The impact of quantitative easing on aggregate mutual fund flows in the UK

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Abstract

This paper examines the relationship between the Bank of England's asset purchase programme (March 2009 to November 2012) and aggregate mutual fund allocation. The key findings of the paper are that *retail* investors increased fund allocation in low risk asset funds and tended to withdraw from high risk asset funds. In the aggregate, *institutional* investors reallocated, in a more nuanced way, within the mutual fund market towards riskier asset classes.

Keywords: Aggregate mutual fund flows, portfolio reallocation, quantitative easing
JEL classification: G11, G14, E52, E58

1. Introduction

Central bank asset purchases have been a major monetary policy tool in the US and the UK and, more recently, in the Eurozone. The purpose of these programmes broadened from initially alleviating financial market distress to achieving inflation targets, stimulating the real economy and containing the European sovereign debt crisis. To date, considerable research has been conducted on the effects of these programmes on financial markets and the wider economy. More recently, Carpenter *et al*. (2015) for the USA and Joyce *et al.* (2014) for the UK analyse investors' portfolio allocation in response to QE.

This paper adds to the literature on investors' response to quantitative easing (QE) (Joyce *et al*., 2014; Carpenter *et al*., 2015) in that it examines whether the asset purchasing programmes by the Bank of England changed *mutual* fund investors' portfolio allocation in the UK. A vast literature suggests three channels through which central bank asset purchases may affect asset prices: the portfolio rebalancing, the signalling and liquidity channels (for instance, Volume 28, No. 4 of the *Oxford Review of Economic Policy* and the references therein is dedicated to unconventional monetary policy). The Bank of England used central bank money to purchase mainly medium to long-term gilts from the private sector. These gilts are less close substitutes for money and thus the Bank's asset purchases altered the characteristics of investors' portfolios. In order to rebalance these portfolios, investors will seek to re-invest the money they hold searching for higher return assets which are relatively cheaper than government bonds. According to the signalling channel, asset purchases send a signal to investors that lowers market expectations about future monetary policy (Bauer and Rudebusch, 2011; Christensen and Rudebusch, 2012). In addition to the signalling effect, the purchases by the Bank as a significant buyer in the market may improve market functioning and reduce liquidity premia since investors will find it easier to sell when required.

Ultimately, to which extent these three channels can change asset prices and investor behaviour is an empirical matter.[1] Joyce *et al*. (2011) and Kapetanios et al (2012) for the UK and Gagnon *et al.* (2011) and Chen *et al*. (2012) for the USA find that the first QE programme reduced long-term bond yields. Joyce *et al*. (2014) find that institutional investors rebalance their portfolio by replacing gilts with corporate bonds. Carpenter *et al*. (2015) contend that various types of investors adjust their portfolios in a way that is consistent with the portfolio rebalancing channel and the preferred habitat theory. Lutz

[1] For instance, Woodford (2012) disputes the importance of the transmission channels.

(2015) concludes that unexpected expansionary monetary policy increases exchanges between stock and bond mutual funds. These arguments lend some credibility to the notion that unconventional monetary policy may affect mutual fund flows.

Knowing how investors adjust their portfolios provides some guidance on how monetary policy is transmitted to fund investors. By analysing the net inflows into mutual fund classes with different risks, it can be uncovered whether investors (in the aggregate) responded to the Bank's asset purchase programme by withdrawing investment from less risky and switching towards more risky assets, a response that would be expected if the unconventional monetary policy transmission channels operated. Evaluating investors' preferences could also provide some guidance as to how an unwinding of the QE programmes may affect mutual fund flows. These results can be beneficial for the efficient management of mutual funds. This is important for individual funds, but also for the stability of the financial system. In particular, the Financial Policy Committee (2015) of the Bank of England has expressed concerns that large scale redemptions by mutual fund investors could test market liquidity.

This paper distinguishes between investment decisions by institutional and retail investors. The vast literature on trading behaviour of investor groups finds distinctive behaviour in fund allocation between individual and institutional investors (e.g., Barber and Odean, 2000; Barber *et al.*, 2008); Grinblatt and Kehoharju, 2000; Frazzini and Lamont, 2008). Mahani and Potesham (2008) find that individual investors tend to overreact to news. Carpenter *et al*. (2015) find that after selling to the Fed, not all investor types rebalance their portfolios and there is no uniformity of asset types into which those investors that do rebalance, invest. A major question of the analysis is whether the two types of investors responded differently to the asset purchase programmes.

In addition, a comparison of the response of institutional and retail investors may show whether the Bank's asset purchases had distributional effects. Most of the UK mutual fund investment is by individual investors and various studies indicate that households may have incurred loss in income due to quantitative easing. For instance, the Bank of England (2012) is concerned with the distributional effects of its asset purchase programme on savers and annuitants and concedes that the rise in the price of a range of assets has boosted the value of households' financial wealth held outside pension funds, although holdings are highly skewed with the top 5% holding 40% of these assets. Similarly, Bullard (2014) finds for the US that the Fed's asset purchases reduced real yields on relative safe assets and encouraged savers to move to more risky assets such as equity. But only half of the households in the US hold equity which tend to be the wealthier households so that wealth distribution may have become more unequal. Dobbs, *et al*. (2013) suggest that as a result of low rates in the US, UK and the euro area, households have lost a combined $630 billion in income as lower interest earned on deposits and other fixed income investment has outweighed lower interest payment on debt. Qualitatively similar results were found by Saikia and Frost (2014) for Japan.

The Investment Management Association (IMA) obtains monthly mutual fund flows for different categories of fund assets and whether these flows were placed through individual or institutional channels. To investigate the effect of asset purchases on fund flows, aggregate monthly net fund flows into a wider range of mutual fund asset classes are related to the two asset purchase programmes (from March 2009 until January 2010 and from October 2011 until November 2012) launched by the Bank of England and to a set of control variables which have been relevant to driving portfolio allocation. Quantitative Easing may have worked by having reduced the inflow into low risk asset funds below, and increased flows into riskier asset classes above, what they otherwise would have been. This

issue is addressed by conducting a counterfactual analysis as suggested by Pesaran and Smith (2012) and Joyce *et al.* (2014).
Results suggest that overall QE affected mutual fund flows. In line with early results by Goodhart and Ashworth (2012), I find diminishing effects from the second asset purchase programme. Furthermore, QE impacted differently on institutional and retail investment flows. At the beginning of QE, institutional investors rebalanced their portfolios *between* mutual funds' asset classes from low return to higher return fund asset classes, thus increasing risk and compensating for losses from the general fall in returns during QE. There is no evidence that retail investors did the same *within* the mutual fund industry. The implication is that retail investors may have been better off if their investment strategy had followed that of their institutional counterparts.
The rest of the paper is structured as follows. Section 2 discusses the empirical methodology, Section 3 outlines the data, Section 4 analyses the results and Section 5 concludes.

