Did Quantitative Easing Increase Income Inequality?*

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Abstract

The impact of the post-crisis Federal Reserve policy of near-zero interest rates and Quantitative Easing (QE) on income and wealth inequality has become an important policy and political issue. Critics have argued that by raising asset prices, near-zero interest rates and QE have significantly contributed to increases in inequality, while practitioners of central banking, counter that the distributional impact have probably been either neutral or even egalitarian in nature due to its employment impacts. Yet there has been little academic research that addresses empirically this important question. We use data from the Federal Reserve's Tri-Annual Survey of Consumer Finances (SCF) and look at the evolution of income by quantile between the "Pre-QE period" and the "QE period" analyzing three key impact channels of QE policy on income distribution: 1) the employment channel 2) the asset appreciation and return channel, and 3) the mortgage refinancing channel. Using recentered influence function (RIF) regressions pioneered by Firpo et. al (2007) in conjunction with the well-known Oaxaca-Blinder decomposition technique, we find that while employment changes and mortgage refinancing were equalizing, these impacts were nonetheless swamped by the large dis-equalizing effects of asset appreciations. In order to identify causality, we propose a simple counterfactual exercise building on the extensive literature on macroecomic impacts of QE. We conclude that QE led to modest increases in inequality despite having some positive impacts on employment and mortgage refinancing.

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1 Introduction

A controversy over the distributional impact of Federal Reserve monetary policy has erupted. Some politicians, pundits and even former central bankers have argued that, since the Great Financial Crisis struck in 2008, the Federal Reserve's near-zero interest rate policy and rounds of "unconventional" monetary policy have contributed to an increase in income and wealth inequality in the United States by promoting large increases in asset prices, and driving down returns to middle class savers with "money in the bank" (Brookings Institution, 2015). On the other side, former Federal Reserve Chair Ben Bernanke, current Chair Janet Yellen, and others have argued that Fed policy has been broadly supportive of those at the bottom and in the middle of the income distribution, largely because policy placed a floor under the economic collapse, and, since then, has promoted economic recovery, employment creation, and economic growth (Bernanke, 2015; Appelbaum, 2015). This discussion is not just of historical interest: it interjects considerations of inequality into the very lively debate over whether the Federal Reserve should raise interest rates and if so, by how much.

Public debates over the distributional effects of monetary policy are certainly not unheard of but they tend to have a counter-cyclical profile. Politicians and mainstream economists tend to ignore the issue during periods of prosperity, preferring to focus on "aggregate" issues such as inflation and growth (see Gornemann et al., 2012, for a review of these models). By contrast, in times of financial crisis and resulting active intervention by the Federal Reserve, these distributional issues finally appear on the radar of politicians and make their way into economic discourse. A key example is the "Volcker" disinflation policy and deep recession of the late 1970's and early1980's. At that time, the Federal Reserve was accused by some as raising interest rates excessively aggressively and keeping them too high for too long, leading to excessive levels of unemployment and job destruction, all in the interest of protecting the real wealth of bankers and other creditors from the scourge of inflation (Epstein, 1981; Greider, 1989).

Indeed, the question of the distributional impact of monetary policy has a longer history, going back, for example, to the writings of Keynes who criticized high interest rates pursued by the Bank of England in the 1920's and 30's, and the related decision by Britain to return to the gold standard at pre-war parity after the First World War. Reminiscent of the discussion during the Volcker period, Keynes accused the Bank of England and the treasury of trying to protect creditors' wealth, while ignoring the impacts of tight money and an over-valued currency on the incomes and jobs of workers (Keynes, 1931, 1936). And, going further back, of course one should remember the fights over the gold standard and the populist movement in the late 19th early 20th century US, where over-valued exchange rates and over-valued currencies were battled over on distributional, and highly rhetorical, terms (Goodwyn, 1976; Frieden, 2006).

What is striking in the current debate is this: in all the historical cases mentioned earlier, it is high interest rates and restrictive monetary policy that are indicted as transferring income from the poor to the rich, whereas in the current period, the accusation is that it is low interest rates and expansionary monetary policy that is making inequality worse. Can both of these claims be true? Are there special factors that characterize the US economy now that generate results the opposite of those historically claimed?

While theory has an important role to play in understanding the relationship between monetary policy and income distribution in different periods and structural contexts, ultimately, adjudicating these claims becomes an empirical question.

There are two broad approaches to looking at the distributional impacts of monetary policy, or any policy for that matter. One looks at the functional distribution of income, and the second looks at the impact of policy on the personal distribution of income. In fact, the concerns expressed by Keynes and the populists, as mentioned above, largely relate to the functional distribution. Keynes and the populists were concerned about the impact of high interest rates on the incomes of the "financiers" or "rentiers" versus the workers and or the farmers. Concerns with the impact of monetary policy on financiers or bank profits, versus farmers and/or workers thus has a long history, though empirical work on this topic is thin (but see, for example, Epstein and Ferguson (1984) and the research summarized in Frieden (2006)).[1]

Most of the discussion on this issue, however, has focused on the impact of monetary policy on the distribution of personal or household income, and generally has not covered the period since the beginning of the Great Recession and QE. This small and relatively recent literature has found a strong relationship between contractionary monetary policy and increases in inequality. A careful and widely cited paper by Coibion et al. (2012) analyzes empirically this question for the United States, but their data ends in 2008, just before the beginning of QE. Drawing on quarterly distributional data from the Consumer Expenditures Survey (CEX), they analyze the distributional impacts of monetary policy shocks (based on the method of Romer and Romer (2004) for identifying monetary policy shocks), as well as the impacts of longer term changes in the objectives of the Federal Reserve. They find that restrictive "monetary policy shocks have statistically significant effects on inequality: a contractionary monetary policy shock raises the observed inequality across households in income, labor earnings, expenditures and consumption (emphasis added)... In addition, (contractionary) monetary policy shocks appear to have played a non-trivial role in accounting for cyclical fluctuations in inequality over this time period..." They also "show that permanent decreases in the inflation target also systematically increase income and consumption inequality... Monetary policy therefore may well have played a more significant role in driving recent historical inequality patterns in the US than one might have expected."

