Quantitative Easing, Portfolio Choice and International Capital Flows[*]

Marcel Fratzscher
European Central Bank & CEPR

Marco Lo Duca
European Central Bank

Roland Straub
European Central Bank

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Abstract

The paper analyses the impact of announcements and actual operations of the Federal Reserve's unconventional monetary policy measures on portfolio allocations across asset classes as well as on asset prices in 65 countries. The findings show that the impact of Fed operations, such as Treasury and MBS purchases, on portfolio allocations and asset prices dwarfed those of Fed announcements. Fed policies functioned mainly through a portfolio balance channel across countries rather than across asset classes within the US. They magnified the pro-cyclicality of capital flows to EMEs, but acted in a counter-cyclical manner for the US. Yet in terms of economic significance, Fed policies exerted larger overall effects on global asset prices than on capital flows and portfolio allocations. The results thus illustrate how US monetary policy since 2007 has contributed to portfolio reallocation as well as a re-pricing of risk in financial markets at the global level.

"I see … that such purchases work primarily through the so-called portfolio balance channel, [through] which the Federal Reserve's purchases of longer-term securities affect financial conditions by changing the quantity and mix of financial assets held by the public. Specifically, the Fed's strategy relies on the presumption that different financial assets are not perfect substitutes in investors' portfolios, so that changes in the net supply of an asset available to investors affect its yield and those of broadly similar assets."

Ben Bernanke, Fed Chairman (2010)

"While everybody wants the US economy to recover, it does no good at all to just throw dollars from a helicopter."

Guido Mantega, Finance Minister of Brazil (2010)

1 Introduction

The intensification of the 2007-09 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 started conducting non-standard measures from the end of 2008 onwards. The Federal Reserve has been one of the most active, implementing several types of non-standard measures, ranging from specific liquidity operations to support banks to two separate rounds of large-scale asset purchase (LSAP) programs which included a broad array of assets, including GSE debt, agency debt, mortgage-backed securities (MBS) and Treasury securities.

Apart from attempting to improve the functioning of specific financial market segments, an important objective has been to help stimulate the economy by lowering yields and thus make financing conditions for firms and households more favorable, and to push up asset prices in riskier market segments inducing thereby positive wealth effects on aggregate demand.

A growing literature has analyzed whether quantitative easing (QE) and other non-standard measures were effective in achieving these objectives. There is indeed strong empirical evidence that the announcements of the Fed's Treasury purchases lowered US yields significantly (e.g. Gagnon et al. 2010, 2011; D'Amico and King 2010; Wright, 2011; Bauer and Rudebusch, 2011), with similar evidence for the UK (see Joyce et al. 2011). A related part of the literature looks into the impact of other unconventional measures such as the introduction of the Term Auction Facility (Thornton, 2010) and MBS purchases (Hankock and Passmore 2011, Stroebel and Taylor 2011) providing mixed evidence on their success.[1]

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[1] Thornton (2010) argues that the announcement of the TAF increased risk premia because market participants interpreted the Fed announcement as a sign that the financial crisis was worse than expected. Hankock and Passmore (2011) argue that the Fed's MBS purchase program re-established a robust secondary mortgage market, and was therefore successful. Stroebel and Taylor (2011) suggest,

An open issue is through which channels QE has functioned. As indicated also by the above quote by Fed Chairman Bernanke, some have stressed the importance of the portfolio balance channel, through which Fed purchases e.g. of Treasuries drive down term premia and thus yields of Treasuries and similar assets, and increase demand and returns for other types of assets in riskier market segments. Others have emphasised the importance of a signaling effect, through which announcements of QE reveal information about the Fed's view on future economic conditions and change agents' expectations about the future path of policy interest rates (e.g. Bauer and Rudebusch 2011). A third channel is via liquidity and risk premia, whereby policy measures that improve the functioning of specific financial market segments lower liquidity and risk premia and raise market demand and prices. And a fourth channel functions via confidence effects, as Fed operations or announcements may provide signals as to the future prospects of the economy.

Most of the literature to date has focused on the effects of QE on *domestic* financial markets and the domestic economy. Yet each of these four channels could also potentially affect foreign assets prices and market conditions. In the portfolio balance channel, QE may not only trigger a portfolio rebalancing towards more risky domestic assets, but also towards foreign assets. Similarly, a signaling about future US economic conditions and policy rates, or changes in risk and liquidity premia in the US are likely to have implications for economic conditions and financial markets elsewhere in the world. However, with a few notable exceptions, little analysis has been conducted so far to gauge these spillover effects.[2]

At the same time, a controversial debate has been raging among policy-makers in key international fora, such as the G20, about the potentially adverse effects of QE and other non-standard measures on other economies. As indicated by the above quote by Brazil's Finance Minister Mantega, policy-makers in emerging market economies (EMEs) have been arguing that unconventional monetary policy measures have created excessive global liquidity, which in turn has been the key factor behind the massive acceleration of capital flows to EMEs between 2009 and mid-2011. 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. Moreover, proponents of this view argue that ultimately the creation of global liquidity will induce global inflationary pressures.

On the contrary, policy-makers and observers on the other side of the argument are questioning the validity of this view, stressing the benefits of such policies for the global real

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however, that when controlling for prepayment and default risk, the MBS program had no significant impact on US mortgage markets.
[2] Neely (2011) finds significant and sizeable effects of announcements of the Fed's first LSAP on sovereign yields in a small sample of other advanced economies. Chen et al. (2011) document significant spillovers of QE into Asian financial markets.

economy as a whole and pointing to common global risk and liquidity factors as well as strong EME fundamentals as pull factors (in particular the robust growth and financial health) as the main drivers of global capital flows.

This paper analyses the effects of the unconventional monetary policy measures of the Federal Reserve on private sector investment portfolio decisions and global capital flows since 2007.[3] The objective is to gauge the full functioning, the underlying mechanism and channels of Fed policies. This means that the analysis of the paper does not only investigate the effects on asset prices, as most of the literature does, but also on portfolio decisions by investors, and explores both the effects on the US itself and on other economies (EMEs and other advanced economies). 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 can not only track capital injections into US bond and equity funds, but also inflows into EME and other advanced economy funds covering 65 foreign economies.

We analyze different types of US unconventional monetary policy measures in order to understand how the different elements of the Fed's policy tool kit have functioned. We specifically distinguish between liquidity operations (largely direct lending to US financial institutions) in the early stages of the crisis in 2008 and early 2009 that aimed at helping US financial institutions, purchases of MBS which had the objective to improve the functioning of a specific market segment, and the purchase of US Treasuries which came to dominate later in 2009 and 2010.

An important distinction we make is between announcements of Fed interventions and the actual market operations by the Federal Reserve. Most of the literature on US QE has focused narrowly on the effects announcements of the two large-scale asset purchase (LSAP) programs, but not the actual operations and purchases, assuming that only the announcement contain new information, while the latter do not, or do much less so.

Finally, we aim to uncover not only the magnitude of the effects, but also the mechanism and channels that are at play. Specifically, the distinction between Fed announcements and actual interventions allows us to understand the importance and functioning of the portfolio balance channel. One specific channel is whether unconventional monetary policy measures have induced a portfolio rebalancing across asset classes, e.g. from less risky to more risky types of assets, or vice versa. A different, yet related portfolio balance mechanism refers to cross-

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[3] Note that we use the terms "capital flows" and "portfolio choice/decision" interchangeably throughout the paper with regard to EMEs and other advanced economies. As we will discuss below, the great majority of funds, and most of the underlying investors, in our dataset is located in the USA. Hence portfolio decisions by these funds reflect capital flows to EMEs or other advanced economies from a balance-of-payments definition. By contrast, a portfolio decision of a US-domiciled fund regarding US assets does not necessarily reflect a balance-of-payments transactions (depending on the counterparts of such transactions).

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country investment allocations, e.g. the question whether policy decisions "push" capital from the US into EMEs and other countries – as argued by a number of EME policy-makers.

Turning to the empirical results, the paper finds that US unconventional monetary policies have exerted significant and sizeable effects on portfolio decisions and cross-border capital flows, as well as on asset prices. Importantly, the Fed's LSAP announcements had overall comparatively lower effects on portfolio decisions and on asset prices than actual Fed operations, especially Fed purchases of Treasury securities. This is particularly the case for portfolio decisions and asset prices outside the US (in EMEs and other advanced economies (AE)). It suggests that investors in no way fully priced in and reacted in response to Fed announcements, and it highlights the importance of analyzing not only Fed announcements but Fed operations as well, a feature which has been missing so far in the literature.

Second, we find that US monetary policy measures have functioned through both types of portfolio rebalancing – across asset classes and across countries – albeit in fundamentally different ways across types of Fed policy measures. QE1 announcements and Fed liquidity injections mainly induced a cross-country portfolio rebalancing into the US, triggering sizeable inflows into US equities and bonds. By contrast, QE2 announcements of the second round of the LSAP program in 2010 caused a portfolio rebalancing in the opposite direction, mainly from US bonds into EME equities and bonds. Fed purchases of US Treasuries and MBS have functioned through both a portfolio rebalancing across asset classes and across countries – a shift from US, EME and other AE bonds into EME equities in response to US Treasury purchases, and a shift in the opposite direction through MBS purchases.

A third major finding of the paper is that the cumulated effects of US unconventional monetary policy measures on capital flows to EMEs has been relatively small compared to other factors. In cumulative terms, US unconventional monetary policy measures together explain EME net equity inflows of 5% and EME net bond outflows of 6% of the fund's assets under managements in our data set between mid-2007 and early 2011. Of course these are sizeable magnitudes, yet they are moderate relative to the total cumulative net equity inflows to EMEs of more than 25% and net bond inflows to EMEs of 34% during this period.

However, although Fed policies may explain only a limited share of the large swings in cross-border capital flows during 2007-11, they are found to have magnified the pro-cyclicality of capital flows to EMEs, while acted in a counter-cyclical manner for the United States. In late 2008-09, Fed measure contributed significantly to net capital outflows from EMEs – in a period when EMEs experienced sudden stops and massive capital flight overall – and then since mid-2009 induced a gradual reversal of these outflows, contributing to the surge in capital inflows to EMEs during that period. Hence one key message of the empirical findings of the paper is that US unconventional monetary policy measures have not so much affected

the overall magnitude of capital flows to EMEs over time, but have magnified the variability and pro-cyclicality of capital flows.

As a fourth main finding, Fed policy measures have exerted a comparatively larger effect on asset prices than on portfolio flows. Over the sample period 2007-11, US equity prices declined by a total of 20% and EME equity prices by 1%, whereas Fed policies in fact pushed up equity prices of the US by a total of 14% and EMEs of 16%, thus functioning again in a counter-cyclical manner. Similarly, the effects of Fed policies account for a large share of the overall depreciation of the US dollar during that period, in particular against currencies of other AEs. This is an important finding because it suggests that Fed policies have influenced EMEs and AEs mainly through asset prices, and only to a lesser extent via capital flows.

The findings have a number of implications. The empirical estimates of the paper are consistent with the argument that US unconventional monetary policy measures since 2007 have exerted a significant effect on capital flows to EMEs, and in particular that they have exacerbated the pro-cyclicality of capital flows to EMEs, and have exerted a substantial upward pressure in many economies in the form of higher equity prices and stronger exchange rates. This suggests that there is indeed a global dimension and externalities to monetary policy decisions in advanced economies that are relevant and important. However, the paper is mute on whether such externalities are overall positive or negative for other economies – as the potentially undesirable effects of these measure on the pro-cyclicality of EME capital flows need to be weighed against potential benefits such as e.g. through higher economic activity and a better financial market functioning in advanced economies and thus in the global economy.

The paper is organized as follows. The next section discusses in detail the various elements of the US monetary policy stance and their objectives and functioning since 2007, as well as links the current paper to the related literature and details some of potential the transmission channels. Section 3 outlines the empirical methodology and data. Section 4 then presents the empirical findings, both for the overall effects of US unconventional monetary policy measures as well as for the various transmission mechanisms. Section 5 summarizes the main findings and concludes by discussing policy implications.

2 US Non-Standard Monetary Policy Measures

2.1. The Fed policy menu

A collapse of the US sub-prime mortgage market and the reversal of the housing boom in the United States resulted in a crisis of global dimension in 2008. US policy makers reacted with a set of countercyclical policy measures to the economic downturn. First, the US Congress

passed large-scale countercyclical fiscal packages as response to the crisis. Second, the Federal Reserve reduced the Fed Fund Target rate nearly to its zero lower bound.

In addition to these more standard policy measures, the Federal Reserve decided to introduce a new set of non-standard policy tools, which have been labeled as credit-easing tools. These measures are partly an extension of the Fed's traditional role of the lender of last resort, aimed at providing sufficient liquidity to the financial institutions in times of stress. These new facilities dramatically affected both the composition and the size of the Fed's balance sheets.[4]

In general, the non-standard measures implemented by the Federal Reserve can be divided into three groups:[5] (i) lending to financial institutions, (ii) providing liquidity to key credit markets, and (iii) large-scale asset purchase program (LSAP). In what follows, we provide a short description of each of these groups.

In late 2007 and early 2008, the Federal Reserve implemented several programs associated with direct lending to financial institutions. These measures intended to address the extremely 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. The provision of credit to financial institutions exposed the Federal Reserve to only minimal credit risk, as the loans made were generally over-collateralized and made with recourse to the affected financial institution.

The programs under this category included the Term Auction Facility, which auctioned term loans to depository institutions, as well as 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 in their jurisdictions.

The financial crisis intensified dramatically in the second half of 2008, after the collapse of Lehman Brothers, with many financial market segments all but shutting down. These developments induced the Federal Reserve to implement a number of additional programs with the aim for providing liquidity to key credit markets. To reduce funding pressures experienced by money market mutual funds and borrowers in the commercial paper markets, 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

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[4] In fact, the latter distinguishes the introduced credit easing tools from Japanese style of quantitative easing policy, which main focus was the quantity of reserves rather than the composition of loans and securities of the central bank's balance sheet.
[5] See Carlson, Haubrich, Cherny and Wakefiled (2009) for a detailed discussion.

(Maiden Lane LLCs) to facilitate lending in support of specific institutions such as Bear Sterns, JP Morgan and AIG.

Both 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.[6] As a result, in what follows, we will subsume both of them under the category of liquidity providing measures by the Fed. What are the anticipated benefits of these measures? Bernanke (2009) outlined two potential gains. Since banks typically fund long-term assets with short-term money, a loss of confidence may force them to engage in a fire-sale of assets. By providing a liquidity backstop this potential fire-sale is avoided. In other words, the Fed's objectives were to mitigate the propagation of the crisis through a balance sheet channel.[7]

These policies therefore have a different impact on the economy than the Fed's third policy tool, the so called large scale asset purchases program (LSAP). The overall LSAP composed of asset purchases of mortgage back securities (MBS), and in a later stage of US Treasury bonds. While the MBS program was introduced with the explicit aim of reducing mortgage interest rates and stabilizing 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.[8] The channels through which the Fed's Treasury purchases affect longer-term interest rates and financial conditions have been subject to a controversial debate. One view is that such purchases work primarily through a portfolio balance channel, which holds that once short-term interest rates have reached zero, the Federal Reserve's purchases of longer-term securities affect financial conditions by changing the quantity and mix of financial assets held by the public.[9] Specifically, the Fed's strategy relied on the presumption that different financial assets are not perfect substitutes in investors' portfolios, so that changes in the net supply of an asset available to investors affect its yield and those of broadly similar assets. Thus, one intention of the purchases of long-term assets is to reduce the yields on the purchased securities and to push investors into holding other assets. For example, some investors who sold Treasuries to the Fed may have replaced them in their portfolios with longer-term, high-quality corporate bonds, depressing the yields on those assets as well. The logic of the portfolio balance channel implies that the degree of accommodation delivered by the Federal Reserve's securities purchase program is determined

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[6] See Bernanke (2009)
[7] See Sarkar (2009)
[8] The implementation of the LSAP came in several steps. In November 2008 the Federal Reserve announced plans to purchase the direct obligations of the housing-related government-sponsored enterprises (GSEs), specifically Fannie Mae, Freddie Mac, and the Federal Home Loan Banks. In March 2009, the Federal Open Market Committee (FOMC) decided to expand its purchases of agency-related securities and to buy long-term government bonds as well. In August 2010 the Fed decided to renew the quantitative easing programme. The list of Fed announcements for the Fed's LSAP programme is presented in Table 1.
[9] See Bernanke (2010)

primarily by the quantity and mix of securities the central bank holds or is anticipated to hold at a point in time (the "stock view"), rather than by the current pace of new purchases (the "flow view").