2. *Empirical Methodology*

I estimate single equation regressions for mutual fund net flows of varying asset classes using a three - step approach. In the first step, principal component analysis (PCA) is applied to extract a set of latent factors that capture the dynamics of mutual fund flows. Instead of selecting a few regressors that are thought to capture the financial and macroeconomic dynamics of the target variable, Stock and Watson (2002) suggest pooling the information of all potentially useful variables using PCA and, in a second step, using the estimated factors for regressing the outcome variable. [2] They find that the predictions of the target variable are improved compared to a variety of other models. More specifically, it is assumed that mutual fund flows are affected by the Bank of England's asset purchasing programme, which is the vector of observed factors, and the from the PCA derived latent factors. In the second step, standard single equation regressions that include the key QE variables and the latent factors are estimated, from which the effects of QE on fund flows are identified. Finally, a counterfactual analysis is conducted.
In a recent paper, Pesaran and Smith (2012) argue that a full structural model is not always necessary when the aim is to evaluate the effect of a policy change. Instead they suggest a model where the outcome variable y_t is conditional on the policy variable x_t and a set of control variables w_t where w_t is independent of the policy change. They distinguish between control variables z_t that may not be invariant to policy changes and a set of control variables w_t which affect z_t and y_t, but which are invariant to changes in the policy variable x_t.
The policy reduced form equation for y_t is given as:

$$y_t = \pi x_t + \lambda w_t + v_t \quad (1)$$

I follow Joyce *et al.* (2014) in selecting US macroeconomic and financial variables as well as debt issuance by the Debt Management Office as control variables w_t. These variables are independent of Bank of England's intervention but are determinants of y_t that have spill-over effects to the UK and may also have been affected by monetary policy in the USA. However, I use instead of selected control variables w_t the principal components estimated from a broad range of US financial and macroeconomic variables. More specifically, there are 107 US variables plus the mutual fund flow variables that are used to estimate five

[2] See also for instance, Bernanke *et al.* (2005), Bovin *et al.* (2009).

principal components. The US variables, their transformations and the choice of the number of principal components are from Lutz (2015, see appendix).[3]

To explain the net fund flows into different asset classes, the basic model is based on (Joyce *et al.,* 2014):

$$y_t^k = \beta_0^k + \pi x_t + \lambda_1^k control_t + \lambda_2^k gilt_t^{out} + \sum_1^4 \beta_i^k y_{t-i}^k + v_t^k \qquad (2)$$

Where y_t^k is the net inflow into mutual funds with asset class *k* at time *t*, x_t is the percentage change in gilts bought by the Bank during the two QE periods and is split into two periods, QE1 (from March 2009 until January 2010) and QE2 (from October 2011 until November 2012) to measure the relative size effect of each asset purchase programme on mutual fund flows. The variable is zero outside the QE periods. The variable $control_t$ stands for the five latent factors and $gilt_t^{out}$ is the percentage change in outstanding gilts issued by the Debt Management Office. Additionally, the lagged dependent variable up to order 4 to account for inertia in the adjustment process is included. The lag length was determined by the Akaike information criterion. As in Joyce *et al.* (2014) the regression looks to determine the net flow into varying asset classes and thus enables me to examine investors' active portfolio decision making.

Since the principal components in equation (2) are derived, standard errors are better estimated using a bootstrapping algorithm. Since the QE variable is zero during most of the estimation period, this approach is not applicable here and we only report Newey-West adjusted standard errors.

To infer what would have happened to mutual fund flows in the absence of quantitative easing, I conduct the same counterfactual analysis as in Joyce *et al*. (2014). The first analysis measures the ex-ante impact of QE, which is calculated as the difference between the expected QE effects and the expected non-QE policy effects. Both scenarios are estimated with equation (2) over the entire sample period for each asset class:

$$d_{T+h}^{ex-ante} = E(y_{T+h} \mid \mathrm{y}_{T,}\, x_{T+h}, controls_{T,} \Omega_{full}) - E(y_{T+h} \mid \mathrm{y}_{T,}\, x_{T+h}^0, controls_{T,} \Omega_{full}) \quad (3)$$

Where y_{T+h} is the prediction from the model estimated in (2) and where Ω_{full} is the parameter set based on the entire estimation period. The counterfactual with no QE is when $x_{T+h}^0 = 0$. I use the full sample period because there was no QE before March 2009.

The ex-post counterfactual is calculated as the difference between the realised values of the outcome variable during the QE period and the counterfactual for the outcome variable when there was no QE:

$$d_{T+h}^{ex-post} = y_{T+h} - E(y_{T+h} \mid \mathrm{y}_{T,}\, x_{1T+h}^0, x_{2T+h}^0, controls_{T,} \Omega_{\mathrm{sub}}) \quad (4)$$

The expected no-QE counterfactual is produced using information on the pre-QE sample until February 2009.

3. Data

Monthly net mutual fund flow data from the Investment Management Association (IMA) are available.[4] Mutual funds in the UK are UK-authorised unit trusts and open-ended investment companies (OEICs). IMA members manage about 85% of the fund industry. The IMA obtains fund flow information from its member companies every month. Not all members provide this information and to give some intuitive idea of the data, for instance in December 2010, there were a total of 2,574 UK-authorised funds as members of the IMA

[3] The four sentiment indices in Lutz (2015) are not included in w_t.

[4] For data and further information see www.investmentuk.org.

and the IMA collected data of 2,483 of these funds (IMA Survey, 2010/11). The information is collected live and historical data are not discarded, so that there is no survivorship bias. The IMA captures asset management activity in the UK on behalf of domestic and overseas clients (IMA Survey, 2014). It provides gross and net flows for different categories of assets and whether these flows were placed through retail or institutional channels. The IMA distinguishes between the following client types: Pension Fund, Insurance Company, Other Institutional, Retail Client and Private Client. 18% (441 funds) are purely institutional funds which means that they must have a minimum lump sum of £50,000 (IMA Survey, 2010/11). The category 'Other Institutional' has grown recently from about 14% in 2005 to about 20% in 2011. The IMA contends that this is due to the increasing use of pooled vehicles by institutional clients where the end client may be retail but the relationships between managers and sub-managers are essentially institutional IMA Survey, (2010/11).
The broad fund classification by the IMA is equity, bonds, balanced funds, money market funds, property and other. The non-overlapping sub-classifications of these broad categories can be found in the appendix. I combine funds into five asset categories: emerging market equity, equity, which comprises all equity but emerging market equity funds, corporate bond, gilt and money market funds. The classification of the IMA only has one emerging market equity and one money market fund asset class. Here, 'gilts' comprises the IMA classes UK gilts and UK Index Linked Gilts while 'corporate bond' consists of the remaining bond categories (see appendix). These asset classes are chosen because they expose investors to different degrees of risks. If the transmission channels (portfolio rebalancing, signalling and liquidity channel) operated, it is expected that investors in the aggregate reallocate investment from less risky fund asset classes such as money market and gilt funds to more risky classes such as corporate bond and equity classes. Furthermore, since the Bank purchased gilts, the operation of the portfolio rebalancing channel would show in a fall in net inflows into gilt funds and a (similar sized) rise into riskier asset classes. Further, for each asset class I use the data distinguished between institutional and retail investors. Net fund flows are divided by the size of the equity market at the end of the previous month to account for the varying size of the equity market over the sample period (Warther, 1995) and divided by 10^{-4}.
The remaining variables are the Bank of England's purchases of medium and long-term government bonds from March 2009 until January 201202012 (QE1) and October 2011 until November 2012 (QE2). Furthermore, the total amount of gilts outstanding is a control variable which is, like the policy variable measured as a relative change. It is obtained from the Debt Management Office. Further control variables are the 107 US macroeconomic variables from Lutz (2015), who tabulates the variable description, mnemonic, source and transformation. All variables are stationary and the estimation period is from October 1994 until November 2012, the end of the asset purchasing programmes. The definition of the variables and their sources can be found in the appendix.

