flows on expected equity price fluctuations proxied by the VIX. A VIX index significantly reacting to GSG and GBG flows 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 are shown in Table 3. During the entire sample period (1994-2007), the coefficients of both types of foreign inflows are negative and significant (Panel A, first three columns), meaning that their increase 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 inflows are significant if included one at a time, only flows into corporate bonds remain 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

[10] The introduction of the euro occurred during the third phase of the Economic and Monetary Union (EMU), which formally started on January 1, 1999.

Panel A: Credit spread

	1994 – 2007			1999 – 2007		
D.FFtarget	-2.18^{***} (0.26)	-2.14^{***} (0.26)	-2.16^{***} (0.26)	-2.34^{***} (0.24)	-2.27^{***} (0.25)	-2.28^{***} (0.24)
D.exp infl	0.65 (0.49)	0.54 (0.50)	0.54 (0.48)	0.42 (0.49)	0.20 (0.53)	0.21 (0.51)
D.logreer	-6.88 (5.22)	-5.05 (5.26)	-6.45 (5.29)	-1.81 (5.37)	1.66 (5.50)	-1.65 (5.37)
D.Cinflows	-0.36 (0.34)		-0.53 (0.37)	-0.55^{**} (0.28)		-0.82^{***} (0.29)
D.TAinflows		0.20 (0.23)	0.34 (0.26)		0.37 (0.25)	0.63^{**} (0.27)
Constant	1.87^{***} (0.06)	1.86^{***} (0.06)	1.87^{***} (0.06)	2.28^{***} (0.06)	2.25^{***} (0.06)	2.27^{***} (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^{***} (0.19)	-0.71^{***} (0.19)	-0.72^{***} (0.19)	-0.48^{***} (0.16)	-0.48^{***} (0.16)	-0.49^{***} (0.16)
D.exp infl	0.27 (0.25)	0.30 (0.26)	0.30 (0.26)	-0.02 (0.22)	-0.02 (0.24)	-0.01 (0.24)
D.logreer	-6.22^{*} (3.71)	-6.16^{*} (3.61)	-6.31^{*} (3.67)	-3.31 (3.28)	-2.38 (3.14)	-3.31 (3.27)
D.Cinflows	-0.09 (0.23)		-0.06 (0.25)	-0.23 (0.15)		-0.23 (0.16)
D.TAinflows		-0.08 (0.20)	-0.07 (0.22)		-0.08 (0.22)	-0.00 (0.24)
Constant	2.01^{***} (0.04)	2.01^{***} (0.04)	2.01^{***} (0.04)	2.34^{***} (0.04)	2.33^{***} (0.04)	2.34^{***} (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^{***} (0.19)	-1.43^{***} (0.19)	-1.44^{***} (0.19)	-1.85^{***} (0.21)	-1.79^{***} (0.20)	-1.80^{***} (0.20)
D.exp infl	0.37 (0.29)	0.24 (0.30)	0.24 (0.28)	0.44 (0.33)	0.21 (0.35)	0.22 (0.34)
D.logREER	-0.66 (2.98)	1.10 (2.98)	-0.14 (2.92)	1.49 (5.14)	4.05 (4.97)	1.66 (4.85)
D.Cinflows	-0.27 (0.23)		-0.48^{*} (0.24)	-0.32 (0.25)		-0.59^{**} (0.26)
D.TAinflows		0.28^{*} (0.15)	0.40^{**} (0.17)		0.45^{*} (0.25)	0.63^{**} (0.27)
Constant	-0.14^{***} (0.04)	-0.16^{***} (0.04)	-0.14^{***} (0.04)	-0.05 (0.06)	-0.08 (0.05)	-0.06 (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 2: 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*), Cinflows and TAinflows. 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.

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 in 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 corporate bond inflows is stronger in terms of reducing equity investors' risk aversion (Table 3, Panels B and C). Finally, note that the effects are strongest in the 1999-2007 subperiod, which is consistent with the large increase in GBG flows observed during those years (Figure 2.1).

3.4 Bank leverage

Results in Sections 3.2 and 3.3 suggest that both types of flows acted as push factors on US financial markets, leading to lower US long-term rates and a reduction in risk 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.[11]

Our results, reported in Table 4, suggest two interesting facts. First, flows into US corporate bonds (and not those into public securities) 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 global banking glut flows and, hence, also in influencing financial conditions in the US, particularly after the euro changeover in 2002.[12] Second, the lagged VIX index also significantly affects banking leverage: banks' leverage decreases when expected stock market volatility

[11] 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.

[12] 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 1.1).

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.Cinflows	-0.33^{**}		-0.25^{*}	-0.40^{***}		-0.42^{***}
	(0.15)		(0.15)	(0.15)		(0.16)
D.TAinflows		-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.Cinflows	-0.66^{**}		-0.62^{**}	-0.72^{**}		-0.83^{***}
	(0.27)		(0.29)	(0.29)		(0.31)
D.TAinflows		−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.Cinflows	-0.91^{**}		-0.75^{*}	-1.04^{**}		-1.09^{**}
	(0.40)		(0.45)	(0.42)		(0.47)
D.TAinflows		-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 3: 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*), Cinflows and TAinflows. 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 (0.40)	-0.50 (0.42)	-0.51 (0.42)	-0.44 (0.44)	-0.76^{*} (0.44)	-0.67 (0.48)	-0.66 (0.45)	-0.61 (0.49)	-0.09 (0.49)	0.06 (0.48)	0.20 (0.45)	0.20 (0.44)
L(3).logVIX	-0.61^{***} (0.18)	-0.52^{***} (0.20)	-0.56^{***} (0.20)	-0.50^{**} (0.20)	-0.76^{***} (0.22)	-0.65^{**} (0.26)	-0.72^{***} (0.24)	-0.64^{**} (0.27)	-0.96^{***} (0.36)	-0.81^{**} (0.38)	-0.94^{**} (0.37)	-0.80^{**} (0.39)
L.D.Cinflows		0.55^{*} (0.29)		0.52^{*} (0.29)		0.39 (0.33)		0.44 (0.31)		0.69^{**} (0.31)		0.87^{***} (0.31)
D.Cinflows		0.55^{*} (0.31)		0.40 (0.29)		0.31 (0.30)		0.16 (0.32)		0.62^{**} (0.30)		0.42 (0.33)
L.D.TAinflows			0.18 (0.22)	0.06 (0.22)			0.06 (0.25)	-0.07 (0.23)			-0.04 (0.30)	-0.35 (0.30)
D.TAinflows			0.42 (0.29)	0.30 (0.30)			0.37 (0.26)	0.32 (0.27)			0.59^{*} (0.35)	0.35 (0.39)
Constant	1.86^{***} (0.53)	1.55^{***} (0.58)	1.69^{***} (0.57)	1.50^{**} (0.60)	2.37^{***} (0.66)	2.01^{**} (0.78)	2.23^{***} (0.70)	1.98^{**} (0.81)	2.78^{***} (0.98)	2.26^{**} (1.07)	2.68^{**} (1.03)	2.23^{**} (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 4: 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*), Cinflows and TAinflows. 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.

increases.[13] The first paper that highlights this important result is Bruno and Shin (2015a), which also finds evidence that the change in the VIX may be induced by variations in the monetary policy stance, thereby supporting the view of a so-called "risk-taking channel" of monetary policy. According to our results, the impact of corporate inflows on banking leverage is *independent* from the corresponding effect of the VIX regressor.[14] We will return to this result in the next section.

