

ON THE INTERNATIONAL SPILLOVERS OF US QUANTITATIVE EASING*

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This article analyses the effects of the Federal Reserve's quantitative easing (QE) on global portfolio flows, differentiating across recipient region of the flows, type of flow and QE rounds. Furthermore, the analysis differentiates between the impact of QE expansionary announcements and the actual market operations. The analysis shows that QE1 resulted in (slight) rebalancing towards the US, while QE2 and QE3 resulted in rebalancing towards non-US assets. This suggests that QE increased the procyclicality of flows outside the US, in particular into emerging market equities. The results also suggest a link between US macro-financial conditions and the transmission of QE to portfolio flows.

This crisis started in the developed world. It will not be overcome . . . through . . . quantitative easing policies that have triggered . . . a monetary tsunami, have led to a currency war and have introduced new and perverse forms of protectionism in the world.

(President Rousseff of Brazil, 2012)

The 2007–9 global financial crisis triggered unprecedented policy interventions by central banks around the globe. After cutting policy rates to close to the zero lower bound, several central banks launched so called non-standard monetary policy measures as a response to the crisis. The Federal Reserve has been among the most active central banks, implementing several types of non-standard measures during different periods.

While most of the debate has focused on the effects of quantitative easing (QE) on the US economy, foreign policy makers – in particular in emerging markets, as highlighted by the above quote by President Rousseff of Brazil – have been criticising the Fed's policies, arguing that these have created excessive global liquidity and, thus, caused the massive acceleration of capital flows to emerging market economies (EMEs) between 2009 and 2012. In turn, this capital flow surge is widely blamed for appreciation pressures on EME currencies, a build-up of financial imbalances and asset price bubbles in EMEs, high credit growth and the threat of an over-heating of the domestic economies. As the above quote suggests, some see the unconventional monetary policy measures of advanced economies (AEs) even as a form of protectionism.

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This article contributes to the growing literature on the global effects of unconventional monetary policies, in contrast with the large literature focusing on the effects of QE on US domestic markets,¹ and their underlying channels. Through the portfolio balance channel, QE may not only trigger a portfolio rebalancing towards more risky domestic assets but also towards foreign assets. Similarly, a signalling about future US economic conditions and policy rates, or changes in risk and liquidity premia in the US, and confidence effects are likely to have implications for economic conditions and financial markets elsewhere in the world.

This article analyses the effects of the Federal Reserve's QE both on portfolio flows in the US and in 52 other countries.² Importantly, the article identifies the impact of QE policies on portfolio decisions by investors. This is important as portfolio decisions are central for identifying the portfolio balance channel of Fed policies. For this purpose, we use a relatively novel database of high-frequency daily portfolio flows into bond and equity mutual funds, taking primarily a US investor perspective. The advantage of the data is that we do not only track capital injections into US bond and equity funds but also inflows into EME assets and other advanced economy funds.

We analyse different types of US unconventional monetary policy measures in order to understand whether and why QE1, QE2 and QE3 have exerted different effects on US and foreign markets. A distinction we make is between announcements of Fed interventions and the actual market operations. Most of the literature on US QE has focused narrowly on the effects of announcements of the two large-scale asset purchase (LSAP) programmes, but not on the actual operations and purchases, assuming that only announcements contain new information, while the actual operations do not (or do much less so).

Turning to the empirical results, the analysis shows that QE1 policy announcements and liquidity operations triggered primarily a portfolio rebalancing into riskier market segments, with capital flowing mainly into US equity funds. In contrast, QE2 and to some extent also QE3 announcements and Treasury purchases had the strongest impact on inflows to EMEs.

Interestingly, the finding that purchases affect flows is consistent with results of D'Amico and King (2013) that had earlier shown a strong effect of QE purchases on prices, despite purchases being announced *ex ante*. In addition, the results suggest a

¹ Most of this work focuses on QE1, generally finding empirical evidence that the announcements of the Fed's purchases lowered US yields (Gagnon *et al.*, 2011; Wright, 2012; D'Amico and King, 2013) with similar evidence for the UK (Joyce *et al.*, 2011), while yielding more mixed evidence for the effectiveness of the Term Auction Facility (Thornton, 2011) and mortgage backed securities (MBS) purchases (Hancock and Passmore, 2011; Stroebel and Taylor, 2012). Hamilton and Wu (2012) discuss the effectiveness of unconventional monetary policy tools at the zero lower bound. Krishnamurthy and Vissing-Jorgensen (2011) discuss the transmission channels of quantitative easing. Gilchrist and Zakrajsek (2013) analyse the transmission of QE to corporate yields

² Some studies document the international macro implications of QE (Chen *et al.*, 2012*a,b*). Leduc and Glick (2012) look at the impact of QE on commodity markets. Other studies document the international spillovers of QE announcements to asset prices: Chen *et al.*, 2012*a,b*; Hattori *et al.* (2013); Gilchrist *et al.* (2014), Rogers *et al.* (2014), Bauer and Neely (2014), Bowman *et al.* (2015) and Neely (2015). Only a few studies look at the impact of unconventional policies on quantities: Lo Duca *et al.* (2016) analyse the link between QE and global bond issuance; Lim *et al.* (2014) analyse the impact of QE on different type of capital flows to emerging markets.

link between US domestic macro-financial conditions and the transmission of QE to portfolio flows across countries and instruments. In particular, in periods when macroeconomic uncertainty is lower and the US outlook is positive, QE announcements are transmitted with more intensity to portfolio flows outside the US. The same holds for purchases although the link with macro conditions is weaker. Also market frictions and liquidity conditions appear to play a role in the transmission of QE.

The article is organised as follows: Section 1 briefly reviews the main unconventional policy actions adopted by the Fed and the potential channel of transmission to global financial markets; Section 2 presents the empirical approach, including data, modelling strategy and main results; Section 3 discusses time variation in the transmission of QE; Section 4 concludes.

1. US Non-standard Monetary Policy Measures

This Section provides an overview of the various instruments of the Fed's tool kit employed during the period 2007–13 and discusses the different transmission channels of policies.

1.1. *The Fed Policy Menu*

As a result of the global financial crisis in 2008, US policy makers reacted with a set of policy measures to reverse the economic downturn. Beside the more standard countercyclical policy measures,³ the Federal Reserve decided to introduce a new set of non-standard policy tools. These new tools dramatically affected both the composition and the size of the Fed's balance sheets.

In general, the non-standard measures implemented by the Federal Reserve can be divided into two groups:

- (i) facilities providing liquidity to the financial sector and
- (ii) large-scale asset purchase programmes (LSAPs), commonly labelled quantitative easing (QE).

In what follows, we provide a short description of these two groups of policies.⁴

In late 2007 and early (2008), the Federal Reserve implemented several programmes associated with direct lending to financial institutions. These measures intended to address the limited availability of credit in short-term funding markets, which are used by financial institutions and other businesses to finance their day-to-day operations.⁵

³ The US Congress passed large-scale countercyclical fiscal packages as response to the crisis. Also, the Federal Reserve reduced the Fed funds target rate to close to its zero lower bound.

⁴ See Fawley and Neely (2013) for more details on US QE policies and an insightful comparison of different QE policies across advanced countries. See Carlson *et al.* (2009) for details on policies.

⁵ The programmes under this category included: the Term Auction Facility, which auctioned term loans to depository institutions, the Primary Dealer Credit Facility and the Term Securities Lending Facility, which provided overnight and term loans to primary dealers, a group of major financial firms that have an established trading relationship with the Federal Reserve Bank of New York. Furthermore, to address a severe US dollar shortage overseas, the Federal Reserve established dollar liquidity swaps with foreign central banks to help them provide dollar loans to financial institutions.

Following the collapse of Lehman Brothers, and the consecutive shutdown of many financial market segments, the Federal Reserve implemented a number of additional programmes with the aim of providing liquidity to key credit markets in order to reduce funding pressures.⁶

All of these facilities can be associated with the central bank's role as lender of last resort, with the purpose of providing liquidity to the financial sector (Bernanke, 2009). We thus subsume all of them under the category of liquidity-providing measures by the Fed. The aim of these policies was to avoid fire sales of assets by providing a liquidity backstop to financial institutions (Bernanke, 2009). In other words, the Fed's objectives were to mitigate the propagation of the crisis through a balance sheet channel (Sarkar, 2009).

These policies should therefore have a different impact on the economy than the second group of policies consisting of the so called large-scale asset purchase programmes (LSAPs). The list of key announcements for the Fed's LSAP is presented in Tables 1A–1C. The first LSAP, which was initially announced in November 2008 and subsequently extended in the following months, consisted of purchases of Government Sponsored Enterprise (GSE) debt for \$200 billion and of mortgage backed securities (MBS) for more than \$1,000 billion. Since March 2009, the Fed also started purchasing \$300 billion in US Treasury debt. This first round of purchases, which is commonly labelled QE1, was concluded in early 2010. While the MBS programme was introduced with the explicit aim of reducing mortgage interest rates and stabilising the housing markets, the ultimate goal of Treasury purchases was to stimulate economic activity by lowering long-term rates to support investment and by boosting asset prices to stimulate demand. In August 2010, the Federal Open Market Committee (FOMC) decided to stabilise the quantity of securities held by the Federal Reserve by re-investing principal payments of agency securities and MBSs into longer term Treasury securities. Subsequently, it extended the purchases in late 2010 (QE2) by committing to add \$600 billion US Treasuries to its balance sheet by June 2011. As a result, Treasury purchases by the Fed became the dominant instrument within the LSAP programme.

In September 2011, the Fed launched the Maturity Extension Program (MEP), implying the purchase of Treasuries with remaining maturities of 6–10 years and the sale of an equal amount with remaining maturities of three years and less. In late 2012, the Fed engaged in a new round of balance sheet expansion with purchases of MBS and Treasury bonds under the QE3 programme. In particular, the Fed committed to a pace of purchases (\$40 billion MBS per month as of September 2012 and \$45 billion Treasury bonds per month as of December 2012) conditional to developments in labour markets. Purchases were scaled down and halted between 2013 and 2014.

All these measures led to a significant increase in the size and a change in the composition of the Fed's balance sheet (see Figure 1). While direct lending to financial institutions played a significant role at the beginning of the crisis, large-scale

⁶ The Federal Reserve established the Asset-Backed Commercial Paper, Money Market Mutual Fund Liquidity Facility, the Commercial Paper Funding Facility and the Money Market Investor Funding Facility. The Fed decided to set up three limited liability companies (Maiden Lane LLCs) to facilitate lending in support of specific institutions such as Bear Stearns, JP Morgan and AIG.

Table 1A
Key US QE Announcements Between 2008 and 2012 (Based on Fawley and Neely, 2013)

	Date	Programme	Event	Description
1	25/11/2008	QE1	FOMC statement	LSAPs announced: fed will purchase \$100 billion in GSE debt and \$500 billion in MBS
2	01/12/2008	QE1	Bernanke speech	First suggestion of extending QE to Treasuries
3	16/12/2008	QE1	FOMC statement	First suggestion of extending QE to Treasuries by FOMC
4	28/01/2009	QE1	FOMC statement	Fed stands ready to expand QE and buy Treasuries
5	18/03/2009	QE1	FOMC statement	LSAPs expanded: fed will purchase \$300 billion in long-term Treasuries and an additional \$750 and \$100 billion in MBS and GSE debt, respectively
6	08/12/2009	QE1	FOMC statement	LSAPs slowed: all purchases will finish by the end of October, not mid-September
7	23/09/2009	QE1	FOMC statement	LSAPs slowed: agency debt and MBS purchases will finish at the end of 2010:Q1
8	11/04/2009	QE1	FOMC statement	LSAPs downsized: agency debt purchases will finish at \$175 billion
9	08/10/2010	QE1	FOMC statement	Balance sheet maintained: the Fed will reinvest principal payments from LSAPs in Treasuries
10	27/08/2010	QE2	Bernanke speech	Bernanke suggests role for additional QE 'should further action prove necessary'
11	21/09/2010	QE2	FOMC statement	FOMC emphasises low inflation, which 'is likely to remain subdued for some time before rising to levels the Committee considers consistent with its mandate'
12	10/12/2010	QE2	FOMC minutes released	FOMC members' 'sense' is that '[additional] accommodation may be appropriate before long'
13	15/10/2010	QE2	Bernanke speech	Bernanke reiterates that Fed stands ready to further ease policy
14	11/03/2010	QE2	FOMC statement	QE2 announced: fed will purchase \$600 billion in Treasuries
15	22/06/2011	QE2	FOMC statement	QE2 finishes: treasury purchases will wrap up at the end of month, as scheduled; principal payments will continue to be reinvested
16	21/09/2011	MEP	FOMC statement	Maturity Extension Program ('Operation Twist') announced: the Fed will purchase \$400 billion of Treasuries with remaining maturities of 6–30 years and sell an equal amount with remaining maturities of three years or less; MBS and agency debt principal payments will no longer be reinvested in Treasuries, but instead in MBS
17	20/06/2012	MEP	FOMC statement	Maturity Extension Program extended: The Fed will continue to purchase long-term securities and sell short-term securities through the end of 2012. Purchases/sales will continue at the current pace, about \$45 billion/month
18	22/08/2012	QE3	FOMC minutes released	FOMC members 'judged that additional monetary accommodation would likely be warranted fairly soon ...'
19	13/09/2012	QE3	FOMC statement	QE3 announced: the Fed will purchase \$40 billion of MBS per month as long as 'the outlook for the labour market does not improve substantially ... in the context of 'price stability'
20	12/12/2012	QE3	FOMC statement	QE3 expanded: the Fed will continue to purchase \$45 billion of long-term Treasuries per month but will no longer sterilize purchases through the sale of short-term treasuries