4. Empirical Analysis
4.1 Descriptive Statistics

In order to analyse the impact of the Bank of England's asset purchase programme on mutual fund allocation, I model fund allocation into the asset classes from, arguably, the highest risk to the lowest risk class: emerging market equity (EME equity), equity (except for emerging market equity), corporate bonds (Corp bonds), gilts and money market funds. If the channels of the asset purchase programme operated, it is expected that investors reduce the flow into safer assets (like gilts and money market assets) and increase flow into corporate bonds and stock. The Bank of England's asset purchasing programme operated

from March 2009 until November 2012. The first asset purchasing programme was the larger of the two, with £200bn, and was from March 2009 until January 2010, while the second programme was smaller with asset purchases of £125bn from October 2011 until November 2012.

Table 1 displays descriptive statistics for net fund flows into the five asset classes. The sample is split into the pre-QE and QE periods. Over both periods, most fund investment is in equity funds, followed by corporate bond funds. During the QE period, mean net fund inflows into these asset classes have been higher in total compared to the mean net inflows in the pre-QE period. During the pre-QE period, all fund asset classes had positive mean and median net inflows. During the later period, there are average net outflows from gilt and money market funds. For instance, during the pre-QE period, the average gilt inflow was 1.7% while from March 2009 until November 2012 average net outflow is calculated as 13.5%.[5] Average net inflow into emerging market equity is about 23% in the first period and about 11% during the QE period. Investment increased relatively in equity and corporate bond funds during the QE period compared to the pre-QE period. Taking these results together, there is some evidence that during the QE period investors allocated funds into riskier asset classes such as equity and corporate bond funds and reduced inflow into less risky funds such as gilt and money market funds. While mean inflows into emerging market equity is higher in the second period, weighted with total fund investment of these asset classes, it is lower than during the earlier period. It appears that investors in general did not regard emerging market equity fund investment as a substitute for gilt and money market fund assets.

Table 1: Descriptive statistics for net fund flows pre-QE period and during QE period in percent

	Flows from October 1994 until February 2009 (pre-QE period)					*Flows from March 2009 until November 2012 (QE period)*				
	EME Equity	Equity	Corp Bond	Gilt	Money Market	EME Equity	Equity	Corp Bond	Gilt	Money Market
Mean	0.0011	0.0319	0.0141	0.0008	0.00003	0.0066	0.0425	0.0202	-0.0082	-0.0004
Median	0.0007	0.0300	0.0117	0.0017	0.0005	0.0062	0.0261	0.0132	-0.0040	-0.0005
STD	0.0041	0.0554	0.0154	0.0110	0.0127	0.0081	0.1006	0.0348	0.0173	0.0067

Note: 'Equity' comprises all equity fund classes but emerging market equity funds.

One of the questions the paper addresses is whether there is a difference between retail and institutional fund investment allocation. If both investor types respond in a similar way to changes in markets, then the correlations between investor types that invest in the same asset class should be positive and high. Another aspect that can be examined is the correlations between asset classes of each investor type which may reveal whether investors in the aggregate reallocate from less risky to riskier assets and vice versa (see for instance, Chalmers *et al.*, 2013).

Table 2 below shows the correlation matrix of net fund flows to broader asset classes for institutional and retail investors over the entire sample period. Overall, flow correlations between funds and investor type are low and only few are significant. The numbers in bold

[5] These are calculated as the individual mean net flows into the five asset class over the sum of the mean flows of all five asset classes, during the respective period.

on the diagonal show the flow correlations between institutional and retail investors for the same fund asset class. The correlations for equity and bond funds are positive and significant between investor profiles, but not significant for money market funds. It appears that with respect to equity and bond fund investment retail and institutional fund investment may be driven by market conditions in the same direction but to quite a different extent. Furthermore, there are only significant correlations between asset classes for retail investors. The correlation between flows into money market and equity funds is negative so that it seems that retail investors reallocate between funds of opposite risk classes. The correlation between money market and bond funds is positive for retail investors. Retail investors may perceive both asset classes as similar in risk. Bonds are fixed income securities and thus provide a known income stream and, additionally, 'All Bonds' include corporate bonds and gilts, where the latter are on the lower risk scale.

Table 2: Correlation matrix of fund flows by institutional and retail investors from September 1994 to December 2012

	All Equity (institutional)	All Bond (institutional)	Money Market (institutional)	All Equity (retail)	All Bond (retail)	Money Market (retail)
All Equity (institutional)	1					
All Bond (institutional)	0.02	1				
Money Market (institutional)	-0.07	-0.01	1			
All Equity (retail)	**0.17***	0.11	0.00	1		
All Bond (retail)	0.09	**0.15***	-0.08	0.09	1	
Money Market (retail)	-0.01	0.06	**0.06**	-0.14*	0.15*	1

Note: 'All Equity' combines emerging market equity and equity funds and 'All Bonds' combines gilt and corporate bond funds. '*' denotes that the correlation coefficient is significant at the 5% level or below.

4.2 Regression Results

4.2.1 The extent of the effect of QE on institutional and retail fund flows

In this section the following questions will be addressed:

- Did the asset purchase programmes by the Bank affect mutual fund flows?
- Did QE affect fund flows by institutional and retail investors in the same way?
- Were both programmes effective to the same extent?

Table 3 displays estimations of net fund flows into the three major fund asset classes: equity, bonds and money market instruments for both retail and institutional investors taken together. The variable 'crises' is a dummy variable that equals one during major financial shocks and zero otherwise. To construct the variable, I use the major financial shocks as

identified in Chalmers *et al.* (2013) and add the turbulent period of the European sovereign debt crisis which was at its height during 2011.[6] The dummy variable serves as a control for shocks, thereby allowing us to assess the general relationship between fund flows and the Bank's unconventional policy. All estimations include lags of the dependent variable (up to order four), US macroeconomic control variables and the growth in the total amount of gilts outstanding (not reported in Table 3). QE1 and QE2 measure the growth of the asset purchases from March 2009 until January 2010 and October 2011 until November 2012, respectively. All coefficients are standardised and standard errors are heteroscedasticity autocorrelated consistent.