Gornemann et al. (2012) reach a similar conclusion using a different approach. They build a New Keynesian model which allows for heterogeneous agents, incomplete asset markets and significant labor market frictions. Their approach contrasts with standard models that make assumptions that rule out distributional impacts of monetary policy – assumptions such as homogenous agents, perfect unemployment insurance, and perfect financial markets. Calibrating their model on publicly available US data, they find that contractionary "monetary policy shocks have strikingly different implications for the welfare of different segments of the population." In particular, "while households in the top 5 percent of the wealth distribution benefit slightly from a contractionary monetary policy shock, the bottom 5 percent would lose from this measure. For example, a monetary tightening of 1 percentage point (annualized) induces a loss equivalent to a permanent .1 percent consumption for the lowest 5 percent of the wealth distribution. This heterogeneity in sign and size of welfare losses from monetary policy shocks stands in stark contrast to TFP (total factor

[1] We have undertaken several papers looking at the distributional impacts of QE with respect to a functional or sectoral perspective. In Montecino and Epstein (2014) we assess the direct impact of the first round of asset purchases (popularly referred to as "QE1") on the profits of banks that sold MBS to the Federal Reserve, as well as the indirect impact on those that held large quantities of such assets prior to QE. We found that QE1 led to statistically and economically significant increases in bank profitability after controlling for common determinants of bank profits. In Montecino and Epstein (forthcoming) we carried out a broader event study of all three rounds of QE (1, 2, and 3) and examined the impact of QE policy announcements on the equity returns of all S&P 500 firms. Our results uncovered substantial heterogeneity in the impact of QE announcements on equity returns across sectors and across QE rounds. Consistent with our previous study, financial institutions were expected to be the big beneficiaries of QE1, with consistently positive and substantial abnormal returns, but were also joined by non-financial firms in the construction and automobile sectors. By the time of QE3, however, the expected impact of the Federal Reserve's asset purchases had waned across most sectors of the economy with the exception of financial firms, which continued to exhibit positive abnormal returns.

productivity) shocks which affect the population more uniformly." (P. 4).

Empirical literature on the distributional impacts of the loose monetary policy undertaken since the Great Financial Crisis is quite thin. Notable contributions include Bell et al. (2012), Bivens (2015), McKinsey Global Institute (2013), Doepke et al. (2015), Beraja et al. (2015), Montecino and Epstein (2014), and Montecino and Epstein (forthcoming). The results are mixed. Part of the challenge in this literature is to distinguish between the impacts of the near-zero interest rate policy pursued by the Fed and QE policies themselves. Distinguishing these policies present both theoretical and empirical challenges. Theoretically, the question is whether the policies have different mechanisms and channels of influence; and empirically, it is difficult to ascertain whether the impacts discerned after the implementation of QE are lagged impacts of zero interest rate policies, or some interaction of the two. Various papers deal with these issues differently.

The literature on the impacts of monetary policy in general and QE in particular has tried to distinguish among the specific channels through which policy could affect income distribution. Ben Bernanke presents a useful list of proposed distributional channels of QE and low interest rates Bernanke (2015).

1. The "asset price appreciation" channel: Bernanke notes that "The claim that Fed policy has worsened inequality usually begins with the (correct) observation that monetary easing works in part by raising asset prices, like stock prices. As the rich own more assets than the poor and the middle class, the reasoning goes, the Fed's policies are increasing the already large disparities of wealth in the United States."

An additional dis-equalizing aspect of this financial asset channel is the lower interest rate on short term assets, which might disproportionately affect less rich households (Bell et al. (2012) and McKinsey Global Institute (2013) emphasize this channel).

Bernanke notes two important caveats about the importance of the asset price appreciation channel in the current context. He argues that middle class households, not just the wealthy, hold financial assets. And Bernanke raises questions about the extent to which asset price increases, and especially stock price increases are due to QE or are, rather, simply a "return to trend." He also notes that wealthy households also hold short term assets whose returns decline due to zero interest rate policies.

Bernanke then goes on to describe what he calls the inequality countervailing channels.

2. The "employment" channel: "...easier monetary policies promote job creation..."

3. The "debtor redistribution and refinancing" channel: "All else equal, debtors tend to benefit (and creditors lose) from higher inflation which reduces the real value of debts. Debtors are generally poorer than creditors, so on this count easier monetary policy...reduces inequality...Debtors are also made better off by low interest rates, all else equal. For example, homeowners with mortgages benefit when they can refinance at a lower rate."

As this list of channels suggest, there are important forces that move in countervailing directions. In our analysis below, we try to measure the size of the impacts of these channels. The real issue of concern, however, is not simply the evolution of these channels over time, but the role of monetary policy and QE: how much of the change in income distribution via these channels is due to QE, and how much is due to other factors?

In fact, there has been an enormous amount of empirical investigation of the effects of QE on many of these channels considered separately. The greatest effort has been expended on analyzing the impact of

QE on various asset prices (see, for example, Krishnamurthy and Vissing-Jorgensen (2013) and Hancock and Passmore (2014); also see Engen et al. (2015) and Bivens (2015) reviews of this voluminous literature). The consensus in this literature is that QE has lowered mortgage interest rates, lowered short and long term treasury rates, and thereby caused appreciations in long term treasury bonds, and mortgage backed securities (MBS). There is also some evidence that QE has increased the price of corporate bonds. Evidence on the impacts on corporate equities is more mixed, but recent papers suggest that equity prices have increased as a result of QE (Kiley, 2014, see our discussion below). As for the employment channel, most evidence indicates that zero-interest rate policy and QE have contributed to employment growth, but real wages have been stagnant, or even declining over this period (Engen et al., 2015; Bivens and Mishel, 2015). The over-all impact on income distribution will thus depend on the net effect and the distribution of these two components across income groups.

There has not been much research on the debt redistribution channel during this period. Part of the problem is that inflation has not increased as a result of QE. Hence, this inflation channel has not been operative (see Doepke et al., 2015, for a discussion of this channel). The mortgage refinancing channel is more interesting and potentially important; indeed, creating more opportunities for refinancing and lowering refinancing costs, presumably were some of the goals of the low interest rate and QE policies. However, as Beraja et al. (2015) and others referenced there show, the steep declines in house prices, which meant that many borrowers were "under water", along with other complex factors, severely limited the ability of many homeowners, and particularly those in the lower quantiles of the income distribution, from taking advantage of the lower interest rates. Thus, the distributional impacts of the refinancing channel are very much up for grabs empirically. Consistent with this effect, Beraja et al. show that there was a large disparity in the regional impacts of QE policy as a function of how far housing prices had fallen in different regions of the country.

The only previous paper that has attempted to put together many of these channels and look at the overall impact of QE on income distribution is Bivens (2015). Bivens does not distinguish in his analysis between the near-zero interest rate policy and the QE policy, arguing that it is impossible to disentangle the effects of these two related efforts. Bivens' approach is to use the secondary literature rather than new empirical work. He has a two stage approach: first Bivens assess the overall impacts on inequality of QE relative to a fiscal policy that has a similar impact on employment. And then, he assesses the impact of low interest rates and QE relative to a neutral monetary policy. In the first case, Bivens argues that QE does not increase inequality relative to a fiscal policy that has a similar labor market outcome.