Table 1B
Asset Price Changes on QE Announcement Days

Date	Programme	Event	US two year sov yield, p-p.	US 5 years sov yield, p-p.	US 10 years sov yield, p-p.	US S&P500 index (%)	VIX, p-p.	Median 10 years sov yields in AEs (ex. US) (p.p.)	Median 10 years sov yields in EMEs (p.p.)	Median equity index in EMEs (%)	Median equity index in AEs (ex. US) (%)
25/11/2008	QE1	FOMC statement	-0.147	-0.197	-0.242	0.653	-3.800	0.470	-0.058	1.029	-0.064
01/12/2008	QE1	Bernanke speech	-0.131	-0.246	-0.248	-9.354	13.230	-3.826	-0.060	-1.922	-0.010
16/12/2008	QE1	FOMC statement	-0.109	-0.149	-0.175	5.008	-4.390	0.672	-0.068	0.631	-0.040
28/01/2009	QE1	FOMC statement	0.022	0.113	0.139	3.301	-2.590	2.413	-0.038	0.628	0.002
18/03/2009	QE1	FOMC statement	-0.206	-0.460	-0.470	2.064	-0.740	0.271	0.009	0.462	-0.025
12/08/2009	QE1	FOMC statement	-0.048	-0.034	0.008	1.146	-0.540	0.921	0.012	0.510	0.014
23/09/2009	QE1	FOMC statement	0.008	-0.008	-0.031	-1.012	0.410	0.014	-0.019	0.192	-0.017
04/11/2009	QE1	FOMC statement	-0.018	0.020	0.061	0.104	-1.090	1.640	0.040	0.764	0.017
10/08/2010	QE1	FOMC statement	-0.011	-0.074	-0.060	-0.599	0.230	-0.972	0.020	-0.533	-0.019
27/08/2010	QE2	Bernanke speech	0.030	0.119	0.163	1.645	-2.920	0.688	0.046	0.199	-0.001
21/09/2010	QE2	FOMC statement	-0.044	-0.112	-0.127	-0.257	0.850	0.051	-0.043	-0.017	-0.010
12/10/2010	QE2	FOMC minutes released	0.031	0.034	0.046	0.381	-0.030	-0.214	0.020	0.359	-0.004
15/10/2010	QE2	Bernanke speech	-0.021	0.010	0.057	0.203	-0.850	0.026	0.046	-0.141	0.025
03/11/2010	QE2	FOMC statement	-0.018	-0.048	-0.046	0.367	-2.010	-0.195	-0.022	0.522	-0.012
22/06/2011	QE2	FOMC statement	0.000	-0.007	0.006	-0.649	-0.340	-0.414	-0.023	-0.242	0.007
21/09/2011	MEP	FOMC statement	0.040	0.020	-0.070	-2.983	4.460	-1.239	-0.009	-1.265	0.061
20/06/2012	MEP	FOMC statement	0.005	0.042	0.022	-0.169	-1.140	0.311	0.030	-0.155	-0.025
22/08/2012	QE3	FOMC minutes released	-0.024	-0.081	-0.087	0.023	0.090	-0.708	-0.044	0.008	-0.006
13/09/2012	QE3	FOMC statement	-0.008	-0.042	-0.012	1.618	-1.750	-0.030	-0.018	1.041	0.000
12/12/2012	QE3	FOMC statement	0.000	0.016	0.050	0.045	0.380	-0.022	0.001	0.045	0.012

Table 1C
Portfolio Flows on the Day After QE Announcements

	Date	Programme	Event	Equity flows		Equity flows		Bond flows		Bond flows	
				US	EMEs	AEs	US	EMEs	AEs		
1	25/11/2008	QE1	FOMC statement	0.098	0.074	0.138	-0.031	-0.219	-0.087		
2	01/12/2008	QE1	Bernanke speech	-0.012	-0.132	0.023	-0.019	-0.078	-0.065		
3	16/12/2008	QE1	FOMC statement	0.401	0.085	-0.021	0.027	-0.280	-0.371		
4	28/01/2009	QE1	FOMC statement	0.130	0.115	0.008	0.081	-0.106	-0.026		
5	18/03/2009	QE1	FOMC statement	0.683	0.184	0.024	0.042	-0.081	-0.042		
6	12/08/2009	QE1	FOMC statement	0.035	0.153	0.055	0.102	0.138	0.144		
7	23/09/2009	QE1	FOMC statement	-0.001	0.144	0.099	0.175	0.246	0.223		
8	04/11/2009	QE1	FOMC statement	0.088	0.019	0.011	0.103	0.206	0.063		
9	10/08/2010	QE1	FOMC statement	-0.148	0.024	-0.115	0.049	0.129	0.148		
10	27/08/2010	QE2	Bernanke speech	0.097	0.047	-0.006	0.070	0.086	0.041		
11	21/09/2010	QE2	FOMC statement	0.144	0.090	-0.027	0.046	0.115	0.081		
12	12/10/2010	QE2	FOMC minutes released	0.101	0.176	-0.025	0.041	0.223	0.219		
13	15/10/2010	QE2	Bernanke speech	-0.005	0.175	0.094	0.044	0.283	0.159		
14	03/11/2010	QE2	FOMC statement	0.030	0.119	0.051	0.029	0.130	0.083		
15	22/06/2011	QE2	FOMC statement	-0.054	-0.070	0.021	0.002	0.042	-0.014		
16	21/09/2011	MEP	FOMC statement	-0.134	-0.042	-0.010	0.199	-0.132	-0.022		
17	20/06/2012	MEP	FOMC statement	-0.107	0.037	0.008	0.097	0.111	0.059		
18	22/08/2012	QE3	FOMC minutes released	-0.005	-0.019	-0.006	0.015	0.023	0.046		
19	13/09/2012	QE3	FOMC statement	0.117	0.232	0.086	0.019	0.183	0.094		
20	12/12/2012	QE3	FOMC statement	-0.113	0.075	-0.107	-0.035	0.011	0.002		

Notes. The date refers to QE announcements. See Table 4 for more information on the portfolio flow variable.

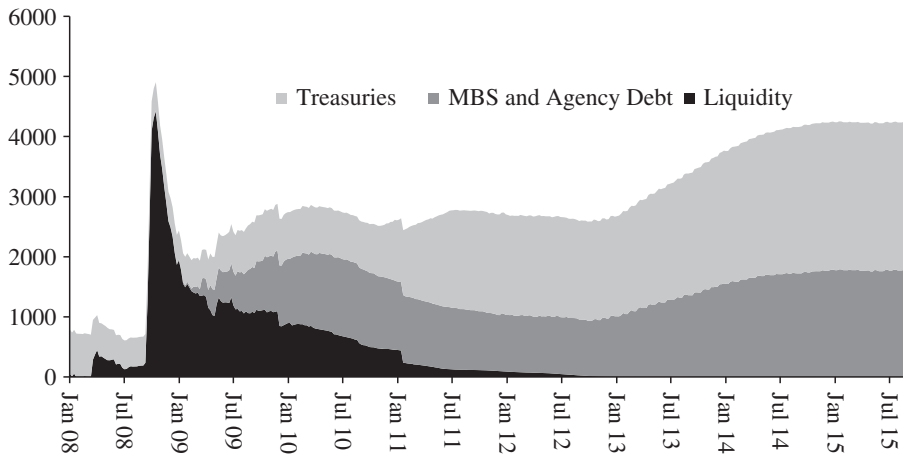


Fig 1. *Main Items of Interest in the Balance Sheet of the Federal Reserve*

Note. US\$ billions.

Source. Federal Reserve.

asset purchases have since become dominant in the dynamics of the Fed's balance sheet.

Each of the Federal Reserve's quantitative easing strategies intended to stabilise financial market and real economic activity in the United States. Observers, however, have argued that besides their domestic impact, credit easing policies affected global asset prices and were the main driver of the surge in capital flows to EMEs. It is, in particular, this latter point on which the current article focuses.

1.2. *Channels of Transmission*

The channels through which the Fed's Treasury purchases affect longer term interest rates and financial conditions have been subject to a controversial debate. In general, there are four channels through which Fed unconventional policies may affect portfolio decisions by investors and asset prices, both domestically and internationally. The channels discussed below are by no means mutually exclusive, i.e. several channels may be at work simultaneously. A first one is a portfolio balance channel. Fed purchases of US Treasury securities influence the available supply of this asset to private investors (Bernanke, 2010). As bond premia should be determined by the underlying risk characteristics of the asset and the risk appetite of investors, Fed purchases influence yields of the asset only to the extent that the asset is not perfectly substitutable. Portfolio rebalancing can be triggered in two ways. First, treasury purchases affect yields across the entire maturity spectrum, with larger effects in longer duration securities, which results into a change in the term premia. Second, assuming preferred habitat, i.e. the notion that investors prefer one maturity length over another, the impact is larger for securities where the shortage of supply is bigger, independently of their durations. And indeed, a number of studies have provided

evidence that preferred habitat theories hold (Doh, 2010; Gagnon *et al.*, 2011; D'Amico and King, 2013).

The signalling channel is a second mechanism through which Fed interventions may influence asset prices and portfolio decisions. Bond yields may decline via a lower risk-neutral component of interest rates, if Fed announcements or operations are understood by markets to signal lower future policy rates than was previously expected. Bauer and Rudebusch (2014) stress the relevance of a signalling effect for Fed announcements since 2008 and show that this channel had similar importance as the pure portfolio balance channel via lower term premia.

At the same time, Fed announcements may also provide new information about the current state of the economy. Such a third channel, which may be dubbed confidence channel, can affect portfolio decisions and asset prices by altering the risk appetite of investors.⁷

A fourth channel is related to the effects of Fed announcements and operations on the functioning of markets, and thus on portfolio decisions and asset prices by affecting, for example, liquidity premia. In particular the liquidity operations and purchases of MBS, as outlined above, are likely to have functioned, at least in part, through such a channel by improving market functioning and decreasing liquidity premia (Gagnon *et al.*, 2011; Joyce *et al.*, 2011).

2. Empirical Methodology and Results

In this Section, we discuss the data and the empirical strategy that we employ for assessing the impact of US unconventional monetary policies on capital flows. We then turn to the presentation of the results.

2.1. Data

We use daily data on portfolio equity and bond investment flows from 1 January 2008 to 31 December 2012, compiled by the data provider EPFR. The dataset contains daily flows for more than 16,000 equity funds and 8,000 bond funds. EPFR data captures about 5–20% of the market capitalisation in equity and in bonds for most countries, but importantly, it is a fairly representative sample as shown by Jotikasthira *et al.* (2010), Miao and Pant (2012) and Fratzscher (2012), with EPFR portfolio flows and portfolio flows stemming from total balance-of-payments data mostly matching quite closely.⁸

At the fund level, EPFR data provides information on the total assets under management (AUM), allowing for a distinction between capital flows net of valuation changes, and valuation changes (due to asset returns and exchange rate changes) to calculate each period's change in AUM. Importantly, in our benchmark specification, we focus on total net injections into the funds (which abstracts from valuation changes), aggregated at the country level, because these reflect the active decisions of investors about whether or not to add or reduce investments in a particular fund class.

⁷ See Bekaert *et al.* (2014) on how monetary policies may affect the transmission of shocks in equity markets.

⁸ Other papers using the EPFR dataset are Forbes *et al.* (2012), Lo Duca (2012) and Raddatz and Schmukler (2012).

Therefore, our focus is not on analysing the portfolio allocation strategy of individual fund managers, but rather that of individual firms, households and/or institutional and retail investors following monetary policy actions.

A caveat to conducting an analysis that compares allocations to equity funds with those to bond funds is that each of these categories is fairly broad, comprising a very heterogeneous set of financial assets. For instance, bond funds include investments in Treasury securities, i.e. the very same assets in which the Fed intervened, as well as a broad array of corporate bonds with a wide spectrum of risk and liquidity. This implies that the empirical analysis yields merely the average effects across individual market segments.

Table 2 provides summary statistics for the net flows aggregated at the level of the group of countries of destination of the flows (expressed as percentage of assets under management in the destination country) for our selected sample of countries. Note that in our benchmark regression, we consider both US and non-US domiciled funds, with US domiciled funds accounting for more than 80% of the number of funds. Moreover, due to legal restrictions, most of the investors in the funds are located in the same domicile as the fund itself. This means that strictly speaking, the analysis is from a US investor perspective, while it can say little about the portfolio decisions of, for example, investors located in EMEs.⁹ This is important because it implies that investment decisions *vis-à-vis* EMEs or other AEs imply cross-border transactions and thus gross capital flows in a balance-of-payments definition. By contrast, investment decisions *vis-à-vis* the US do not constitute such balance-of-payments transactions. For simplicity, we use the terms ‘capital/portfolio flows’ and ‘portfolio choice/decision’ interchangeably throughout the article.

2.2. Empirical Approach

The empirical methodology is based on the following regression that is estimated separately for different groups of countries (emerging markets, advanced economies and US) and for different type of portfolio flows (bond and equity).

$$y_{i,t} = \alpha_i + \beta_{1,j} QE_{j,t-1} + \beta_{2,j} TR_{j,t-1} + \beta_3 LIQ_{t-1} + \gamma X_t + \varepsilon_{i,t}. \quad (1)$$

$y_{i,t}$ is portfolio flows (either bond or equity) in country i on day t expressed as percentage of the portfolio assets invested in country i .¹⁰ Summary statistics for portfolio flows are reported in Table 2. $QE_{j,t}$ is an indicator capturing the US QE announcements differentiating among different QE rounds ($j = 1, 2$ and 3). Details are provided in the next Section where we focus on the effects of QE announcements. $TR_{j,t}$ is an explanatory variable capturing the purchases of Treasury bonds by the Fed in day $t - 1$ while LIQ_{t-1} is a variable capturing Fed liquidity operations. Both variables,

⁹ As a consequence, it can be problematic to draw overall conclusions on total capital flows when flows of non-US investors are negatively correlated with flows of US investors (i.e. when local investors withdraw at the time when US investors come in).

¹⁰ This transformation ensures that flows are expressed in relation to the size of the market. In addition, this transformation overcomes problems emerging from the fact that the population of funds might change over time. In particular, changes in the level of the flows might simply reflect changes in the reporting fund population. When dividing flows by the assets of the reporting funds, we overcome this problem by taking into account the number and the size of the reporting funds. This is a standard approach in articles using EPFR data.