In August 2010, the FOMC stopped the purchase of MBS and agreed to stabilize the quantity of securities held by the Federal Reserve by re-investing payments of principal on agency securities into longer term Treasury securities, extending thereby its Treasury purchases program. The Fed argued that reinvestment in Treasury securities is more consistent with the FOMC's longer-term objective of a portfolio made up principally of Treasury securities. As a result, Treasury purchases by the Fed became the dominant instrument within the LSAP program.

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

Each of the Federal Reserve's credit easing strategies—lending to financial institutions, providing liquidity to key credit markets, and purchasing long-term securities—intended to stabilize financial market and real economic activity in the United States. Observers, however, argued that beside of their domestic impact, credit easing policies were the main driver of the surge in capital flows to emerging economies (EMEs). It is in particular this latter point on which the current paper focuses.

2.2 Channels of transmission and international repercussions

There are four channels through which Fed unconventional policies may affect portfolio decisions by investors and asset prices, both domestically and internationally.

A first one is a portfolio balance channel. A Fed purchase e.g. of a US Treasury security influences the available supply of this asset to private investors. As bond premia should be determined by the underlying risk characteristics of the asset and the risk appetite of investors, such a Fed purchase influences yields of the asset only to the extent that the asset is not perfectly substitutable. A number of studies have referred to the assumption that Habitat theories hold (see Gagnon et al. 2010, D'Amico and King 2010, and Doh 2010) to rationalize imperfect substitutability and how a Fed purchase pushes down Treasury yields and induces a portfolio rebalancing into riskier assets. Moreover, a Fed purchase of longer term securities may reduce the average duration available in markets, thus reducing term premia and yields of all fixed-income securities. In turn, the shift in portfolio allocations towards riskier assets, such as equities, should also raise returns for those assets.

The signaling channel is a second mechanism through which Fed interventions may influence asset prices and portfolio decisions. In particular 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 interest rates than was previously expected. Bauer and Rudebusch (2011) stress the importance of this channel for Fed announcements in 2008 and 2009, and show that empirically this channel had similar importance as the pure portfolio balance channel via lower term premia.

However, Fed announcements may not only send a signal about the future path of interest rates, but provide also information about the state of the economy. Such a third channel, or what may be dubbed confidence channel, can affect portfolio decisions and asset prices by altering the risk appetite of investors. Importantly, the information of such a confidence channel may be fundamentally different from that contained in the signaling channel. For instance, a Fed LSAP announcement may be understood by markets as indicating that economic conditions are worse than previously expected, hence driving down all asset prices and triggering a flight to safety (e.g. Neely 2011). Alternatively, if a Fed LSAP announcement may trigger a positive market reaction and net inflows into all US assets if markets expect to be effective in improving the economic outlook for the economy, as e.g. stressed by Joyce (2010) and Wright (2011). Hence it is hard to derive a clear prior as to what this channel should imply for asset prices and portfolio decisions, though measures of market risk, such as implied in the VIX, should be affected significantly under such a channel.

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 e.g. 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 decrease liquidity premia (Joyce, 2010; Gagnon, 2010). Thereby, QE prevents fire sales of assets by financial institutions that are in need of cash (Bernanke, 2009). That said, in case financial sector deleveraging is enforced by market conditions, fire sales could take place in assets that cannot be used as collateral by the Federal Reserve, resulting in sudden stops and capital outflows from EMEs.

Table 4

Table 4 attempts to provide a stylized summary of the different channels and how they may affect portfolio decisions and asset prices, both domestically within the US and in EMEs, under the assumption of a Fed LSAP program of US treasury securities. Again, it cannot be stressed enough that this is merely a sketch that should help us derive some general priors for the empirical analysis below. For instance, whether the private demand for EME bonds

increases or decreases as a result of a Fed purchase of US Treasury securities depends on whether EME bonds are considered as sufficiently close substitute to US Treasuries.

Three key points need to be emphasised at this point. A first one is that the four channels discussed above are by no means mutually exclusive, but several channels may be at work simultaneously. For instance, the Fed's LSAP program may have, an in fact is likely to have functioned both through a portfolio balance channels, a signaling channel (by lowering the expected path of future US policy rates) and at the same time via a confidence channel.

Second, the way non-US portfolio allocations and asset prices are affected by Fed announcements and operations depends on how foreign assets are considered by investors. For instance, whether a flight-to-safety phenomenon leads to a flight out of non-US bonds depends on the degree to which such securities are considered "safe" by US investors. This may help explain why e.g. EMEs have been affected very differently by Fed policies.

Third, the dominant focus in the literature on Fed unconventional policy measures, as outlined above, has primarily been on the functioning of the portfolio balance channel in response to Fed announcements (rather than actual operations). An important caveat is that Fed announcements do not imply any change in supply of e.g. US Treasury securities at the time the announcements are made, but they merely indicate that such a change will occur at some point in the future and to some degree (with LSAP announcements declaring an upper bound of future purchases of various instruments). Hence a change in the available supply of US Treasuries is not the impetus of the portfolio balance channel of such announcements. It is rather the change in expectations about future asset prices that triggers changes in portfolio allocations and current asset prices.

This point is also important for understanding the rationale for analyzing Fed operations, rather than limiting our study to announcements as done by most of the literature. One potential objection and concern to analyzing Fed operations is that they may not contain any new information, as e.g. amounts and timing about LSAP programs were known at the time of their announcements. Hence, efficient markets should have priced in fully such information with the announcements.

There are three replies to this point. A first one takes issue with the assumption of efficient markets implied in this point. Many of the Fed measures were implemented precisely because markets were not functioning. The Fed's liquidity support measures to banks and also its MBS purchases are two examples. The mere announcement of MBS purchases may have been much less effective than the actual purchase because the latter restored liquidity to markets and allowed investors to adjust their portfolios.

A second point relates to US Treasury markets, which had remained functional and highly liquid throughout the crisis. However, a key difference between LSAP announcements and actual purchases is that the latter, but not the former, had a direct effect on the amount of

liquidity available in markets. This implies a change in portfolio allocations with the latter, although asset prices may or may not have responded much to actual purchases.

A third point relates to the accuracy of market expectations. Although market participants may have had a fairly accurate idea about the timing and amounts of Fed operations under the LSAP programs, they may not have been accurate in their expectations about the effectiveness of such operations in e.g. re-establishing the functioning of markets or enhancing the prospects of the US or global economy. Thus such surprises may have influenced asset prices and portfolio allocations in response to Fed operations, although it is obviously hard to have a prior as to the direction of such effects on financial markets.

3 Empirical Methodology and Data

In this section, we discuss the empirical strategy we employ for assessing the impact of US unconventional monetary policy measures on portfolio decisions and asset prices. We conclude the section by outlining the data used, in particular the fund-level data on portfolio decisions.

3.1 Methodology

Our empirical approach for evaluating and quantifying the impact of QE is to analyze the response of portfolio decisions, capital flows, asset prices and exchange rates to specific unconventional policy actions and events. Importantly, we differentiate between US and foreign variables (further distinguishing between EMEs and other AEs).. This allows testing whether foreign markets were affected differently from the US, as well as whether different types of investment were influenced differently. We evaluated the impact of QE according to the following model:

$$y_{i,t} = E_{i,t-1}\left[y_{i,t} \right] + (\beta\ + \gamma^{EME} D_i^{EME} + \gamma^{AE} D_i^{AE}) MP_t + \varepsilon_{i,t} \tag{1}$$

$$\text{with} \quad MP_t = [AN1_t, AN2_t, LQ_t, TR_t, MBS_t]'$$

with the dependent variable $y_{i,t}$ as the net inflows (into bonds or into equities), expressed in percent of all assets under management, or asset prices in country i and day t. D_{EME} is a dummy with a value of unity if country i is an emerging economy, and D_{AE} for other AEs. Hence the impact of a particular policy measure MP_t on the US is given by the coefficient β, while the additional impact on EMEs and AEs is denoted by the respective coefficients γ.

We distinguish between two types of unconventional monetary policy measures in the analysis. Announcements (denoted AN1 and AN2) are impulse dummies equal to 1 for QE1

and QE2 announcements, respectively. As stated above, such announcements mostly occur several weeks or even months before actual operations are implemented. As is common in the literature (Gagnon et al 2009, Wright 2011), we analyze 12 key announcements by the Fed which are primarily related to Fed purchases or reversals of US Treasuries and span from 2008 to 2010.[10] The list of announcements is provided in Table 1.

The second set of policy measures relates to actual market interventions by the Fed and is measured as the weekly changes of outstanding amounts of the following operations in the Fed balance sheet:[11] (i) liquidity support measures for the financial sector (LQ_t), (ii) purchases of long term treasury bonds (TR_t), and (iii) purchases of long term mortgage backed securities (MBS_t).[12] Note that all of these measures can take positive or negative values, e.g. in the latter case when such purchases are reversed.

Importantly, we also include a set of control variables which capture the expected component of changes in portfolio allocations and asset prices for country i at time t. In the basic setting, we take account of (i) country fixed effects α_i to capture country-specific, time-invariant elements, (ii) lagged variables reflecting financial shocks and global market conditions, such as the option implied volatility on the S&P 500 index (VIX), the 10-year T-bond yield in the US, the liquidity spread (defined as the difference between 3-month OIS rate and T-Bill yield);[13] and (iii) lagged returns of the domestic market return[14]. In practice, it turns out that the inclusion of different sets of controls influences the magnitude of the estimated coefficients, but does not alter the sign or statistical significance of the estimates.

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[10] As commonly done in the literature, we consider QE_1, QE_3, QE_4, QE_5, as part of announcements of the first LSAP programme (QE1), and QE_{10}, QE_{11}, and QE_{12} as constituting the second LSAP programme (QE2). The second and ninth announcements, as listed in Table 1, are excluded from the analysis as the occurred on days on which other news dominated financial markets – in the case of the second announcement US and global equity markets collapsed as a result of official news of the US recession, and similarly negative market news dominated the ninth event, which were unrelated to the Fed's announcement. Events 6 through 8 announced reductions or a halt to LSAP programmes, and have been shown in the literature to have been mostly irrelevant as news for financial markets.

[11] This classification is based on a lecture of Chairman Ben Bernanke given on 13 January 2009 at the London School of Economics. http://www.clevelandfed.org/research/trends/2009/0209/02monpol.cfm

[12] We separate between purchases of long term mortgage backed securities, and purchases of long-term treasury bonds, since the latter become prominent following the QE2 announcement in August 2010.

[13] The OIS rate can be considered (almost) free of credit risk because the swap 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 mostly reflects the expected path of monetary policy over the three month time horizon of the contract. Also the Treasury Bill is a risk free assets, however, in periods of liquidity shortage, it can be considered as a close substitute of cash because it has a short term maturity and it can be used as collateral in central bank open market operations. As a consequence, in times of liquidity strains, the price of the Treasury Bill increases while the yield decreases deviating from the expected path of monetary policy i.e. the OIS rate. The differential can be therefore considered a measure of liquidity strains..

[14] There are some differences as to the precise specification of the models for flows and for asset prices, such as that the estimation for the former includes levels of VIX, of the liquidity spread and of the 10-year T-bond, while the model for prices includes changes of these variables.

Three important caveats need to be stressed. First, Fed operations and market interventions may to some extent not have been exogenous, but endogenous to market developments. For instance, a decision by the Fed to provide more liquidity support to banks is likely to have been influenced by market conditions and banks' needs for liquidity, and thus may have been higher during weeks when spreads were high, equity markets fell and investors withdrew capital from markets. It is very hard to deal with this issue in a precise manner, and an IV approach is hard to conduct as there are no good instruments to capture this endogenous component. We nevertheless try to do so in several ways. In particular, we control for market developments and previous trends in our empirical model, as outlined above, and also use interventions with lags in the robustness exercise. Most importantly, we note that if there is such an endogeneity bias, removing it should strengthen the estimates of our empirical findings because Fed operations in most cases were of a "leaning-against-the-wind" type through which the Fed responded to market distortions and attempted to remove these.

A second query relates to the speed with which financial markets respond to Fed announcements and operations. As shown in the literature, asset prices responded mostly instantaneously to Fed measures. However, portfolio decisions by investors may be substantially more sluggish in their responses (see e.g. the evidence provided in Forbes et al, 2012). In the benchmark specification, we therefore include Fed policies on the day and the subsequent day in the estimation of empirical model, while for operations we include them for the entire week.

A third caveat is about the extent to which Fed announcements and operations have been anticipated by financial markets. If these policies have been correctly anticipated, then asset prices and portfolio allocations may have partly adjusted already ahead of the event. The previous section discussed why in particular operations may nevertheless still exert some effects on asset prices and portfolio allocations, even when they do not constitute "news" per se. Nevertheless, as for the potential endogeneity bias, such an anticipation should make the estimated coefficients larger and more significant statistically.

3.2 Data

We use daily data on portfolio (equity and bonds) investment flows from January 2007 to December 2010 compiled by the data provider EPFR. The dataset contains daily flows of more than 16,000 equity funds and more than 8,000 bond funds. Although EPFR data captures only about 5-20% of the market capitalization in equity and in bonds for most countries, it is a fairly representative sample; Jotikasthira, Lundblad and Ramadorai (2010) and Fratzscher (2011) make this point convincingly by showing in detail a close match

between EPFR portfolio flows and portfolio flows stemming from total balance-of-payments data.

At the fund level, EPFR data contains information on the total assets under management (AUM) at the end of each period, as well as 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 fund (which abstracts from valuation changes), because these reflect the *active* decisions of investors about whether or not to add or reduce investments in a particular fund class. Therefore our focus is not on analyzing the portfolio allocation strategy of individual fund managers, but rather that of individual households, firms or other institutional 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 may underestimate the effects on individual market segments.

Table 2 provides summary statistics for the net flows aggregated at the level of the group of countries of destination (expressed as percentage of assets under management in the destination country) for our selected sample of countries, as well as for asset prices. 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 e.g. investors located in EMEs. This is important because it implies that investment decisions vis-à-vis EMEs or other AEs imply cross-border transactions and thus 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.

Asset prices comprise changes in MSCI equity return indices in local currency terms, changes in 10-year government bond yields, and in the bilateral exchange rate vis-à-vis the US dollar (and the NEER for the US) with a rise in all cases implying an appreciation of the US dollar.

Finally, Table 3 provides summary statistics for the US monetary policy measures as well as a broad set of control variables, both common factors (Table 3) and country-specific, idiosyncratic variables as discussed above.

4 Empirical Results

This section first presents the findings of the benchmark model (section 4.1), then the results for the economic significance (section 4.2), and concludes with the robustness analysis (section 4.3).

4.1 Benchmark model

The estimated coefficients of the benchmark regression are reported in Table 6 for portfolio flows, in Table 7 for asset returns/yields and Table 8 for exchange rate reactions to US monetary policy measures. The tables show the estimated coefficients of equation (1) for the five variables for the US unconventional monetary policy measures.[15]

Table 6

We first turn to the response of portfolio allocations and capital flows to US monetary policy measures, as shown in Table 6. First, the estimates indicate that Fed announcements primarily triggered a portfolio rebalancing across countries. Interestingly, QE1 announcements had the opposite directional effects on flows compared to QE2 announcements. QE1 announcements triggered mainly inflows into both US equities and, to a lesser extent, into US bonds. By contrast, QE2 announcements induced mainly a portfolio rebalancing out of US bonds and into EME equities (and no significant response of US equities).