In the second case – monetary policy vs nothing – Bivens argues that the dis-equalizing effects of financial asset price increases are more than compensated for by increases in incomes of the non-rich due to increases in employment. Moreover, he argues that non-rich households' major asset is their home, and shows that home price appreciation was considerable over the QE period. The bottom line in the second case, according to Bivens is the following: "As bad and unequal as wage growth was since the onset of the Great Recession, it would have been even slower and less equal had the Fed not pursued its easy money policies. In short, compared to a counterfactual of no change in fiscal policy in response to a recession, monetary stimulus reduces inequality significantly."

Our paper also attempts to draw an overall picture of the net impacts of these several channels on the personal distribution of income.[2] We use data from the Federal Reserve's Survey of Consumer Finances

[2] When we can, we distinguish between the low interest policy and the QE policy and mostly focus on QE. At a few points, however, we will discuss the impacts of the broader loose monetary policy since the financial meltdown.

(SCF) to empirically assess the quantitative contribution of each of these theoretical channels to changes in inequality. We focus specifically on the distribution of what we term "net income," which consists of total household income minus debt payments. This makes it possible to integrate the distributional consequences of low interest rates on households' interest burdens. To assess the net impact of channels associated with QE, we implement the distributional decompositions method proposed by Firpo et al. (2007). This approach enables detailed accounting of the observed change in a distributional statistic between two periods and how much of this change is due to channels associated with QE. Specifically, it makes it possible to decompose the change in, for example, the ratio of the 99th to the 10th percentiles of the net income distribution into the contributions of changes in employment, returns on financial assets, and other covariates. Thus, this decomposition method provides well defined estimates of the quantitative contribution of various factors affecting the distribution of household income since the implementation of QE.

Our overall results are the following: we find that while employment changes and mortgage refinancing were highly equalizing during the QE period, these impacts were nonetheless swamped by the large dis-equalizing effects of equity price appreciations. Reductions in returns to short term assets added further to dis-equalizing processes between the periods. Bond price appreciations, surprisingly, had little distributional impact. It is worth emphasizing that this decomposition approach does not yield causal estimates of the impact of QE on the distribution of income. This approach does, however, yield well defined estimates of the relative importance of the various channels through which QE affects inequality and thus makes it possible to precisely frame the upper and lower bound causal impacts of QE under plausible assumptions about the counterfactual paths of employment and stock prices. To get some idea of the causal influences we use the results from our decomposition to carry out a series of "counterfactual exercises" to assess the quantitative range of impacts of QE on the main channels. Drawing on consensus QE impact estimates from the empirical literature, we conclude that, most likely, QE was modestly dis-equalizing, despite having positive impacts on employment and mortgage refinancing.

The rest of our paper is organized as follows. In the next section we describe in more detail the channels of monetary policy we will study and describe the "net income" measure we will use to map these channels onto income changes. In section 3 we discuss important data issues that we must deal with in using our data set. Section 4 presents our empirical methodology for analyzing the evolution of income distribution during the QE period. Section 5 presents our distributional results. Section 6 attempts to frame a causal analysis of the impacts of QE on inequality by using a counter-factual analysis based on consensus impacts from the literature. Section 7 summarizes and concludes with some remarks about the implications for the debate over QE's impacts on income distribution.

2 Net income and the theoretical effects of QE

The onset of the 2007-8 financial crisis led the Federal Reserve to lower short-term interest rates to nearly zero in an effort to prop up the financial sector and prevent the U.S. economy from sliding into a depression. With nominal rates up against the zero lower bound and thus having exhausted the traditional tools of monetary policy, the Fed resorted to "unconventional" measures. In particular, the Federal Reserve announced a program to purchase vast amounts of securities in what is known as the Large Scale Asset Purchase program (LSAP), or alternatively as "Quantitative Easing" (QE). The first round of asset purchases (QE1) was formally announced on November 25, 2008 and initially covered Agency mortgage-backed securities (MBS), long-term Treasuries, and government-sponsored enterprises (GSE) debt. A second round of purchases (QE2) was subsequently announced on November 3, 2010, followed by a third and final round (QE3) beginning in August 2012. The Federal Reserve officially announced the end of QE3 on October 29, 2014.

As already noted, QE is expected to affect the distribution of income through a variety of countervailing channels.[3] The two most commonly cited channels – and perhaps most controversial – are through the effect of asset purchases and low interest rates on employment and the prices of financial assets. The third channel we focus on is on the impact of low interest rates on household debt service.

The employment channel is presumed to decrease inequality, though note that this should not necessarily hold *a priori*. The overall impact of changes in employment on inequality depends both on which parts of the distribution experience the greater increase in employment, as well as the relative returns to employment across the distribution. For instance, it could be the case that firms respond to expansionary monetary policy by increasing total employment but by mostly hiring among high-skilled and high-paying jobs. Similarly, even if the bottom range of the distribution has greater employment gains, if wages in the upper tail are sufficiently larger, the relatively smaller employment gains at the top could still translate into increases in overall inequality.

Financial asset prices are expected to increase income inequality through capital gains and interest and dividend income. The sign of this channel is theoretically unambiguous for two reasons. First, the stock of financial assets is highly concentrated in households at the upper end of the income distribution. Note that this statement is not a tautology as one should be careful to avoid conflating wealth inequality and income inequality. Second, richer households likely have access to a greater rate of return on financial assets than do poorer households.

In theory, expansionary monetary policy should benefit debtors at the expense of creditors. Since low income households are more likely to be indebted, expansionary monetary policy should decrease inequality. In practice, this is expected to result from the effects of higher inflation, which reduces the real value of debt, and through the direct impact of lower interest rates on household debt payments. Although interest rates have remained at historically low levels due to the Federal Reserve's crisis response, it is not obvious if most household have been able to take advantage of them. Indeed, a number of commentators have argued that the fall in housing prices and the tightening in lending standards have prevented indebted household from refinancing at a lower interest rate. For instance, a Federal Reserve White Paper on housing noted:

> Many homeowners have been unable to take advantage of historically low mortgage rates because of low or negative home equity, slightly blemished credit, or tighter credit standards. Perhaps only about half of homeowners who could profitably refinance have the equity and creditworthiness needed to qualify for traditional refinancing. (Board of Governors of the Federal Reserve System, 2012)

This relationship between falling home prices and the ability to refinance was investigated by Feroli et al. (2012), who showed that states with small declines in home prices experienced booms in refinancing during the post-crisis period while states with large home price declines experienced a collapse in refinancing rates. As Feroli et al. write, "the evidence suggests that a large fraction of homeowners in large house price decline states are unable to take advantage of lower mortgage interest rates."