Table 3 Regression results on portfolio allocation between major fund asset classes during QE1 and QE2

	All Equity	All Bond	Money Market
QE1	0.074***	-0.029	-0.138***
	(3.41)	(-0.62)	(-2.99)
QE2	-0.100**	0.013	0.008
	(-2.48)	(0.25)	(0.44)
Crises	-0.105*	-0.132*	0.061*
	(-1.67)	(-1.94)	(1.62)
$\bar{R}^2$	0.20	0.36	0.69
DW	2.09	1.93	1.93

Note: The money market equation contains a dummy variable for December 2008 to account for the massive outflow from institutional investors.[7]

If the transmission channel of unconventional monetary policy operated during the Bank of England's asset purchasing programme, we should expect that net fund inflows increased into funds with riskier assets like bonds and equity and net outflows increased from money market funds. During the first round of QE, outflows from money market funds are significant and so are inflows into equity funds. During the second QE period, only the coefficient on equity flows is significant and with an unexpected sign. The coefficient in the bond fund equations is insignificant which may be because the fund class includes a mixture of bonds of different risks. While there is some indication that fund investors withdrew from low return funds and invested in higher return ones, this is only evident during the first QE period. The signs of the coefficients of the 'crises' variable indicate a flight-to-safety and they are significant in all equations, but only marginally.

To analyse the effect of the asset purchasing programme in more detail, the fund asset classes are refined to five distinct ones, arguably in the order of their riskiness: Emerging market equity funds, equity funds (all equity funds except emerging market funds), corporate bond funds, government bond funds and money market funds. Furthermore, investments by institutions and individuals are distinguished.

[6] The Mexican currency crisis (December 1994-February 1995), the Asian currency crisis (July-September 1997), the failure of Long Term Capital Management Hedge Fund (August – October 1998), the 'Crash of 2000' (September – December 2000), the credit crisis (August 2007 – December 2008), the European sovereign debt crisis (January 2011 – December 2011). All crises periods except the last one are from Chalmers *et al.* (2013).

[7] Money market funds managed from the UK and that are IMA members are a very small fraction of those managed outside the UK. They did not suffer the massive outflows over a longer period beginning in September 2008 that their cousins experienced (IMA Survey, 2008 and 2009).

Table 4 Regression results on portfolio allocation between asset classes during QE1 and QE2

A: Institutional Investors					
Variables	EME equity	Equity	Corp bond	Gilt	Money Market
QE1	-0.026	0.042**	0.154*	-0.229***	-0.178***
	(-0.57)	(2.34)	(1.74)	(-3.27)	(-3.74)
QE2	-0.085**	-0.061	-0.046	-0.018	-0.022***
	(-2.05)	(-1.42)	(-1.45)	(-0.18)	(-2.61)
Lag	0.244***	0.161**	0.016	0.044	0.068*
	(3.98)	(2.11)	(0.06)	(0.29)	(1.81)
Gilt outstanding	-0.067	-0.007	0.149***	-0.164***	0.006
	(-0.86)	(-0.11)	(2.57)	(-2.62)	(0.16)
US control	0.669***	0.494*	-0.665*	0.190	0.007
variables	(3.05)	(1.88)	(-1.68)	(0.82)	(0.04)
Long-run impact QE1	-0.034	0.050	0.157	-0.239	-0.191
Long-run impact QE2	-0.112	-0.073	-0.047	-0.019	-0.024
$\beta_{QE1} = \beta_{QE2}$	2.87*	5.74**	7.57***	1.37	9.91***
Observations	218	217	214	214	218
$\bar{R}^2$	0.11	0.02	0.17	0.25	0.71
DW	2.01	2.03	1.96	1.95	1.93
B: Retail Investors					
Variables	EME equity	Equity	Corp bond	Gilt	Money Market
QE1	-0.422***	0.119***	-0.037	-0.030	0.227***
	(-3.23)	(2.75)	(-1.29)	(-0.36)	(4.27)
QE2	-0.055**	-0.012	0.022	-0.118	0.209**
	(-2.04)	(-0.78)	(0.72)	(-1.02)	(2.21)
Lag	0.211*	0.572***	0.765***	0.482***	0.027
	(1.93)	(9.75)	(15.86)	(4.81)	(0.24)
Gilt outstanding	0.042	-0.172***	0.062	0.095	0.032
	(0.91)	(-2.62)	(1.49)	(1.29)	(0.43)
US control	0.461***	0.610***	-0.049	-0.229	-0.414
	(2.53)	(3.31)	(-0.34)	(-1.13)	(-1.44)
Long-run impact QE1	-0.534	0.278	-0.156	-0.056	0.239
Long-run impact QE2	-0.070	-0.028	0.094	-0.228	0.218
$\beta_{QE1} = \beta_{QE2}$	6.47***	8.20***	1.31	0.73	0.53
Observations	218	215	218	216	218
$\bar{R}^2$	0.54	0.45	0.77	0.33	0.11
DW	1.69	2.08	1.90	1.93	2.02

Note: All equations contain an intercept and lags of the dependent variable up to 4th order. 'EME Equity' denotes the net inflow into emerging market equity funds, 'Equity' comprises the net inflow into all equity funds but emerging market equity funds, 'Corp Bond' is net inflows into corporate bond funds, 'Gilt' denote UK government bond funds and 'Money Market' are inflows into money market mutual funds. The money market flow equation for institutional investors has a dummy variable to account for the massive outflow in December 2008. All standard errors are Newey-West adjusted and t-statistics are in brackets. '***', '**' and '*' indicate significance at or below 1%, 5% or 10%, respectively. The results of the Wald test to test for the equality of the coefficients of the two asset purchasing programmes are reported in their Chi-squared version.

Table 4 shows OLS estimations of institutional and retail investors' fund flows into the varying asset classes during QE1 and QE2. The coefficients on 'lags' and 'US control

variables' are the sum of lags up to order four and the sum of the five principal components of the 107 US and the mutual fund flow variables, respectively. 'Gilt outstanding' controls for the issuance of gilts by the Debt Management Office.

Turning first to institutional investors' fund flows, Panel A reveals that during the first asset purchasing programme, institutional investment increased into equity and corporate bond funds and net outflows rose from gilt and money market funds. The greatest outflow comes from gilt funds. Since the Bank bought gilts massively under the first and the largest of the two asset purchasing programmes, the price of gilts rose and institutional investors withdrew investment from gilt funds. The highest inflow is into corporate mutual funds and there is a smaller but also positive significant coefficient on QE1 in the equity fund equation. This is consistent with the idea that institutional investors (in the aggregate) may have rebalanced mutual fund portfolios by withdrawing funds from less risky fund classes and increasing flows into higher return fund classes. There is no significant flow into the emerging market equity class. This may indicate that institutional investors do not consider emerging market equity as a potential substitute for gilt or money market funds.

Turning to the results of the impact of QE2, it is notable that coefficients are generally smaller in the short-run and long-run compared to the QE1 coefficients. QE2 only has a significant negative coefficient in the money market and the emerging market equity fund equations. The Wald test results show that the differences in coefficients between the two QE periods are significant in all equations but the gilt regression. The coefficient of QE2 in the gilt equation is negative and thus in line with the QE1 result, but it is insignificant. The outflow from money market funds is significant but the coefficient is smaller than during QE1. The coefficient of QE2 in the emerging market equity equation is much larger and significantly negative compared to QE1, pointing to a larger reaction to QE2 than QE1 but not to the expected portfolio allocation. The significant outflow from emerging market equity may be related to heightened risk aversion due to the European sovereign debt crisis which was at its height during the second QE period and may have offset or delayed the impact of the asset purchasing programme (Joyce *et al.,* 2014).[8] There is evidence of the portfolio rebalancing channel during QE1 in that institutional aggregate investment flows out of less risky asset classes (gilt and money market funds) into riskier ones (equity funds). This is not so during QE2.