Table 2
Summary Statistics for the Dependent Variables

Variable	Unit	Source	Country group	Units (countries)	Observations	Mean	SD	Minimum	Maximum
Portfolio bond flows	Investment flow in percentage of the assets invested in the country	Emerging Portfolio Fund Research (EPFR)	US	1	1,558	0.032	0.065	-0.277	0.577
			Advanced economies (ex US)	22	33,954	0.014	0.204	-7.993	6.704
			Emerging markets	30	45,573	0.032	0.201	-2.603	2.439
Portfolio equity flows	Investment flow in percentage of the assets invested in the country	EPFR	US	1	1,558	0.001	0.137	-1.080	1.226
			Advanced economies (ex US)	22	34,276	-0.005	0.202	-7.951	12.118
			Emerging markets	30	46,524	0.005	0.194	-8.671	7.724

Notes: Sample period 1 January 2008–31 December 2012, daily data. See Figure A1 in the Appendix for a visual representation of portfolio flows.

$TR_{j,t}$ and LIQ_{t-1} , are discussed in the Section where we discuss the impact of quantities (i.e. purchases and liquidity operations). Finally, α_i is a country-specific constant (fixed effects) and X_i is a set of control variables. Among the control variables, the benchmark specification includes ‘day of week’ dummies to capture seasonal effects, which might be relevant for portfolio flows in particular days, and macroeconomic surprises. The latter are measured as the difference between macroeconomic data releases and expectations according to the Bloomberg survey. A total of 30 macroeconomic indicators for the US and the euro area and some large individual euro area countries are included as control variables in the regressions (see Appendix A for a list of the indicators). The benchmark regression is estimated with daily data over a period ranging from 1 January 2008 to 31 December 2012. The benchmark panel regression across countries in a group (emerging markets or advanced economies) includes fixed effects and standard errors that are robust to heteroscedasticity. When the regression is estimated for the US, it becomes a time series regression (the dimension i is dropped) with standard errors that are robust to heteroscedasticity. In the robustness Section, we discuss alternative specifications and estimation techniques.

The next subsection discusses the impact of announcements, while the subsequent subsection extends to operations.

2.3. Assessing the Impact of QE Announcements

In this subsection, we assess the impact of QE announcements on portfolio flows, focusing on the coefficients of the QE_{jt} variables.

We measure the effects of QE announcements by a ‘dummy’ variable approach. The latter consists of defining an impulse dummy variable equal to 1 on days when expansionary QE announcements took place. We differentiate thereby between the different QE rounds, i.e. we estimate the impact of QE1, QE2 and QE3 separately. Specifically, $QE1_t$ includes four expansionary QE announcements, namely events 1, 3, 4 and 5.¹¹ $QE2_t$ includes three expansionary QE announcements, namely events 10, 13 and 14 in Table 1, while $QE3_t$ includes five expansionary QE announcements, namely events 16–20. For simplicity, we included announcements related to the Maturity Extension Program in the group of QE3 announcements. In selecting the considered announcements, we broadly follow the expansionary announcements listed by Fawley and Neely (2013). We discuss alternative sets of events and alternative strategies for measuring the impact of announcements in the robustness Section.

The estimated coefficients of the QE_{jt} variables under different settings are presented in Table 3. The benchmark specification is reported in column (4). For simplicity, Table 4 summarises the results of the benchmark specification across countries.¹²

¹¹ See Table 1A for information on the events and Tables 1B and 1C for daily changes in asset prices and portfolio flows on announcement days. Events 2 and 9 are excluded from the analysis as they occurred on days when other news dominated financial markets developments. In the case of event 2, the US and global equity indexes dropped substantially as a result of the official news of the US recession. Similarly, negative market news unrelated to the Fed’s announcement dominated event 9. Events 6, 7, 8 and 15 relate to reductions or interruptions in LSAP and have been shown in the literature to have been mostly irrelevant as news for financial markets.

¹² The coefficients of the dummies capturing QE announcements are unaffected by the inclusion of purchases in our benchmark specification.

Table 3
Model Summary and Regression Results

This Table displays the estimated coefficients of the following regression:

$$y_{i,t} = \alpha_i + \beta_{1,j} QE_{jt-1} + \beta_{2,j} TR_{jt-1} + \beta_3 LIQ_{j-1} + \gamma X_i + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is the dependent variable (portfolio flows) indicated in the title of the Table in country i on day t (summary statistics for portfolio flows in Table 2); the regression is separately estimated for two groups of countries (Emerging Markets and Advanced Economies) and for the US; QE_{jt} is an impulse dummy equal to 1 on a subset of the QE announcements listed in Table 3A–F*, differentiating among QE rounds ($j = 1, 2$ and 3). $TR_{j,t}$ are the purchases of Treasury bonds by the FED in day $t - 1$; $LIQ_{j,t}$ is the unexpected component of liquidity operations as described in subsection 2.4. α_i are country specific constants (fixed effects); X_i is a set of control variables as indicated in Tables 3A–3F, row ‘Control Variables’. Control variables always include ‘day of week’ dummies to capture seasonal effects in particular days and a dummy to capture specificities of flows during the ‘Arab Spring’ between January and March 2011;

List of estimated models in Table 3A–F:

- (i) Column (1) ‘No purchases, No Controls’: only QE announcement dummies
- (ii) Column (2) ‘No purchases’: only QE announcement dummies and Macroeconomic surprises (‘Macro Surp.’) †
- (iii) Column (3) ‘Purchases, No Controls’: only QE announcement dummies, treasury purchases and liquidity interventions.
- (iv) Column (4) ‘Benchmark’: QE announcement dummies, treasury purchases, liquidity interventions and Macroeconomic surprises (‘Macro Surp.’).
- (v) Column (5) ‘Additional Controls A’: benchmark model plus additional control variables (lagged US 10 year government bond yield, lagged VIX, lagged returns of the S&P500 index).
- (vi) Column (6) ‘Additional Controls B’: benchmark model plus additional control variables (lagged US 10 year government bond yield, lagged VIX, lagged returns of the S&P500 index, domestic GDP forecast (WEO)).
- (vii) Column (7) ‘Additional Controls C’: benchmark model plus additional control variables (lagged US 10 year government bond yield, lagged VIX, lagged returns of the S&P500 index, domestic and US GDP forecast (WEO and Consensus Economics)).
- (viii) Column (8) ‘Additional Controls D’: benchmark model plus additional control variables (lagged US 10 year government bond yield, lagged VIX, lagged returns of the S&P500 index, domestic and US GDP forecast (WEO and Consensus Economics), two lags of median equity (bond) flows across countries).
- (ix) Column (9) ‘Additional Controls E’: benchmark model plus additional control variables (lagged US 10 year government bond yield, lagged VIX, lagged returns of the S&P500 index, domestic and US GDP forecast (WEO and Consensus Economics), two lags of median equity (bond) flows across countries; two lags of the endogenous variable)
- (x) Column (10) ‘Dummy t and $t + 1$ ’: announcement dummies are equal to 1 on the day of the announcement (t) and on the day after the announcement ($t + 1$), the rest is as in the benchmark model
- (xi) Column (11) ‘Dummy $t + 1$ and $t + 2$ ’: announcement dummies are equal to 1 on the day two days after the announcement ($t + 1$ and $t + 2$), the rest is as in the benchmark model
- (xii) Column (12) ‘No MEP’: MEP announcements (events 16 and 17) are excluded, the rest is as in the benchmark model
- (xiii) Column (13) ‘B&N events’: announcement dummies for the events considered in Bauer and Neely (2014). QE_1 includes events 1, 2, 3 and 5; QE_2 includes events 9, 11 and 14. QE_3 includes events 18 and 19. The rest is as in the benchmark model.

Table 3
(Continued)

(xiv)	Column (14): US 10 year: impulse dummies are replaced with the change in the US 10 year Government bond yield on announcement days (a negative coefficient indicates inflows). The rest is as in the benchmark model.
(xv)	Column (15): Bootstrap: benchmark specification with bootstrapped standard errors, clustered by country (500 bootstrap repetitions)
(xvi)	Column (16): D&K: benchmark specification with Driscoll and Kraay standard errors (robust to cross sectional dependence)
(xvii)	Column (17): MG: benchmark specification, Pesaran and Smith 'Mean Group' estimator.

* Unless differently specified the announcement dummies are set as follows: *QE1*, includes four expansionary QE announcements, namely events 1, 3, 4 and 5 in Table 1A-1C; *QE2*, includes three expansionary QE announcements, namely events 10, 13 and 14 in Table 1A-1C, while *QE3*, includes five expansionary QE announcements, namely events 16-20. More information in subsections 2.4 and 2.6.

† Purchases occurring in 2009 are *QE1* purchases (TR1), purchases occurring between November 2010 and June 2011 are *QE2* purchases (*QE2*), and purchases occurring since October 2012 are *QE3* purchases (TR3)

‡ Macroeconomic surprises (Macro Surp.) measured as the difference between macroeconomic data releases and expectations according to the Bloomberg survey. A total of 30 Macroeconomic indicators for the US and the euro area are included as control variables in the regressions (See Appendix A for a list of the indicators)

Table 3A
Model Summary and Regression Results: Dependent Variable: Equity Flows (US)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No purchases No controls	No purchases	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E
QE1	0.324*** (0.119)	0.341** (0.137)	0.345*** (0.115)	0.369*** (0.130)	0.356** (0.147)	0.355*** (0.147)	0.394** (0.153)	0.374*** (0.131)	0.371*** (0.130)
QE2	0.050* (0.027)	0.050* (0.027)	0.050* (0.027)	0.051* (0.027)	0.031* (0.017)	0.032* (0.017)	0.029* (0.017)	0.041 (0.030)	0.038 (0.029)
QE3	-0.044 (0.049)	-0.043 (0.050)	-0.043 (0.050)	-0.041 (0.050)	-0.033 (0.043)	-0.033 (0.043)	-0.026 (0.043)	-0.045 (0.050)	-0.048 (0.051)
TR1			0.002 (0.003)	0.002 (0.003)	0.001 (0.003)	0.000 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)
TR2			0.003 (0.002)	0.004 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)
TR3			-0.001 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.001 (0.004)	-0.003 (0.004)	-0.002 (0.004)
LIQ			0.129 (0.086)	0.169* (0.090)	0.140 (0.092)	0.140 (0.092)	0.121 (0.090)	0.193** (0.089)	0.179** (0.089)
Observations Number	1,298	1,297	1,298	1,297	1,297	1,297	1,297	1,287	1,287
of countries									
Fixed effects									
Control variables		Macro Surp.		Macro Surp.	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500
						GDP forecast	GDP forecast	GDP forecast	GDP forecast
							US GDP for.	US GDP for.	US GDP for.
							Lags Glo. Flows	Lags Glo. Flows	Lags Dom. Flows

Table 3A
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10 years	Bootstrap	D&K	MG
QE1	0.189* (0.099)	0.120 (0.183)	0.370*** (0.131)	0.305* (0.163)	-1.103*** (0.349)	0.369** (0.153)		
QE2	0.057*** (0.015)	0.025 (0.056)	0.051* (0.027)	0.006 (0.072)	-0.457 (0.704)	0.051* (0.030)		
QE3	0.004 (0.030)	-0.021 (0.040)	-0.031 (0.078)	0.074 (0.058)	-0.191 (0.354)	-0.041 (0.053)		
TR1	0.002 (0.003)	0.001 (0.003)	0.002 (0.003)	0.001 (0.003)	0.001 (0.003)	0.002 (0.003)		
TR2	0.004* (0.002)	0.003 (0.002)	0.004 (0.002)	0.004 (0.002)	0.004 (0.002)	0.004 (0.002)		
TR3	-0.002 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.002 (0.004)		
LIQ	0.165* (0.091)	0.142 (0.091)	0.169* (0.090)	0.132 (0.092)	0.131 (0.092)	0.169** (0.086)		
Observations	1,297	1,297	1,297	1,297	1,297	1,297		
Number of countries								
Fixed effects								
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. In Column (14) a negative coefficient for QE_{ij} indicates inflows.

Table 3B
Model Summary and Regression Results: Dependent Variable: Equity Flows (Emerging Markets)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No purchases No controls	No purchases No controls	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E	
QE1	0.107*** (0.017)	0.131*** (0.015)	0.096*** (0.019)	0.116*** (0.018)	0.085*** (0.019)	0.093*** (0.019)	0.127*** (0.015)	0.158*** (0.017)	0.163*** (0.017)
QE2	0.106*** (0.013)	0.109*** (0.013)	0.113*** (0.013)	0.116*** (0.013)	0.101*** (0.014)	0.104*** (0.014)	0.095*** (0.012)	0.038*** (0.012)	0.034*** (0.012)
QE3	0.053*** (0.008)	0.055*** (0.008)	0.060*** (0.008)	0.061*** (0.008)	0.065*** (0.008)	0.066*** (0.008)	0.063*** (0.008)	0.031*** (0.008)	0.036*** (0.008)
TR1			0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.003*** (0.001)	0.007*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
TR2			0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.001)	0.001 (0.001)	-0.001 (0.000)	-0.001 (0.000)
TR3			0.022*** (0.003)	0.018*** (0.002)	0.018*** (0.002)	0.017*** (0.002)	0.016*** (0.002)	0.010*** (0.002)	0.010*** (0.002)
LIQ			-0.122*** (0.018)	-0.131*** (0.021)	-0.146*** (0.020)	-0.119*** (0.018)	-0.124*** (0.019)	0.026 (0.018)	0.023* (0.013)
Observations	38,822	38,793	38,822	38,793	38,793	38,793	38,793	38,493	38,483
Number of countries	30	30	30	30	30	30	30	30	30
Fixed effects		Macro Surp.		Macro Surp.	VIX US10y SP500	VIX US10y SP500	VIX US10y SP500	VIX US10y SP500	VIX US10y SP500
Control variables					GDP forecast	GDP forecast US GDP for.	GDP forecast US GDP for.	GDP forecast US GDP for.	GDP forecast US GDP for. Lags Glo. Flows Lags Dom. Flows

Table 3B
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10 years	Bootstrap	D&K	MG
QE1	0.016 (0.012)	0.051*** (0.017)	0.115*** (0.018)	0.065*** (0.012)	-0.238*** (0.051)	0.116*** (0.017)	0.116*** (0.033)	0.116*** (0.017)
QE2	0.127*** (0.013)	0.108*** (0.012)	0.116*** (0.013)	0.074*** (0.018)	-0.785*** (0.191)	0.116*** (0.013)	0.116*** (0.031)	0.116*** (0.013)
QE3	0.039*** (0.006)	0.029*** (0.005)	0.092*** (0.014)	0.109*** (0.012)	-0.191* (0.101)	0.061*** (0.008)	0.061 (0.044)	0.062*** (0.008)
TR1	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.001)	0.010*** (0.003)	0.010*** (0.001)
TR2	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.001)	0.002 (0.002)	0.002*** (0.000)
TR3	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.002)	0.018*** (0.005)	0.018*** (0.002)
LIQ	-0.142*** (0.022)	-0.139*** (0.022)	-0.131*** (0.021)	-0.143*** (0.020)	-0.143*** (0.020)	-0.131*** (0.021)	-0.131 (0.091)	-0.132*** (0.022)
Observations	38,793	38,793	38,793	38,793	38,793	38,793	38,793	38,793
Number of countries	30	30	30	30	30	30	30	30
Fixed effects								
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** p < 0.01, ** p < 0.05, * p < 0.1. In Column (14) a negative coefficient for QEj indicates inflows.