Standard definitions of income are inadequate to investigate the interest burden channel since they do not include debt payments. Indeed, there is no reason to expect a fall in interest rates to have a direct effect

[3]See Coibion et al. (2012) for a detailed discussion for the channels through which traditional monetary policy might affect inequality. For a discussion specifically applied to QE see Bivens (2015).

on household income other than through a *negative* effect through interest-paying assets and macroeconomic spillovers through, for instance, employment. To directly incorporate the distributional consequences of household debt burdens, we alternatively define *net household income*, which consists of total household income – wages, dividends, capital gains, government transfers, and business income – minus total interest payments on debt. The low interest rates associated with expansionary monetary policy should therefore be associated with lower debt service and hence higher net income. Formally, we define net income as:

$$\textit{Net Income} = Wages + Interest + Business + Gov + \textit{Capital gains} - \textit{Debt payments} \tag{1}$$

In equation (1), $Wages$ denotes total wage income, $Interest$ denotes all interest and dividends income, $Business$ stands for any income from owning a controlling share or running a business, *Gov* denotes government transfers, *Capital gains* stands for realized capital gains on financial assets, and *Debt payments* are total annual expenditure on debt service. Defining net income this way has several advantages. First, it is not possible to directly examine the reduced debt burden channel of expansionary monetary policy using traditional definitions of income. Second, including capital gains as a component of net income makes it possible to assess the financial assets price channel.

Summary statistics for household total and net income are presented in Table 1. Although broadly similar, it is worth highlighting a few differences between the two definitions of income. As one would expect, net income tends to be lower than total income. Mean total income was approximately $84,000 in the 2010 SCF sample compared to around $72,000 for net income. Net income appears to have somewhat different dynamics between periods than total income. For instance, while median total income fell between the 2010 and 2013 SCF samples, median net income actually increased slightly. Finally, net income appears to be more concentrated at the top than total income, indicating that poorer households are either more heavily indebted than richer households, face higher interest rates on debt, or both. Moreover, this discrepancy between the two definitions is even more pronounced at the very top of the distribution. Although ratio of the 90th to 50th percentiles are roughly the same between the two definitions, the 90/10 and 99/10 ratio are much larger for net income.

To examine contribution of each factor to overall changes in household net income we begin by defining functional forms for each relevant component. Fortunately for our purposes, each of the three channels through which QE might affect the distribution of net income maps cleanly onto a component of net income: unemployment drives wage income, financial assets drive capital gains, and debt refinancing affects interest payments. The wage income of household i during period t is assumed to depend on:

$$Wages_{it} = \alpha_t EMP_{it} + \boldsymbol{\tau X}_{it} + \epsilon_{it} \tag{2}$$

where EMP is a dummy variable that is equal to one if the head of the household is employed and equal to zero otherwise. The wage function also includes a vector of controls for demographic and human capital factors, including race, age, and education. Total financial income, which combines interest and dividend income and realized capital gains, is assumed to depend linearly on the ownership of various financial assets:

$$\textit{Capital gains}_{it} = A_{it}\beta_t + \varepsilon_{it} \tag{3}$$

where A_{it} is a vector of dummy variables for whether or not household i owns a non-zero amount of each type of financial asset. We specify our model using ownership dummies due to the highly skewed distribution of the levels of the financial assets we consider, as well as the large proportion of households with financial

Table 1: Summary statistics for household total income and net income by period.

	Total Income		Net Income	
	Pre QE (2010-08)	Post QE (2013-11)	Pre QE (2010-08)	Post QE (2013-11)
Mean	83,949	86,596	71,595	76,116
Percentiles				
10	14,162	14,203	11,393	11,160
20	21,788	20,291	17,619	17,247
50	49,022	46,668	39,218	39,422
80	101,313	101,453	83,363	86,639
90	152,514	154,209	129,989	133,711
99	659,079	692,925	608,486	664,943
Percentile ratios				
99/10	46.54	48.79	53.41	59.58
90/10	10.77	10.86	11.41	11.98
90/50	3.11	3.30	3.31	3.39
50/10	3.46	3.29	3.44	3.53

Note: All the distributional statistics presented above were calculated using the sampling weights provided by the SCF. Total income refers to the sum of wage earnings, interest and dividends, government transfers, business income, and realized capital gains. Net income refers to total income minus debt service.

balances of zero.[4] We consider the following financial assets: directly owned stocks ($STOCK$), directly held bonds ($BOND$), bonds owned indirectly through bond-based mutual funds ($MFBOND$), and a composite of all short-term/liquid assets ($SHORT$). Each element of the vector β_{it} can be interpreted as the rate of return on each financial asset in A_{it}.

Debt service is assumed to be a linear function of mortgage refinancing as well as overall credit worthiness, which we capture by including variables for whether or not a survey respondent has feared or actually been denied credit during the period or has recently filed for bankruptcy. Household interest payments thus depend on:

$$Debt\ payments_{it} = \gamma_t RF_{it} + \eta_t D_{it} + \mu_t B_{it} + \nu_{it} \tag{4}$$

where RF_{it} is dummy for having refinanced the primary mortgage within the last three years, D_{it} is a dummy for fearing or having been denied credit during the period, and B_{it} is a dummy for having recently filed for bankruptcy. Adding the components together, we arrive at a functional form for net household income:

$$Net\ Income_{it} = b_{1t} EMP_{it} + \boldsymbol{\tau} \boldsymbol{X}_{it} + b_{2t} A_{it} + b_{3t} RF_{it} + b_{4t} D_{it} + b_{5t} B_{it} + e_{it} \tag{5}$$

where e_{it} is a composite error term of ε_{it}, ϵ_{it}, and ν_{it}. In order to identify the contribution of each factor in the decomposition exercises reported below, we will assume:

$$\mathbb{E}\{e_{it} | EMP_{it}, X_{it}, A_{it}, RF_{it}, D_{it}, B_{it}, t\} = \lambda \quad \text{for} \ \ t = 0, 1 \tag{6}$$

[4] We also tested a number of other specifications including IHS transformations of the levels of each financial asset. The key results are robust to these alternative specifications and available upon request.

for some constant λ. This is often referred to as the ignorability assumption and is weaker than the more common assumption that unobservables are conditionally independent. Ignorability does not assume that unobservables are mean independent of covariates but instead that this dependence is the same across both groups t. For example, for our purposes we are interested in changes in net income between the pre-QE ($t = 0$) and post-QE ($t = 1$) periods. In this context ignorability means that any correlation between unobservable factors contributing to net income and, say, stock ownership, is constant across both periods.

3 Data Issues

The Survey of Consumer Finances (SCF) is almost ideal for assessing the impact of financial and labor market factors on the distribution of income. The SCF offers an unparalleled level of detail on a household's balance sheet. It also contains a full set of standard demographic and labor market variables. The SCF also records information on mortgage refinancing, allowing us to answer questions about the role of refinancing on household interest payments.