Turning to the analysis of QE on retail investor fund allocation in Panel B, both QE programmes have a positive impact on money market and a negative impact on emerging market equity fund flows. Additionally, there is a positive significant inflow into equity funds during QE1 but its coefficient is relatively small compared to the coefficients on money market fund and emerging market equity fund flows. Neither of the two asset purchasing programmes had an impact on corporate bond and gilt fund flows. While the rise in net equity fund inflows seems to show that retail investors respond to QE by investing more into higher risk assets, the high outflow from the emerging market equity funds and the inflow into the low risk money market funds during both QE periods is inconsistent with the expected workings of the channels of the transmission mechanism of the unconventional policy by the Bank. Furthermore, in contrast to the results of their counterparts, diminishing effects of QE are only significant in both stock equations. Also, in contrast to institutional investment flow, retail investment, particularly into equity, corporate bond and gilt funds seems to be mostly and exclusive w.r.t to the latter two fund classes driven by previous flows into these funds.

[8] It is not obvious how to measure the debt crisis and when the 'crises' dummy variable from Table 3 was included, estimates of the QE2 coefficient and t-statistics did not change materially.

For both investor types, the coefficients on QE1 are higher than on QE2. This may also indicate, that QE2 may have lost effectiveness. The more gilt yields drop, the more they become substitutes for non-interest bearing money so that Bank of England's gilt purchases with central bank money may result in diminishing marginal portfolio rebalancing (Cochrane, 2011; Goodhart and Ashworth, 2012). We included lagged dependent variables to account for the adjustment process so that the long-run coefficients are generally greater than the short-run coefficients, suggesting that the impact of QE increases over time.

In Table 3 the results suggest a general outflow from money market funds during QE1 and no impact from QE2. The more detailed analysis in Table 4 shows however that the investment behaviour of retail and institutional investors is quite different with institutional investors increasing outflow from low return money market funds during QE1 and QE2 while retail investors increase inflows over both QE periods. During QE1 both, retail and institutional investors increase net inflows into equity funds, but the split up into emerging market equity and equity funds shows that investors distinguish between the two types of equity. Both investor types reduce emerging market equity flows, institutional investors only during QE2, however. This may not only indicate that QE2 was less effective than QE1 but perhaps also that emerging market equity is not a substitute for the other asset classes. Lastly, the estimation results of the bond equation in Table 3 revealed no significant impact from either asset purchasing programme. The distinction between institutional and retail investors and the separation of corporate bonds from gilts shows that institutional investors responded to QE1 by investing less in gilt and more in riskier corporate bond funds while retail investment into these fund asset classes is not affected by QE. Overall, the comparison between the results of Tables 3 and 4 stresses the importance of the distinction between retail and institutional investment and the split of the broad fund asset classes into sub-classes of assets with different levels of risk for evaluating the effect of unconventional monetary policy.

It may be suggested to use a multivariate estimation method like for instance seemingly unrelated regression because the estimations contain lagged dependent variables and the error terms between the regressions may be correlated. The coefficient estimates were not materially different from those reported in Table 4 and the null hypothesis of the Breusch-Pagan test of independence for institutional and retail investors could not be rejected.[9]

Retail investors increased flows into lower return funds and withdrew investment from higher return asset fund classes during both QE periods. This investment strategy appears to have provided retail investors on average with lower fund returns than they may have achieved had they followed their institutional counterparts. Consequently, retail fund investment experienced during both QE periods a lower wealth effect compared to institutional investment. However, the relative loss in wealth may have been mitigated if retail investors had for instances reallocated funds from, let us say, bank and building society deposits in search of higher yields into money market mutual funds. There is no data available that would allow such an analysis. At least, the Office for National Statistics has conducted a 'Wealth and Asset Survey' since 2006 from which data on the financial asset allocation of households in Great Britain can be obtained. [10] While the data here is only indicative, Table 5 shows household allocation of formal financial assets approximately

[9] The probability level of the Breusch-Pagan test is 0.029.

[10] More specifically, I use Table 5.2 from Wealth in Great Britain Wave 3, 2010-2012, http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171776_362818.pdf to create Table 5.

during the QE periods. The survey periods for which asset allocation is reported here are from 2008-2010 and 2010-2012. The first column shows the asset classes in which households invest.[11] The most popular asset types households invested during the both survey periods are 'Cash ISAs', followed by 'Fixed Term Bonds' and 'Savings accounts'. In the period from 2010 until 2012, which covers most of the period in which the Bank launched the asset purchase programmes, investment in insurance products in particular and fixed term bonds fell. The positive growth rates for other asset classes are relatively low, including investment into unit and investment trusts. The only exception is the comparatively high additional investment in 'Stocks and Shares ISAs'. This suggests that households were searching with about 12% of their total financial assets for higher return in riskier assets outside mutual fund investment. Considering that 'Insurance products' are low return assets, it may perhaps be hypothesised that households allocated some moneys into money market funds as an alternative to relatively low risk and slightly higher returns investment. The Investment management Association reports that from January 2009 to June 2011, average monthly net retail sales were over £2.4bn compared to the monthly average of £0.8bn in the seven years before 2009 (IMA Survey, 2012). They provide data that shows that over this period UK households' bank and building societies deposits fell significantly compared to the years before 2009 (ibid). They cautiously infer that households may have regarded money market funds as a low risk substitute to holding deposits and at the same time increased holdings in equity funds to achieve higher yields.

Table 5 Allocation of formal financial assets by households in Great Britain

	July 2008 – June 2010	**July 2010 – June 2012**		
Financial Asset	**Percent (%)**	**Percent (%)**	**Change in percentage points**	**Growth in percent (%)**
Current account (in credit)	6.69	7.55	0.86	1.21
Savings accounts	15.14	16.21	1.07	1.82
Cash ISAs	19.85	20.95	1.10	2.07
Stocks and Shares ISAs	8.75	12.31	3.56	4.13
Insurance Products	13.58	9.80	-3.78	-3.32
Fixed Term Bonds	17.66	16.02	-1.64	-0.90
Unit/Investment Trusts	6.74	7.56	0.81	1.16
Other Formal Financial Assets	11.57	9.59	-1.98	-3.98

Notes: Percent of each financial asset group is calculated from the median asset value of households and the weighted frequencies divided by total value of assets. The original data are from the Wealth and Asset Survey, ONS, 2014. The category 'Other Formal Financial Assets' is not identical with that of the ONS. I added asset which made less than 5% of the total household assets (Overseas bonds/gilts, Overseas shares, UK bonds/gilts, Employee shares and share options and UK shares). Insurance products are Life Insurance, Friendly Society or endowment policies (excluding endowments linked to the mortgage of the property).