All in all the results reported in Table 4 point to the fact that flows into private fixed-income securities act as a rather different and stand-alone conduit of the leverage cycle than the VIX index. Corporate inflows exert an autonomous pro-cyclical effect on banking leverage, a result that, to our knowledge, has not been emphasized in the literature so far.

3.5 Tests of Granger causality

The previous results suggest that foreign flows have exerted a significant impact on US financial variables and risk-taking behavior. In this section, we briefly address the possible reverse causality between financial inflows and the target variables (i.e. the regressors) considered in the previous regressions by running a series of Granger causality tests.[15] Granger causality is estimated by means of Wald tests computed on estimated VAR models. We consider VARs with three variables, i.e. $Cinflows$, $TAinflows$ and one of the previous dependent variables (credit spread, VIX and bank leverage) at a time.

Tests are conducted only for the subperiods 1999-2007 and 2002-2007, in which both inflows to the US were at their peak. Results are reported in Appendix B, Table F. Overall, Granger causality runs from foreign inflows to the target variables and not the other way around. Note that the null hypothesis of the tests is mainly rejected in the 2002 - 2007 subsample, that is exactly the period in which the credit spread and the VIX fell substantially. While the credit spread and the VIX are Granger caused by corporate flows only, both types of flows Granger cause bank leverage.

[13] 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.

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

[15] A variable x is said to Granger-cause a variable y if, given the past values of y, past values of x are useful for predicting y. A common method for testing Granger causality is to run a VAR with x and y and, alternatively, make Wald tests on the lagged values of the two variables. Failure to reject the null hypotheses is equivalent to failing to reject the hypothesis that the tested variable does not Granger-cause the dependent variable in each equation.

4 BVAR analysis

The empirical estimates presented so far have highlighted interesting linkages between financial inflows and US financial variables. We now construct specific measures of GBG and GSG flows in order to identify two distinct shocks in a BVAR framework. The identified shocks can be viewed as external portfolio preference shocks, i.e. preference shocks of non-US agents. The aim of this analysis is to evaluate the timing and persistence of the response of US financial variables to those shocks and to extend the investigation to other macroeconomic aggregates, which so far have been left out of the analysis.

4.1 Identification of GSG and GBG shocks

Inflow shocks are identified recursively. This is justified by the way we construct our GSG and GBG variables, and in particular by the fact that the selection of countries from which those flows originated minimizes endogeneity issues between the two types of flows. To construct GSG shocks, we simply retain net purchases of US Treasury and Agency bonds by investors from Asian emerging economies. These inflows started before international banks invested massively in US markets, and were basically due to preference shifts which followed previous local financial crisis episodes; for this reason, they reasonably can be considered *ex-ante* as exogeneous to US monetary policy and to other factors (like global financial regulation). We thus place GSG flows as first in our recursive identification scheme.

Concerning the GBG variable, we ideally look for banking inflows from Europe spurred by bank-related preference shocks, including regulatory shocks (like the advent of the euro and Basel II regulation) which, according to Shin (2011), induced overseas diversification and risk-taking by global banks. In order to avoid endogeneity with respect to GSG flows, we select European countries as follows: we compare financial inflows into the US corporate bond market with portfolio inflows (on equity and debt securities) *targeting* European countries. For each European country, if portfolio flows from Asian (saving glut) countries were negative (i.e., outflows were greater than inflows) during the core of the banking glut phase, then concomitant flows from these countries to the US are considered as exogenous with respect to the global saving glut phenomenon, and as such are included in the computation of the GBG variable used in the BVAR. Thus, only this latter subset of the countries in our original GBG flow variable is retained in the BVAR framework.

Portfolio flows to European countries are provided by Hobza and Zeugner (2014), who constructed a database of bilateral financial flows on a global scale. Data are computed by aggregating information from national and international sources and, differently from previous datasets, are based on adjusted stock data (to fix mismatches between stocks reported in the two countries) and avoid model-based estimates (as is commonly done to obtain historical observations). Table 5 compares flows from European countries to US corporate bonds (upper panel) with flows from non-EU, non-OECD emerging countries to Europe between 2002 and 2006, the period in which banking glut flows are at their peak.[16] The table shows that, between 2002 and 2006, Belgium and Luxembourg, Ireland, Italy, Switzerland, Denmark, Sweden and the UK experienced cumulated *outflows* from emerging economies, in a period when they were at the same time heavily investing in US securities (especially in the case of Belgium and Luxembourg, UK, Ireland and Switzerland). This entails that those countries, and in particular their resident banks, did not recycle concomitant saving glut inflows. As such, only these countries are retained to construct the GBG variable used in the BVAR analysis. Given the above selection procedures, we compute GSG and GBG flows as before by using Equations 2.1 and 2.2.

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) US bank leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate, and (7) the 10-year Treasury yield.[17] We then augment this benchmark specification by adding, alternatively, a measure of household debt and house prices (BVAR #2 and #3 respectively).

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. 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. (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 due to data availability, well past the onset of the financial crisis that led to an abrupt retrenchment

[16] Pre-2002 bilateral portfolio flow data, which would have allowed to identify those countries (if any) which received substantial saving glut flows also before the peak phase of the global banking glut, are unfortunately not available for most of Asian emerging economies.

[17] The VIX index (and not its premium component) is included in the BVAR because, according to the regression estimates, both the conditional variance and the variance premium are affected by foreign flows.