Table 3C
Model Summary and Regression Results: Dependent Variable: Equity Flows (Advanced Economies)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No purchases No controls	No purchases	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E
QE1	0.049*** (0.013)	0.062*** (0.013)	0.037** (0.013)	0.050*** (0.013)	0.033** (0.016)	0.031* (0.016)	0.045*** (0.015)	0.069*** (0.013)	0.072*** (0.012)
QE2	0.059*** (0.009)	0.060*** (0.009)	0.061*** (0.009)	0.063*** (0.009)	0.056*** (0.010)	0.061*** (0.010)	0.057*** (0.010)	0.030*** (0.009)	0.033*** (0.009)
QE3	0.006 (0.012)	0.006 (0.012)	0.008 (0.012)	0.008 (0.012)	0.010 (0.012)	0.010 (0.011)	0.009 (0.011)	-0.005 (0.011)	-0.003 (0.010)
TR1			0.002** (0.001)	0.002*** (0.001)	0.002** (0.001)	-0.003*** (0.001)	-0.001* (0.001)	-0.000 (0.000)	-0.001 (0.001)
TR2			0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.002** (0.001)	0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)
TR3			0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.008*** (0.001)	0.008*** (0.001)	0.006*** (0.002)	0.006*** (0.002)
LIQ			-0.094*** (0.021)	-0.089*** (0.025)	-0.096*** (0.026)	-0.082*** (0.025)	-0.083*** (0.025)	-0.018 (0.023)	-0.019 (0.021)
Observations	28,556	28,534	28,556	28,534	28,534	28,534	28,534	28,314	28,314
Number of countries	22	22	22	22	22	22	22	22	22
Fixed effects									
Control variables		Macro Surp.		Macro Surp.	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500 GDP forecast	Macro Surp. VIX US10y SP500 GDP forecast US GDP for.	Macro Surp. VIX US10y SP500 GDP forecast US GDP for.	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows Lags Dom. Flows

Table 3C
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10 years	Bootstrap	D&K	MC
QE1	0.015 (0.011)	0.075*** (0.012)	0.049*** (0.013)	0.068*** (0.012)	-0.177*** (0.032)	0.050*** (0.013)	0.050 (0.033)	0.050*** (0.013)
QE2	0.039*** (0.008)	0.033*** (0.007)	0.063*** (0.009)	-0.016 (0.042)	0.215 (0.358)	0.063*** (0.009)	0.063*** (0.024)	0.063*** (0.009)
QE3	0.032*** (0.009)	0.028*** (0.008)	0.004 (0.012)	0.055*** (0.015)	-0.237 (0.180)	0.008 (0.011)	0.008 (0.028)	0.008 (0.012)
TR1	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002 (0.002)	0.002*** (0.001)
TR2	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
TR3	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.009*** (0.001)	0.009*** (0.002)	0.009*** (0.002)
LIQ	-0.092*** (0.027)	-0.086*** (0.025)	-0.089*** (0.025)	-0.094*** (0.025)	-0.094*** (0.025)	-0.089*** (0.025)	-0.089 (0.076)	-0.089*** (0.025)
Observations	28,534	28,534	28,534	28,534	28,534	28,534	28,534	28,534
Number of countries	22	22	22	22	22	22	22	22
Fixed effects								
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes: *** $p < 0.01$, ** $p > 0.05$, * $p < 0.1$. In Column (14) a negative coefficient for QE_j indicates inflows.

Table 3D
Model Summary and Regression Results: Dependent Variable: Bond Flows (US)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No purchases No controls	No purchases	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E
QE1	-0.015 (0.023)	0.005 (0.032)	-0.032 (0.025)	-0.013 (0.032)	-0.039 (0.035)	-0.031 (0.035)	-0.015 (0.038)	0.015 (0.022)	0.010 (0.021)
QE2	0.010 (0.011)	0.008 (0.011)	0.013 (0.011)	0.010 (0.011)	0.010 (0.014)	0.006 (0.013)	0.005 (0.013)	-0.009 (0.013)	0.004 (0.010)
QE3	0.020 (0.037)	0.020 (0.037)	0.022 (0.037)	0.022 (0.037)	0.021 (0.039)	0.017 (0.039)	0.020 (0.039)	0.019 (0.040)	0.028 (0.041)
TR1			0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.010*** (0.002)	0.010*** (0.002)	0.007*** (0.001)	0.006*** (0.001)
TR2			-0.005*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.005*** (0.001)
TR3			0.010 (0.007)	0.009* (0.005)	0.009* (0.005)	0.008* (0.005)	0.009* (0.005)	0.005 (0.005)	0.006 (0.005)
LIQ			-0.126*** (0.039)	-0.119*** (0.043)	-0.121*** (0.042)	-0.120*** (0.041)	-0.128*** (0.041)	-0.060* (0.035)	-0.052 (0.034)
Observations	1,298	1,297	1,298	1,297	1,297	1,297	1,297	1,287	1,287
Number of countries									
Fixed effects									
Control variables		Macro Surp.		Macro Surp.	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500 GDP forecast	Macro Surp. VIX US10y SP500 GDP forecast US GDP for.	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows

Table 3D
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10y	Bootstrap	D&K	MG
QE1	-0.042 (0.029)	-0.009 (0.019)	-0.013 (0.032)	-0.018 (0.030)	0.072 (0.069)	-0.013 (0.080)		
QE2	0.015 (0.012)	-0.016 (0.034)	0.010 (0.011)	-0.004 (0.005)	0.034 (0.050)	0.010 (0.014)		
QE3	-0.001 (0.021)	0.061 (0.055)	0.024 (0.059)	-0.018*** (0.005)	0.289*** (0.052)	0.022 (0.041)		
TR1	0.007*** (0.001)	0.008*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)		
TR2	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)		
TR3	0.009* (0.005)	0.009* (0.005)	0.009* (0.005)	0.009* (0.005)	0.009* (0.005)	0.009** (0.004)		
LIQ	-0.127*** (0.042)	-0.119*** (0.042)	-0.119*** (0.043)	-0.118*** (0.042)	-0.118*** (0.042)	-0.119*** (0.043)		
Observations	1,297	1,297	1,297	1,297	1,297	1,297		
Number of countries								
Fixed effects								
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** p < 0.01, ** p < 0.05, * p < 0.1. In Column (14) a negative coefficient for QFj indicates inflows.

Table 3E
Model Summary and Regression Results: Dependent Variable: Bond Flows (Emerging Markets)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No purchases No controls	No purchases	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E
QE1	-0.221*** (0.005)	-0.177*** (0.004)	-0.289*** (0.006)	-0.247*** (0.005)	-0.307*** (0.006)	-0.296*** (0.008)	-0.067*** (0.006)	-0.110*** (0.004)	-0.103*** (0.004)
QE2	0.116*** (0.021)	0.119*** (0.021)	0.122*** (0.021)	0.125*** (0.021)	0.136*** (0.021)	0.140*** (0.022)	0.084*** (0.022)	0.027 (0.021)	0.029 (0.022)
QE3	-0.011** (0.005)	-0.008 (0.005)	-0.007 (0.005)	-0.005 (0.005)	-0.008 (0.005)	-0.007 (0.005)	-0.026*** (0.005)	-0.018*** (0.005)	-0.018*** (0.004)
TRI			-0.003*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.011*** (0.002)	0.013*** (0.001)	-0.004*** (0.001)	-0.003*** (0.000)
TR2			0.002*** (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.001 (0.001)	-0.007*** (0.001)	-0.003*** (0.000)	-0.002*** (0.000)
TR3			0.039*** (0.003)	0.035*** (0.003)	0.034*** (0.003)	0.033*** (0.003)	0.030*** (0.003)	0.013*** (0.002)	0.014*** (0.002)
LIQ			-0.475*** (0.013)	-0.464*** (0.014)	-0.480*** (0.014)	-0.442*** (0.012)	-0.475*** (0.013)	-0.174*** (0.009)	-0.154*** (0.008)
Observations	38,020	37,991	38,020	37,991	37,991	37,991	37,991	37,703	37,695
Number of countries	30	30	30	30	30	30	30	30	30
Fixed effects									
Control variables		Macro Surp.		Macro Surp.	Macro Surp. VIX US10y SP500	Macro Surp. VIX US10y SP500 GDP forecast	Macro Surp. VIX US10y SP500 GDP forecast US GDP for.	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Dom. Flows

Table 3E
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10 years	Bootstrap	D&K	MG
QE1	-0.208*** (0.008)	-0.191*** (0.012)	-0.247*** (0.005)	-0.168*** (0.004)	0.517*** (0.012)	-0.248*** (0.005)	-0.247*** (0.055)	-0.231*** (0.012)
QE2	0.133*** (0.009)	0.139*** (0.014)	0.124*** (0.021)	0.078*** (0.007)	-0.798*** (0.058)	0.125*** (0.018)	0.125*** (0.052)	0.124*** (0.021)
QE3	-0.008 (0.009)	-0.065*** (0.006)	-0.023*** (0.005)	0.061*** (0.007)	0.027 (0.105)	-0.005 (0.005)	-0.005 (0.049)	-0.005 (0.005)
TR1	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.004)	0.003 (0.004)
TR2	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.003)	-0.000 (0.000)
TR3	0.035*** (0.003)	0.035*** (0.003)	0.035*** (0.003)	0.035*** (0.003)	0.035*** (0.003)	0.035*** (0.002)	0.035*** (0.009)	0.034*** (0.003)
LIQ	-0.478*** (0.014)	-0.460*** (0.013)	-0.464*** (0.014)	-0.438*** (0.013)	-0.437*** (0.013)	-0.464*** (0.013)	-0.464*** (0.210)	-0.427*** (0.038)
Observations	37,991	37,991	37,991	37,991	37,991	37,991	37,991	37,991
Number of countries	30	30	30	30	30	30	30	30
Fixed effects								
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** p > 0.01, ** p > 0.05, * p > 0.1. In Column (14) a negative coefficient for QEj indicates inflows.

Table 3F
 Model Summary and Regression Results: Dependent Variable: Bond Flows (Advanced Economies)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	No purchases No controls	No purchases	Purchases No controls	Benchmark	Additional controls A	Additional controls B	Additional controls C	Additional controls D	Additional controls E
QE1	-0.155*** (0.010)	-0.112*** (0.008)	-0.184*** (0.012)	-0.141*** (0.009)	-0.196*** (0.008)	-0.199*** (0.008)	-0.057*** (0.010)	-0.049*** (0.010)	-0.076*** (0.013)
QE2	0.076*** (0.012)	0.077*** (0.012)	0.084*** (0.013)	0.084*** (0.013)	0.092*** (0.013)	0.099*** (0.013)	0.065*** (0.011)	0.020* (0.011)	0.018 (0.013)
QE3	0.020 (0.014)	0.021 (0.014)	0.027* (0.014)	0.028* (0.014)	0.025* (0.014)	0.026* (0.014)	0.013 (0.014)	0.018 (0.014)	0.017 (0.014)
TRI			0.007*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.000 (0.002)	0.014*** (0.002)	0.006*** (0.002)	0.005*** (0.001)
TR2			0.006*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.006*** (0.001)	0.002* (0.001)	0.003*** (0.001)	0.002*** (0.000)
TR3			0.024*** (0.003)	0.021*** (0.003)	0.020*** (0.003)	0.019*** (0.003)	0.016*** (0.003)	0.006** (0.003)	0.007*** (0.002)
LIQ			-0.240*** (0.025)	-0.224*** (0.023)	-0.236*** (0.023)	-0.211*** (0.026)	-0.227*** (0.026)	-0.033* (0.018)	-0.055*** (0.016)
Observations	28,238	28,217	28,238	28,217	28,217	28,217	28,217	28,001	27,990
Number of countries	22	22	22	22	22	22	22	22	22
Fixed effects									
Control variables		Macro Surp.		Macro Surp.	VIX US10y SP500	VIX US10y SP500 GDP forecast	VIX US10y SP500 GDP forecast US GDP for.	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows	Macro Surp. VIX US10y SP500 GDP forecast US GDP for. Lags Glo. Flows Lags Dom. Flows

Table 3F
(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Dummy t and $t + 2$	Dummy $t + 1$ and $t + 2$	No MEP	B&N events	US 10 years	Bootstrap	D&K	MG
QE1	-0.122*** (0.015)	-0.090*** (0.005)	-0.141*** (0.009)	-0.117*** (0.010)	0.328*** (0.021)	-0.141*** (0.009)	-0.141*** (0.038)	-0.141*** (0.009)
QE2	0.084*** (0.011)	0.074*** (0.013)	0.084*** (0.013)	0.086*** (0.007)	-0.847*** (0.048)	0.084*** (0.012)	0.084*** (0.030)	0.080*** (0.013)
QE3	0.016* (0.008)	-0.017* (0.008)	0.017 (0.017)	0.064** (0.025)	-0.551** (0.262)	0.028** (0.013)	0.028 (0.022)	0.028** (0.014)
TR1	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008** (0.003)	0.008*** (0.002)
TR2	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	0.005** (0.002)	0.005*** (0.001)
TR3	0.021*** (0.003)	0.021*** (0.003)	0.021*** (0.003)	0.021*** (0.003)	0.021*** (0.003)	0.021*** (0.003)	0.021*** (0.006)	0.021*** (0.003)
LIQ	-0.233*** (0.023)	-0.219*** (0.023)	-0.224*** (0.023)	-0.209*** (0.022)	-0.208*** (0.022)	-0.224*** (0.022)	-0.224 (0.142)	-0.225*** (0.023)
Observations	28,217	28,217	28,217	28,217	28,217	28,217	28,217	28,217
Number of countries	22	22	22	22	22	22	22	22
Fixed effects	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.
Control variables								

Notes: *** p > 0.01, ** p > 0.05, * p > 0.1. In Column (14) a negative coefficient for QE_{ij} indicates inflows.