Summarising, the asset purchase programme had distinct effects on institutional and retail investment. There is evidence that institutional investors withdrew funds from low risk asset classes (gilts and money market funds) and increased inflow into equity funds during QE1. In the second asset purchase period institutional investors withdrew from money market

[11] The survey reports also the following asset classes: Overseas bonds/gilts, Overseas shares, UK bonds/gilts, Employee shares and share options and UK shares. They are here subsumed in 'Other Formal Financial Assets' since their proportion on total financial assets was well below 5%.

funds, but also from emerging market equity funds. The latter is inconsistent with the expected workings of the transmission channel. The effect of QE2 is generally lower and indicates that QE may have run into diminishing returns. In contrast to its counterparts, during both asset purchase periods, retail investors have the highest investment flow into money market funds in tandem with a rise in equity funds during QE1. Over both periods retail investors withdraw funds from emerging market funds. This result may indicate that retail investors did not benefit as much as their counterparts from investments in higher return fund classes.

4.3 Counterfactual analysis of the impact of QE

We can evaluate the effectiveness of QE on net fund flows into various asset classes by computing the ex-ante and ex-post forecasts as described by equations (3) and (4) for institutional and retail investment. Figures 1 and 2 show the QE impact on institutional and retail fund flows, respectively.

[Insert figures 1 and 2 here]

The line denoted '*ex-ante*' depicts the ex-ante QE impact as the difference between the expected flow in the presence of the QE programme and the expected flow under the counterfactual, i.e. in the absence of the QE programme. The difference between the actual net flow and the counterfactual forecast (i.e. the out-of-sample forecast based on the pre-QE regression period) is denoted ~~as~~ '*ex-post*'. If the *ex-ante* or *ex-post* lines lie above (below) the zero line, then QE had a positive (negative) impact on fund flows, compared to the counterfactual of no QE. The vertical lines denote the beginning of the first asset purchasing programme in March 2009 and the second in October 2011, respectively.

Figure 1 displays the results of the counterfactuals for institutional fund investors. At the beginning of QE1 and during QE2, there is conflicting evidence on the QE impact on emerging market equity flows, depending on whether the counterfactual is based on the *ex-ante* or *ex-post* criterion. With a delay of a few months, both criteria suggest that emerging market equity flows were higher than without QE from the beginning of 2010 until towards the end of 2011. The *ex-ante* counterfactual indicates that flows were higher than otherwise already from mid-2009 onwards. The delayed QE effect indicates that the impact of monetary policy occurs with a lag (Friedman, 1961) or, also, that institutional investors may not initially have regarded emerging market equity, arguably the most risky asset class here, as a substitute for lower risk assets. Throughout the first asset purchasing programme, net inflow into equity market funds were higher than they would have been without QE. This result is consistent with the estimation in Table 4 and indicates that in the aggregate institutional investors increased investment in risky assets more than they would have done without QE. During QE2, the *ex-ante* and *ex-post* counterfactual results are not clear cut. Comparing the counterfactual for corporate and government bond flows, in both cases, both counterfactuals show very high inflows into corporate bonds at the very beginning of QE1 which almost seems to match with very high initial outflows from gilt funds. From then onwards, the effect diminishes rapidly. There is no consistent evidence during QE2 which is consistent with the diminishing effect of the second asset purchasing programme. The money market flow counterfactual shows a short-lived initial strong fall during QE1 and overall a greater outflow during QE2. With the exception of equity flows which were higher throughout QE1 than the counterfactual, the impact of QE seems to be short lived. During QE2, only money market flows were lower than the counterfactual. In all other cases, evidence during the second asset purchase programme is inconsistent between the two counterfactual criteria.

Turning to the *ex-ante* and *ex-post* effects of QE for retail investment in Figure 2, at the beginning of QE1 from May 2009 until the end of the year, equity investment is higher than it would have been without QE. From then onwards, the ex-post criterion suggests higher investment due to QE until the end of the sample period while the *ex-ante* criterion shows no discernible counterfactual effect. Corporate bond flows were lower during the entire QE1 period and there is differing evidence on both counterfactual criteria during QE2. Compared to corporate bond flows, government bond flows are higher between mid - 2010 and the beginning of 2011 compared to the counterfactual and only towards the end of QE2, government bond flows are lower than without QE. In the first few months of QE, money market flows rose relative to the counterfactual and from mid – 2010 until mid – 2011 flows were lower than without QE. During QE2, the evidence is not clear. Generally, episodes of evidence of the impact of QE on mutual flows are short lived and there is some initial evidence for higher inflow into equity funds and a fall in flows in corporate bond funds compared to the counterfactual but in many scenarios the evidence is small and conflicting. An important issue is whether the effectiveness of QE is significant. We applied the test statistic by Pesaran and Smith (2012) which considers whether the *average ex-post* QE effect is significant. In none of the asset classes was the test significant. This may be so because the QE effect was only temporary. The reversal of the QE impact during the later period may result in the *average* effect of the policy computed over the three year period to be zero. Nevertheless, the insignificance of the test statistic is compatible with the policy having a statistically significant impact effect without the policy effect being significant over the longer period (Pesaran and Smith, 2012).
As a robustness test the estimations and the counterfactual were conducted from January 2000 until November 2012. In order to calculate the ex-post counterfactual, which is computed on the basis of an out - of sample forecast on a regression until February 2009, a sufficient number of observations is needed. The original period was reduced by more than five years and the sub-sample comprises the great moderation, the crisis and the QE period. The results of the regression and counterfactuals of the sub-period confirm those of the entire period.

5. Conclusion

Monetary policy can have large effects on financial markets and the economy as a whole. The asset purchase programme by the Bank of England was large and it was believed that it was to change investors' portfolio allocation. This research indicates that QE had some impact on aggregate mutual fund flows. During QE, the average inflow into mutual funds increased and overall investment was on average withdrawn from money market and gilt funds while average flows into equity and corporate bond funds increased compared to the pre-QE period. Furthermore, conventional Wald tests show that the correlation between the second asset purchase programme and fund flows was significantly lower than during QE1, indicating possibly some diminishing returns of QE (Goodhart and Ashworth, 2012; Cochrane, 2011). Both investor types reacted to the lower returns and lower risks caused by QE but investment into mutual funds was not uniform between investor types (Carpenter *et al.,* 2015; Joyce *et al.*, 2014). At the beginning of QE, institutional investors increased flows into corporate bond and equity funds and withdrew funds from lower risk asset funds. The regression results suggest that retail investors followed a strategy that increased their holdings in low return asset

funds and reduced holdings in high return funds. The results of the counterfactual, however, are more subdued in this respect. In view of mutual fund investment, retail investors may have increased their wealth better by following their institutional counterparts. There is no firm evidence, but retail investors may have re-allocated from low return assets outside the mutual fund industry into mutual funds.
The results of this paper are not only interesting to the question of how QE may have impacted on mutual fund allocation, but understanding the effect of monetary policy is also important in the efficient management of mutual fund portfolios. Open-ended mutual funds are exposed to redemption risk and unexpected shifts in investor preferences incur high trading costs. Also, the evaluation of different investor type's preferences may provide some guidance to how an unwinding of the asset purchase programme may affect mutual fund flows and financial markets.