Nevertheless, the SCF is "almost" ideal due to several shortcomings that complicate its usage. First, due to its relatively small sample size, many variables that would be useful are withheld from the public data releases in order to prevent users from identifying the survey respondents. Specifically, geographical data and interview dates are omitted. The former makes it impossible to control for geographic-specific unobserved effects. Second, the SCF is only released every 3 years and the cross-sectional sample for each release spans the entire 3 year window. Combined with the absence of publicly available interview dates, this makes it very difficult to split the survey data across precise event dates. Specifically, the 2007 release includes interviews collected from 2005 to 2007, the 2010 release includes 2008 to 2010, and the 2013 release includes 2011 to 2013. Therefore, it is tricky to split the data between the pre and post QE period, which began at the end of 2010.

We settle on treating the observations in the 2010 survey as the pre QE period ($t = 0$) and the 2013 survey as the post period ($t = 1$). Admittedly, our "pre QE" period is not ideal since it is contaminated by the first round of QE, which took place between the end of 2009 and 2010. Nevertheless, this choice of periods is unavoidable given the data constraints and reasonably captures the timing of the fallout from the crisis and the path of the subsequent recovery. In other words, the 2010 SCF release, which includes 2009 and 2008, is the only release that includes real crisis years.[5] This problem, however, is not as severe as it may first seem. This is because the macroeconomic effects of QE likely occurred with substantial lags. For instance, Engen et al. (2015) found that the peak impact of QE on employment did not take place until as late as 2015. Moreover, the second and third rounds of QE took place after 2010, as did most of the post-crisis growth in stock prices.

A third issue that causes more technical problems for estimation and inference is that the SCF is released as a set of multiple imputed datasets. This means that each data release contains 5 versions of each observation for each different method used to impute the missing variables. Informally, this is difficult to deal with because it means that the SCF is actually five different datasets instead of one. More precisely, the presence of five imputations causes the coefficients to be biased and the standard errors to be too small. Although there is no perfect solution to the first two problems, there exists a more or less standard solu-

[5] Specifically, unemployment only increases during the 2010 SCF release and falls during the 2013 release. The unemployment rate for the head of the household in the 2007 release is 4.1 percent. This increased to 7.1 percent in the 2010 release and fell to 5.9 percent in the 2013 release.

tion to estimating and carrying out inference with multiple imputations. This is the repeated imputations inference (RII) method pioneered by Rubin (1987), which first estimates the empirical model separately for each imputation and then combines the estimated coefficients and standard errors to carryout inference.[6] All coefficients and standard errors reported below have been adjusted using the RII method.

A final complication arises due to our definition of net income. It is common in applied work to transform earnings variables by taking logs as this renders its distribution approximately normal. This is not possible however in this case since net income can also take on large negative values if debt service sufficiently exceeds income. Since negative observations would be undefined in logs, the transformation would result in a significant loss of information. Note that this is also a problem for stock variables with a significant number of zero observations. An alternative transformation useful in this context is the inverse hyperbolic sine (IHS) function, which was first proposed by Johnson (1949).[7] The IHS transformation is similar to transforming variables using logs but has the added advantage of being continually defined everywhere along the real numbers line. Moreover, coefficients of IHS transformed variables can also be interpreted roughly as elasticities. The IHS transformation has also been shown to outperform other common transformations in empirical applications related to household income and wealth. (Burbidge et al., 1988; Pence, 2006). Given these advantages, in what follows net income and all stock variables have been transformed using the IHS transformation.

4 The distributional decomposition

In order to decompose changes in the distribution of net income between the pre and post QE periods we implement an approach proposed by Firpo et al. (2007), which combines recentered influence functions (RIF) regressions with the popular Oaxaca-Blinder decomposition method. This approach is easy to implement and makes it possible to decompose changes in distributional statistics into the contribution of an "explained" component comprised of changes in covariates or endowments and the contribution of an "unexplained" component, which consists of changes in the coefficients or returns to factors. The explained and unexplained components can also be further decomposed into the contribution of each individual covariate, enabling comparisons of the relative contributions of different factors to the overall observed change in the distributional statistic of interest.

First proposed by Firpo et al. (2009), a RIF regression is essentially the same as a standard regression

[6] Formally, let $\hat{\beta}_i$ and $\hat{se}_i$ denote the estimated coefficients and standard errors for implicates $i = 1, 2, \ldots, M$. Rubin's RII method is to estimate all $\hat{\beta}_i$'s separately and then combine them by simply averaging over every implicate:

$$\bar{\beta} = \frac{1}{M}\sum_{i=1}^{M}\hat{\beta}_i$$

Correct standard errors can then be derived by combining the standard errors obtained from each implicate separately as follows:

$$\tilde{se} = \bar{se} + \left(1 + \frac{1}{M}\right) Var(\hat{\beta}_i)$$

where

$$\bar{se} = \frac{1}{M}\sum_{i=1}^{M}\hat{se}_i \quad \text{and} \quad Var(\hat{\beta}_i) = \left(\frac{1}{M-1}\right)\sum_{i=1}^{M}(\hat{\beta}_i - \bar{\beta})^2$$

The correct combined standard error is the sum of the average of the M estimated standard errors and the variance of the coefficients across implicates.

[7] For a variable y_i, the IHS transformation is calculated as $IHS(y) = \ln\left(y + \sqrt{y^2+1}\right)$.

except that it replaces the dependent variable Y with the recentered influence function for a chosen distributional statistic. Adopting the notation from Firpo et al. (2007), let ν denote a given distributional statistic (e.g. the gini coefficient or 90th quantile). The RIF for statistic ν is defined as $RIF(y;\nu) = \nu(F_y) + IF(y;\nu)$, where y is an individual observation of Y, F_y is the cumulative density function of Y, and $IF(y;\nu)$ denote the influence function corresponding to statistic ν at y. The advantage of using the recentered influence function is that its expectation yields the original statistic of interest, so that $\mathbb{E}\{RIF(y;\nu)\} = \nu$. The RIF regression assumes that the conditional expectation of $RIF(y;\nu)$ is a linear function of the explanatory variables X:

$$\mathbb{E}\{RIF(Y;\nu)|X\} = X\gamma + \epsilon$$

where the coefficients γ can be estimated using OLS.

Therefore, all that is necessary to estimate the partial effects of the dependent variables X on a statistic ν to first calculate the $\widehat{RIF}$ for ν and then run a standard regression of $\widehat{RIF}$ on X. For example, for the τth quantile, Q_τ, one first calculates the RIF as

$$\widehat{RIF}(y;\hat{Q}_\tau) = \hat{Q}_\tau + \frac{\tau - \mathbb{1}\{y \leq \hat{Q}_\tau\}}{\hat{f}_y(\hat{Q}_\tau)} \tag{7}$$

where $\hat{Q}_\tau$ and $\hat{f}_y(\cdot)$ are, respectively, estimates of quantile τ and the probability density function of Y, and $\mathbb{1}\{\cdot\}$ is an indicator function. In practice, the density $\hat{f}_y$ is estimated using Kernel methods.