Table 4
Estimated Coefficients for the Benchmark Regression

	Equity flows			Bond flows		
	US	EMEs	ADV	US	EMEs	ADV
QE1	0.369*** (0.130)	0.116*** (0.018)	0.050*** (0.013)	-0.013 (0.032)	-0.247*** (0.005)	-0.141*** (0.009)
QE2	0.051* (0.027)	0.116*** (0.013)	0.063*** (0.009)	0.010 (0.011)	0.125*** (0.021)	0.084*** (0.013)
QE3	-0.041 (0.050)	0.061*** (0.008)	0.008 (0.012)	0.022 (0.037)	-0.005 (0.005)	0.028* (0.014)
TR1	0.002 (0.003)	0.010*** (0.001)	0.002*** (0.001)	0.007*** (0.001)	-0.001 (0.001)	0.008*** (0.002)
TR2	0.004 (0.002)	0.002*** (0.000)	0.001 (0.001)	-0.006*** (0.001)	-0.000 (0.000)	0.005*** (0.001)
TR3	-0.002 (0.004)	0.018*** (0.002)	0.009*** (0.002)	0.009* (0.005)	0.035*** (0.003)	0.021*** (0.003)
LIQ	0.169* (0.090)	-0.131*** (0.021)	-0.089*** (0.025)	-0.119*** (0.043)	-0.464*** (0.014)	-0.224*** (0.023)

Notes. The Table reports the results in column (4) (benchmark specifications) of each panel of Table 3 across countries. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

As discussed beforehand, the QE1 period was characterised by a degree of macroeconomic uncertainty and risk aversion and Fed policies aimed mainly at avoiding a credit crunch and reduce the underlying uncertainty in the US economy.¹³ And indeed, the results of our benchmark specification (Column (4), row 1 in each Table) indicate that the Fed was fairly successful in pursuing this objective as QE1 policy announcement triggered primarily a portfolio rebalancing into riskier market segments out of the fixed income markets, with capital flowing mainly into US equity funds. The impact on equity flows to emerging market and other advanced economies has been positive, but small in magnitude.

The impact of QE2 and QE3 announcements on portfolio flows shows a different picture. In response to QE2 announcements, inflows to mutual funds have been generally positive but the strongest impact has been on inflows to EMEs. The impact of QE3 announcements essentially shows positive inflows only to emerging market equities (and weakly significant and small inflows in advanced economies' bonds).

In sum, the results indicate that early QE announcements resulted into a portfolio rebalancing into the US, particularly into equities, while the impact of latter announcements (QE2 and QE3) resulted into relative portfolio rebalancing out of US assets mostly into EME equities (and to lesser extent bonds) and into the bond markets in other advanced economies.

¹³ A speech by Bernanke (2008) stated that 'the Federal Reserve's response has followed two tracks: efforts to support market liquidity and functioning and the pursuit of our macroeconomic objectives through monetary policy.'

2.4. *Assessing the Impact of Operations*

In this subsection, we discuss the impact of Fed Treasury bond purchases (i.e. explanatory variables $TR_{j,t-1}$ in (1)) and liquidity operations (i.e. explanatory variable $LQ_{j,t-1}$ in (1)). Specifically, $TR_{j,t-1}$ is the total purchases of Treasury bonds in US\$ billions on day $t - 1$ during the QE round j ($j = 1, 2$ or 3).¹⁴ Purchases under different QE rounds were announced in advance by the Fed. At the beginning of each month, a tentative calendar with a minimum and maximum range of purchases for one individual bond in each day of the month was published. Therefore, purchases on individual days have limited surprise for markets and, therefore, should have little or no impact on prices, having limited information content.¹⁵

Indeed, one potential objection and concern in analysing Fed operations is that they may not contain any new information, as, for example, amounts and timing about LSAP were known at the time of their announcements. Hence, efficient markets should have priced in fully such information with the announcements. But this might be different in times of financial crisis and in the case of portfolio flows. Actual purchases might lead to actual portfolio rebalancing by alleviating cash constraints or market frictions. More generally, the impact response of (impaired) price and quantities to asset purchase announcements might not be informative about the overall dynamic response of these variables. Dedola *et al.* (2013) show that the impact effect of announcements is a small fraction of the total effect (in absolute value) and (e.g. for asset prices) of the opposite sign. This finding suggests that a dynamic econometric model or a model that explicitly includes asset purchases could be more appropriate in order to assess the impact of non-standard measures. In addition, Fed announcements do not imply any change in supply of, for example, US Treasury securities at the time the announcements are made and, overall, QE announcements do not provide all details about the operations. For example, the QE announcements under consideration entail at best the overall amount of purchases but fail in some cases to provide further operational details, such as, the time profile of the operations and the composition of asset classes, as well as the expectations about corresponding impact on interest rates and asset prices. Finally, even if market participants may have had a fairly accurate idea about the overall amounts of Fed operations, they may not have been accurate in their expectations about the effectiveness of such operations in, for example, re-establishing the functioning of markets or enhancing the prospects of the US or global economy. Furthermore, during the financial crisis, markets were fragmented and liquidity was insufficient. So, one can easily take issues with the assumptions that markets functioned efficiently during the financial crisis.

All of this motivates our decision to include pre-determined purchases in the model and to interpret the results as tentative indications of portfolio rebalancing occurring in response to actual operations.

¹⁴ Purchases occurring in 2009 are QE1 purchases (TR1), purchases occurring between November 2010 and June 2011 are QE2 purchases (TR2), and purchases occurring since October 2012 are QE3 purchases (TR3).

¹⁵ D'Amico and King (2013), however, show the existence of a puzzle, as they find that Fed purchases had an impact on bond prices.

In the model, we include also the explanatory variable LIQ_{t-1} that captures the liquidity operations by the Fed in the earlier stage of the crisis.¹⁶ *Ex ante*, the impact of liquidity operations is unclear. On the one hand, they might have prevented excessive deleveraging, limiting the impact of shocks on portfolio flows, at least in the US. On the other hand, they might have induced a stronger sell-off of those assets that are not eligible as collateral (or have high haircuts) for accessing central bank liquidity.

The size of liquidity operations was not pre-determined. To the contrary, it might have been related to the very same common factors (i.e. market conditions) that affected portfolio flows.¹⁷ To reduce/eliminate the endogeneity bias that could emerge in this situation, we focus on the impact of unexpected quantities of liquidity, i.e. injected liquidity in excess of what could be expected under the prevailing market conditions. To this aim, the explanatory variable LIQ_{t-1} is the residual of a regression (2) below) where the actual size of Fed liquidity operations in week t ($FLIQ_t$) is explained by indicators related to market conditions (X_t) which might affect the demand for liquidity.

$$FLIQ_t = \alpha + \beta X_t + LIQ_t. \quad (2)$$

To capture market conditions in X_t , we use intraday data from European markets in a narrow time window between 12 PM and 2 PM (CMT) before the opening of US markets, as well as the macroeconomic environment, as measured by Citigroup surprise indexes.¹⁸ These variables that capture or influence market conditions might affect the quantity of liquidity provided by the FED. However, at the same time, these variables are not affected by liquidity provision, as macro news can be considered exogenous and the intraday time window used to calculate indicators of market conditions does not overlap with the opening hours of US markets. As data for liquidity operations are only available on a weekly basis, we split the calculated value of the unexpected intervention equally over the week when intervention took place.¹⁹

Turning to the results (Table 3A–F – column (4) for the benchmark model – and Table 4 for a view of the benchmark model across regions and type of flows), liquidity operations (row ‘LIQ_t’ in the Table) resulted into inflows into US equities very much in line with the aim of these operations to reduce market tensions and risk aversion. Concerning Treasury purchases, during QE1 (‘ $TR1_{t-1}$ ’) the impact seems to be limited and not following a particular pattern. This might be due to the fact that market conditions and the related transmission channels of QE have changed substantially during the implementation of QE1, something that we discuss in Section 3. Purchases during QE2 (‘ $TR2_{t-1}$ ’), and in particular during QE3 (‘ $TR3_{t-1}$ ’) confirm the picture provided by announcements, namely a relative rebalancing of capital flows towards EMEs.

¹⁶ The variable LIQ_{t-1} captures all Fed lending to financial intermediaries which is described in Section 2.

¹⁷ At the daily frequency, however, it is implausible that market movements affect banks’ demand for liquidity at longer time horizons.

¹⁸ Specifically, the matrix X_t includes the average (over the week) of the realised volatility of the Euro stoxx index and of the US\$ exchange rate with the euro, the average (over the week) of the return of the Euro stoxx. Realised volatility and returns are calculated using intraday data for the time interval between 12 PM and 2 PM (CMT). X_t also includes the first difference of the Citigroup surprise index.

¹⁹ Fratzscher *et al.* (2016) use a similar approach to calculate the impact of ECB bond purchases under the Security Market Programme (SMP).

2.5. Total Impact of QE Policies

After discussing whether the impact of QE on portfolio flows is significant from a statistical point of view, we turn to the discussion of whether QE policies had economically sizeable effects on flows.

To this aim, we calculate the total flows implied by QE policies by multiplying the estimated elasticity of flows to different instruments by the 'total size' of instruments. In particular, the total impact of announcements under different QE rounds is calculated by multiplying the estimated elasticity by the number of announcement dummies that we included for each QE round. The total impact of operations under different QE rounds is calculated by multiplying the estimated elasticity by the total size of QE round, which is 300 bn US\$ for QE1 and 600 bn US\$ for QE2. For QE3, we calculate the total impact of indicative 600 bn US\$ Treasury purchases, which also allows for a direct comparison of the total effects of QE2 and QE3. Finally, for liquidity operations, the impact is calculated at the moment of maximum expansion of liquidity policies.

This way of calculating the total impact implies that the effects of operations and announcements are permanent. The literature is not conclusive regarding the persistence of the effects of unconventional monetary policy. Some studies show that the impact of monetary policy shocks on long-term yields either 'wears off' fairly slowly (Rogers *et al.*, 2014) or is very persistent (Neely, 2014). With these caveats in mind, our Tables focus on the 'total impact' to provide the reader with a broad idea of the economic significance of QE policies.

The total effects of different QE rounds are reported in Table 5. Regarding the impact of announcements, the largest effects on flows relate to the announcements of the first QE round that led to portfolio rebalancing into US equities of about 1.5% of the assets invested in US equities, mainly out of emerging market and advanced economies' bonds (−1% and −0.5% of the assets invested in the respective regions). QE1 announcements also benefited, to some extent, equity flows in emerging markets

Table 5
Total Impact on QE on Portfolio Flows under the Benchmark Specification

	Equity flows (percentage of asset under management)			Bond flows (percentage of asset under management)		
	US	EMEs	ADV	US	EMEs	ADV
QE1	1.48***	0.46***	0.20	−0.05	−0.99***	−0.56***
QE2	0.15*	0.35***	0.19***	0.03	0.38***	0.25***
QE3	−0.21	0.31***	0.04	0.11	−0.03	0.14*
TR1	0.60	3.00***	0.60***	2.10***	−0.30	2.40***
TR2	2.40	1.20***	0.60	−3.60***	0.00***	3.00***
TR3	−1.20	10.80***	5.40***	5.40*	21.00***	12.60***
LIQ	1.01*	−0.79***	−0.53***	−0.71***	−2.78***	−1.34***

Notes. The Table reports the total portfolio flows (in % of asset under management) implied by the estimated coefficient of the benchmark model (Tables 4 and 3A–F, column (4)). Total flows are calculated by multiplying the estimated coefficients by the number of announcements or the total size of the operations. Number of announcements: QE1 4 announcements; QE2 3 announcements, QE3 5 announcements. Total size of operations: TR1, 300 billion US\$; TR2 and TR3 600 bn US\$. See subsection 2.5. for more details. Stars refer to the significance of the underlying coefficients. (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(+0.45%) and advanced economies (+0.2%). The total effects of other QE announcements are smaller.

Our results suggest that somehow larger effects on flows were associated with actual purchases of Treasury bonds and liquidity operations. The total flows into US equities implied by liquidity operations are around 1% of the assets under management, while the outflows from US bonds and other regions across type of investment range from -0.5% (advanced economies' equities) to -2.8% (emerging market bonds). The largest total flows are those implied by Treasury purchases under QE3 which led to substantial flows into emerging market equity (+10.8%) and bonds (+21.0%), as well as strong inflows into advanced economies' equities (+5.4%) and bonds (+12.6%).