Europe $\rightarrow$ US corporate bonds

billion USD	2002	2003	2004	2005	2006	**total 2002-2006**
EA:						
Austria	0.2	1.2	0.8	- 0.1	2.4	**4.5**
Belgium and Luxembourg	143.1	229.5	207.4	65.1	245.9	**891.0**
Germany	- 2.5	10.5	19.1	8.0	19.7	**54.8**
Spain	- 0.6	0.6	3.2	2.9	1.2	**7.4**
Finland	- 0.0	0.2	0.4	- 0.1	0.4	**0.9**
France	3.2	5.5	2.1	3.9	24.4	**39.0**
Greece	- 0.1	0.1	0.0	- 0.1	0.1	**0.0**
Ireland	8.0	10.8	9.3	10.1	45.8	**83.9**
Italy	- 0.3	1.7	- 0.8	0.1	1.4	**2.1**
Nederlands	2.5	9.2	20.8	21.8	16.1	**70.4**
Portugal	- 0.0	- 0.0	0.2	0.7	0.4	**1.3**
non EA:						
Switzerland	1.4	16.1	18.7	6.6	22.5	**65.4**
Denmark	0.5	1.0	2.5	- 0.6	- 0.5	**2.9**
Norway	3.5	5.5	4.1	3.5	12.3	**28.9**
Sweden	0.2	1.2	4.9	2.2	2.5	**11.1**
UK	- 24.1	61.7	54.2	27.4	97.2	**216.4**

Portfolio flows from RoW $\rightarrow$ Europe

billion EUR	2002	2003	2004	2005	2006	**total 2002-2006**
EA:						
Austria	- 2.4	1.1	3.6	- 0.4	2.2	**4.2**
Belgium and Luxembourg	- 528.9	104.6	- 9.6	109.8	- 20.1	**- 344.1**
Germany	2.4	154.4	- 23.0	- 1.5	7.3	**139.6**
Spain	27.1	- 2.2	6.9	- 19.5	51.2	**63.5**
Finland	- 2.2	2.9	- 4.8	5.4	9.6	**10.8**
France	1.0	3.9	45.8	61.3	- 60.3	**51.6**
Greece	- 3.9	13.3	1.0	- 0.1	1.2	**11.6**
Ireland	- 58.0	44.8	29.3	66.8	- 88.4	**- 5.5**
Italy	- 70.2	1.9	- 15.0	- 22.1	68.5	**- 36.8**
Nederlands	169.5	11.4	0.9	66.6	83.2	**331.6**
Portugal	4.7	2.7	9.1	3.2	- 18.4	**1.4**
non EA:						
Switzerland	- 11.6	- 5.3	0.0	18.0	- 21.4	**- 20.3**
Denmark	- 11.4	- 5.0	2.9	- 13.3	9.0	**- 17.8**
Norway	- 1.2	- 0.2	1.6	5.6	5.5	**11.3**
Sweden	- 24.4	2.5	- 2.0	- 8.7	5.1	**- 27.3**
UK	- 66.6	- 19.6	1.6	8.5	- 20.4	**- 96.5**

Table 5: Comparison between flows from Europe to the US and flows targeting Europe, 2002 – 2006, billion of US dollars (upper panel) and billions of euros (lower panel). Upper panel: Inflows from European countries to US corporate bonds taken from Bertaut and Judson (2014). Lower panel: portfolio flows (debt and equity) from Rest-Of-The-World (ROW) economies to European countries, where ROW economies are all economies but EU-27 countries, OECD countries, Hong Kong, Singapore and offshore countries (Bahamas, Bahrain, Barbados, Bermuda, Cayman Islands, Gibraltar, Guernsey, Isle Of Man, Jersey, Lebanon, Macao, Mauritius, Netherlands Antilles, Panama, Samoa, British West Indies, Andorra, Liechtenstein); data are taken from Hobza and Zeugner (2014).

in foreign financial flows.[18]

4.3 Structural shocks testing

Results coming from the analysis carried out in Section 3 do not a priori completely rule out the possibility that foreign inflows were endogenous to the accommodative monetary policy stance in the US. Thus, before discussing the impulse responses we test whether, under our identification assumptions, GSG and GBG shocks are correlated to US monetary policy shocks. The structural shocks from our identified BVAR are computed as follows. From the reduced-form representation

$$x_t = Fx_{t-1} + u_t \tag{4.1}$$

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

$$Ax_t = Bx_{t-1} + e_t \tag{4.2}$$

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

$$e_t = Au_t \tag{4.3}$$

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 4.3. 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.[19] Results of linear correlations with bootstrapped confidence intervals are reported in Table 6, and the dynamics of GSG and GBG shocks identified

[18] The estimation period is also 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 2.1). Second, the VIX Index is not available prior to 1990.

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

with our benchmark specification, along with that of the FF4 proxy (the preferred instrument in Gertler and Karadi, 2015) are shown in Figure 4.1. Correlations are low and not significant for any of the five instruments with respect to both GSG and GBG shocks; similar outcomes show up when extracting structural GSG and GBG shocks from the other two BVAR specifications.

	GSG			GBG		
	correlation	conf int lowb	conf int ub	correlation	conf int lowb	conf int ub
BVAR # 1:						
FF1	-0.12	-0.30	0.04	-0.01	-0.17	0.18
FF4	-0.15	-0.32	0.03	-0.06	-0.22	0.15
ED2	-0.14	-0.34	0.07	-0.07	-0.27	0.16
ED3	-0.12	-0.32	0.10	-0.03	-0.27	0.20
ED4	-0.11	-0.32	0.11	-0.02	-0.26	0.24
BVAR # 2:						
FF1	-0.05	-0.27	0.17	0.03	-0.12	0.23
FF4	-0.06	-0.25	0.16	0.00	-0.13	0.16
ED2	0.04	-0.16	0.23	0.01	-0.17	0.25
ED3	0.05	-0.17	0.27	0.03	-0.18	0.31
ED4	0.07	-0.15	0.30	0.05	-0.18	0.35
BVAR # 3:						
FF1	-0.06	-0.30	0.16	-0.02	-0.20	0.17
FF4	-0.07	-0.27	0.17	-0.06	-0.23	0.12
ED2	0.04	-0.15	0.25	-0.03	-0.19	0.17
ED3	0.06	-0.16	0.28	-0.01	-0.19	0.21
ED4	0.07	-0.15	0.30	0.02	-0.18	0.25

Table 6: Correlations between the structural GSG/GBG shocks (left/right block) extracted from the three BVAR specifications and the five instruments 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.

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 response analysis

Figures 4.2 and 4.3 present the main impulse response functions of the benchmark specification; Figure 4.4 displays selected impulse responses from BVAR #2 and #3. Each panel in the figure shows the impulse responses over 20 quarters (five years) to a one-standard-deviation shock.