These findings reveal a somewhat different picture of how Fed QE announcements functioned than what has been discussed in the previous literature, which has focused more narrowly on the response of US bond yields and US equity returns to Fed announcements. More specifically, the portfolio rebalancing that appears to have been most pronounced in response to US QE announcements has been one across countries, rather than across asset classes. Moreover, an important finding is the difference between QE1 and QE2 announcements, with the latter not inducing any discernible portfolio rebalancing of investors into US equities, but rather into EME equities and EME bonds.

Second, the response of portfolio allocations to Fed liquidity operations shows a similar pattern as those to QE1 announcements, with liquidity operations inducing a cross-country rebalancing out of EME assets and into US equities and US bonds. This finding seems sensible against the background that liquidity operation, as discussed in detail in section 2, had a very different objective than other Fed non-standard measures, such as Treasury purchases. While the aim of Treasury purchases was mainly to allow the Federal Reserve to

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[15] The full results with the control variables (as listed in Table 3) are not shown for brevity reasons but are available upon request.

conduct expansionary monetary policy at the zero lower bound, operations associated with liquidity support were mainly an extension of the Federal Reserve's role as a lender of last resort. The intention of these operations was to stabilize financial markets, and to avoid a credit crunch in the US economy. This role implies in part also a moral suasion component, i.e. market participants that receive funding from the Fed might be inclined not to reduce their exposures to the domestic economy, but achieved their desired deleveraging by selling off foreign asset holdings in EMEs.[16] In addition, by expanding the pool of collateral eligible to obtain central bank liquidity, the Fed might have increased the willingness of investors to hold US assets at times of global liquidity shortages.

Third, Treasury purchases by the Fed induced primarily a portfolio rebalancing across asset classes, as bond funds in all regions – US, EMEs and other advanced economies alike, experienced net outflows and EME equity funds net inflows. When the Federal Reserve buys long-term government bonds, it crowds out other investors and reduces yields in this market segment. This raises the demand for more risky assets. Relative to the size of assets under management of the funds, the effects of US Treasury purchases by the Fed were even larger for many EMEs than for the US itself, thus suggesting that these operations had a particularly strong impact on capital flows to EMEs. In fact, the estimates indicate some, albeit small, net outflows even out of US equities compared to sizeable net inflows into EME equities. Moreover, opposite to the effects of liquidity operations, US Treasury purchases thus triggered a stronger risk-taking by fund managers, and in particular with regard to equity investment in EMEs.

Fourth, MBS purchases by the Fed induced net inflows into bond funds of all regions and groups, and net outflows out of US equity funds. This finding is consistent with the argument that MBS purchases helped improve the functioning of particular US bond market segments, making these more attractive to investors and hence attracting private capital into funds investing in bond markets. Indeed, the Fed stated as its goal for the MBS purchases to "reduce the cost and the increase the availability of credit for the purchases of houses".[17] As discussed in Hancock and Passmore (2011), the Federal Reserve's MBS Purchase Program re-established robust secondary mortgage market, which meant that the marginal mortgage borrower could be funded via capital markets, which is consistent with our finding of net inflows into US bond markets.

Tables 7 – 8

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[16] See Rose and Wieladek (2011) for a similar argument in the context of the UK.
[17] See http://www.federalreserve.gov/newsevents/press/monetary/20081125b.htm

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As the next step of the analysis, we turn to the response of *prices* – equity returns and bond yields – to Fed policy measures (Table 7), as well as that of the US dollar (Table 8). The first and most obvious market responses to look at are those for US Treasury yields to Fed announcements, as these have been widely analyzed in the literature, with compelling evidence that QE1 announcements reduced US yields substantially. The estimates of Table 7 confirm this result, indicating that each of the QE1 announcements reduced US 10-year Treasury yields on average by 16 basis points, which is consistent with the findings of the literature and also with the stylized facts of Table 5. Interestingly, the estimates in Table 7 suggest that QE2 announcements had a substantially smaller (though still statistically significant) effect on US yields, reducing them on average by about 2 basis points, which is consistent e.g. with the findings by Wright (2011).

Also the response of foreign bond yields is in line with that of the literature (see e.g. Neely 2011 for advanced economies' yields), indicating that QE1 (though not QE2) announcements lowered foreign yields significantly. Interestingly, the decline in bond yields was much larger in EMEs than in other advanced economies, again underlining that EMEs have been exposed significantly more to US unconventional monetary policy measures.

The responses of equity returns and yields to Fed operations are also mostly consistent with our priors. In particular, Fed liquidity operations succeeded in lowering US yields, while Treasury purchases systematically raised equity returns, and did so not only in the US, but also in EMEs and in other advanced economies.

As a final note, the estimates confirm that the Fed's QE measures exerted a significant and sizeable effect on the US dollar exchange rate, and did so in the expected direction (Table 8). QE1 and QE2 announcements as well as Treasury purchases all weakened the US dollar, in particular against currencies of other advanced economies. By contrast, liquidity operations (and also MBS purchases) induced a US dollar appreciation, which is consistent with the fact that such operations were aimed at repairing dysfunctional market segments and thus attracted capital into US markets from abroad. The relatively weaker response of EME currencies to US policy measures compared to exchange rates of other AEs is likely due to the fixed exchange rate regime pursued by several EMEs.

Overall, the comparison of the responses of quantities (portfolio allocations of equity and bond funds), prices (equity returns and bond yields), and exchange rates, provides a consistent picture on the effects of US monetary policy measures. A net inflow into a particular US asset class due to US QE measures is associated in most cases with higher prices (positive equity returns or lower bond yields) and a stronger US dollar, and vice versa. However, there are some notable exceptions.

A key point relates to the response to QE announcements compared to actual Treasury purchases by the Fed. An interesting finding is that while QE1 announcements indeed

lowered US Treasury yields, they induced net inflows into US bond funds. Here the distinction between Fed announcements and actual Fed purchases is crucial. The latter reduces the available supply of Treasuries to other investors, hence triggering an (almost mechanical) outflow out of US Treasuries by private investors, while Treasury yields decline at the same time. By contrast, Fed announcements don't induce such a change in supply, they merely signal for such a change to occur at some point in the future. Investors anticipating a future purchase by the Fed thus react by raising their demand for Treasuries in response to Fed announcements, thus driving down their yields instantaneously. By contrast, QE2 announcements triggered net outflows out of US bond funds, and large inflows into EME equities (with no significant response in the demand for US equities). Hence, while this also entails portfolio rebalancing, it is one that implies a drop in demand for US bonds and cross-border rebalancing into more risky EME equities.

4.2 Economic significance

How important are these effects of US monetary policy measures for changes in portfolio allocations, asset prices and for capital flows? So far, we have discussed the statistical significance and the underlying mechanisms and channels through which US unconventional monetary policy measures have functioned. Yet, we have observed large shifts in portfolio allocations global capital flows during the crisis in 2007-08 and also since 2009. How much of this overall pattern and overall magnitude can be explained through such policy measures?

Tables 9 – 10, Figure 2

We conduct two types of analyses to get at this question. First, we calculate the cumulative effects of the different policy measures on total investment in US, other AE and EME bond funds and equity funds. Table 9 shows the cumulated effects when taking the each US policy measure at its peak, while Table 10 as to the total change over the 2007-11 sample period. The distinction between the two is important primarily for the liquidity operations, which reached a peak with a cumulated USD 2,000 bn in early 2009, but then were unwound to a large extend by the end of 2010. The same analysis is conducted for asset prices (equity returns and bond yields) in panels B of Tables 9 and 10.

The second analysis is to cumulate across all five Fed policy measures, but to do so not at one particular point in time (as in Tables 9 and 10), but to show the evolution of the total cumulated effect of US monetary policy measures over time. This is what is shown in Figure 2 for equity flows and bond flows into EMEs, the US and other AEs.

Three main findings emerge. First, the absolute effect of US monetary policy measures on portfolio allocations, capital flows and asset prices is substantial. For instance, in cumulative

terms, US policy measures together explain EME net equity inflows of 4.4% and EME net bond outflows of 6.0% as a share of the funds' assets under managements between mid-2007 and early 2011 (see Table 10). As the size of EME equity assets held by foreigners is substantially larger than that for EME bond assets, in US dollar terms these figures imply net inflows of USD 22 bn into EME equities and net outflows of USD 6 bn out of EME bonds using our mutual fund database.[18] Similarly for US funds and other AE funds, Fed non-standard measures induced significant effects on allocations, e.g. cumulative inflows into AE bonds of 3.7% and net outflows out of US bond funds of 4.7%.

Importantly, these cumulative figures mask the fact that some of the Fed measures exerted opposing effects on portfolio allocations. Looking at the breakdown by individual Fed measures in Table 10, for instance, shows that Fed purchases of US Treasuries caused large net outflows out of US bond funds of 9.7% and out of EME bond funds of 10.5%, while MBS purchases had the opposite effect inducing net inflows into US bond funds by about 5% and into EME bond funds by 5%.

The responses of asset prices and exchange rates reveal a similar picture in that Fed policies have exerted large and economically meaningful effects on equity returns and bond yields in all three geographical areas – the US, EMEs and other AEs. Panels B of Tables 9 and 10 show that, for instance, QE1 announcement raised US equity prices by 4.3% and lowered US 10-year Treasury yields by 66 b.p. (Table 10), which is in line with the stylized facts presented above.

Similarly, Fed operations – specifically Treasury purchases – exerted even larger effects than Fed announcements on asset prices in all financial market segments globally. Fed Treasury purchases raises US equity prices by 15% (and EME and AE equity prices by more than 18%), and led to an effective depreciation of the US dollar by 4.8%.

As a second main result, although these effects of Fed policies obviously constitute sizeable magnitudes in absolute terms, they are moderate compared to the total cumulative changes in portfolio allocations, capital flows and asset prices when taking a longer-term perspective over the entire sample period. For instance, the total increase in net equity inflows to EMEs over the period 2007-11 was more than 25% and in net bond inflows to EMEs 33%, i.e. far larger than what can be accounted for by Fed announcements and operations. In fact, Figure 2 shows that the control variables (common risk, liquidity and yield factors, and local asset returns) have been substantially more important as drivers of capital flows to EMEs than US

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[18] Using CPIS figures for a back-of-the-envelope calculation to get a proxy for the effect on overall portfolio equity flows and bond flows to EMEs confirms that the magnitudes of these effects are indeed sizeable (proxied USD 159 bn inflows into EME equities and net outflows of USD 112 bn out of EME bonds).

monetary policy measures. The same holds for allocations to US funds and to other AE funds. Hence, overall, a key finding is that Fed non-standard measures account for only a small share in the changes in portfolio allocations and capital flows.

Another important aspect of the results is that capital flows to EMEs have in most cases been substantially more sensitive to Fed policy measures than flows into US funds or other AE funds, when measured relative to fund assets under management. This again confirms that Fed measures have indeed exerted a substantial and economically meaningful effect in particular on capital flows to EMEs.

A final point on this first overall finding is that the effects of Fed announcements have, overall, been smaller than the effects of actual Fed operations on portfolio flows and on asset prices. For instance, QE1 announcements caused net inflows of about 1% into US bond funds and 1.8% into US equity funds. By contrast, Fed purchases of US Treasuries lowered the private mutual fund holdings of US bonds by close to 10% and of US equities of 0.8%. A similar finding holds for asset prices, although QE announcement did exert very substantial effects on equity return and in particular on US Treasury yields.

This finding is important because it challenges the approach in the literature to focus exclusively on the effects of Fed QE announcements, rather than Fed operations themselves. What the findings suggest is that while Fed QE announcement indeed triggered substantial changes in US asset prices, most of the effects on capital flows as well as on asset prices for EMEs and other AEs were caused by Fed operations. Hence analyzing operations is key for understanding how the Fed's unconventional monetary policy measures have functioned, and in particular gauging their global repercussions.

Figure 3

As a third main finding, the evidence suggests that US unconventional monetary policy measures since 2007 have significantly exacerbated the pro-cyclicality of capital flows to EMEs. By contrast, these Fed measures have worked in a counter-cyclical manner for investments in US equity and bond markets, as well as those of other AEs. Figure 2 shows compellingly how during the height of the 2007-08 crisis Fed liquidity operations pulled capital out of EMEs and into US equity and bond funds. By contrast, during the recovery period of 2009 when overall capital inflows into EME surged, the combination of a partial reversal of Fed liquidity operations with Treasury and MBS purchases contributed to the capital flow surge to EMEs, and in particular into EME equities.

Figure 3 reports the correlation (using a centred rolling window of 6 months) between the estimated effects of US monetary policy instruments and the estimated effects of other control variables on portfolio flows. The evolution of the correlation shows that at the peak of the

crisis Fed policies amplified the cycle of portfolio flows to EMEs by generating outflows when also other factors had a negative impact on flows. Conversely, during the recovery in 2009 and 2010, US monetary policy interventions generated inflows in EMEs when also other factors pushed capital to EMEs. Regarding the US, monetary policy had a counter cyclical effect as indicated by the negative correlations at the peak of the crisis.

4.3 Robustness tests

As the final step, we conduct a number of robustness checks and extensions to the analysis, in particular in view of two crucial caveats that need emphasising. The first one relates to the identification of counterfactual capital flows. In other words, one key question is what would have happened to capital flows to EMEs if Fed policy measures had not been implemented. Our prior is that the inclusion of the vector of controls $X_{i,t-1}$ provides a fairly accurate predictor for capital flows in the absence of US policy measures. And indeed as Figures 2 show, the common and country-specific controls $X_{i,t-1}$ in fact do a good job in explaining a substantial share of capital flows.

Tables 11 – 15

Nevertheless, we try to gauge the sensitivity of the benchmark specification in various ways, in particular through the inclusion of alternative controls. In Tables 11-15, we test for the sensitivity of the results to different specifications. For example by (i) changing the set of control variables (e.g. by adding additional explanatory variables capturing macroeconomic surprises[19] in the region where the portfolio of the individual fund is invested, see Table 11), (ii) testing for different econometric specifications (random effects, Table 12), (iii) testing the robustness to the timing of the effects by including the lagged values of Fed policies (Table 13). The results are largely robust to such changes.

A second query is whether Fed operations functioned in an asymmetric manner. More specifically, Fed operations to expand its balance sheet and e.g. to purchase Treasury securities or MBS may have had fundamentally different effects from those that reversed such an expansion. In fact, as we have seen from Figure 1, most of the liquidity injections and MBS purchases were unwound over time. However, Table 14 focuses only on those operations that expanded the Fed balance sheets (i.e. purchases of Treasuries or MBS, or liquidity injections into US financial institutions) but shows that the estimated coefficients are generally very similar to those of the benchmark estimation, exhibiting neither systematically larger or smaller estimates.

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[19] Citigroup economic surprise indexes are used.

A third potential caveat concerns the assumption of the exogeneity of Fed unconventional policy measures. One issue is that Fed policy announcements or actual implementations may to some extent be anticipated by financial markets. Hence e.g. the purchase of Treasury bonds by the Fed in a particular week may not be entirely unexpected by market participants and thus be priced in already in previous weeks. Unlike for the interest rate decisions by the Fed for which we can construct the true surprise components due to the availability of market expectations for FOMC decisions, no such expectations are available for the unconventional measures.

We note that markets should not systematically over- or under-predict e.g. Fed purchases over the many weeks that such purchases were conducted. This would add noise and imply that the coefficient estimates are unbiased, but may be estimated imprecisely. To the extent, that market participants anticipate purchases ahead of time, and thus investors have already reacted before purchases are conducted, such a behavior would rather imply a downward bias of the benchmark estimates. Nevertheless, we try to deal with this issue directly in various ways. The first one is obviously the inclusion of official Fed announcements of such policy measures. A second one is to look specifically at the days (usually on Wednesdays) on which the Fed released information about the magnitude of the operations it conducted in the previous week. The intuition is that if markets react to the information content of Fed operations, rather than the operations themselves, then we should see a stronger reaction on those days when such information is released. However, focusing on those days when the information of Fed operations is released shows that the empirical findings are not much different from other days when such operations were conducted (Table 15). This underlines the importance of the portfolio balance channel, rather than the signaling role implicit in the release of Fed information about these operations.