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Appendix

Table A1: IMA's Fund Classifications

Equity	Bond	Balanced	Money Market	Property	Other
Asia Pacific excluding Japan	Corporate Bond	Cautious Managed	Money Market	Property	Protected
Asia Pacific including Japan	£ High Yield Bond	Balanced			Personal Pensions
Europe excluding UK	£ Strategic Bond	Active Managed			Unclassified Sector
Europe including UK	Global Bond	UK Equity and Bond Income			Absolute Return
Global Emerging Market	UK Gilt				
Global Equity Income	UK Index Linked Gilt				
Japan					
Japan Smaller Companies					
North America					
North America Smaller Companies					
Specialist					
Technology and Communications					
UK All Companies					
UK Equity Income					
UK Smaller Companies					

Table A2: Variable Definitions and Sources

Variable Name	**Definition**	**Source**	**Transformation**
EME Equity	Net flows into emerging market equity funds	IMA	Divided by the size of the equity market and multiplied by 100,000
Equity	Net inflow into all equity funds but emerging market equity funds	IMA	Divided by the size of the equity market and multiplied by 100,000
Corp Bonds	Net flows into corporate bond funds	IMA	Divided by the size of the equity market and multiplied by 100,000
Gilts	Net inflow into gilt funds	IMA	Divided by the size of the equity market and multiplied by 100,000
Money Market	Net inflow into money market funds	IMA	Divided by the size of the equity market and multiplied by 100,000
QE1	Bank of England's amount of gilt purchases from March 2009 until January 2011	Bank of England website	Relative change
QE2	Bank of England's amount of gilt purchases from October 2011 until November 2012	Bank of England website	Relative change
Gilt_out	Total amount of gilts outstanding	Debt Management Office (on request)	Relative change

Additionally, the US macroeconomic and financial variables from Lutz (2015, p. 103f.), who tabulates the variable description, mnemonic, source and transformation. See also Stock and Watson (2002), Bernanke *et al.* (2005).

Figure 1: Ex-ante and ex-post QE effects (Institutional Investors)

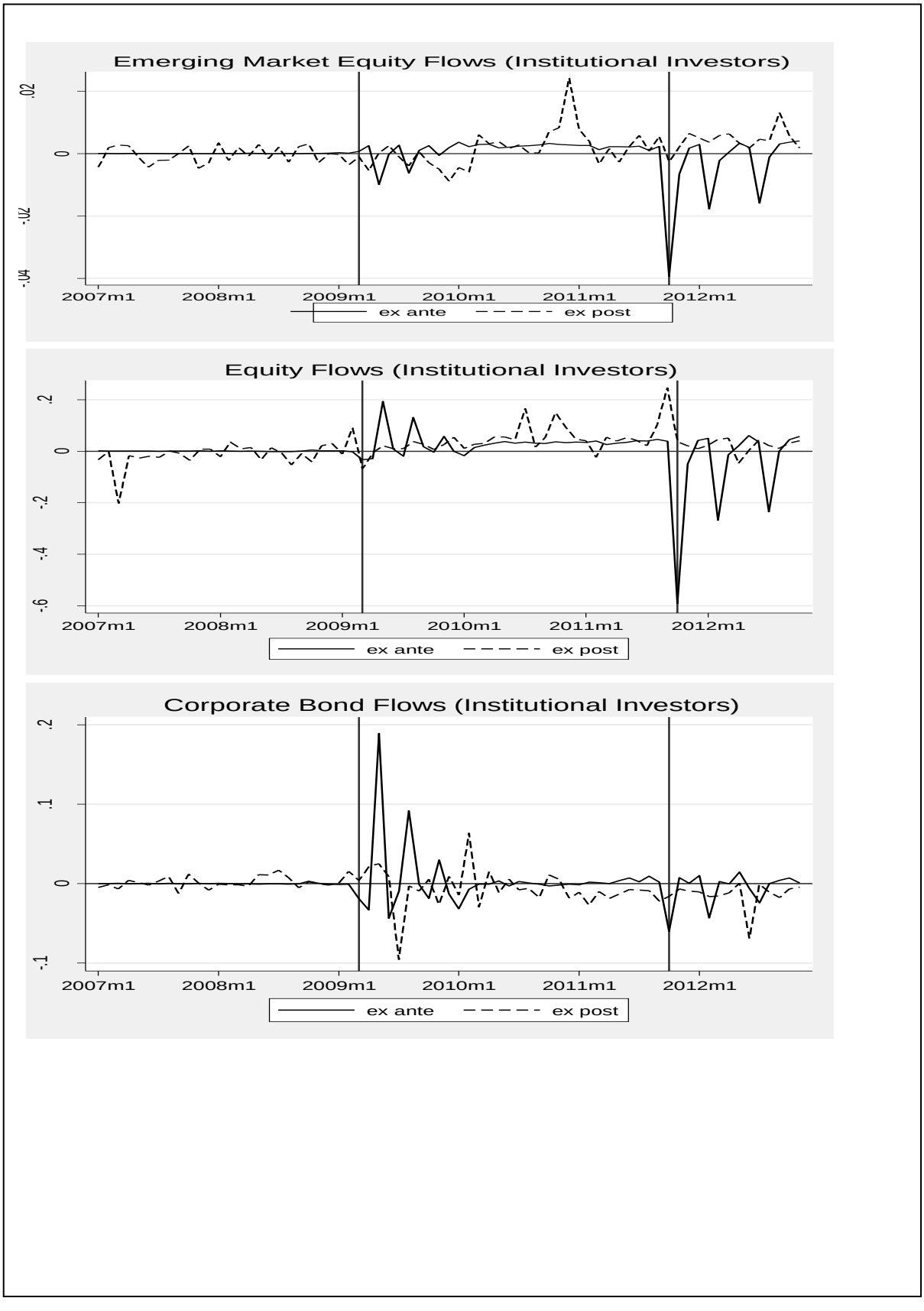
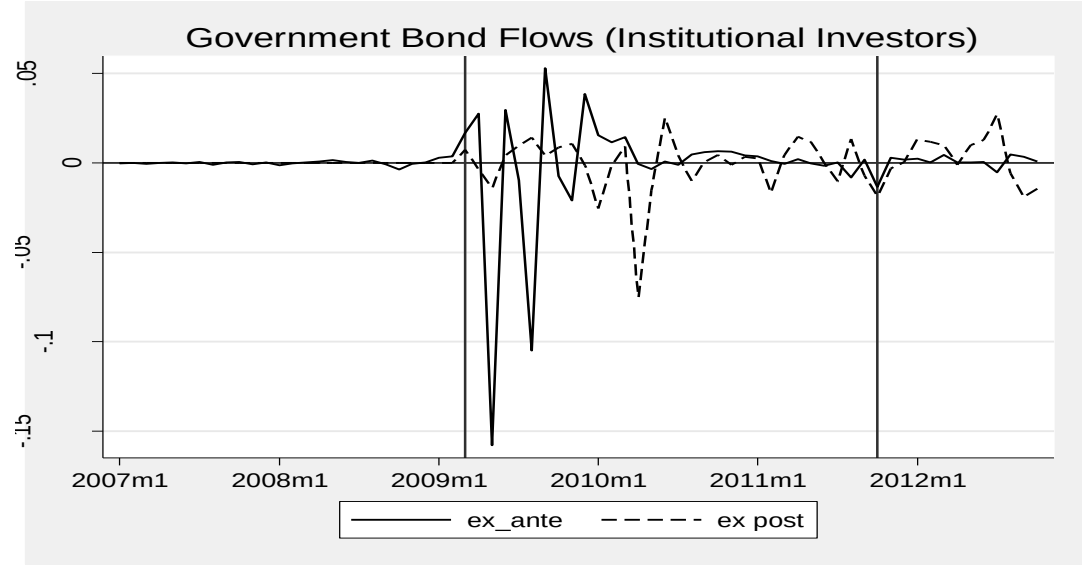