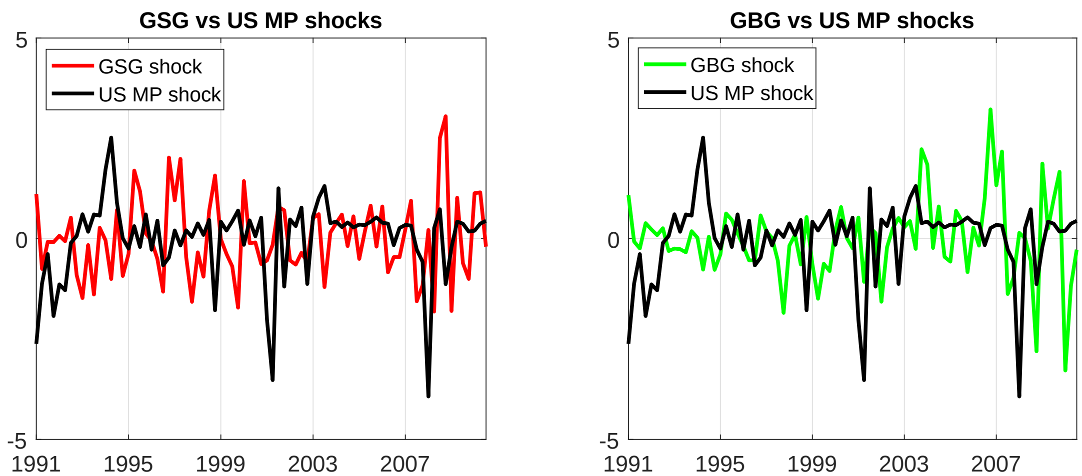

Figure 4.1: Comparison between BVAR-estimated structural shocks and US monetary policy shocks. Structural GSG and GBG shocks are computed from the benchmark BVAR. The proxy for the monetary policy shock is the three-month ahead funds rate surprise (FF4), chosen by Gertler and Karadi (2015) for their baseline estimation. Shocks are standardized in mean and variance.

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. Both GSG and GBG flows lead to a significant increase in banking leverage, even though the effect of GBG is immediate and larger in magnitude (BLEV panels of Figures 4.2 and 4.3). Their effects on bond and equity markets are also quite differentiated. Both shocks compress the excess bond premium, even though the effect of GBG is twice as large and that of GSG is barely significant (EBP panels); GBG shocks significantly reduce the VIX, while the GSG shocks are not significant (VIX panels). This result is in line with those found with linear regressions, and confirms the more important role of GBG flows in inducing higher risk appetite in US financial markets.

The effect on the US real effective exchange is also differentiated: it appreciates on impact following a GSG shock, while it depreciates persistently in response to a positive GBG shock (USREER panels of the same figures). The latter result, while coherent with lower long-term rates (and, more generally, looser financial conditions) induced by GBG shocks, is at odds with the findings in Hofmann et al. (2016) and Blanchard et al. (2015). According to these authors currency appreciations may reflect, for a given monetary policy rate, the outcome of capital inflows associated to overall more expansionary financial and macroeconomic conditions.[20] The effect of GBG shocks on the exchange rate is fur-

[20]One reason for the negative response of real exchange rates to a GBG shock might be that of a substantial market incompleteness in exchange rate risk trading, a result that has been initially highlighted in Hau and Rey (2006). For example, these two authors find that higher returns in the home equity markets (in local currency) relative to the foreign equity market are associated with a home currency depreciation.

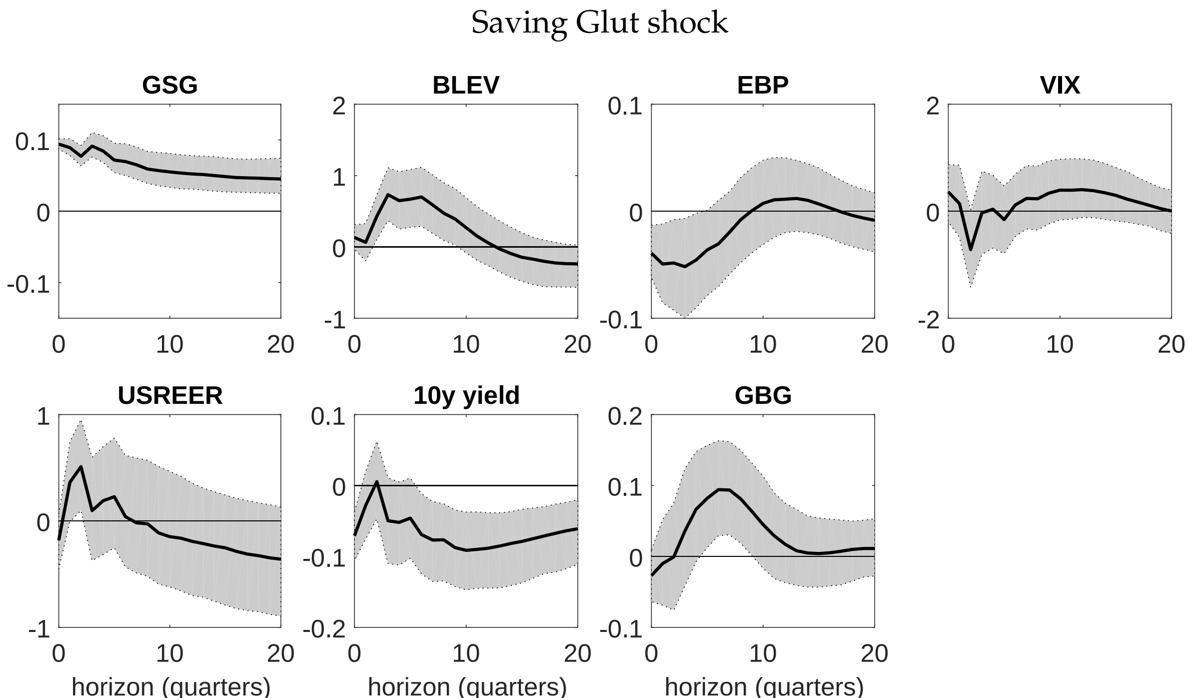

Figure 4.2: Impulse responses from one-standard deviation shock to GSG (benchmark BVAR). The ordering of the variables is (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate (REER), and (7) the 10-year Treasury yield. Bootstrapped 68% confidence bands computed with 1000 replications. Sample: 1990Q1-2010Q3.

ther complicated by the fact that global banks increased their dollar activities both on the asset and liability sides.[21] The final result that emerges from our benchmark BVAR specification is that both types of flows seem to positively affect each other (GBG panel of Figure 4.2 and GSG panel of Figure 4.3). This suggests that the two types of shocks had mutually reinforcing effects on US financial conditions during the run-up to the crisis.

All in all, our results confirm that GSG and, in particular, GBG flows 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 ac-

[21]Considering only the variables included in the baseline specification, the effects of GBG shocks may resemble those of an expansionary US monetary policy shock, even though the two shocks are orthogonal as we have shown in the previous section. In a separate robustness analysis reported in Appendix C, we show however that banking glut shocks differ in an important way from monetary policy shocks: the convenience yield of holding US bonds, proxied by the covered interest rate parity (CIP) deviation between US bonds and foreign bonds, rises in response to an expansionary GBG shock. An expansionary US monetary policy shock tends instead to compress the convenience yield, as shown in Jiang et al. (2019). We abstain from also introducing the convenience yield in our baseline BVAR specification, given the relative shortness of our sample.