Figure 4 – 6

Finally, we try to gauge the cross-country heterogeneity in the effects of Fed policies by estimating model (1) for each individual country, and thus obtaining country-specific parameters. Figure 4 – 6 show these parameters in a graphical way. Two main points emerge. First, each of the groups (EMEs vs. AEs vs. US) individually displays a remarkably strong degree of heterogeneity in that there is a clustering of coefficients within each group. By contrast, the second finding is that the differences across groups is indeed substantial, confirming the findings of the benchmark estimation.

5 Conclusions

The paper has analyzed the impact of US policy measures on investment flows and asset prices both in the US and globally to EMEs and other AEs, using a high-frequency, daily database of mutual fund investment decisions. The empirical analysis of the paper has revealed strong evidence that US unconventional monetary policy measures since 2007 have indeed affected and overall increased portfolio decisions and asset prices, and that these effects are sizeable in absolute terms.

Equally importantly, we find that Fed operations, such as the purchases of Treasuries and MBS through its two LSAP programs, exerted substantially larger effects on portfolio decisions and asset prices, than Fed announcements of these programs. This is important because most of the literature to date has focused on the market impact of announcements, while our results emphasise that actual Fed operations are relatively more important for understanding portfolio decisions and re-pricing of risk at the global level.

In addition, our findings indicate that Fed policies exerted larger effects on asset prices than on capital flows. In fact, relative to the large magnitude of swings in capital flows to EMEs following the collapse of Lehman Brothers in September 2008, and the subsequent capital flow surge to EMEs in 2009 and 2010, the relative share of these movements explained by Fed monetary policy measures is comparatively modest. However, these Fed policy measures have significantly exacerbated the pro-cyclicality of capital flows to EMEs – raising outflows even further in periods when capital flees EMEs, and magnifying inflows when these are already large. By contrast, Fed policies have functioned in a counter-cyclical fashion for investment flows into US equity and bonds funds.

Looking at the channels, we find that the portfolio balance channel at work in the transmission process of US policy measures was markedly different across the different unconventional policy tools. Fed liquidity injections and LSAP announcements affected investment and capital flows primarily through a cross-country portfolio balance channel as both of these measures induced significant outflows out of EME equities and bonds and inflows into US equities and bonds. By contrast, Fed Treasury purchases mainly functioned through a portfolio balance channel across asset classes, inducing a rebalancing from bonds into equities for both the US and EMEs.

The findings of the paper have a number of implications for policy. The potential spillovers of US unconventional monetary policy measures to the global economy remain a controversially debated issue, in particular in international fora. Several EME policy-makers have publicly expressed concerns that these policies generate excess global liquidity that triggers capital flows to other economies, specifically to fast-growing EMEs. The findings of the paper suggest that such policies have indeed contribute to the capital flow dynamics and exacerbated the pro-cyclicality of capital flows to EMEs, and in particular have significantly raised equity prices and reduced sovereign yields globally.

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Table 1. List of QE events

Date	Description of the event	Impact in Gagnon et al. (2010)	Impact in Wright (2011)
(1) QE1 Tuesday 25/11/2008	Type of event: FOMC statement – Expansion of QE. Initial LSAP announcement. The Fed announces purchases of $100 billion in GSE debt and up to 500 billion in MBS.	-22	0.75
(2) QE1 Monday 01/12/2008	Type of event: Bernanke Speech – Expansion of QE. Chairman Bernanke mentions that the Fed could purchase long-term Treasuries.	-19	0.84
(3) QE1 Tuesday 16/12/2008	Type of event: FOMC statement – Expansion of QE. First mentioning of possible purchase of long-term Treasuries. Also FED funds target rate reduced to the range 0-0.25	-26	2.22
(4) QE1 Wednesday 28/01/2009	Type of event: FOMC statement – Expansion of QE. The Fed is ready to expand agency debt and MBS purchases, as well as to purchase long term treasuries. (Also TALF will be implemented).	14	-0.23
(5) QE1 Wednesday 18/03/2009	Type of event: FOMC statement – Expansion of QE. The Fed will purchase an additional $750 billion in agency MBS, to increase its purchases of agency debt by $100 billion, and $300 billion in long-term Treasuries.	-47	3.41
(6) QE1 Wednesday 12/08/2009	Type of event: FOMC statement – Reduction of QE. The Fed will slow the pace of the LSAP, making the full purchase by the end of October instead of mid- September.	5	0.15
(7) QE1 Wednesday 23/09/2009	Type of event: FOMC statement – Reduction of QE. The Fed will slow the purchases of agency MBS and agency debt, finishing the purchases by the end of 2010Q1. Treasury purchases will still be finished by October 2009.	-3	0.85
(8) QE1 Wednesday 04/11/2009	Type of event: FOMC statement– Reduction of QE. The amount of agency debt will be halted at $175 billion, instead of $200 billion.	6	0.12
(9) QE2 Tuesday 10/08/2010	Type of event: FOMC statement – Expansion of QE. The Fed will reinvest principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities. Holdings of Treasury securities will be rolled over as they mature.	NA	0.57
(10) QE2 Friday 27/08/2010	Type of event: Bernanke Speech – Expansion of QE. Bernanke mentions potential policy options for further easing, including additional purchases of long term securities.	NA	-0.83
(11) QE2 Friday 15/10/2010	Type of event: Bernanke Speech – Expansion of QE. The Fed is prepared to provide additional accommodation if needed to support the economic recovery.	NA	-0.21
(12) QE2 Wednesday 03/11/2010	Type of event: FOMC Statement – Expansion of QE. The Fed will purchase a further $600 billion of longer-term Treasury securities by the end of the second quarter of 2011, a pace of about $75 billion per month.	NA	-0.05

Note: The column "Impact in Gagnon et al. (2010)" reports the estimated impact of each announcement on the 10 year Treasury yield, according to Table 1 in Gagnon et al. (2010). The column "Impact in Wright (2011)" reports the estimated impact of each announcement according to table 5 in Wright (2011). The impact is measured as the first principal component of the intraday change in yields on Treasury futures. The surprises are normalised to have a unit standard deviation and signed so that a positive number represents falling yields.

Table 2 – Summary Statistics for the dependent variables

Variable	Description	Group	Mean	Std. Dev.	Min	Max
Equity Portfolio Inflows	Equity inflows in country i expressed in % of the bond assets invested in country i. Source: EPFR.	United States	0.00	0.19	-1.08	1.23
		Emerging Markets	0.03	0.33	-27.24	25.22
		Advanced Economies	-0.02	0.23	-7.95	12.11
Bond Portfolio Inflows	Bond inflows in country i expressed in % of the bond assets invested in country i. Source: EPFR.	United States	0.03	0.07	-0.28	0.27
		Emerging Markets	0.03	0.24	-3.04	3.27
		Advanced Economies	0.00	0.24	-7.99	5.35
Equity Returns	Local equity market daily returns (in %). For EMEs Datastream Total Market indexes, for the US S&P500 index. Source: Datastream.	United States	-0.01	1.68	-9.41	10.90
		Emerging Markets	0.00	1.72	-19.85	23.17
		Advanced Economies	-0.03	1.64	-14.42	16.05
Change in Bond Yields	Daily differences of the 10 year Goverment Bond yield. Source: Datastream.	United States	0.00	0.07	-0.47	0.27
		Emerging Markets	0.00	0.41	-22.85	22.85
		Advanced Economies	0.00	0.45	-9.37	9.37
FX Returns	Daily returns of the bilateral exchange rate with the USD and daily returns of the Nominal Effective Exchange Rate for the US (in %, positive valued indicate appreciation of the USD in all cases). Source: Datastream.	United States	-0.01	0.41	-2.69	1.80
		Emerging Markets	0.00	0.85	-16.45	69.32
		Advanced Economies	-0.01	0.81	-7.07	9.11

Note: The list of the countries included in the sample is in table A1 in the Annex.

Table 3 – Summary Statistics for monetary policy related variables and other control variables

Variable	Description	Mean	Std. Dev.	Min	Max
QE I Annoucements (AN1) *,**	Dummy variable equal to 1 on the day on the announcement and on the day following the announcement, for the following annoucements: event 1, 3, 4 and 5 (see table 1)			0	1
QE II Annoucements (AN2) *,**	Dummy variable equal to 1 on the day on the announcement and on the day following the announcement, for the following annoucements: event 10,11 and 12 (see table 1)			0	1
Liquidity (LQ) *,**	Change in the amount outstanding of unconventional liquidity operations and support measures to key credit markets between week t and week t-1. The weekly change is split evenly among the days of the week. Scale: USD billions. Source: FED.	0.6343	45.2220	-157.5550	332.0070
Treasuries (TR) *,**	Change in the amount outstanding of long term Treasury bonds related to the LSAP between week t and week t-1. The weekly change is split evenly among the days of the week. Scale: USD billions. Source: FED.	4.7714	8.5951	-6.7710	39.6820
MBS (MBS) *,**	Change in the amount outstanding of MBS and GSE debt related to the LSAP between week t and week t-1. Scale: USD billions. The weekly change is split evenly among the days of the week. Source: FED.	4.3581	17.6430	-14.5840	162.5400
VIX *	VIX Implied volatility on options on the S&P 500 Index (in %). Source: CBOE via Datastream.	26.0262	11.8466	9.8900	80.8600
Change in VIX **	Daily differences of VIX	0.0059	2.3843	-17.3600	16.5400
US 10y Bond Yield *	Yield of the the10 year Treasury Bond in the US (in %). Source: Datastream.	3.6769	0.7056	2.0810	5.2490
Change in US 10y Bond Yield **	Daily differences of US 10 year Bond yield	-0.0013	0.0724	-0.4700	0.3520
Liquidity Spread *	Overnight Swap Index 3 month rate minus the 3 month T-Bill yield in the US (in %). Source: Datastream	0.3008	0.3341	-0.1250	1.8130
Change in Liquidity Spread **	Daily differences of the "Liquidity Spread"	-0.0002	0.0898	-1.1020	0.9205
3 month T-bill yield	Yield of the the 3 month Treasury Bill in the US (in %). Source: Datastream.	1.4960	1.8028	0.0050	5.1830
S&P500 Returns *,**	Daily returns of the S&P 500 index (in %)	0.0029	1.6973	-9.0350	11.5800
Local Equity Returns *, **	Local equity market dailyreturns (in %). For EMEs Datastream Total Market indexes, for the US S&P500 index. Source: Datastream.	-0.0076	1.6819	-9.4087	10.9019
Change in the G10 Surprise Index	Daily change in the Economic Surprise Index for the G10. Source: Citigroup.	0.0105	3.5845	-18.0000	16.5000
Change in the EME Surprise Index	Daily change in the Economic Surprise Index for Emerging Markets. Source: Citigroup.	-0.0106	6.1701	-30.2000	41.4000

Note: * Indicates that the variable is included in the benchmark model for portfolio flows. ** Indicates that the variable is included in the benchmark model for equity returns, bond yields and exchange rate returns. When included in the model, variables that are not related to monetary policy are lagged by one period.

Table 4 – Channels of Transmission of Fed unconventional policy measures

	portfolio decisions / flows				prices / yields			
	US		**EMEs**		**US**		**EMEs**	
	equity	bonds	equity	bonds	equity	bonds	equity	bonds
1. Portfolio balance channel	+	−	+	+ ?	+	−	+	− ?
2. Signaling channel	+	−	+	−	+	−	+	−
3. Confidence channel								
flight to safety -- country/US	+	+	−	−	+	−	−	+
flight to safety -- asset class	−	+	−	+ ?	−	−	−	− ?
4. Liquidity/market channel	+ ?	+	− ?	− ?	+ ?	−	?	?

Note: The table shows the priors for the sign of the effects of the various Fed operations, i.e. liquidity operations, and purchases of Treasury securities and MBS, under different channels. As discussed in the text, announcements work somewhat differently, at least with regard to private sector portfolio decisions, as e.g. they do not change the supply of available bond securities.

Table 5– Stylised facts of QE announcements and asset prices

A. United States

	Change in S&P 500 Index	Change in 10y yield	Change in NEER
QE 1	4.19	-0.34	-0.41
QE 2	-4.94	-0.27	0.15
QE 3	4.18	-0.33	-2.46
QE 4	0.04	0.30	0.24
QE 5	0.79	-0.40	-2.90
QE 6	1.84	-0.11	-0.77
QE 7	-1.96	-0.07	0.68
QE 8	2.03	0.06	-0.52
QE 9	-3.41	-0.15	1.16
QE 10	0.19	0.05	0.18
QE 11	0.93	0.01	0.34
QE 12	2.30	-0.13	-0.70
QE I (1 to 5)	4.17	-1.04 ***	-5.37 ***
QE I (1,3,4,5)	9.15 **	-0.78 ***	-5.52 ***
QEII (9 to 12)	-0.09	-0.21	1.02
QEII (10,11,12)	3.36	-0.06	-0.15

B. Emerging Markets

	Change in the local equity price index	Change in 10y yield	Change in FX USD
QE 1	1.60	-0.18	-0.34
QE 2	-2.03	-0.12	0.51
QE 3	1.53	-0.06	-1.64
QE 4	0.28	-0.04	0.63
QE 5	1.52	-0.02	-1.52
QE 6	0.88	0.02	-0.52
QE 7	0.09	-0.04	0.18
QE 8	1.21	-0.03	-0.61
QE 9	-1.30	-0.04	0.99
QE 10	0.56	-0.01	0.10
QE 11	-0.05	0.01	0.29
QE 12	1.33	-0.02	-0.57
QE I (1 to 5)	2.89 ***	-0.69 **	-2.93 ***
QE I (1,3,4,5)	5.07 ***	-0.48	-3.52 ***
QEII (9 to 12)	0.43	-0.08	0.93 **
QEII (10,11,12)	1.86 ***	-0.02	-0.25

Table 5 (continued)

C. Advanced Economies

	Change in the local equity price index	Change in 10y yield	Change in FX USD
QE 1	1.26	-0.11	-0.24
QE 2	-3.56	-0.15	0.37
QE 3	0.75	-0.17	-4.30
QE 4	0.94	-0.07	1.27
QE 5	0.92	-0.12	-4.45
QE 6	1.87	-0.01	-1.09
QE 7	-1.12	-0.05	0.66
QE 8	2.20	0.07	-0.98
QE 9	-2.83	-0.02	2.08
QE 10	0.83	0.01	0.04
QE 11	0.00	0.02	0.41
QE 12	0.69	0.00	-1.20
QE I (1 to 5)	0.28	-0.63 ***	-7.65 ***
QE I (1,3,4,5)	3.86 ***	-0.48 ***	-8.06 ***
QE II (9 to 12)	-1.33	0.02	1.47 ***
QE II (10,11,12)	1.51 **	0.04	-0.74 *

Note: Cumulated impact over the two days following each of the announcements (upper part of the table) and cumulated impact of different groups of announcements (the number in the parenthesis indicate the events included in the group – see table 1 for details). More specifically, the cumulated impact for the groups of announcements has been calculated using the following regression:

$$y_t = c + \beta D + \varepsilon_t$$

Where "D" is a dummy equal to 1 on the day of the announcements and on the day following the announcements included in the group. To capture the cumulated effect of the group of announcements, the coefficient β has been multiplied by the number of observations in which the dummy is equal to 1. "***", "**" and "*" indicate significance at the 1%, 5% and 10% confidence level respectively.