As shown by Firpo et al. (2007), the linearity assumption for $\mathbb{E}\{RIF(Y;\nu)|X\}$ makes it possible to apply the classic Oaxaca-Blinder decomposition method to RIF regressions and decompose general distributional statistics other than just the mean.[8] Let $t = 0, 1$ denote the pre and post QE time periods. The change in, say, the 90th net income quantile between the two periods can be written as

$$\Delta_{90} = \hat{Q}_{1,90} - \hat{Q}_{0,90} = \bar{X}_1\hat{\gamma}_1 - \bar{X}_0\hat{\gamma}_0$$

The decomposition can be obtained by simply adding and subtracting the term $\bar{X}_0\hat{\gamma}_1$ from the right-most side and rearranging to obtain:

$$\begin{aligned} \Delta_{90} &= \Delta_X + \Delta_\gamma \\ \Delta_{90} &= \underbrace{\left(\bar{X}_1 - \bar{X}_0\right)\hat{\gamma}_0}_{\text{explained}} + \underbrace{\left(\hat{\gamma}_1 - \hat{\gamma}_0\right)\bar{X}_0}_{\text{unexplained}} \end{aligned} \tag{8}$$

The explained and unexplained components Δ_X and Δ_γ can be further decomposed into the contribution of each variable in X. For example, the contribution of changes in the coefficients of the k-th independent variable can be calculated simply as $\Delta_{\gamma,k} = (\hat{\gamma}_{1,k} - \hat{\gamma}_{0,k})\bar{X}_{0,k}$.

The explained and unexplained components of the decomposition have intuitive interpretations. The explained component can be interpreted as the contribution of a change in the endowment of a factor X_k between the two periods holding its return constant. For instance, in the case of the stock of financial assets held by a household, the explained component can be interpreted as the extra interest or capital gains income the household would receive from increasing its financial assets by $X_1 - X_0$ obtaining last period's rate of return γ_0. The unexplained component, on the other hand, can be interpreted as the contribution to household net income of a change in the return to a given factor holding the endowment constant at last

[8] In order to identify the each component of the decomposition it is also necessary to assume common support for both comparison groups, as well as either conditional independence on observables or ignorability.

period's level. In the case of financial assets, it is the extra income received from a change $\gamma_1 - \gamma_0$ in the rate of return on financial assets holding the stock fixed.

Putting the pieces together, the steps necessary to carry out the decomposition can be summarized as follows:

- Calculate the recentered influence function for net income for each period $t = 0, 1$.
- Run separate RIF regressions for each period, for a set of quantiles $Q_{t,\tau}$, and obtain the coefficients $\hat{\gamma}_{0,\tau}, \hat{\gamma}_{1,\tau}$.
- Calculate the means of the explanatory variables in each period, $\bar{X}_0, \bar{X}_1$.
- Algebraically combine the estimated coefficients and means to obtain each component of the decomposition.