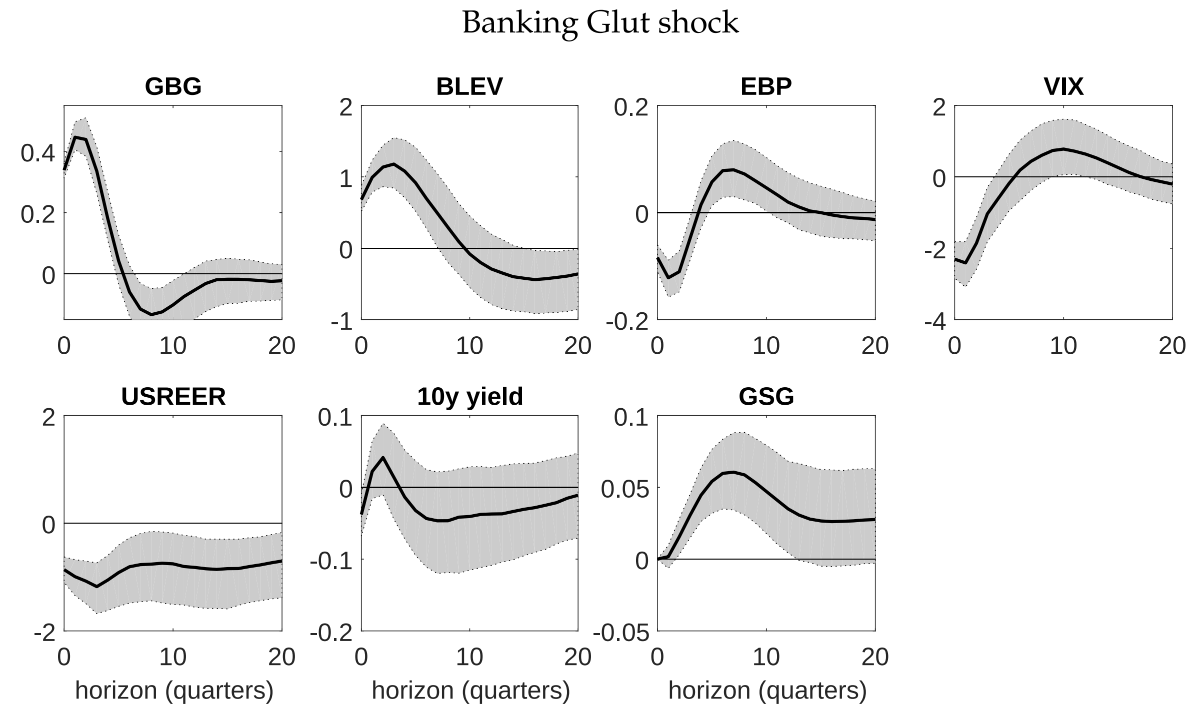

Figure 4.3: Impulse responses from one-standard deviation shock to GBG (benchmark BVAR). The ordering of the variables is (1) GSG flows, (2) GBG flows, (3) banking leverage, (4) the GZ excess bond premium, (5) the VIX index, (6) the US dollar real effective exchange rate (REER), and (7) the 10-year Treasury yield. Bootstrapped 68% confidence bands computed with 1000 replications. Sample: 1990Q1-2010Q3.

tively concur to the determination of these periods. Moreover, GBG 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 effects of GSG and GBG on US macroeconomic conditions We now explore whether GSG and GBG flows have also any direct macroeconomic effects on household 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 10-year yield. Results are shown in Figure 4.4. Only GBG shocks have positive effects on households' indebtedness: the effects of GSG, while positive, are never significant.

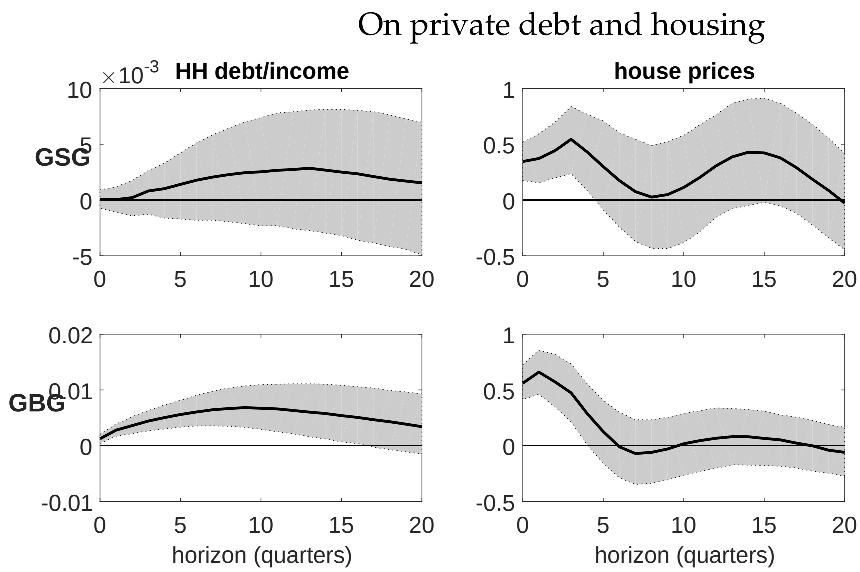

Figure 4.4: Responses of households' debt-to-income ratio (1) and of US house prices (2). Responses of (1) come from BVAR #2, while responses of (2) come from BVAR #3. Bootstrapped 68% confidence bands computed with 1000 replications; sample period is 1990Q1-2010Q3.

The ordering of BVAR #3 is the following: (1) GSG flows, (2) GBG flows, (3) the house price index, (4) banking leverage, (5) the GZ excess bond premium, (6) the VIX index, (7) the US dollar real effective exchange rate and (8) the 10-year yield. Results (in Figure 4.4) supports the view according to which positive shocks to both GBG and 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).

4.5 Robustness analysis

The saving and banking glut flows came from two different set of countries and targeted different US securities. In this section we provide additional evidence on the effects of the two shocks by varying the definition of the saving and banking glut variables in terms of both geographic origin and targeted securities. Figures representing the impulse responses are reported in the Appendix D.

Europe vs. emerging Asia Albeit to a lower extent, inflows to corporate bonds have also come from emerging economies, while at the same time inflows to safe US assets have also come from Europe. In order to test the importance of these residual inflows or, from another perspective, to assess how the geography of financial flows mattered in the run-up to the crisis, we construct saving and banking glut flows by aggregating inflows to *all types* of US bonds, from emerging Asia on one side and from our selected European countries on the other. Namely, we modify Equations 2.1 and 2.2 as follows

$$\text{EMEAsia}_t = \frac{1}{12 * GDP_{t-12}} \sum_{j=1}^{n} \sum_{i=1}^{12} \left(\Delta T_{j,t-i+1}^{eme} + \Delta A_{j,t-i+1}^{eme} + \Delta C_{j,t-i+1}^{eme} \right) \tag{4.4}$$

$$\text{EUselected}_t = \frac{1}{12 * GDP_{t-12}} \sum_{k=1}^{m} \sum_{i=1}^{12} \left(\Delta T_{k,t-i+1}^{eu} + \Delta A_{k,t-i+1}^{eu} + \Delta C_{k,t-i+1}^{eu} \right) \tag{4.5}$$

with *eme* and *eu* indicating the same set of emerging economies and European countries as in the baseline specification. The benchmark model is re-estimated by substituting EMEAsia to GSG and EUselected to GBG, and the impulse responses are displayed in Figures D.1 and D.2. Results are mostly unchanged with respect to those in Figures 4.2 and 4.3, confirming that the safe-haven flows (from emerging Asia) and the search-for-yied flows (from European countries) drive the results.