Table 6: Impact of Fed unconventional monetary policy measures – Portfolio allocations and capital flows

	Dependent variable: inflows in Equity Funds						Dependent variable: inflows in Bond Funds					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	$\gamma_{EME}=0$	$\gamma_{AE}=0$	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN1)	0.44802 ***	0.04111 *	0.08289 ***	***	***		0.23752 ***	-0.08502 ***	0.08410 **	***	***	***
	(.01839)	(.022)	(.02097)				(.01872)	(.01879)	(.03823)			
QE II Announcements (AN2)	0.00831	0.14094 ***	-0.00445	***		***	-0.20395 ***	0.02930 **	-0.06269 **	***	***	***
	(.0101)	(.0192)	(.0167)				(.00944)	(.01406)	(.0239)			
Liquidity (LQ)	0.00247 ***	-0.00077 ***	0.00068 **	***	***	***	0.00173 ***	-0.00232 ***	0.00033	***	***	***
	(.00015)	(.00027)	(.00029)				(.00014)	(.00017)	(.00024)			
Treasuries (TR)	-0.00128 *	0.00621 ***	0.00003	***		***	-0.01851 ***	-0.01988 ***	-0.00392 **		***	***
	(.00077)	(.00108)	(.00133)				(.00057)	(.00121)	(.00176)			
MBS (MBS)	-0.00209 ***	0.00045	0.00042	***	***		0.00419 ***	0.00434 ***	0.00478 ***			
	(.00016)	(.0006)	(.00037)				(.00012)	(.0004)	(.00046)			
Controls	Yes						Yes					
Fixed Effects	Yes						Yes					
Number of Observations	56084						54429					
R-Squared	0.03						0.25					

Note: Estimated impact of the different monetary policy instruments on portfolio flows according to the following equation (1):

$$y_{i,t} = E_{i,t-1}\left[y_{i,t} \right] + (\beta + \gamma^{EME} D_i^{EME} + \gamma^{AE} D_i^{AE})MP_t + \varepsilon_{i,t} \qquad (1)$$

$$\text{with} \quad MP_t = [AN1_t, AN2_t, LQ_t, TR_t, MBS_t]'$$

The dependent variable is indicated at the top of the table. Control variables for portfolio flows: VIX(t-1), Liquidity spread(t-1), US 10 year yield (t-1) and S&P 500 returns (t-1). The description of the dependent and explanatory variables is in table 2 and 3. Sample period: January 2007 to December 2010, daily observations. Column "β" reports the estimated impact of monetary policy instruments on US flows, while column "$\beta + \gamma^{EME}$" ("$\beta + \gamma^{AE}$") reports the estimated impact of monetary policy instruments on flows into emerging markets (advanced economies). Standard errors of the coefficients are reported in parenthesis. Column "γ^{EME}" ("γ^{AE}") indicates the significance of the parameter γ i.e. it tests whether the impact on emerging markets (advanced economies) is statistically different from the impact on the US. Finally "γ^{EME}" -"γ^{AE}", indicates whether the coefficients "γ^{EME}" and "γ^{AE}" are statistically different. "***", "**" and "*" indicate significance at the 1%, 5% and 10% confidence level respectively.

Table 7: Impact of Fed unconventional monetary policy measures – Equity returns and government bond yields

	Dependent variable: Equity returns						Dependent variable: Change in 10 year bond yields					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN1)	1.08812 ***	-0.08615	-0.42340 **	***	***		-0.16317 ***	-0.12211 *	-0.05923 *		**	
	(.09322)	*(.20506)*	*(.16762)*				*(.01141)*	*(.07099)*	*(.0346)*			
QE II Announcements (AN2)	0.96743 ***	0.37365 ***	0.44304 ***	***	***		-0.02050 ***	-0.00386	-0.01777	*		
	(.01607)	*(.12271)*	*(.07349)*				*(.00192)*	*(.00837)*	*(.01807)*			
Liquidity (LQ)	-0.01411 ***	-0.01434 ***	-0.01363 ***				-0.00037 ***	0.00126	-0.00027 ***		***	
	(.0002)	*(.00143)*	*(.00157)*				*(.00002)*	*(.00125)*	*(.00004)*			
Treasuries (TR)	0.02542 ***	0.03043 ***	0.03203 ***				0.00234 ***	-0.00158	0.00007	**	***	
	(.00103)	*(.00622)*	*(.00417)*				*(.00009)*	*(.0018)*	*(.00076)*			
MBS (MBS)	-0.00528 ***	-0.00081	-0.00203	***	*		0.00007 *	-0.00041	-0.00029			
	(.00018)	*(.00153)*	*(.00169)*				*(.00004)*	*(.00065)*	*(.00022)*			
Controls	Yes						Yes					
Fixed Effects	Yes						Yes					
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Note: See note to table 6. Control variables for equity returns and bond yields: change in VIX(t-1), change in the Liquidity spread(t-1), change in the US 10 year yield (t-1) and S&P 500 returns (t-1).

Table 8: Impact of Fed unconventional monetary policy measures – Exchange rates

	Dependent variable: exchange rate return (positive vlues mean appreciation of the USD)					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN1)	-0.84485 ***	-0.21177	-1.45310 ***	***	***	***
	(.05801)	(.12946)	(.07388)			
QE II Announcements (AN2)	-0.06209 ***	-0.08910 ***	-0.28847 ***		***	***
	(.00426)	(.03308)	(.05537)			
Liquidity (LQ)	0.00378 ***	0.00523 ***	0.00435 ***			
	(.00008)	(.00096)	(.00067)			
Treasuries (TR)	-0.00899 ***	-0.00492 **	-0.00892 ***	*		
	(.00037)	(.00229)	(.00147)			
MBS (MBS)	0.00427 ***	0.00274 **	-0.00055		***	***
	(.0001)	(.00115)	(.00047)			
Controls	Yes					
Fixed Effects	Yes					
Number of Observations	59205					
R-Squared	0.04					

Note: See note to table 6. Control variables for exchange rate returns: change in VIX(t-1), change in the Liquidity spread(t-1), change in the US 10 year yield (t-1) and S&P 500 returns (t-1). Note that positive values always indicate the appreciation of the USD.

Table 9: Economic significance – Cumulated impact of Fed policy measures – "Peak" impact

A. Portfolio allocations and capital flows

	Equity Funds			Bond Funds		
	US	EME	AE	US	EME	AE
Total Impact of QE I Announcements						
In % Assets	1.80%	0.16%	0.33%	0.95%	-0.35%	0.34%
In Million USD (according to EPFR)	18,630	383	1,417	4,249	-123	231
In Million USD (according to IMF CPIS)		1,474	8,780		-592	4,575
Total Impact of QE II Announcements						
In % Assets	0.02%	0.42%	-0.01%	-0.61%	0.09%	-0.19%
In Million USD (according to EPFR)	333	2,914	-107	-6,008	96	-348
In Million USD (according to IMF CPIS)		3,844	-355		145	-2,534
Total Impact of Liquidity Operations						
In % Assets	4.88%	-1.46%	1.29%	3.33%	-4.37%	0.62%
In Million USD (according to EPFR)	62,451	-5,067	7,396	14,354	-2,256	481
In Million USD (according to IMF CPIS)					-7,338	8,457
Total Impact of Treasury Purchases						
In % Assets	-0.80%	3.45%	0.01%	-9.73%	-10.52%	-2.04%
In Million USD (according to EPFR)	-11,136	17,725	38	-75,417	-8,210	-2,666
In Million USD (according to IMF CPIS)		31,365	158		-17,666	-27,888
Total Impact of MBS Purchases						
In % Assets	-2.67%	0.61%	0.54%	5.54%	5.80%	6.31%
In Million USD (according to EPFR)	-33,105	2,464	3,030	32,816	2,793	5,675
In Million USD (according to IMF CPIS)					9,740	86,069

B. Asset prices and exchange rates

	Equity prices			Bond yields		
	US	EME	AE	US	EME	AE
Total Impact of QE I Announcements	4.30%	-0.34%	-1.68%	-0.66	-0.48	-0.25
Total Impact of QE II Announcements	2.93%	1.12%	1.33%	-0.07	-0.01	-0.06
Total Impact of Liquidity Operations	-23.56%	-23.90%	-22.87%	-0.69	2.45	-0.69
Total Impact of Treasury Purchases	15.08%	18.31%	18.25%	1.31	-0.87	0.11
Total Impact of MBS Purchases	-6.61%	-1.03%	-2.58%	0.11	-0.57	-0.41

	Exchange rate		
	US	EME	AE
Total Impact of QE I Announcements	-3.24%	-0.62%	-5.61%
Total Impact of QE II Announcements	-0.19%	-0.30%	-0.94%
Total Impact of Liquidity Operations	7.45%	11.44%	8.39%
Total Impact of Treasury Purchases	-4.83%	-2.89%	-5.78%
Total Impact of MBS Purchases	5.71%	3.88%	-0.11%

Note: Figures in Millions USD. The total impact of each monetary policy instrument is calculated by multiplying the estimated coefficient for the operation (see tables 6 to 8) by the size of the operation at each period t and by cumulating the effect from the beginning of the programme to the day of the maximum expansion of the programme. The maximum expansion of the liquidity support measures was reached at the end of December 2008, while the maximum expansion of MBS purchases was reached at the end of June 2010. Regarding the other monetary policy instruments, the maximum expansion was reached at the end of our sample (December 2010).

Table 10: Economic significance – Cumulated impact of Fed policy measures – Total impact (over entire sample period)
A. Portfolio allocations and capital flows

	Equity Funds			Bond Funds		
	US	EME	AE	US	EME	AE
Total Impact of QE I Announcements						
In % Assets	1.80%	0.16%	0.33%	0.95%	-0.35%	0.34%
In Million USD (according to EPFR)	18,630	383	1,417	4,249	-123	231
In Million USD (according to IMF CPIS)		1,474	8,780		-592	4,575
Total Impact of QE II Announcements						
In % Assets	0.02%	0.42%	-0.01%	-0.61%	0.09%	-0.19%
In Million USD (according to EPFR)	333	2,914	-107	-6,008	96	-348
In Million USD (according to IMF CPIS)		3,844	-355		145	-2,534
Total Impact of Liquidity Operations						
In % Assets	0.44%	-0.13%	0.12%	-0.29%	-0.40%	0.06%
In Million USD (according to EPFR)	12,305	-345	1,491	-2,193	-476	20
In Million USD (according to IMF CPIS)		-1,226	3,112		-668	753
Total Impact of Treasury Purchases						
In % Assets	-0.80%	3.45%	0.01%	-9.73%	-10.52%	-2.04%
In Million USD (according to EPFR)	-11,136	17,725	38	-75,417	-8,210	-2,666
In Million USD (according to IMF CPIS)		31,365	158		-17,666	-27,888
Total Impact of MBS Purchases						
In % Assets	-2.38%	0.54%	0.49%	4.92%	5.13%	5.59%
In Million USD (according to EPFR)	-28,197	1,995	2,536	26,977	2,100	4,379
In Million USD (according to IMF CPIS)		4,917	12,927		8,616	76,297
Total impact of all operations						
In % Assets	-0.91%	4.45%	0.93%	-4.76%	-6.05%	3.75%
In Million USD (according to EPFR)	-8,065	22,672	5,376	-52,391	-6,614	1,617
In Million USD (according to IMF CPIS)		40,374	24,622		-10,165	51,203
Total flows						
In % Assets	-4.64%	25.43%	-17.08%	27.33%	33.78%	-3.94%
In Million USD (according to EPFR)	-41,222	130,015	-133,251	177,783	31,541	16,422
In Million USD (according to IMF CPIS)		230,923	-452,651		56,726	-53,742

B. Asset prices and exchange rates

	Equity prices			Bond yields		
	US	EME	AE	US	EME	AE
Total Impact of QE I Announcements	4.30%	-0.34%	-1.68%	-0.66	-0.48	-0.25
Total Impact of QE II Announcements	2.93%	1.12%	1.33%	-0.07	-0.01	-0.06
Total Impact of Liquidity Operations	-2.11%	-2.15%	-2.00%	-0.06	0.19	-0.05
Total Impact of Treasury Purchases	15.08%	18.31%	18.25%	1.31	-0.87	0.11
Total Impact of MBS Purchases	-5.90%	-0.92%	-2.31%	0.09	-0.52	-0.37
Total impact of all operations	14.30%	16.02%	13.59%	0.63	-1.70	-0.62
Total cumulated change over the period	-20.31%	-0.41%	-35.08%	-1.4	-0.23	0.25

	Exchange rate		
	US	EME	AE
Total Impact of QE I Announcements	-3.24%	-0.62%	-5.61%
Total Impact of QE II Announcements	-0.19%	-0.30%	-0.94%
Total Impact of Liquidity Operations	0.54%	0.81%	0.61%
Total Impact of Treasury Purchases	-4.83%	-2.89%	-5.78%
Total Impact of MBS Purchases	5.07%	3.45%	-0.69%
Total impact of all operations	-2.65%	0.45%	-12.41%
Total cumulated change over the period	-8.79%	4.24%	-7.31%

Note: see note to table 9. The total impact of each monetary policy instrument is calculated by multiplying the estimated coefficient for the operation (see tables 6 to 8) by the size of the operation at each period t and by cumulating the effect from the beginning of the programme to December 2010. Flows based on CPIS data are computed on the basis of the stock of portfolio investment by US residents in the target group of countries (i.e. EMEs and AEs) as of end of 2009.

Table 11: Alternative model specifications – Additional control variables

Dependent variable:	Inflows in Equity Funds						Inflows in Bond Funds					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	$\gamma_{EME}=0$	$\gamma_{AE}=0$	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	0.44599 ***	0.03908 *	0.08086 ***	***	***		0.23431 ***	-0.08819 ***	0.08079 **	***	***	***
QE II Announcements (AN)	0.00729	0.13990 ***	-0.00547	***		***	-0.20577 ***	0.02751 *	-0.06450 ***	***	***	***
Liquidity (LQ)	0.00246 ***	-0.00078 ***	0.00067 **	***	***	***	0.00171 ***	-0.00235 ***	0.00031	***	***	***
Treasuries (TR)	-0.00141 *	0.00608 ***	-0.00010	***		***	-0.01853 ***	-0.01990 ***	-0.00394 **		***	***
MBS (MBS)	-0.00212 ***	0.00042	0.00038	***	***		0.00419 ***	0.00433 ***	0.00478 ***			
Number of Observations	56084						54429					
R-Squared	0.03						0.25					

Dependent variable:	Equity returns						Change in 10 year bond yields					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	1.09831 ***	-0.07597	-0.41327 **	***	***		-0.16317 ***	-0.12211 *	-0.05923 *		**	
QE II Announcements (AN)	0.97287 ***	0.37908 ***	0.44850 ***	***	***		-0.02050 ***	-0.00386	-0.01777	*		
Liquidity (LQ)	-0.01389 ***	-0.01412 ***	-0.01341 ***				-0.00037 ***	0.00126	-0.00027 ***			***
Treasuries (TR)	0.02369 ***	0.02870 ***	0.03028 ***				0.00234 ***	-0.00158	0.00007	**	***	
MBS (MBS)	-0.00573 ***	-0.00125	-0.00247	***	*		0.00007 *	-0.00041	-0.00029			
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Dependent variable:	exchange rate return (positive means appreciation of the USD)					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	-0.83597 ***	-0.20288	-1.44421 ***	***	***	***
QE II Announcements (AN)	-0.05981 ***	-0.08685 **	-0.28619 ***		***	***
Liquidity (LQ)	0.00393 ***	0.00538 ***	0.00451 ***			
Treasuries (TR)	-0.00981 ***	-0.00575 **	-0.00974 ***	*		
MBS (MBS)	0.00410 ***	0.00256 **	-0.00072		***	***
Number of Observations	59205					
R-Squared	0.04					

Note: see note to table 6 to 8. Fixed effects and control variables as in the benchmark model unless specified differently. Contemporaneous economic surprise indexes in the G10 and in EMEs added to the benchmark specification.