Figure 1 (continued): Ex-ante and ex-post QE effects (Institutional Investors)



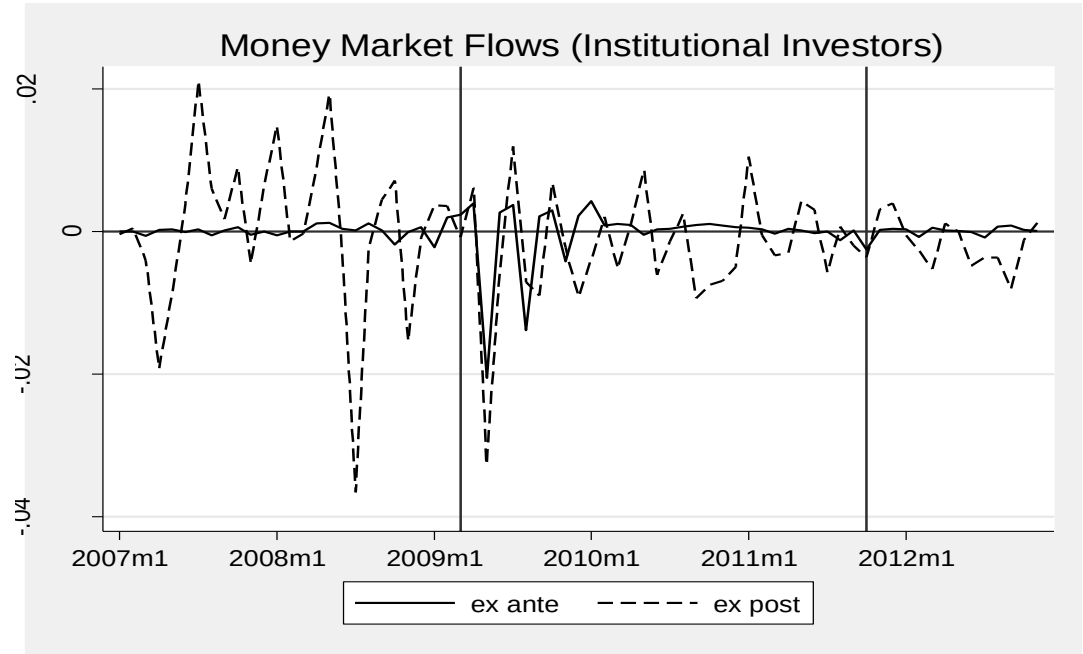
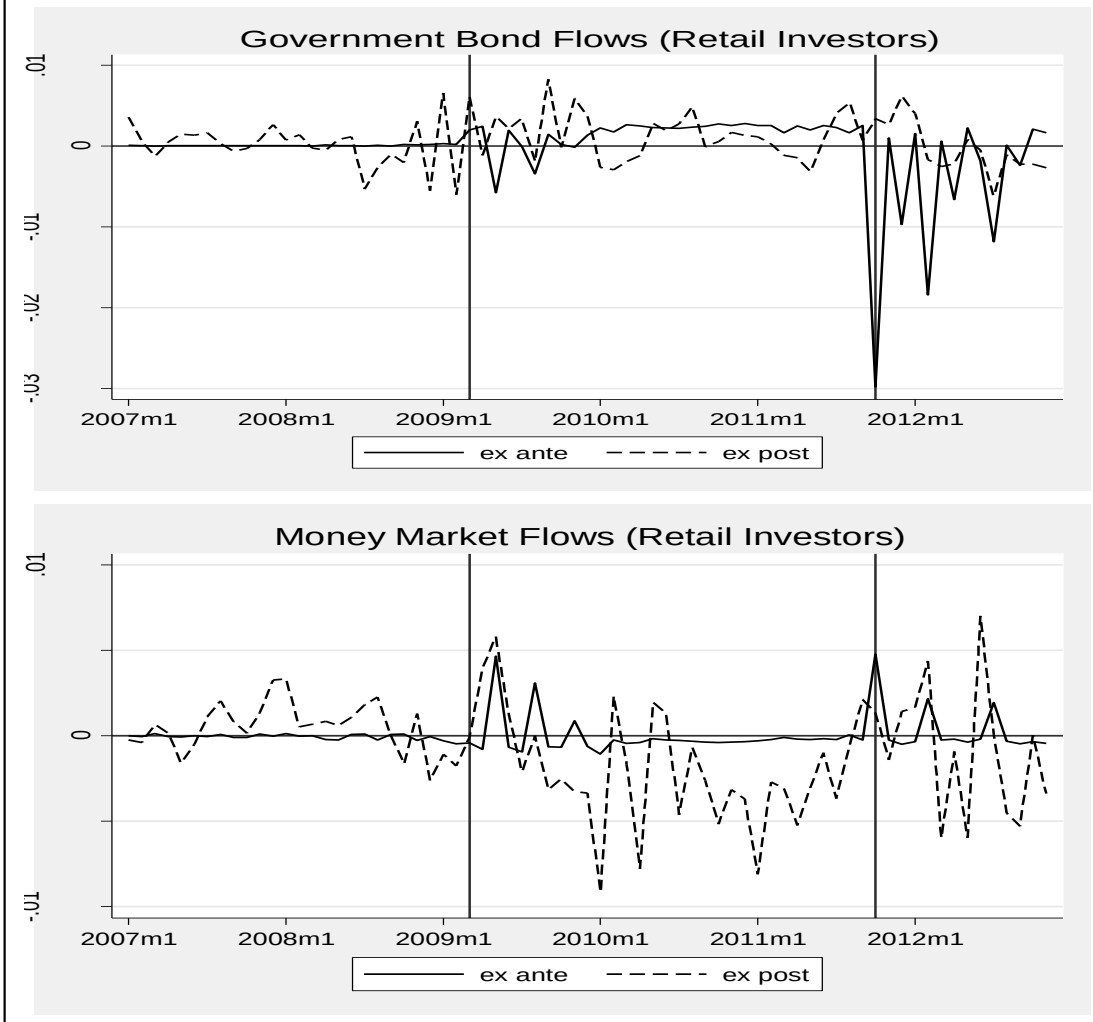


Figure 2: Ex-ante and ex-post QE effects (Retail Investors)
Figure 2 (continued): Ex-ante and ex-post QE effects (Retail Investors)



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