Overall, QE1 (announcements and operations) policies seem to relate to a pattern of (slight) rebalancing towards the US, while QE2 and QE3 policies seem to relate to a pattern of rebalancing into non-US assets. This is evident from Figure 2 which shows actual cumulated portfolio flows and flows net of the estimated contribution of US QE policies. Figure 2 suggests that QE policies might have amplified the pro-cyclicality of equity flows to emerging markets: when high risk aversion and flight safety were pushing capital out of emerging market equity, the marginal impact of QE was relatively smaller or even negative on emerging markets equity. Conversely, during the recovery when several factors pushed capital into emerging market equity, the marginal contribution of QE to portfolio flows was larger and positive, especially during QE3. Figure 2 also suggests that flows resulting from US QE policies were economically sizeable for some asset classes. At the end of the period under review, the estimates underlying Figure 2 suggest that cumulated portfolio equity flows to EMEs would have been more than 10% lower without QE.

2.6. *Robustness Checks*

We do a number of tests, including different specifications of the model and estimation techniques, to ensure that our results are robust. One important result is that the coefficients of the dummy variables capturing announcement effects are not affected by the inclusion of the explanatory variables related to Fed operations. Therefore, in discussing the robustness of the results, we focus on models that include both announcement dummies and quantity variables capturing Fed operations. Results of different model settings are included in Table 3A–F, different specifications of the model are set out in the first panel of the Table.

2.6.1. *Inclusion of different control variables*

Our benchmark specification simply includes country fixed effects, day of the week dummies to capture seasonal effects in flows, a dummy equal to one in the period of the Arab spring (January to March 2011),²⁰ coincident and lagged macroeconomic surprises. In addition to estimating the model with almost no controls (columns (1)

²⁰ The 'Arab Spring' dummy has no implications for the identification of the coefficients of the announcement dummies, it has only marginal implications on the estimation of the coefficient of QE2 purchases for emerging markets.

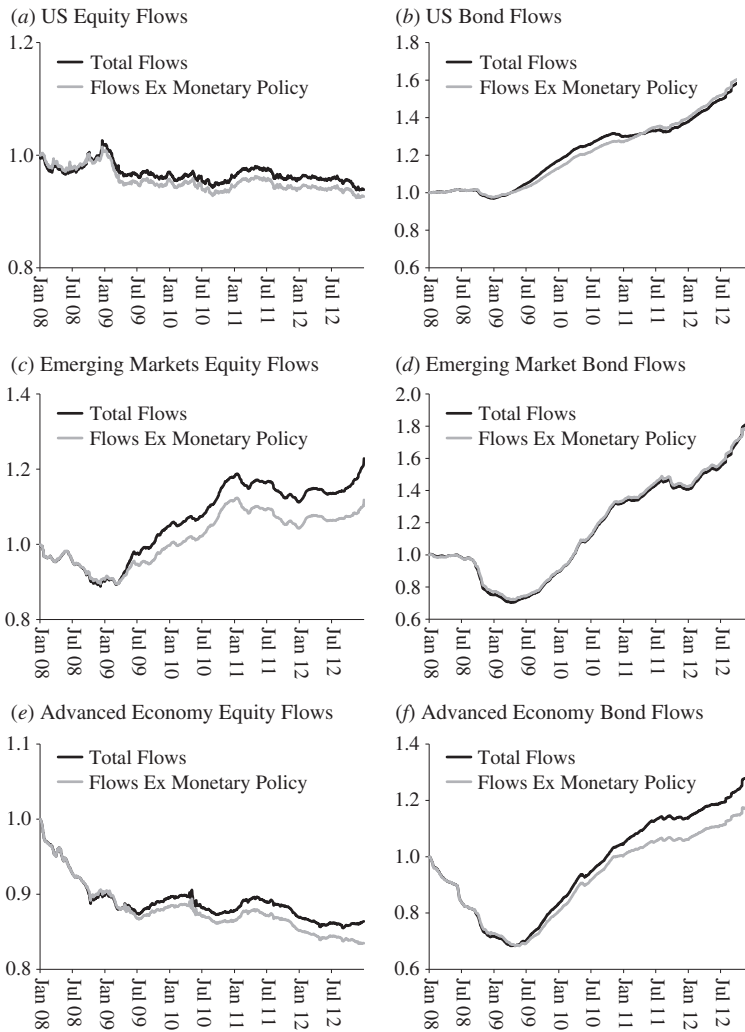


Fig 2. Cumulated Contribution of QE to Portfolio Flows

Notes. The index (equal to 1 on 1 January 2008) shows the actual cumulated portfolio flows (black line) and the estimated portfolio flows after netting out the impact of QE policies (grey line). The index is constructed in the following way: first, the actual portfolio flows and the flows net of QE policies (both measured in % of asset under management in country i on day t) are converted in US\$ millions (i.e. $y_{usd, i, t} = y_{i,t} \times ta_{i,t}$ where $ta_{i,t}$ is total assets under management in country i on day t). The actual flows, the flows net of QE policies and the assets under management are then aggregated across regions (i.e. $Y_{usd,t} = \sum y_{usd, i, t}$ and $TA_t = \sum ta_{i,t}$). Finally, the index is calculated in the following way: $I_t = I_{t-1} \times (+ Y_t)$ with $I_0 = 1$ and Y_t being either the overall flows into the region (as a fraction of asset under management) on day t or the flows into region (as a fraction of asset under management) after netting out the estimated impact QE policies. Calculations are based on the benchmark regressions (column (4) in Table 3A–F). Only for US equity flows, treasury purchases under QE2 were dropped from the benchmark regression as they produce an artificially high contribution of monetary policy to flows on the basis of a coefficient that is not statistically significant.

and (3)), we progressively add the following control variables to our benchmark specification:

- (i) US 10 year government bond yield, VIX and the percentage change in the US S&P500 index (all lagged by one day) (column (5));
- (ii) the real GDP forecast according to the latest vintage of the IMF world economic outlook in recipient countries²¹ which should partly capture the role of pull factors (column (6));
- (iii) the real GDP forecast for the US, according to the latest available vintage of Consensus Economics data²² (column (7));
- (iv) two lags for the median flows across countries (equity or bonds, depending on the type of flows in the equation (column (8)));
- (v) two lags of the endogenous variable (column (9)).²³

These modifications have only a marginal impact on the size and the significance of the coefficients of announcement dummies and do not change the overall picture emerging from the results discussed in the previous subsections. Regarding operations, the following observations are noteworthy:

- (i) the positive effect of QE3 treasury purchases on US bond inflows is not robust, which supports the conclusion of rebalancing into non-US assets in response to QE3;
- (ii) the positive impact of liquidity operations on US equity inflows tends to be stronger when all control variables, including lagged flows are there. Therefore, under this specification, the pro-cyclicality of Fed policies on non-US assets becomes stronger;
- (iii) the positive impact of QE2 bond purchases on emerging market equity inflows weakens in some cases; and
- (iv) the positive effects of QE1 purchases on equity inflows in advanced economies are not robust.

2.6.3. *Different set of QE announcements*

In the benchmark specification, the announcement dummies are equal to one on the day of major expansionary QE announcements (and are included in the model with one lag). We change this specification by including dummies equal to one either on the day of the announcement and the following one (column (10)), or in the two days after the announcement (column (11)). Only the results for US equity flows become weaker in this setting, all the other results are confirmed or strengthened. Next, we change the set of announcements: first, we drop MEP related announcements (event 16 and 17) (column (12)), then we look at the events considered in Bauer and

²¹ In particular, on the basis of different vintages of WEO data, we calculate a fixed one year ahead time horizon forecasts for real GDP growth as weighted average of real GDP for the current and following year. In this way, at each point in time, we can control for expected growth over the next 12-month period.

²² Also for the US, we calculate one year ahead fixed time horizon forecasts.

²³ This dynamic specification addresses issues related to the persistence of flows. In addition, the inclusion of the lagged dependent variable captures trends in portfolio flows resulting also from pull factors.

Neely (2014)²⁴ (column (13)). When excluding MEP related announcements, there are no noteworthy changes in the results for QE3 announcements. When using the events suggested by Bauer and Neely (2014), there are a few notable changes in the results: first, the impact of QE3 announcements gets stronger across the board. Second, QE1 announcements seem to impact negatively emerging market equity inflows. In our view, the latter results should be considered with caution given the inclusion of event 2 among the set of announcements of Bauer and Neely (2014).²⁵ Overall, the message concerning stronger rebalancing towards the US in QE1 and stronger rebalancing towards emerging markets in QE2 and QE3 is not changed.

2.6.4. Different measurement of QE announcement shocks

The impulse dummy approach might not be appropriate if some of the announcements were expected, therefore having little information content. Also, the dummy approach does not capture that announcements were very heterogeneous in terms of the size and type of the announced policy actions. To deal with these issues, we follow Rogers *et al.* (2014) and re-define the QE_{jt} announcement variable as the change in the US 10-year yield on QE announcement days. As explained in Rogers *et al.* (2014), under the market efficiency hypothesis, the change in the US 10-year yield on announcement days captures well the surprise component and the information content of announcements. Rogers *et al.* (2014), Gilchrist *et al.* (2014) and Bowman *et al.* (2015) therefore use the change in the US 10-year yield as QE shock and look at the propagation of QE shocks to other asset prices. More specifically, in our regressions, we set the explanatory variable QE_{jt} to the change in the US 10-year yields on announcement days and to zero elsewhere. In this setting (Column (14)) there are a few changes in the results, although the broad picture is once again confirmed. In particular, the following changes are noteworthy:²⁶

- (i) flows in response to QE3 announcements become more significant across regions (with the exception of emerging market equity);
- (ii) flows in response to QE1 announcements into US equities become substantially weaker. However, the latter finding,
- (iii) crucially depends on the inclusion of the second QE1 announcement, which in our view, as we argued earlier, should be excluded from the set of events.

In any other setting that excludes the second QE1 announcement, flows into US equity in response to other QE1 announcements are estimated to be strong and positive, confirming the baseline results.

²⁴ For QE 1, event 1, 2, 3 and 5 are included; for QE 2 events 9, 11 and 14 are included; for QE3 events, 18 and 19 are included.

²⁵ As discussed earlier, other market developments were the key determinants of financial market developments on the day of the second QE announcement (event 2). For this reason, we consider advisable dropping this announcement from the set of those included in the dummies.

²⁶ These results refer to the setting where we use the announcements considered in Bauer and Neely (2014).

2.6.5. *Different econometric techniques*

The benchmark model is a standard fixed effects panel regression (time series regression for the US) with standard errors that are clustered by country and are robust to heteroscedasticity. We also estimated the model by bootstrapping standard errors (clustering by country) (column (15)), using the Driscoll–Kraay standard errors that are robust to cross-sectional dependence (column (16)), using the Pesaran–Smith mean group estimator to take into account country heterogeneity in the impact of QE policies (column (17)). The results remain substantially unchanged.

2.6.6. *Other robustness tests*

Other robustness tests that are not reported in the Tables²⁷ include: using one-day lagged cumulated purchases over five days instead of daily purchases, including Fed MBS purchases as control variables, estimating regressions that are robust to outliers, dropping outliers for capital flows. The results discussed above are not affected in these alternative settings.

3. Time Variation in the Transmission of QE

In this Section, we discuss potential factors that might explain why the transmission of QE announcements and asset purchases differs across QE rounds.

The transmission of QE might depend on other conditions that prevail in the economy when QE is announced. In other words, the transmission of QE is potentially state-dependent and therefore time-varying.

Indeed, there is a growing empirical literature indicating that the impact of monetary policy shocks is conditional on the state of the economy and is therefore time-varying. Canova and Gambetti (2009) present evidence that there were significant changes in the transmission of US monetary policy shocks in the early 2000s. Olivei and Tenreyro (2007) argue that when the monetary policy shock takes place in the first two quarters of the year, its effect is quick, sizeable and dies out at a relatively fast pace compared to shocks later in the year. They explain the differential response by the uneven staggering of wage contracts across quarters. More recently, Hjortsoe *et al.* (2016) show that the response of the current account to a monetary policy shock is time-varying and mainly driven by the sensitivity of the transmission mechanism to the degree of regulations in financial and product markets. Similarly, Almeida *et al.* (2016) argue that the correlation between the trade balance and the real exchange rate response following a US monetary policy shock depends on whether the economy is in a recession or in a boom.

As a result, in what follows, we test for the role of other variables in explaining why the transmission of QE announcements and asset purchases differ across QE rounds.

For this purpose, we modify the model in (1) in the following way:

$$y_{i,t} = \alpha_i + \beta_1 QE_{t-1} + \beta_2 QE_{t-1} \times Z_t + \beta_1 TR_{t-1} + \beta_2 TR_{t-1} \times Z_t + \gamma_1 X_t + \gamma_2 Z_t + \varepsilon_{i,t}. \quad (3)$$

²⁷ The results are available on request.

Essentially, in our benchmark specification, we introduce the interaction terms $QE_{t-1} \times Z_t$ and $TR_{t-1} \times Z_t$ which allows for the impact of QE announcements and operations to be dependent on a state variable Z_t . By looking at the significance of the interaction term, we essentially test whether the variable Z_t is associated with changes in the transmission of QE announcements and operations on capital flows.