Table 12: Alternative model specifications – Random Effects

Dependent variable:	Inflows in Equity Funds						Inflows in Bond Funds					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	$\gamma_{EME}=0$	$\gamma_{AE}=0$	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	0.44683 ***	0.04349 *	0.07965 ***	**	**		0.23862 ***	-0.08380 ***	0.08229 **	***	*	***
QE II Announcements (AN)	0.00625	0.14447 ***	-0.00955	***		***	-0.20261 ***	0.03144	-0.06616 ***	***	***	***
Liquidity (LQ)	0.00245 ***	-0.00075 **	0.00064 ***	***	***	***	0.00174 ***	-0.00231 ***	0.00031 *	***	***	***
Treasuries (TR)	-0.00161	0.00674 ***	-0.00079	**		***	-0.01831 ***	-0.01957 ***	-0.00444 ***		***	***
MBS (MBS)	-0.00215	0.00056	0.00025				0.00424 ***	0.00440 ***	0.00468 ***			
Number of Observations	56084						54429					
R-Squared	0.03						0.15					

Dependent variable:	Equity returns						Change in 10 year bond yields					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	1.09614	-0.11137	-0.48459 *				-0.16660	-0.12211	-0.05958			
QE II Announcements (AN)	0.95754	0.36222 ***	0.42538 ***				-0.02589	-0.00352	-0.01801			
Liquidity (LQ)	-0.01413	-0.01420 ***	-0.01373 ***				-0.00040	0.00126 **	-0.00027	***		**
Treasuries (TR)	0.02462	0.03066 ***	0.02123 ***				0.00150	-0.00147	0.00002			
MBS (MBS)	-0.00542	-0.00054	-0.00375				-0.00010	-0.00037	-0.00031			
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Dependent variable:	exchange rate return (positive means appreciation of the USD)					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	-0.85631	-0.21193	-1.45208 ***			
QE II Announcements (AN)	-0.08016	-0.08951	-0.28687 **			
Liquidity (LQ)	0.00367 **	0.00522 ***	0.00436 ***			
Treasuries (TR)	-0.01178	-0.00500	-0.00867 **			
MBS (MBS)	0.00371	0.00272 **	-0.00050			
Number of Observations	59205					
R-Squared	0.04					

Note: see note to table 11. Benchmark model estimated with random effects (control variables as in the benchmark model in tables 6 to 8).

Table 13: Alternative model specifications – Lagged monetary policy operations

Dependent variable:	Inflows in Equity Funds						Inflows in Bond Funds					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	$\gamma_{EME}=0$	$\gamma_{AE}=0$	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	0.38780 ***	0.05772 ***	0.07211 ***	***	***		0.22502 ***	0.00719	0.11333 ***	***	***	***
QE II Announcements (AN)	0.01038	0.14411 ***	-0.00127	***		***	-0.17735 ***	0.05032 ***	-0.04248 *	***	***	***
Liquidity (LQ)	0.00174 ***	-0.00095 ***	0.00054 *	***	***	***	0.00168 ***	-0.00431 ***	-0.00054 *	***	***	***
Treasuries (TR)	-0.00416 ***	0.00670 ***	-0.00049	***	***	***	-0.01727 ***	-0.01940 ***	-0.00409 **	**	***	***
MBS (MBS)	-0.00204 ***	0.00090	0.00060	***	***		0.00453 ***	0.00336 ***	0.00443 ***	***		
Number of Observations	56084						54429					
R-Squared	0..03						0.26					

Dependent variable:	Equity returns						Change in 10 year bond yields					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	1.29944 ***	0.14008	-0.20950	***	***		-0.17019 ***	-0.14145 *	-0.04845		**	
QE II Announcements (AN)	0.96534 ***	0.39517 ***	0.46140 ***	***	***		-0.01381 ***	-0.00373	-0.02394			
Liquidity (LQ)	-0.01062 ***	-0.01196 ***	-0.01251 ***				0.00003	0.00041	0.00002			
Treasuries (TR)	0.03066 ***	0.03336 ***	0.02965 ***				0.00129 ***	-0.00277	0.00158 **			
MBS (MBS)	-0.00569 ***	0.00401 ***	0.00219	***	***		0.00150 ***	-0.00038	-0.00164	**	**	
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Dependent variable:	exchange rate return (positive means appreciation of the USD)					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	-0.84280 ***	-0.23371 *	-1.49869 ***	***	***	***
QE II Announcements (AN)	-0.06799 ***	-0.09650 ***	-0.29001 ***		***	***
Liquidity (LQ)	0.00137 ***	0.00111 *	0.00082			
Treasuries (TR)	-0.01418 ***	-0.01059 ***	-0.01582 ***			*
MBS (MBS)	0.00232 ***	0.00104	-0.00128 **		***	*
Number of Observations	59205					
R-Squared	0.03					

Note: see note to table 11. Contemporaneous monetary policy operations replaced by the one period lagged monetary policy operations; otherwise as in the benchmark model.

Table 14: Alternative model specifications – Asymmetric impact of monetary policy operations

Dependent variable:	Inflows in Equity Funds						Inflows in Bond Funds					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	$\gamma_{EME}=0$	$\gamma_{AE}=0$	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	0.46195 ***	0.05162 **	0.07466 ***	***	***		0.21529 ***	-0.04644 ***	0.06145 *	***	***	***
QE II Announcements (AN)	0.06052 ***	0.11795 ***	0.01711	***	***	***	-0.08788 ***	0.03080 ***	-0.02903	***	***	**
Liquidity (LQ)	0.00398 ***	-0.00008	0.00267 ***	***	***	***	0.00560 ***	-0.00223 ***	0.00313 ***	***	***	***
Treasuries (TR)	0.00074	0.00246 **	-0.00230		**	**	-0.01411 ***	-0.01747 ***	-0.00560 ***	***	***	***
MBS (MBS)	-0.00300 ***	0.00133 **	0.00042	***	***		0.00187 ***	0.00440 ***	0.00441 ***	***	***	
Number of Observations	56084						54429					
R-Squared	0..03						0.26					

Dependent variable:	Equity returns						Change in 10 year bond yields					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	1.32454 ***	-0.02193	-0.31871 *	***	***		-0.16043 ***	-0.12578	-0.05603		**	
QE II Announcements (AN)	0.81252 ***	0.23950 *	0.31729 ***	***	***		-0.02951 ***	-0.00007	-0.02277	***		
Liquidity (LQ)	-0.02504 ***	-0.01834 ***	-0.01912 ***	***	***		-0.00060 ***	0.00148	-0.00047 ***		***	
Treasuries (TR)	0.03665 ***	0.02619 ***	0.03222 ***				0.00192 ***	-0.00163	-0.00002		**	
MBS (MBS)	-0.00319 ***	0.00190	-0.00006	***	*		0.00026 ***	-0.00045	-0.00022		*	
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Dependent variable:	exchange rate return (positive means appreciation of the USD)					
	β	$\beta + \gamma_{EME}$	$\beta + \gamma_{AE}$	γ_{EME}	γ_{AE}	$\gamma_{EME}-\gamma_{AE}=0$
QE I Announcements (AN)	-0.90001 ***	-0.28432 **	-1.49625 ***	***	***	***
QE II Announcements (AN)	0.02718 ***	-0.00345	-0.12369 **		**	*
Liquidity (LQ)	0.00696 ***	0.00911 ***	0.00829 ***			
Treasuries (TR)	-0.00597 ***	-0.00322	0.00294		***	*
MBS (MBS)	0.00275 ***	0.00154	-0.00325 ***		***	***
Number of Observations	59205					
R-Squared	0.04					

Note: see note to table 11. Differentiation between expansionary and tightening monetary policy operations. Only the coefficients of expansionary monetary policy operations are reported; otherwise as in the benchmark model.

Table 15: Alternative model specifications – Impact on the day of the release of the Fed Balance sheet

Dependent variable:	Inflows in Equity Funds						Inflows in Bond Funds					
	β	β + γEME	β + γAE	γEME=0	γAE=0	γEME-γAE=0	β	β + γEME	β + γAE	γEME	γAE	γEME-γAE=0
QE I Announcements (AN)	0.39623 ***	0.05557 ***	0.07079 ***	***	***		0.27037 ***	-0.06570 ***	0.08748 **	***	***	***
QE II Announcements (AN)	0.01519	0.13466 ***	-0.01004	***	*	***	-0.21636 ***	0.02006	-0.07244 ***	***	***	***
Liquidity (LQ)	0.00309 ***	-0.00025	0.00061	***	***	*	0.00190 ***	-0.00233 ***	-0.00032	***	***	***
Treasuries (TR)	0.00171 **	0.00597 ***	-0.00044	*		**	-0.01498 ***	-0.01830 ***	-0.00386 **	***	***	***
MBS (MBS)	0.00259 ***	-0.00053	0.00126	***			0.00318 ***	0.00306 ***	0.00383 ***			
Number of Observations	56084						54429					
R-Squared	0.02						0.02					

Dependent variable:	Equity returns						Change in 10 year bond yields					
	β	β + γEME	β + γAE	γEME	γAE	γEME-γAE=0	β	β + γEME	β + γAE	γEME	γAE	γEME-γAE=0
QE I Announcements (AN)	1.10673 ***	-0.16071	-0.50177 ***	***	***		-0.16112 ***	-0.13310 *	-0.04677		*	
QE II Announcements (AN)	0.98134 ***	0.39788 ***	0.45745 ***	***	***		-0.02014 ***	-0.00264	-0.01694	**		
Liquidity (LQ)	-0.02774 ***	-0.01718 ***	-0.02629 ***	***		**	-0.00067 ***	0.00088	0.00043			
Treasuries (TR)	0.09651 ***	0.05850 ***	0.07806 ***	***	**	*	0.00492 ***	-0.00141	0.00151 ***	***	***	
MBS (MBS)	-0.02003 ***	-0.00320	-0.01110 ***	***	***	*	-0.00039 ***	0.00038	-0.00052			
Number of Observations	56062						48825					
R-Squared	0.08						0.01					

Dependent variable:	exchange rate return (positive means appreciation of the USD)					
	β	β + γEME	β + γAE	γEME	γAE	γEME-γAE=0
QE I Announcements (AN)	-0.71391 ***	-0.15965	-1.26222 ***	***	***	***
QE II Announcements (AN)	-0.09405 ***	-0.10730 ***	-0.32205 ***		***	***
Liquidity (LQ)	0.00409 ***	0.00699 ***	0.00270 **	*		**
Treasuries (TR)	-0.02446 ***	-0.03203 ***	-0.03822 ***		***	
MBS (MBS)	-0.00284 ***	0.00169	-0.01273 ***	*	***	***
Number of Observations	59205					
R-Squared	0.04					

Note: see note to table 11. The change in the amounts outstanding of the different operations is included only on the day the information is made available, it is zero elsewhere; otherwise as in the benchmark model.

Figure 1. Unconventional operations in the balance sheet of the Fed.
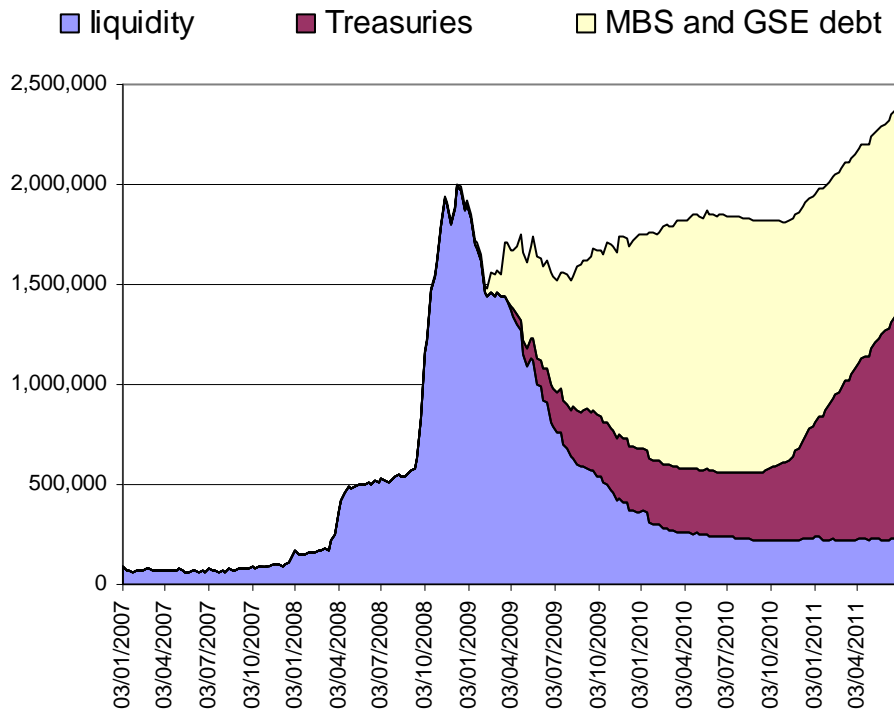
Source: Federal Reserve.
Note: Amounts outstanding in USD millions.

Figure 2: Cumulated effects of US monetary policy measures on portfolio investment
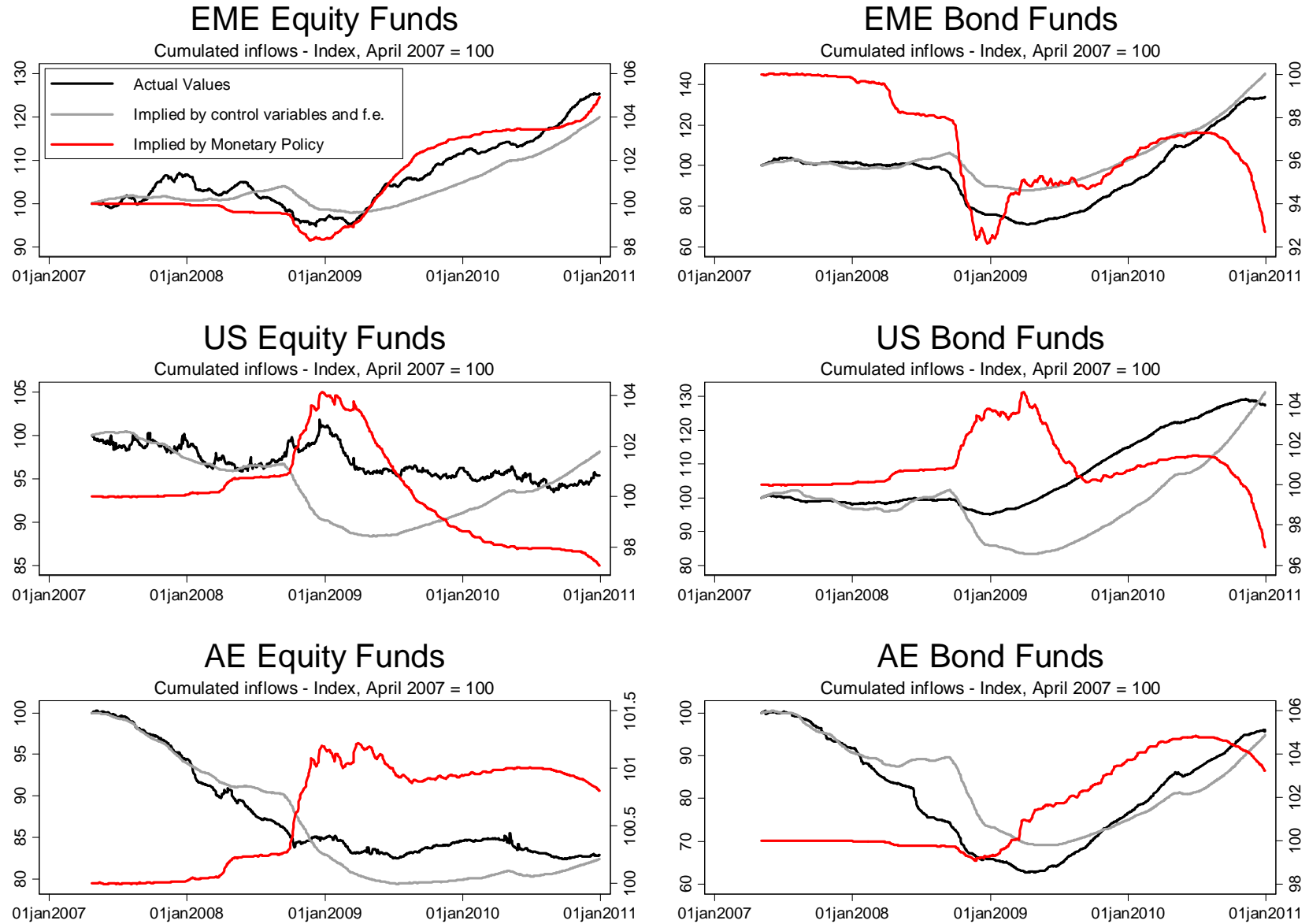

EME Equity Funds
Cumulated inflows - Index, April 2007 = 100

— Actual Values
— Implied by control variables and f.e.
— Implied by Monetary Policy