Treasuries vs. Agency bonds The saving glut has targeted both Treasuries and Agency bonds. Agency bonds partly originated from securitization of fixed-rate mortgages, which received the Agency's guarantee. Provided that the degree of safety between Treasury and agency bonds diverged on the eve of the crisis, the flight to safety of Asian investors could have shifted towards Treasuries in the same period. Therefore, it is worth to analyze the effects of safe haven inflows into US Treasuries and US agency bonds using two separate VAR specifications. The two new proxies of GSG are

$$\text{GSGTreas}_t = \frac{1}{12 * GDP_{t-12}} \sum_{j=1}^{n} \sum_{i=1}^{12} \Delta T_{j,t-i+1}^{eme} \tag{4.6}$$

$$\text{GSGAg}_t = \frac{1}{12 * GDP_{t-12}} \sum_{k=1}^{m} \sum_{i=1}^{12} \Delta A_{k,t-i+1}^{eme} \tag{4.7}$$

The benchmark model is re-estimated twice, maintaning in each estimation the baseline specification for GBG. The impulse responses are displayed in Figures D.3 and D.4. Results show that the purchases of Treasuries had a more pronounced effect on US financial markets and that they were responsible for the negative response of the US exchange rate and the upward pressure on the US bank leverage. Instead, purchases of agency bonds seem to have played a minor role.

5 Conclusions

This paper explores the effects on the US economy of international financial flows coming from different economic areas during the run-up to the global financial crisis, the so-called global banking glut and global saving glut flows. 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 risk aversion and higher banking leverage. Moreover, during the period of strongest global financial expansion, both types of flows have been complementary in that they tended to reinforce each other. Finally, both GSG, and to a greater extent, GBG flows have exerted a positive impact on housing market developments. These effects appear to be independent from monetary policy developments in the United States.

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 can inform the development of more general quantitative open economy models which, in the spirit of Justiniano et al. (2014), could be used to further investigate the broader macroeconomic and financial stability consequences of foreign inflows on the US economy. We leave this very interesting extension for future research.

Appendix

A 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 refer 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 asset types, 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 A 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, China's holdings in 2000 were about a third of the Japanese ones; since then, 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 B). 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 D. 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 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 bn 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

#	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 A: 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 and 1994 (col. 4). Net positions for the United Kingdom also comprises Channel 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 B: 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 and 1994 (col. 4).

	2002		2003		
Country	#	Tot. assets	#	Tot. assets	% 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 C: Cayman Islands - Geographical distribution of banks in 2002 and 2003 (total assets are in bn USD).

United Kingdom and some euro area countries, in particular Belgium plus Luxembourg, Ireland and Germany, are among the leading buyers (see Table E).

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 C 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.

To sum up, 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. 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

#	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 D: 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 and 1994 (col. 4). Net positions for the United Kingdom also comprises Channel 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	275.5	703.5	2737.6	2462.1	2034.1

Table E: 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 and 1994 (col. 4). Net positions for the United Kingdom also comprises Channel Islands and the Isle of Man.

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).

B Granger causality tests

h0: x does not GC y	Jan 1999 – Jun 2007 Prob > chi2	Sep 2002 – Jun 2007 Prob > chi2
Cinflows → GZspread	0.154	0.018
TAinflows → GZspread	0.395	0.345
ALL → GZspread	0.392	0.073
GZspread → Cinflows	0.807	0.485
TAinflows → Cinflows	0.847	0.787
ALL → Cinflows	0.899	0.668
GZspread → TAinflows	0.868	0.256
Cinflows → TAinflows	0.538	0.234
ALL → TAinflows	0.790	0.296

h0: x does not GC y	Jan 1999 – Jun 2007 Prob > chi2	Sep 2002 – Jun 2007 Prob > chi2
Cinflows → log VIX	0.198	0.113
TAinflows → log VIX	0.313	0.995
ALL → log VIX	0.360	0.284
log VIX → Cinflows	0.067	0.279
TAinflows → Cinflows	0.682	0.655
ALL → Cinflows	0.194	0.479
log VIX → TAinflows	0.305	0.225
Cinflows → TAinflows	0.373	0.196
ALL → TAinflows	0.429	0.269

h0: x does not GC y	Jan 1999 – Jun 2007 Prob > chi2	Sep 2002 – Jun 2007 Prob > chi2
Cinflows → bank leverage	0.175	0.049
TAinflows → bank leverage	0.245	0.012
ALL → bank leverage	0.315	0.026
bank leverage → Cinflows	0.850	0.642
TAinflows → Cinflows	0.690	0.609
ALL → Cinflows	0.915	0.773
bank leverage → TAinflows	0.061	0.078
Cinflows → TAinflows	0.291	0.155
ALL → TAinflows	0.131	0.117

Table F: Tests of Granger causality between foreign inflows and credit spread (upper panels), VIX (medium panels) and bank leverage (lower panel). $Cinflows$ and $TAinflows$ are in first difference. The null hypothesis of the tests is that variable x does not Granger cause variable y. Longer sample: January 1999 – December 2007 (108 obs., *left panels*); shorter sample: September 2002 – December 2007 (58 obs., *right panels*).

C The response of Treasury premium to banking glut shocks

The puzzling response of the dollar exchange rate to a banking glut shock suggests that further analysis on the shock transmission is needed. In particular, while our structural GBG shocks are shown to be uncorrelated to standard US monetary policy shocks, the responses of US market variables seem quite similar (at least in terms of sign) to those obtained with a loosening of US monetary policy. Indeed, following a banking glut shock, the long-term rate, the credit spread and the VIX fall, while the bank leverage increases, as in the case of a loosening monetary policy shock.

To investigate the differences between the effect of foreign bank flows from those of domestic monetary policy, we analyze the behavior of the Treasury premium, a financial variable constructed by Du et al. (2018) for a number of countries. This variable proxies the deviation from covered interest rate parity (CIP deviation) which arises between one unit of currency and the US dollar: a positive premium embedded in US vs. local bond yields indicate a positive convenience yield of holding US securities as more liquid and safer assets. The Treasury premium should act in the opposite way following the two shocks. On one hand, larger purchases of US with respect to local bonds by foreign residents should increase the Treasury premium, because they reduce the supply of dollar safe assets; on the other hand, a loosening of US monetary policy increases the supply of US dollar assets, putting downward pressure on the premium. The latter evidence is reported in Jiang et al. (2019).