We focus on three potential sources of time variation in the transmission mechanism, namely macroeconomic conditions in the US, macroeconomic conditions in recipient countries and financial frictions/market stress. Accordingly, Z_t is alternatively:

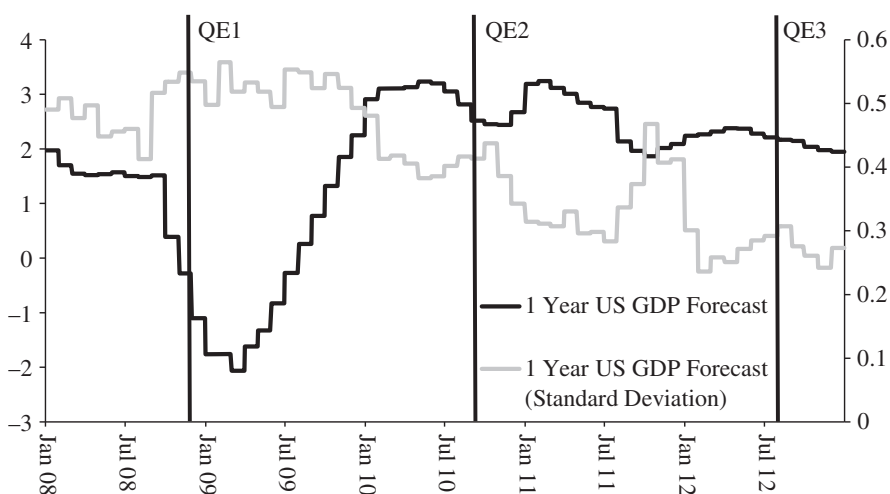
- (i) the US economic outlook as measured by a one year ahead (constant time horizon) real GDP forecast calculated on the basis of the prevailing vintage of Consensus Economics data;
- (ii) macroeconomic uncertainty, as measured by the standard deviation around the GDP forecast (also based on vintages of Consensus Economics data);
- (iii) the domestic economic outlook in recipient countries as measured by a one year ahead (constant time horizon) real GDP forecast calculated on the basis of vintages of the IMF World Economic Outlook;
- (iv) global risk aversion as measured by the (two days lagged) VIX index, which captures risk aversion and uncertainty; and
- (v) market liquidity conditions as measured by the (two days lagged) spread between the three-month T-bill and the three-month Overnight Swap Index rate (OIS).²⁸ US conditioning variables are depicted in Figures 3(a) and (b).

The estimated coefficients for (2) are reported in Table 6A–C. With only a few exceptions, state variables are significant and, therefore, appear to be somehow associated with the transmission of QE. In particular, higher VIX and better domestic macro outlook have a positive marginal contribution on the impact of QE on capital flows across countries, type of flows and type of QE variable (i.e. higher VIX or better domestic outlook tend to make the transmission of QE more positive or less negative). The transmission to bond and equity flows appear to be different. Better US economic outlook and lower US uncertainty seem to have a positive marginal contribution to the transmission of QE announcements and operations on equity flows, while the results are more muted for bond flows.

In order to gauge the economic relevance of the effects of state variables, Table 7A–B shows the total capital flows implied by the different models, under the benchmark specification (no conditioning variables for the transmission of QE during different

²⁸ The OIS rate can be considered (almost) free of credit risk as the contract does not involve the exchange of the principal amount, it only involves netting out the net gain/loss at the end of the contract. As a consequence, the OIS rate reflects the expected path of the risk-free rate (i.e. the monetary policy rate) over the three-month time horizon of the contract. Treasury Bills are also risk-free assets, however, in periods of liquidity shortage, they become a close substitute of cash for various reasons: first, there is a very liquid market for them; second, they have short-term maturity; third, they can be used as collateral in repos and to access central bank liquidity. As a consequence, when market conditions tighten and liquidity dries up, the high demand for Treasury bills pushes their yield below the expected path of the risk-free rate, as measured by the OIS rate, leading to an interest rate differential associated with liquidity tensions (see Figure 3(b)).

(a) US GDP Forecast and US Macroeconomic Uncertainty
(Standard Deviation of the GDP Forecast)



(b) VIX and Liquidity Spread

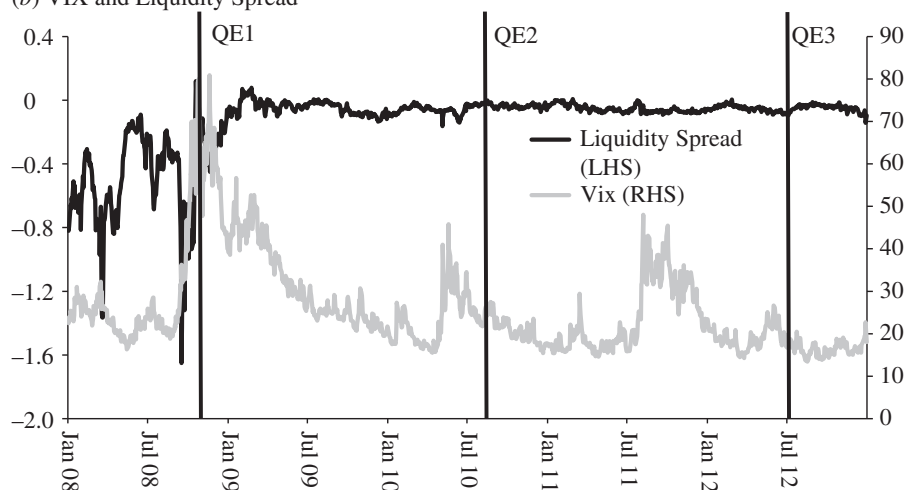


Fig 3. Market and Macroeconomic Conditions During Different QE Rounds

Notes. Prevailing US GDP forecast over a fixed one-year time horizon. The forecast at fixed one-year time horizon ($FGDP_t$) was calculated as a weighted average of the prevailing forecast for the current and next year at each point of time: $FGDP_t = FGDP_{t,year} \times [(1 - t)/12] + FGDP_{t,year+1} \times [(t)/12]$, where t is the month of the year when the forecast is calculated. The standard deviation of the forecast over the fixed time horizon of one year, which refers to the dispersion of the individual forecast in the Consensus panel, is calculated in the same way. The liquidity spread is the difference between the three months' T-bill yield and the OIS three month swap rate. (See Section 4 for details).

Source. Datastream, Consensus Economics and authors' calculation.

rounds) and under the five other specifications with alternative variables conditioning the transmission of QE. In addition, Table 8 reports the correlation between the total flows stemming from QE calculated with the benchmark model and the QE flows calculated with other models. The correlation helps gauging which state variable reproduces more closely

Table 6
Determinants of the Time Variation in the Transmission of QE

The following Tables display information on the following regression:

$$y_{i,t} = \alpha_i + \beta_1 QE_{t-1} + \beta_2 QE_{t-1} \times Z_t + \beta_1 TR_{t-1} + \beta_2 TR_{t-1} \times Z_t + \gamma_1 X_t + \gamma_2 Z_t + \varepsilon_{i,t}. \quad (3)$$

Equation (2) has the same specification of the benchmark regression in Table 3A-F (column (4)). However, there is no differentiation between different QE rounds for announcements and purchases. Announcements QE_t and purchases TR_t are interacted with Z_t , which is also included among the control variables. Columns in 'US outlook' Z_t is the one year ahead real GDP forecast from Consensus Economics ('One Year GDP Consensus Forecast'); in 'Macro uncertainty' Z_t is the standard deviation of the one year ahead real GDP forecast from Consensus Economics ('Consensus GDP volatility (SD)'); in 'Domestic Outlook' Z_t is the one year ahead real GDP forecast (IMF WEO) in recipient countries ('One Year GDP WEO Forecast'); in 'VIX' Z_t is VIX at $t - 2$ ('L2.VIX'); in 'Liquidity' Z_t is the spread between the three month Treasury Bill and the three month OIS rate at $t - 2$ ('L2.Liquidity Spread'); See Section 3

Table 6A
Determinants of the Time Variation in the Transmission of QE: US

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Equity flows	Equity flows	Equity flows	Equity flows	Equity flows	Bond flows	Bond flows	Bond flows	Bond flows	Bond flows
	US outlook	Macro uncertainty	Domestic outlook	VIX	Liquidity	US outlook	Macro uncertainty	Domestic outlook	VIX	Liquidity
QE	0.241*** (0.073)	-0.540** (0.229)	0.406*** (0.157)	-0.150 (0.102)	0.086 (0.090)	0.012 (0.021)	-0.022 (0.084)	-0.027 (0.038)	-0.035 (0.041)	0.003 (0.023)
QE × Z	-0.110*** (0.034)	1.626*** (0.629)	-0.168** (0.067)	0.009** (0.004)	-0.327 (0.428)	-0.001 (0.008)	0.066 (0.204)	0.019 (0.021)	0.002 (0.001)	0.018 (0.227)
TR	0.003 (0.003)	0.001 (0.006)	0.002 (0.002)	0.009* (0.005)	0.002 (0.003)	0.006*** (0.001)	-0.022*** (0.004)	0.005*** (0.001)	-0.018*** (0.003)	-0.002 (0.002)
TR × Z	0.000 (0.001)	0.005 (0.016)	0.000 (0.001)	-0.000 (0.000)	-0.011 (0.056)	-0.004*** (0.001)	0.056*** (0.009)	-0.004*** (0.001)	0.001*** (0.000)	-0.014 (0.034)
One year GDP forecast	0.008* (0.004)					0.006*** (0.002)				
Consensus GDP volatility (SD)		-0.047 (0.043)					-0.115*** (0.029)			
One year GDP WEO forecast			-0.000 (0.004)					0.005** (0.002)		
L2.VIX Spread				-0.001 (0.000)					-0.002*** (0.000)	
Observations	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297	1,297
Number of countries	1	1	1	1	1	1	1	1	1	1
Fixed effect	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors in parentheses.

Table 6B
Determinants of the Time Variation in the Transmission of QE: Emerging Markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Equity flows	Equity flows	Equity flows	Equity flows	Equity flows	Bond flows	Bond flows	Bond flows	Bond flows	Bond flows
	US outlook	Macro uncertainty	Domestic outlook	VIX	Liquidity	US outlook	Macro uncertainty	Domestic outlook	VIX	Liquidity
QE	0.117*** (0.009)	0.014 (0.026)	0.087*** (0.017)	0.021* (0.012)	0.079*** (0.008)	-0.032*** (0.003)	0.136*** (0.010)	-0.083*** (0.013)	-0.025*** (0.009)	-0.009 (0.007)
QE × Z	-0.019*** (0.004)	0.190*** (0.064)	0.002 (0.004)	0.003*** (0.000)	-0.090*** (0.041)	0.016*** (0.002)	-0.476*** (0.032)	0.010*** (0.003)	0.000** (0.000)	0.570*** (0.032)
TR	0.011*** (0.001)	-0.009*** (0.001)	0.002** (0.001)	-0.013*** (0.002)	0.004*** (0.001)	0.018*** (0.000)	-0.021*** (0.002)	-0.007*** (0.002)	-0.024*** (0.001)	-0.013*** (0.001)
TR × Z	-0.003*** (0.000)	0.037*** (0.003)	0.000* (0.000)	0.001*** (0.000)	-0.007 (0.017)	-0.007*** (0.000)	0.059*** (0.004)	0.002*** (0.001)	0.001*** (0.000)	-0.251*** (0.009)
One year GDP consensus forecast	0.008*** (0.003)					0.061*** (0.002)				
Consensus GDP volatility (SD)		-0.063*** (0.013)					-0.577*** (0.024)			
One year GDP WEO forecast			-0.014*** (0.002)					-0.019*** (0.004)		
L2.VIX				-0.003*** (0.000)					-0.011*** (0.000)	0.310*** (0.013)
L2.Liquidity spread					0.119*** (0.015)					
Observations	38,793	38,793	38,793	38,793	38,793	37,991	37,991	37,991	37,991	37,991
Number of countries	36	36	36	36	36	30	30	30	30	30
Fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors in parentheses.

Table 6C
Determinants of the Time Variation in the Transmission of QE: Advanced Economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Equity flows	Equity flows	Equity flows	Equity flows	Equity flows	Bond flows	Bond flows	Bond flows	Bond flows	Bond flows
	US	Macro	Domestic	VIX	Liquidity	US	Macro	Domestic	VIX	Liquidity
	outlook	uncertainty	outlook			outlook	uncertainty	outlook		
QE	0.035*** (0.008)	-0.072** (0.034)	0.036*** (0.011)	-0.017 (0.017)	0.005 (0.011)	-0.012 (0.010)	0.131*** (0.035)	-0.043* (0.023)	0.027 (0.021)	0.006 (0.011)
QE × Z	-0.000 (0.003)	0.264*** (0.078)	-0.000 (0.004)	0.002*** (0.000)	-0.339*** (0.090)	0.016*** (0.003)	-0.370*** (0.078)	0.024* (0.012)	-0.001 (0.001)	0.334*** (0.101)
TR	0.002** (0.001)	-0.001 (0.002)	-0.000 (0.000)	0.005** (0.002)	0.003 (0.002)	0.016*** (0.001)	-0.017*** (0.002)	0.004*** (0.001)	-0.004 (0.002)	-0.003** (0.001)
TR × Z	0.000 (0.000)	0.007 (0.004)	0.001*** (0.000)	-0.000 (0.000)	0.051 (0.038)	-0.004*** (0.000)	0.060*** (0.004)	0.002*** (0.001)	0.000*** (0.000)	-0.137*** (0.023)
One year GDP consensus forecast	0.000 (0.001)					0.033*** (0.003)				
Consensus GDP volatility (SD)		-0.044*** (0.014)					-0.349*** (0.034)			
One year GDP WEO forecast			-0.011*** (0.001)					-0.018** (0.007)		
L2.VIX				-0.001** (0.000)					-0.006*** (0.000)	
L2.Liquidity spread					0.068*** (0.006)					0.294*** (0.014)
Observations	28,534	28,534	28,534	28,534	28,534	28,217	28,217	28,217	28,217	28,217
Number of countries	22	22	22	22	22	22	22	22	22	22
Fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Control variables	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.	Macro Surp.

Notes. *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors in parentheses.