EME Bond Funds
Cumulated inflows - Index, April 2007 = 100

US Equity Funds
Cumulated inflows - Index, April 2007 = 100

US Bond Funds
Cumulated inflows - Index, April 2007 = 100

AE Equity Funds
Cumulated inflows - Index, April 2007 = 100

AE Bond Funds
Cumulated inflows - Index, April 2007 = 100

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Figure 3: Correlation between the effects of US monetary policy measures and the effects of other control variables on portfolio flows
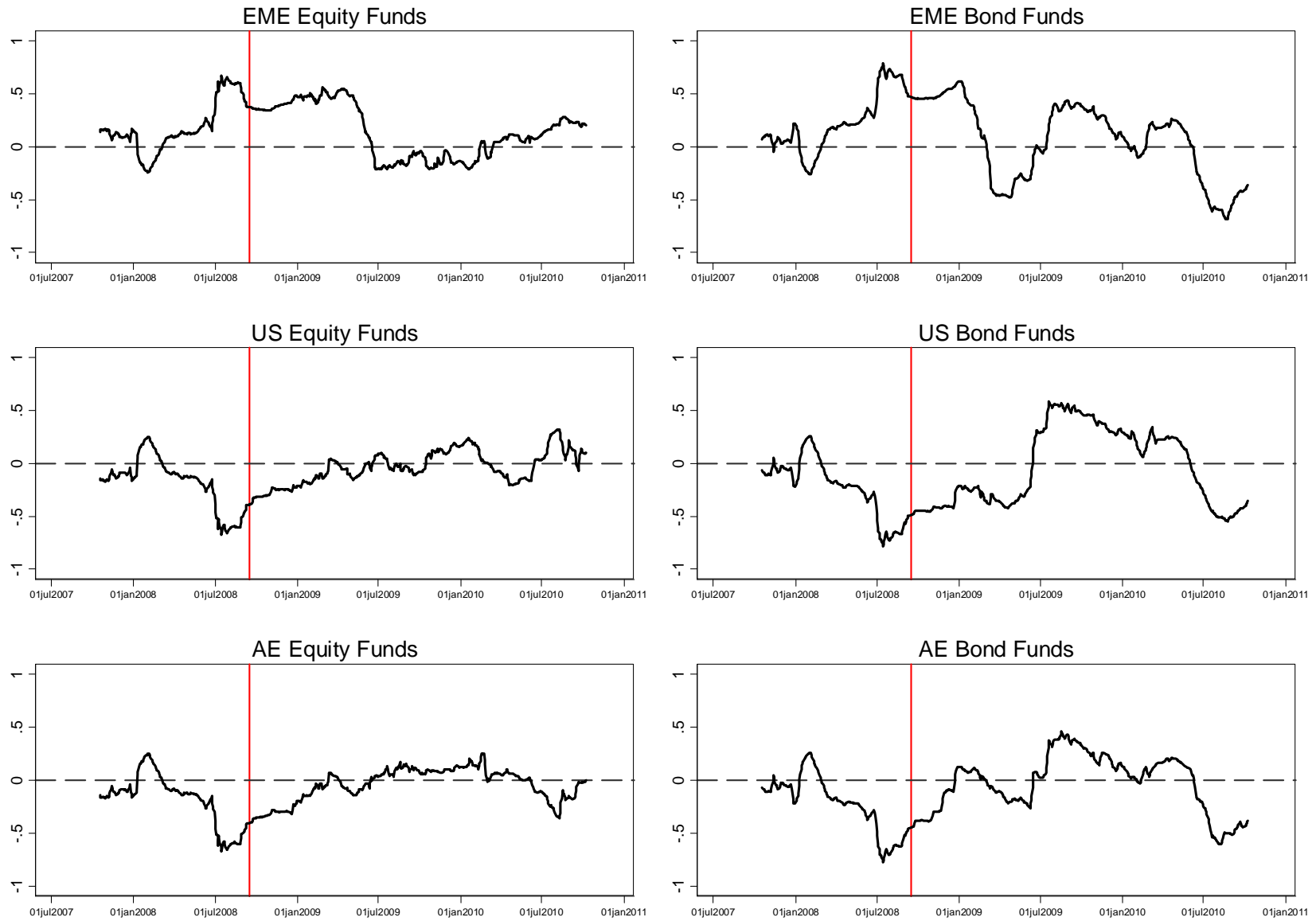
Note: the correlation is calculated over a 6 month centred rolling window.

Figure 4: Cross-country heterogeneity in impact of Fed policy measures – portfolio flows & asset prices

A. Equity and Bond flows: total impact of QE I announcements
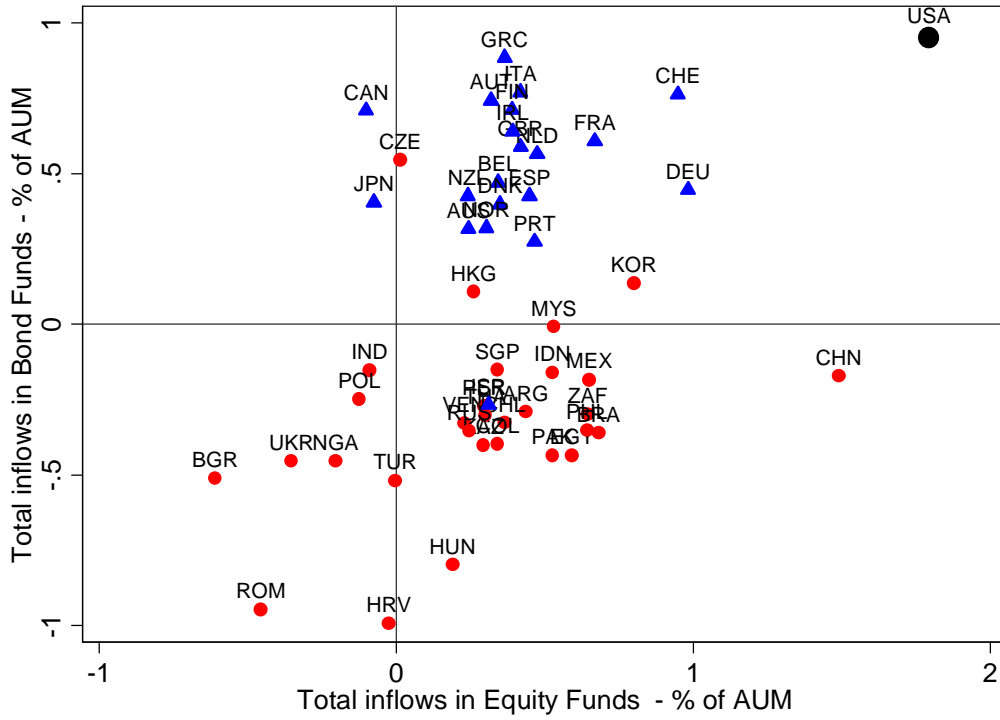
B. Equity and Bond flows: total impact of QE II announcements
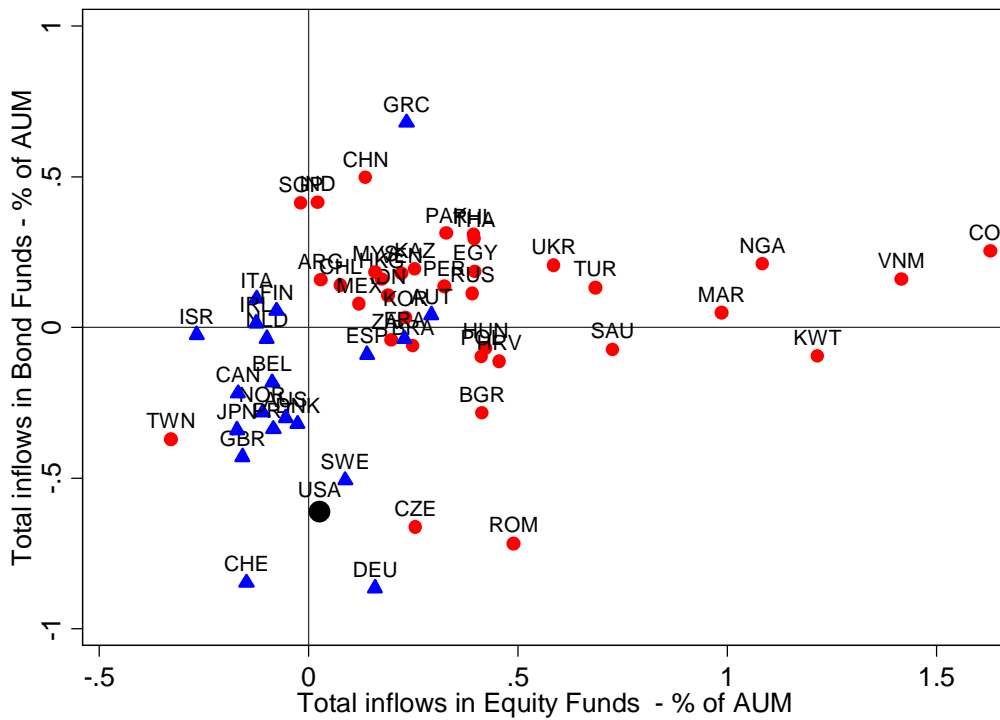
C. Equity and Bond flows: Impact of liquidity operations at the maximum expansion of the programme
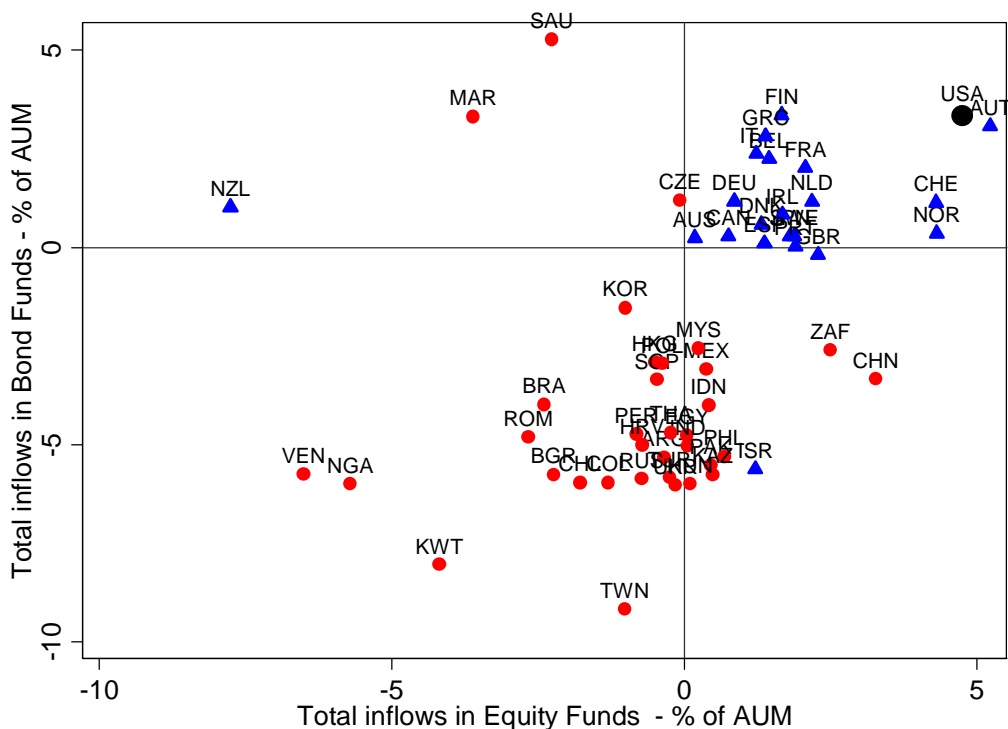
D. Equity and Bond flows: Impact of treasury purchases at the maximum expansion of the programme

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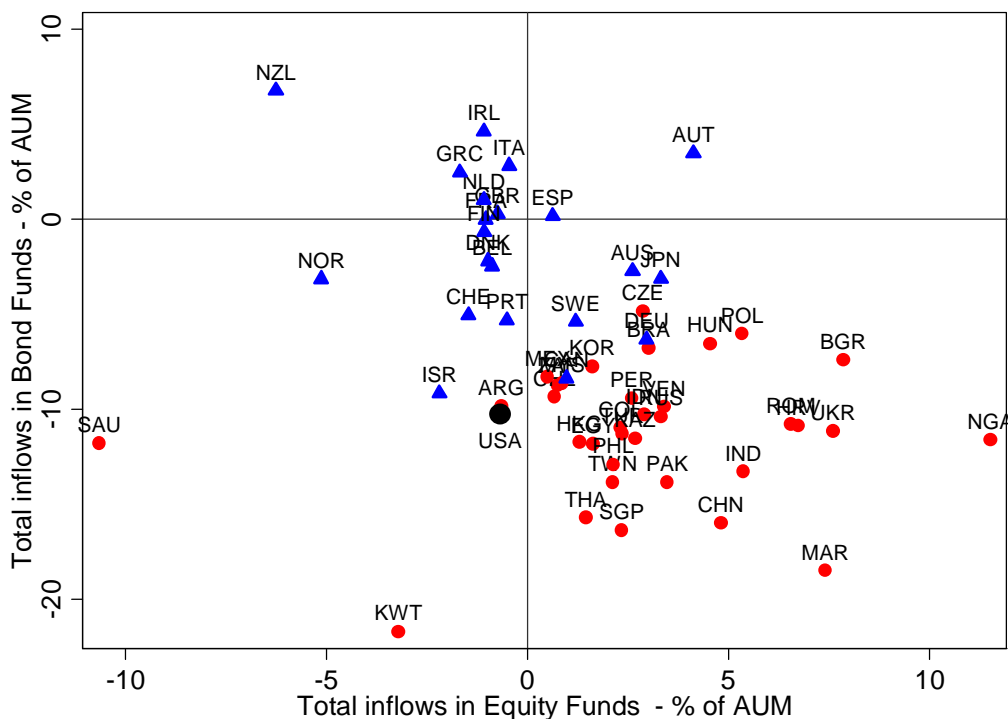
Figure 5: Cross-country heterogeneity in impact of Fed policy measures – asset prices