We construct our Treasury premium variable by averaging the Treasury premia of the countries included in our GBG specification. More specifically, we include the premium at 5-year maturity for Switzerland, Denmark, Sweden and the UK; the country average is also averaged across time, obtaining quarterly values (from daily series) between 1991Q1 and 2010Q3.[22] We re-run our benchmark model by augmenting the set of variables with our premium variable. Resuls from the banking glut shock are reported in Figure C.1. Following the shock, the Treasury premium slowly increases, becoming significant after 2 years (first panel, second row). This response highights one important difference between the effects of a banking glut shock to those of a domestic monetary policy shock.

D Impulse responses of the robustness section

[22]We obviously excluded the premium with respect to the euro because it is available only since 1999. Between 1991Q1 and 1994Q1, the average premium is replaced with the UK premium, the only available for those years.

Banking Glut shock - Response of the Treasury Premium

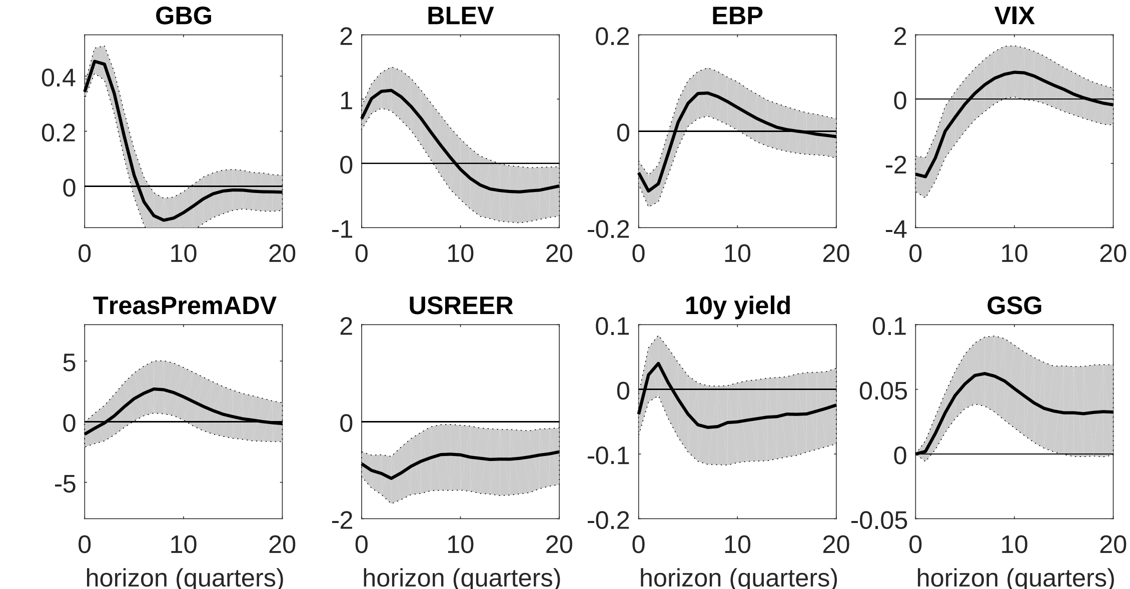

Figure C.1: IRFs from GBG shock: bechmark model augmented with our Treasury premium. Our average Treasury Premium of banking glut countries (TreasPremADV) is included in the VAR between the VIX and the real exchange rate. Sample: 1991Q1-2010Q3.

Shock to all flows from emerging Asia

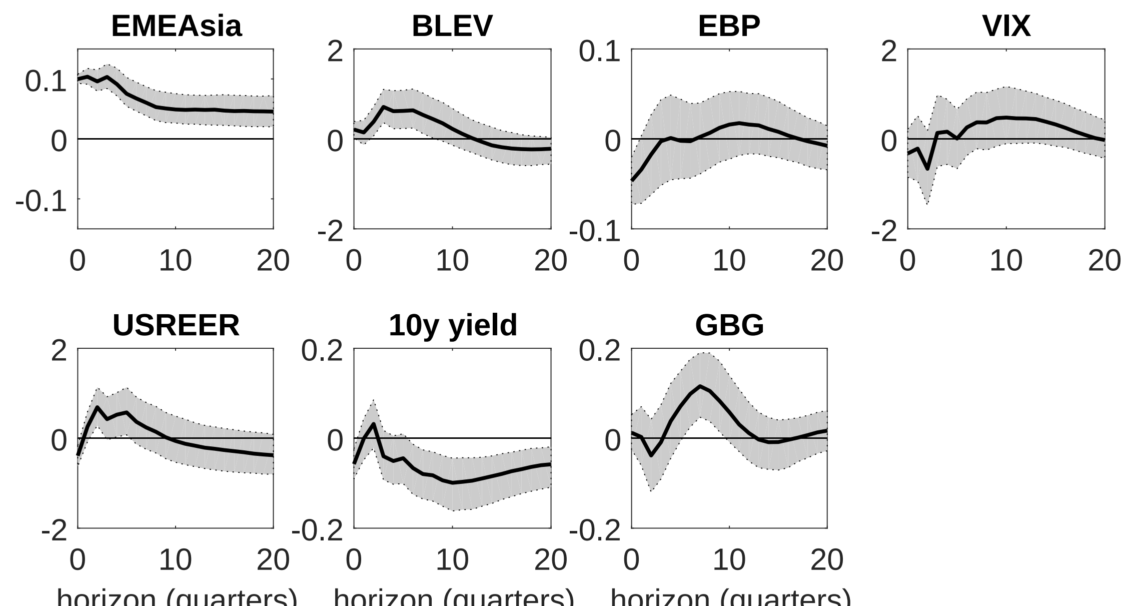

Figure D.1: IRFs from one-standard deviation shock to GSG, constructed using all flows from emerging Asia. The variable ordering is the same of the benchmark model. Sample: 1990Q1-2010Q3