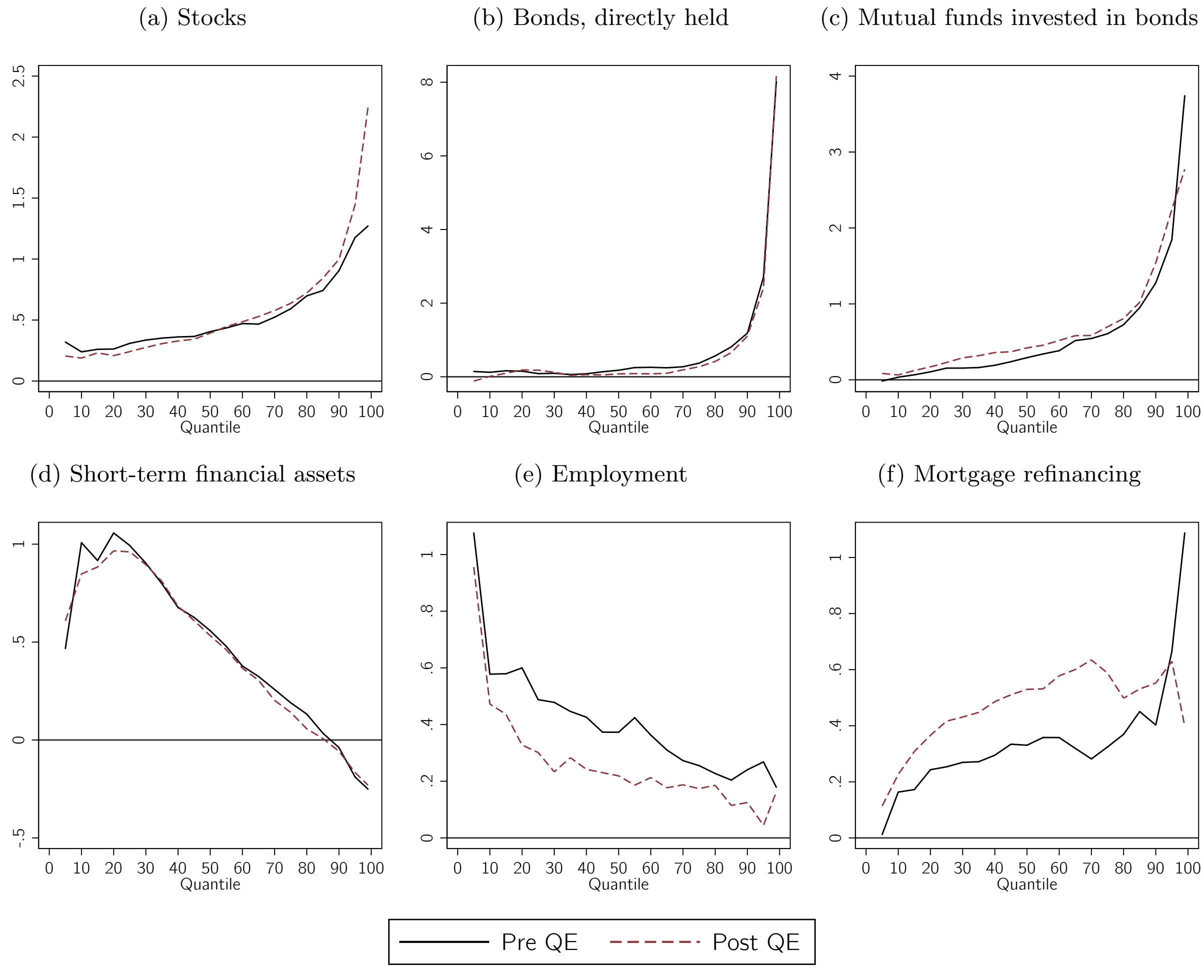
5 Decomposition results

We start by calculating the recentered influence functions of net income for quantiles Q_t^τ, $\tau = \{5, 10, \ldots, 95\}$, as well as for $\tau = 99$ in order to get a complete picture of the upper end of the distribution.[9] In addition, we calculate the RIFs for the gini coefficient and variance of net income. Next, we estimate (5) replacing the dependent variable N_{it} with its RIF for each quantile τ and for both periods $t = 0, 1$. The coefficients from the RIF regressions are shown by quantile in Figure 1. The solid lines depict the coefficient during the pre QE period (2010-08), while the dashed lines depict the coefficients during the post QE period (2013-11). Intuitively, the RIF regression graphs show the correlation between a given independent variable and net income at each point in the distribution. For example, let's consider the employment graph (panel e). The level of the curve at the very middle of the distribution (quantile 50) indicates the size of the coefficient on the employment dummy for the median. In other words, the graph shows the effect of employment on median income. Similarly, going right on the graph – towards, say, quantile 90 – shows the impact of employment on the net income of richer households. A smaller coefficient on quantile 90 indicates that employment has a smaller impact on the net income of the wealth relative to the middle class. Thus, a downward sloping curve in this context indicates that a given independent variable is equalizing in the sense that it has a greater impact on the income of the bottom relative to the top. Conversely, an upward slope indicates a disequalizing or regressive impact on the distribution of net income.

In line with previous studies, employment has a strong equalizing effect on net income, as can be seen from the downward sloping coefficients curve. The inverse is that unemployment is strongly disequalizing. Since the income of households near the bottom of the distribution consists almost entirely of wage earnings, the coefficient on EMP is close to one for the poorest households. In other words, households where the primary income earner is employed have net incomes around 100 percent higher compared to those with an unemployed primary earner. The importance of employment status decreases as one moves higher up in the distribution of net income. Employment increases real median income by around 40 percent and has an even smaller impact on the 90th quantile – roughly 20 percent. The "return" to employment appears to have decreased between the two periods, as indicated by the downward shift in the coefficients curve. This can be interpreted as a fall in real wages over the two periods.

[9] For all RIF calculations, we use the default Epanechnikov kernel when obtaining the probability density of net income.

Figure 1: RIF regression coefficients during pre and post QE periods



Note: These figures show the coefficients from the RIF regressions by period and by quantile. The solid line shows the pre QE period (2010-08), while the dashed line shows the post QE period (2013-11).

As anticipated, stocks and bonds are highly disequalizing. This may reflect that ownership of these types of assets is highly concentrated at the top and that richer households have access to a higher rate of return on financial assets. The return on stocks increased during the post QE period for the upper quantiles. This increase was most pronounced for the 90th and above quantiles. Curiously, despite the consensus in the empirical literature that QE boosted bond prices, the return on directly held bonds was essentially flat over the two periods and actually decreased mildly. One possible explanation for this result is that bond ownership impacts household income through interest revenue and not through capital gains. As a result, households would not benefit from increases in bond prices. In contrast, the return on bond-based mutual funds increased for most quantiles except for the 99th.

The RIF regression results also suggest that mortgage refinancing, as anticipated, is associated with higher household net income, and this holds across all quantiles. Nevertheless, mortgage refinancing appears to be regressive, with a much greater impact near the top of the net income distribution. This implies that even if poor households in need of refinancing gain access to credit, they may not receive as favorable terms as those received by richer households. The coefficients for refinancing also increase during the post QE period for nearly every quantile, which is consistent with the fall in interest rates brought on by QE. The only exception is the 99th quantile, where the coefficients for refinancing actually fell by a substantial amount. This decrease in the return to refinancing for the very rich is paradoxical and it is not clear *a priori* if the large returns observed during the pre QE period were unusually high compared to some "normal" benchmark.

To assess the actual quantitative contributions of each channel on inequality, we now turn to the detailed decomposition results. Recall that the point of this exercise is to decompose the overall estimated change in a distributional statistic into a component explained by the change in levels of the independent variables, and a second "unexplained" component due to the change in the coefficients. Also, note that in the case of financial assets, the coefficients component can be interpreted as the contribution of changes in the rate of return on financial assets. Thus, the unexplained component of $STOCK$ is the contribution of rising stock prices on net income via capital gains.

As alluded to in the introduction, it is worthwhile analytically to distinguish between monetary policy in general and specific channels associated with QE. For example, returns on short-term or liquid financial assets are clearly one channel through which general monetary policy may affect the distribution of income but is arguably not a channel specific to QE, which aimed to boost the economy through purchases of longer-term assets. Thus it is useful to consider the contribution of QE as a subset of the broader contribution of monetary policy. To focus the discussion on the most hotly debated channels through which QE is expected to influence inequality, we will refer to *QE channels* as the contributions of (1) the change in the employment rate, (2) the change in the return on stocks, and (3) the overall contribution of mortgage refinancing. Thus, we are intentionally distinguishing these specific channels from those associated with monetary policy more generally. We are also excluding from this tally the contributions of returns on short-term assets, for reasons already mentioned, and bonds, either held directly or through bond-based mutual funds. Bonds are excluded from the tally because it is not possible to identify their maturity composition using the SCF data and therefore it is not clear what share of the observed bond holdings would be sensitive to price changes due to QE. The unexplained component of employment is also excluded from the QE channels tally. This is because it is not clear how QE should affect this component. It is also worth emphasizing that restricting our attention to these specific channels results in a conservative estimate of the overall contribution of QE channels to inequality during this period.

For expositional ease, Table 2 reports the decomposition results for the main theoretical channels.[10] Intuitively, each column reports the observed percentage change ("total change") in a given distributional measure and breaks up this total into the percentage point contribution of each sub-component. Thus, all subcomponents within a column add up to the total at the top. Note that nothing in this exercise precludes a component from "subtracting" from the total, which means that a given channel may reduce inequality. Moreover, the total change in inequality may actually be smaller than the contribution of a component. This would imply that some components have a tendency to strongly increase inequality but are offset by other equalizing factors that subtract from the measure of inequality during this period.

Each column presents the decomposition result for a separate distributional statistic, where the first

[10] The complete set of results for every variable in the specification, all distributional statistics, and every decomposition component are available in the Appendix. Table A.3 reports the full results for a range of inequality measures. Tables A.4 and A.5 report the decomposition results for the bottom and top halves, respectively, of the distribution. These tables also include bootstrapped standard errors for the decomposition components.

Table 2: Decomposition results – contributions of the three main theoretical channels.