Table 7
Total Impact of QE Announcements Across Models

The Table shows the total impact of QE announcements expressed as flows in % of assets under management in the region. 'Benchmark' indicates the implied flows by the benchmark model (same as Table 5). Other columns indicate the total implied flows by the models in Table 6A–C. Total flows within different QE rounds are calculated in the following way on the basis of (3): for announcements, total flows in QE round j are $\sum \beta_1 QE_{j,i,t-1} + \beta_2 QE_{j,i,t-1} \times Z_t$ where i are the announcements in QE round j and Z_t the average value of the instrumenting variable on the day before announcement days in QE round j . For purchases, total flows in QE round j are $\beta_1 TTR_j + \beta_2 TTR_j \times Z_t$ where TTR j are total purchases of Treasury bonds under QE round j (example, 300 USD bn for QE1) and Z_t the average value of the instrumenting variable during the QE round j (i.e. the average value calculated over the period when purchases are taking place)

Table 7A
Total Impact of QE Announcements Across Models: Equity Flows

	Benchmark	US outlook	US uncertainty	Domestic outlook	VIX	Liquidity
<i>Emerging markets</i>						
QE1	0.46	0.48	0.45	0.38	0.62	0.37
QE2	0.35	0.21	0.27	0.29	0.25	0.25
QE3	0.31	0.39	0.37	0.48	0.44	0.42
TR1	3.00	3.71	3.15	0.60	5.41	1.28
TR2	1.20	1.32	1.69	1.20	3.13	2.58
TR3	10.80	3.00	0.37	1.20	2.21	2.64
<i>Advanced economies</i>						
QE1	0.20	0.14	0.25	0.14	0.29	0.23
QE2	0.19	0.11	0.10	0.11	0.07	0.05
QE3	0.04	0.18	0.06	0.18	0.14	0.11
TR1	0.60	0.60	0.81	-0.28	1.50	0.29
TR2	0.60	1.20	0.74	1.16	3.00	0.50
TR3	5.40	1.20	0.49	0.63	3.00	0.05
<i>United States</i>						
QE1	1.48	1.03	1.18		1.01	0.55
QE2	0.15	-0.09	0.33		0.12	0.29
QE3	-0.21	0.05	-0.11		0.25	0.51
TR1	0.60	0.90	1.09		2.70	0.73
TR2	2.40	1.80	1.56		5.40	1.48
TR3	-1.20	1.80	1.38		5.40	1.58

the results of the benchmark model where the transmission across different QE rounds is estimated using period dummies and therefore is 'unrestricted'.

Overall, the results suggest that US macroeconomic variables are more closely associated with the transmission of QE announcements than other variables. The models where the transmission of QE announcements depends on the US GDP forecast somehow match more closely the 'unrestricted' estimates of the benchmark model for equity and bond flows across countries. Also when looking at time variation in the transmission of purchases, the model including the US GDP forecast produces the closest results to the dummy model. In this case, however, the matching is weaker than for announcements as indicated by the lower correlation of flows across models.

Table 7B
Total Impact of QE Announcements Across Models: Bond Flows

	Benchmark	US outlook	US uncertainty	Domestic outlook	VIX	Liquidity
<i>Emerging markets</i>						
QE1	-0.99	-0.14	-0.43	-0.18	-0.10	-0.39
QE2	0.38	0.02	-0.16	-0.12	-0.08	-0.09
QE3	-0.03	0.01	-0.08	-0.20	-0.13	-0.18
TR1	-0.30	6.36	3.04	-1.23	2.11	-0.92
TR2	0.00	-1.53	-1.29	1.19	-3.47	-1.39
TR3	21.00	2.40	-3.40	0.39	-4.39	0.79
<i>Advanced economies</i>						
QE1	-0.56	-0.06	-0.24	-0.11	-0.07	-0.18
QE2	0.25	0.08	-0.05	0.00	0.02	-0.02
QE3	0.14	0.11	0.07	-0.02	0.02	-0.05
TR1	2.40	5.35	4.39	0.64	-1.20	0.73
TR2	3.00	2.56	1.30	4.73	-2.40	1.70
TR3	12.60	4.80	-0.85	3.66	-2.40	2.89
<i>United States</i>						
QE1	-0.05	0.05	0.05		0.22	0.00
QE2	0.03	0.03	0.01		0.02	0.01
QE3	0.11	0.05	0.00		0.05	0.01
TR1	2.10	2.35	2.26		3.91	-0.43
TR2	-3.60	-3.44	-2.47		0.13	-0.84
TR3	5.40	-1.20	-4.47		-0.79	-0.72

Table 8
Correlation of the Impact of QE Announcements in the Benchmark Model with Other Models

	US outlook	US uncertainty	Domestic outlook	VIX	Liquidity
<i>Announcements</i>					
Equity	0.921	0.978	0.672	0.882	0.439
Bond	0.895	0.775	0.523	0.315	0.828
Across	0.838	0.886	0.595	0.751	0.666
<i>Purchases</i>					
Equity	0.513	-0.309	0.337	-0.272	0.347
Bond	0.278	-0.388	0.104	-0.554	0.578
Across	0.307	-0.407	0.180	-0.465	0.385

Notes. The Table displays the correlation between the total flows (Table 7A–B) across regions implied by the benchmark model and the other models. ‘Equity’ (‘Bond’) indicates the correlation between total equity (bond) flows. ‘Across’ indicates the correlation across regions and instruments (i.e. without differentiating between bond and equities).

Interestingly, market liquidity conditions have implications for the transmission of QE, both announcements and operations, on bond flows.

To conclude, the results suggest that in periods when macroeconomic uncertainty is lower and the US outlook is positive, QE announcements are transmitted with stronger intensity to portfolio flows outside the US. The same holds for purchases although the results are weaker.

In this respect, one could associate the heterogeneous response of different QE rounds with the change in macroeconomic uncertainty. This is also demonstrated in

Figure 3(a). The macro environment when QE1 took place was characterised by high macroeconomic uncertainty, in contrast to QE2 and QE3, where uncertainty had declined significantly.

4. Conclusions

The article analyses the impact of the Federal Reserve's QE policies on portfolio flows in the US and globally.

First, the results show a heterogeneous response of capital flows following different QE rounds. QE1 (announcements and operations) prompted rebalancing towards the US, particularly into US equities. While QE2 and QE3 policies triggered a rebalancing outside the US. The findings suggest that QE increased the pro-cyclicality of flows outside the US, in particular, into emerging market equities.

Second, the results argue that the heterogeneous response of different QE rounds can be explained by variation in macro-financial uncertainty. In periods when macroeconomic uncertainty is low and the US outlook is positive, QE announcements are transmitted with stronger intensity to portfolio flows outside the US. The same holds for purchases although the results are weaker.

The key findings of the article may be interpreted as lending support to concerns expressed by policy makers in EMEs. In particular, EMEs have been adversely affected by pro-cyclical effects of QE policies, inducing capital outflows from EMEs when capital is scarce and pushing capital into EMEs when capital is abundant. This interpretation is, however, premature. A possible extension of the article, which is left for future research, could be to analyse whether EMEs are indeed innocent by-standers, and whether they are able to insulate their countries via sound domestic policies and institutions from fluctuations in international capital flows and the spillovers of international monetary policy.

Appendix A. Additional Tables

Table A1

List of Countries and Number of Observations for the Dependent Variables in Each Country

Country number	Country name	Country group	Observations for equity flows	Observations for bond flows
1	Australia	Advanced economy	1,299	1,299
2	Austria	Advanced economy	1,299	1,299
3	Belgium	Advanced economy	1,299	1,299
4	Canada	Advanced economy	1,299	1,299
5	Denmark	Advanced economy	1,299	1,299
6	Finland	Advanced economy	1,299	1,299
7	France	Advanced economy	1,299	1,299
8	Germany	Advanced economy	1,299	1,299
9	Greece	Advanced economy	1,299	1,299
10	Ireland	Advanced economy	1,299	1,299
11	Israel	Advanced economy	1,299	1,299
12	Italy	Advanced economy	1,299	1,299

Table A1
(Continued)

Country number	Country name	Country group	Observations for equity flows	Observations for bond flows
13	Japan	Advanced economy	1,299	1,299
14	Lithuania	Advanced economy	1,299	1,257
15	Netherlands	Advanced economy	1,299	1,299
16	New Zealand	Advanced economy	1,299	1,146
17	Norway	Advanced economy	1,299	1,299
18	Portugal	Advanced economy	1,299	1,175
19	Spain	Advanced economy	1,299	1,299
20	Sweden	Advanced economy	1,299	1,299
21	Switzerland	Advanced economy	1,299	1,299
22	UK	Advanced economy	1,299	1,299
23	US	Advanced economy	1,299	1,299
24	Argentina	Emerging market	1,299	1,299
25	Brazil	Emerging market	1,299	1,299
26	Bulgaria	Emerging market	1,299	1,299
27	Chile	Emerging market	1,299	1,299
28	China	Emerging market	1,299	1,299
29	Colombia	Emerging market	1,299	1,299
30	Czech Republic	Emerging market	1,299	1,299
31	Egypt	Emerging market	1,299	1,299
32	Hong Kong	Emerging market	1,299	1,299
33	Hungary	Emerging market	1,299	1,299
34	India	Emerging market	1,299	1,299
35	Indonesia	Emerging market	1,299	1,299
36	Kazakhstan	Emerging market	1,299	1,299
37	Korea	Emerging market	1,299	1,299
38	Kuwait	Emerging market	1,242	807
39	Malaysia	Emerging market	1,299	1,299
40	Mexico	Emerging market	1,299	1,299
41	Pakistan	Emerging market	1,299	1,299
42	Peru	Emerging market	1,299	1,299
43	Philippines	Emerging market	1,299	1,299
44	Poland	Emerging market	1,299	1,299
45	Romania	Emerging market	1,299	1,299
46	Russia	Emerging market	1,299	1,299
47	Saudi Arabia	Emerging market	1,280	870
48	Singapore	Emerging market	1,299	1,299
49	South Africa	Emerging market	1,299	1,299
50	Thailand	Emerging market	1,299	1,299
51	Turkey	Emerging market	1,299	1,299
52	Ukraine	Emerging market	1,299	1,299
53	Venezuela	Emerging market	1,256	1,299

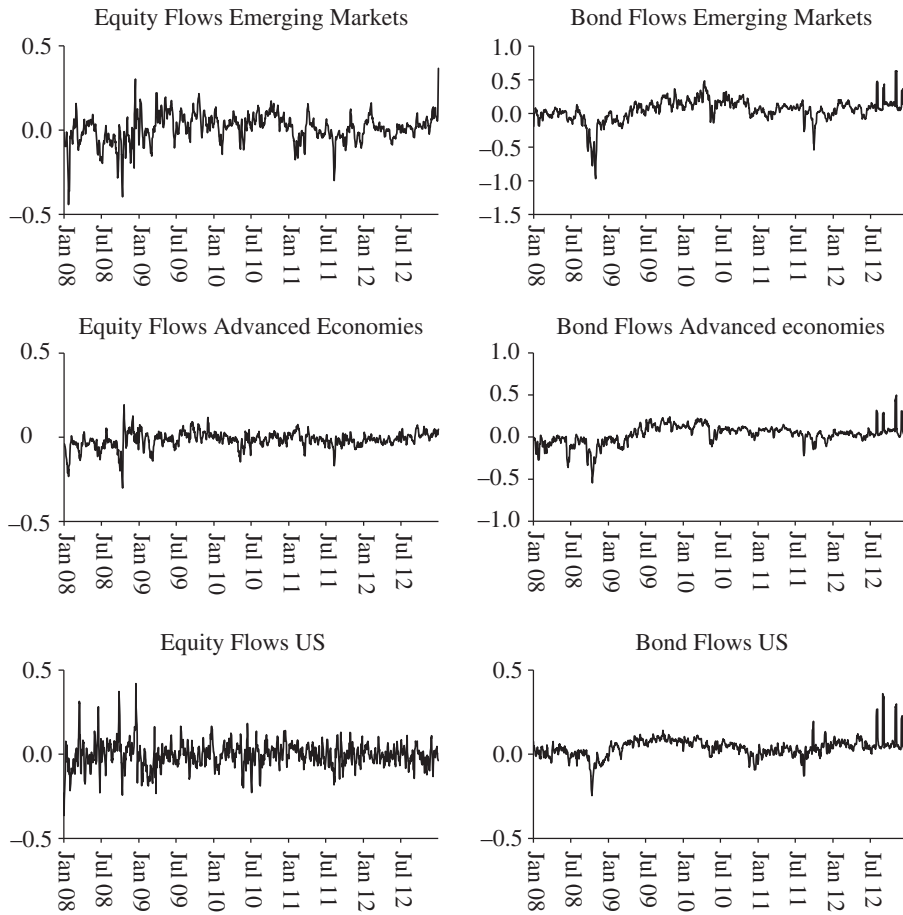


Fig. A1. *Portfolio Flows*

Notes. Flows in percentage of assets under management in the region, five-day moving averages. For emerging market and advanced economies, median flows across countries
Source. EPFR.

A.1. *Information on Macroeconomic Surprises*

We calculated economic surprises as the deviation of the actual data release from the median expectation, according to Bloomberg survey data. Surprises are normalised by their own standard deviation prior to 2007. We calculated surprises for a number of key economic variables for the US and euro area. The variables are listed below.

- EU Area: ECB announces Interest Rates
- EU Area: GDP SA QoQ
- EU Area: CPI YoY
- EU Area: GDP SA YoY
- EU Area: Consumer Confidence Index
- EU Area: CPI Estimate YoY
- EU Area: CPI MoM
- EU Area: PMI Manufacturing
- EU Area: PMI Composite – Output

EU Area: PMI Composite – New Orders

EU Area: PMI Services

US – Actual Release: Consumer Confidence Index

US – Actual Release: CPI MoM

US – Actual Release: PPI MoM

US – Actual Release: Initial Jobless Claims

US – Actual Release: Nonfarm Payrolls

US – Actual Release: FOMC Rate Decision

US – Actual Release: GDP Annualised QoQ

US – Actual Release: ISM Manufacturing

US – Actual Release: University of Michigan Confidence

US – Actual Release: Durable Goods Orders

US – Actual Release: New Home Sales

US – Actual Release: Retail Sales Advance MoM

US – Actual Release: Existing Home Sales

US – Actual Release: Leading Index

US – Actual Release: Personal Income

US – Actual Release: Personal Spending

US – Actual Release: Factory Orders

US – Actual Release: Unemployment Rate

US – Actual Release: Housing Starts

US – Actual Release: Industrial Production MoM

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European Central Bank

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