A. Equity prices and Bond yields: total impact of QE I announcements
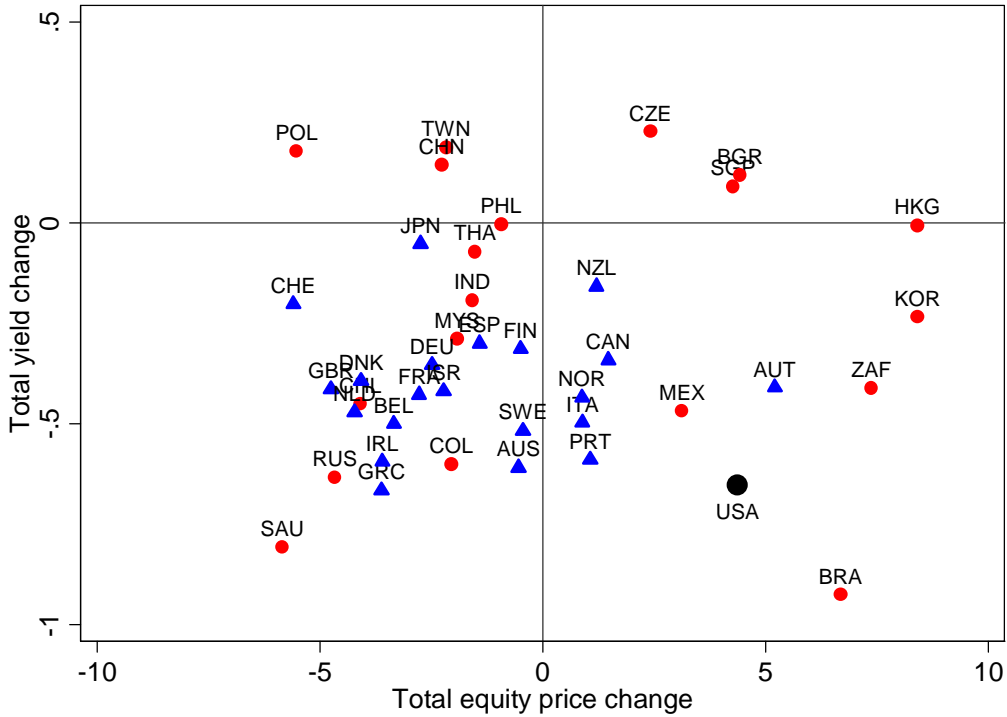
B. Equity prices and Bond yields: total impact of QE II announcements
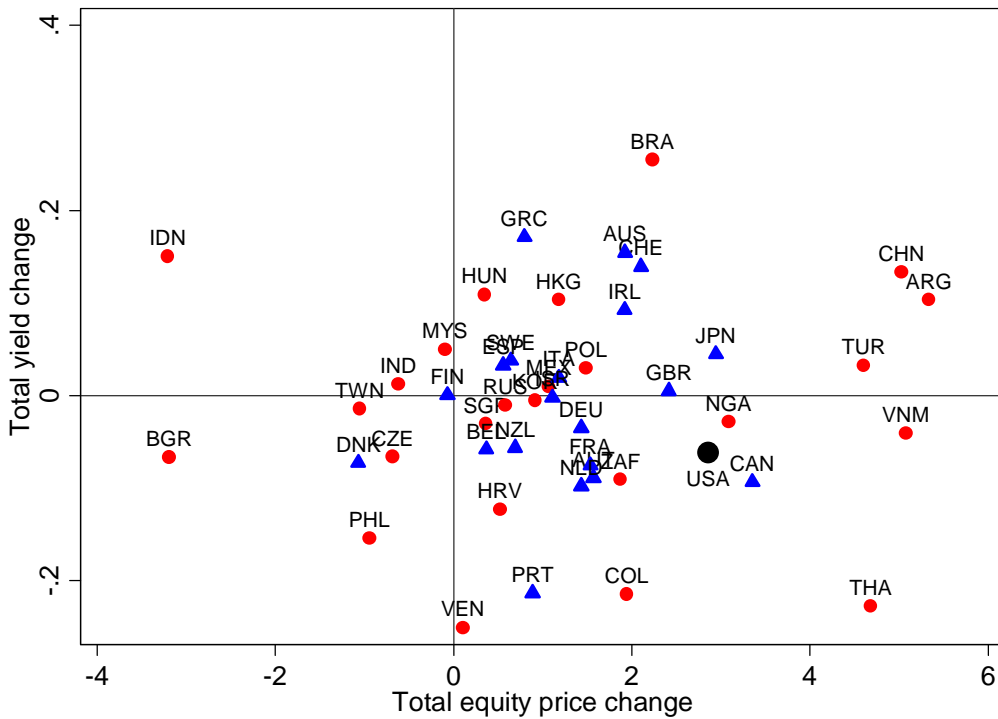
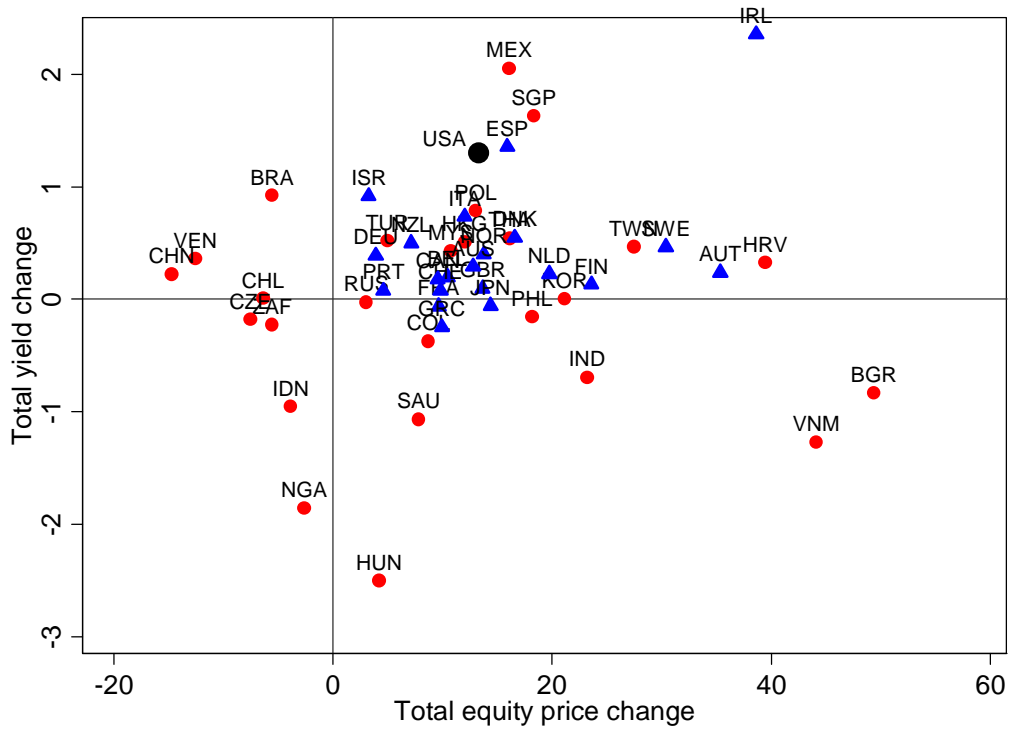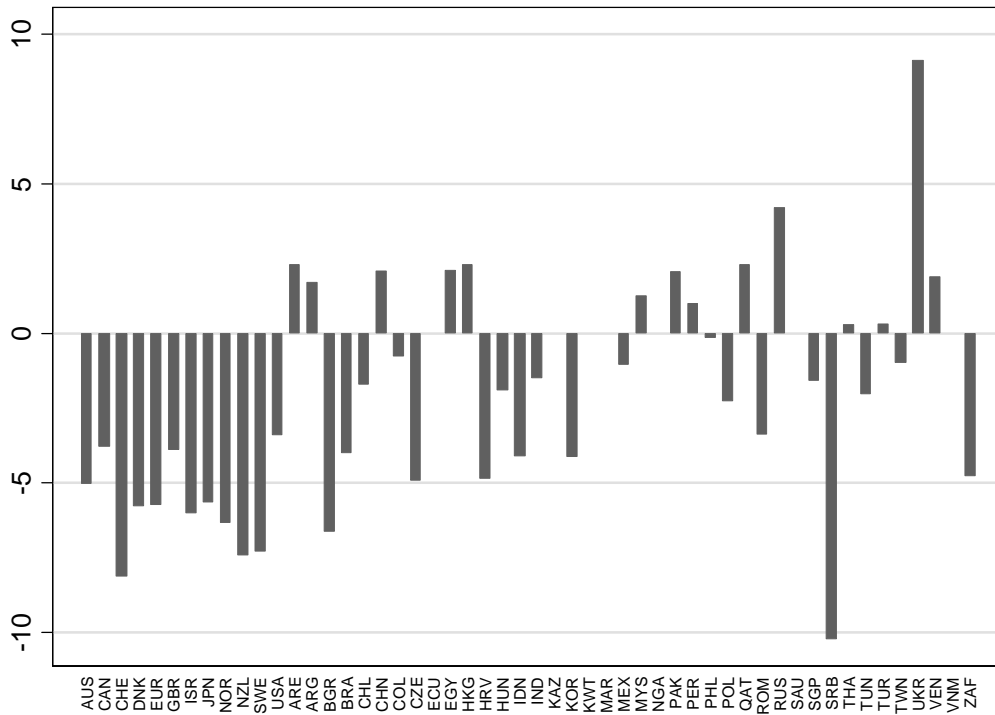**C. Equity prices and Bond yields: Impact of treasury purchases at the maximum expansion of the programme**
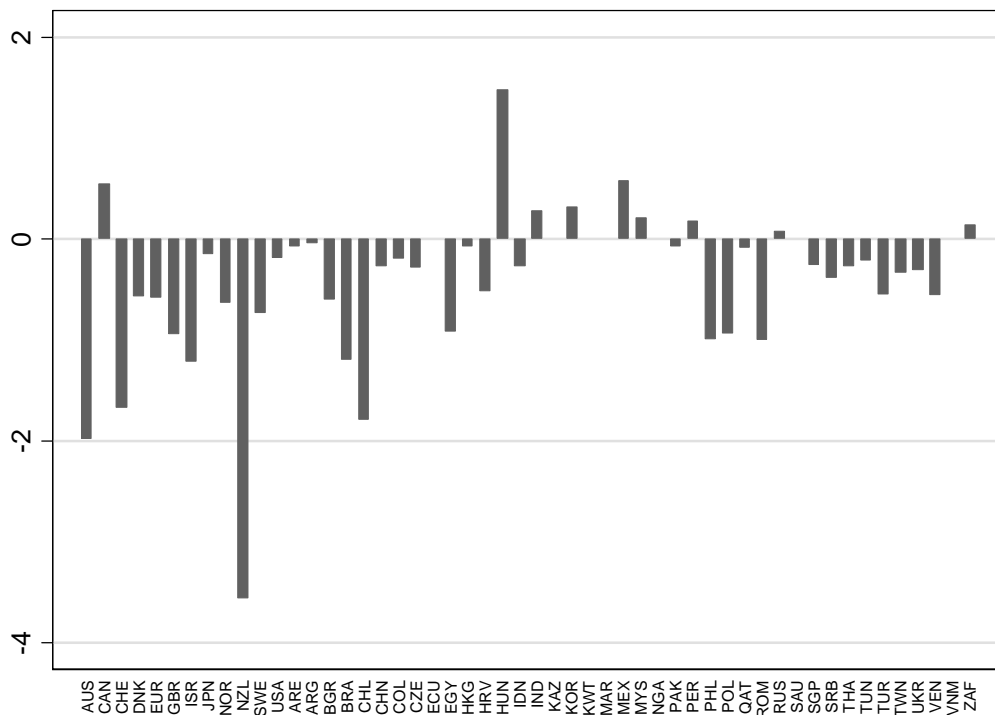
Figure 6: Cross-country heterogeneity in impact of Fed policy measures – exchange rates
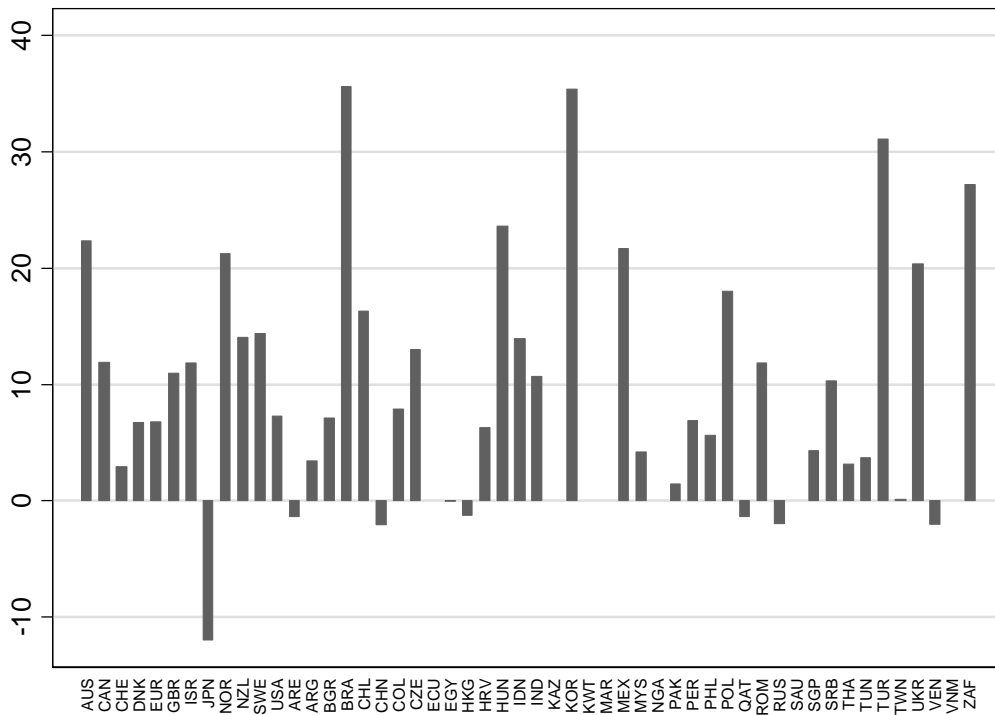
A. Exchange rate (total USD appreciation in %): total impact of QE I announcements
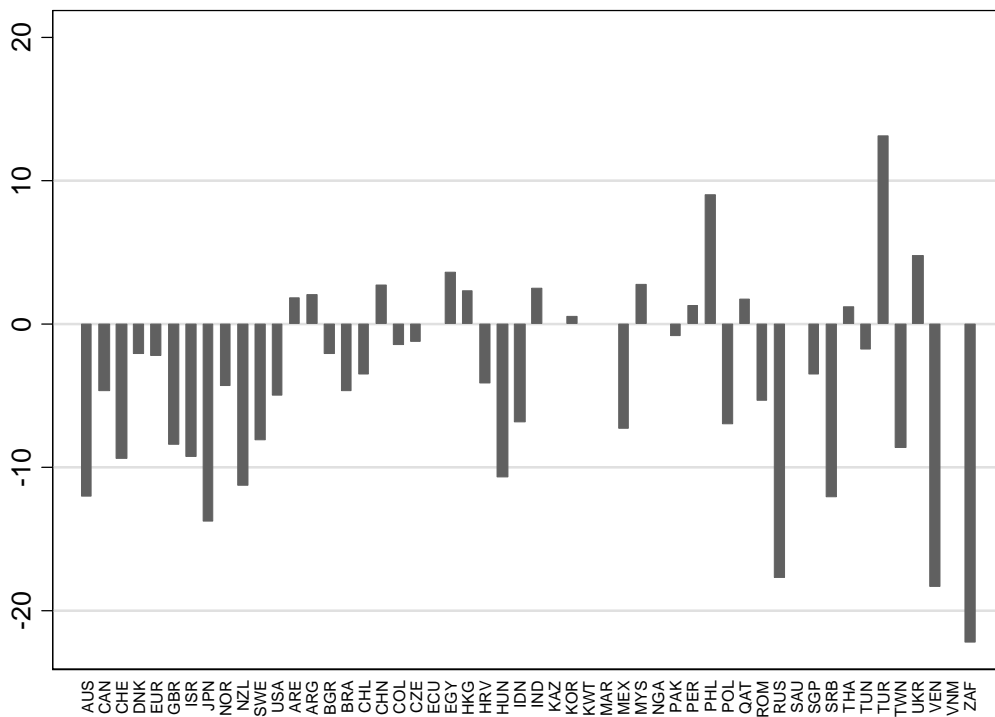

B. Exchange rate (total USD appreciation in %): total impact of QE II announcements

C. Exchange rate (total USD appreciation in %): Impact of liquidity operations at the maximum expansion of the programme

D. Exchange rate (total USD appreciation in %): Impact of treasury purchases at the maximum expansion of the programme

ANNEX

Table A1: countries included in the sample

Emerging Markets		Advanced Economies	
Argentina	ARG	Australia	AUS
Brazil	BRA	Austria	AUT
Bulgaria	BGR	Belgium	BEL
Chile	CHL	Canada	CAN
China	CHN	Denmark	DNK
Colombia	COL	Finland	FIN
Croatia	HRV	France	FRA
Czech Republic	CZE	Germany	DEU
Ecuador	ECU	Greece	GRC
Egypt	EGY	Ireland	IRL
Estonia	EST	Israel	ISR
Hong Kong	HKG	Italy	ITA
Hungary	HUN	Japan	JPN
India	IND	Netherlands	NLD
Indonesia	IDN	New Zealand	NZL
Kazakhstan	KAZ	Norway	NOR
Korea	KOR	Spain	ESP
Kuwait	KWT	Sweden	SWE
Latvia	LVA	Switzerland	CHE
Lithuania	LTU	UK	GBR
Malaysia	MYS	USA	USA
Mexico	MEX		
Morocco	MAR		
Nigeria	NGA		
Pakistan	PAK		
Peru	PER		
Philippines	PHL		
Poland	POL		
Romania	ROM		
Russia	RUS		
Saudi Arabia	SAU		
Serbia	SRB		
Singapore	SGP		
Slovak Republic	SVK		
Slovenia	SVN		
South Africa	ZAF		
Taiwan	TWN		
Thailand	THA		
Turkey	TUR		
Ukraine	UKR		
Venezuela, Rep. Bol.	VEN		
Vietnam	VNM		