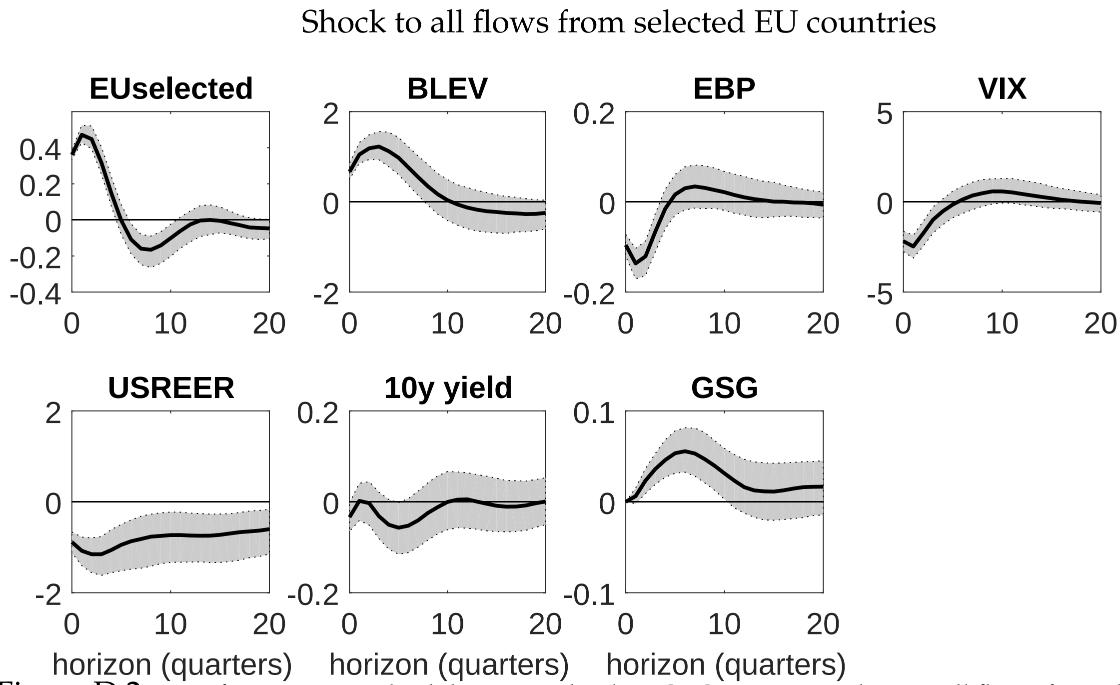

Figure D.2: IRFs from one-standard deviation shock to GBG, constructed using all flows from the selected European countries. The variable ordering is the same of the benchmark model. Sample: 1990Q1-2010Q3.

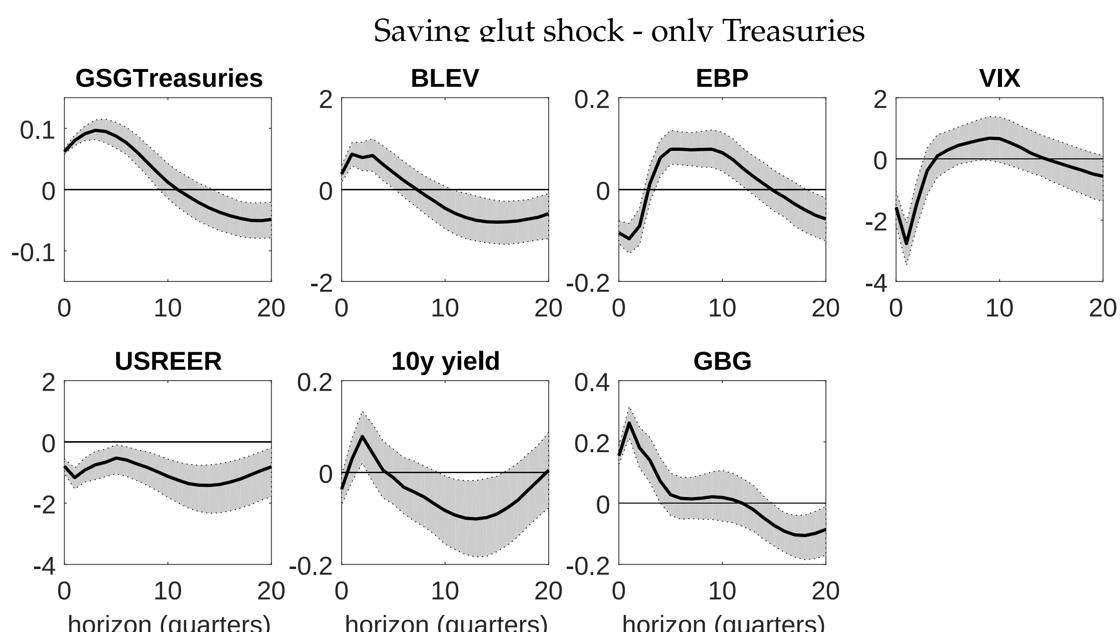

Figure D.3: IRFs from one-standard deviation shock to GSG, constructed using only flows into US Treasury bonds. The variable ordering is the same of the benchmark model. Bootstrapped 68% confidence bands computed with 1000 replications. Sample: 1990Q1-2010Q3.

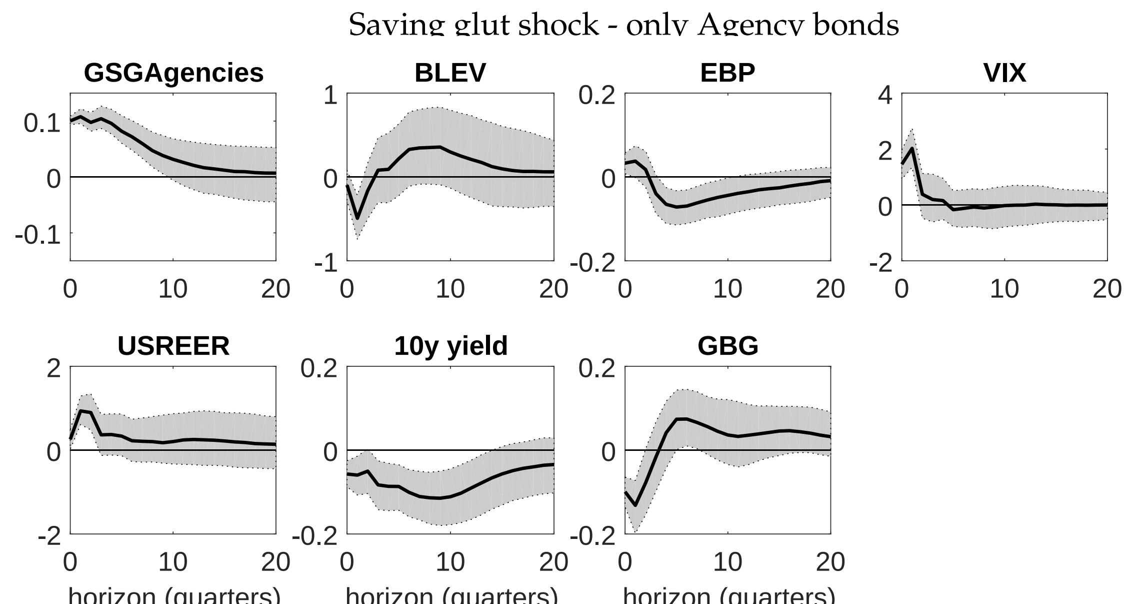

Figure D.4: IRFs from one-standard deviation shock to GSG, constructed using only flows into US Agency bonds. The variable ordering is the same of the benchmark model. Bootstrapped 68% confidence bands computed with 1000 replications. Sample: 1990Q1-2010Q3.

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