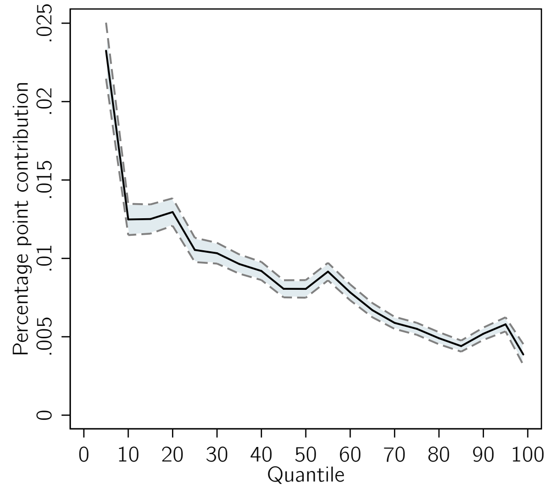
		Δ Inequality			Δ Level by quantile		
		99/10 ratio	90/10 ratio	Gini	Q = 10	Median	Q = 99
1	**Total change**	0.0830	0.0189	-0.0063	0.0092	0.0009	0.0923
2	**QE channels**†	0.1439	0.0401	-0.0017	0.0227	0.0491	0.1667
3	**Employment channel**	0.0745	-0.0166	0.0012	-0.0857	-0.1351	-0.0113
3a	*Explained*	-0.0086	-0.0073	-0.0010	0.0125	0.0081	0.0039
3b	*Unexplained*	0.0831	-0.0093	0.0022	-0.0981	-0.1431	-0.0152
4	**Financial returns**	0.2851	0.1621	0.0144	-0.1561	-0.0218	0.1290
4a	*Stocks*	0.1541	0.0217	-0.0011	-0.0077	-0.0019	0.1465
4b	*Bonds, directly held*	0.0042	0.0005	0.0007	-0.0018	-0.0016	0.0023
4c	*Bond mutual funds*	-0.0396	0.0094	0.0007	0.0011	0.0051	-0.0385
4d	*Short-term / liquid assets*	0.1665	0.1304	0.0142	-0.1477	-0.0234	0.0187
5	**Mortgage refinancing**	-0.0016	0.0257	0.0004	0.0179	0.0429	0.0163
5a	*Explained*	0.0682	0.0177	0.0009	0.0121	0.0244	0.0802
5b	*Unexplained*	-0.0698	0.0080	-0.0005	0.0059	0.0185	-0.0639

Note: This table reports the change in a given distributional statistic between the pre and post-QE periods as well as the decomposed contributions of each of the three main theoretical channels: unemployment, financial asset returns, and mortgage refinancing. The explained component is the contribution of changes in endowments (Δ_X) while the unexplained component is the contribution of changes in coefficients (Δ_γ). All financial return contributions refer to the unexplained component of each financial asset. †QE channels = 3a+4a+5.

three columns are devoted to inequality measures, including ratio of the 99th to 10th percentiles, the 90/10 ratio, and the Gini coefficient. The second set of columns report the level effects on the 10th, 50th and 99th percentiles. For each decomposed statistic, the first two rows report the total change in that statistic and how much the combined channels contributed to that change. The third row, *QE channels*, defined above, is the sum of the explained component of employment, stock returns, and the total contribution of mortgage refinancing. For all distributional measures, the combined contribution of monetary policy channels exceed the total change during the QE period. As described above, this implies that monetary policy channels were enormously disequalizing during this period but that other factors unrelated to monetary policy had an offsetting, equalizing impact. Put differently, holding everything else constant, if monetary policy channels were the only factors contributing to the distribution of income, the total increase in inequality would have been much larger.

The contributions of the three main theoretical channels are also depicted graphically by quantile in Figures 2 through 4. The graphs show how much of the change in net income of a given quantile is due to the component in question. The components are reported as 99 percent confidence intervals, which were calculated for each quantile using bootstrapped standard errors with 100 repetitions. As with the RIF regression graphs discussed above, a downward sloping curve indicates that the component is equalizing, in the sense that it contributed to a decrease in inequality. Conversely, an upward sloping curve indicates that the component in question increased inequality.

Figure 2: Explained contribution of changes in employment



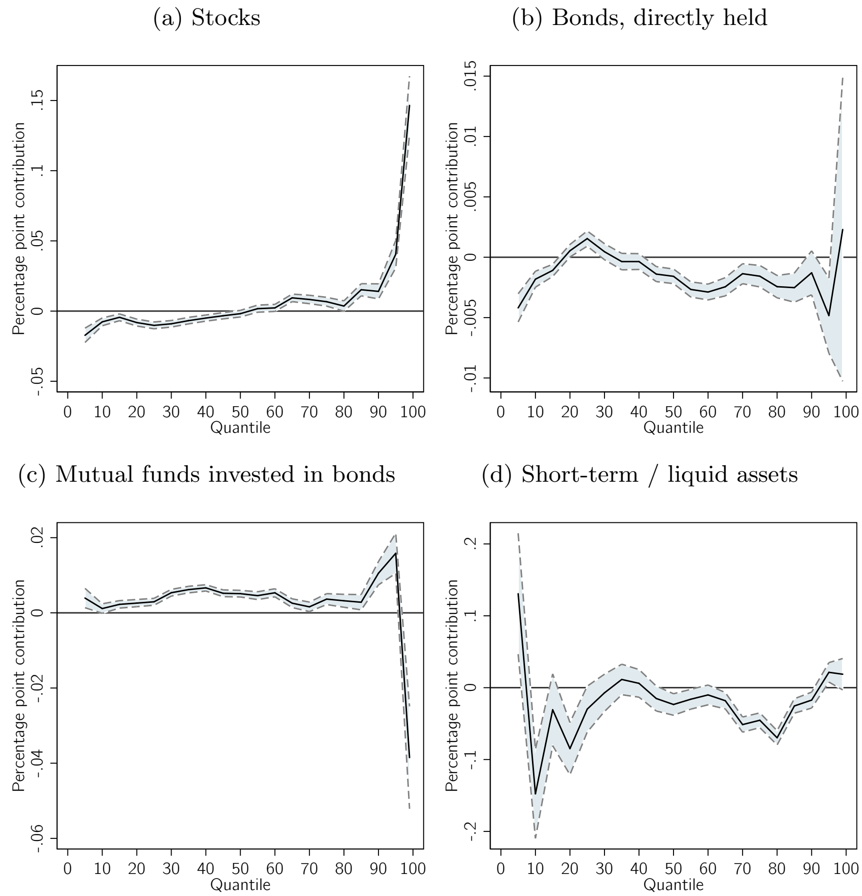
Note: This figure shows the explained component of employment (Δ_X) by quantile. The vertical axis measures the percentage point change in each net income quantile that is attributable to the change in the employment rate. The decomposition corresponds to the same specification presented in Tables A.3 through A.5. The range represents the 99% confidence interval based on bootstrapped standard errors with 100 repetitions.

No matter what measure of inequality one uses, changes in the level of employment unambiguously decreased net income inequality. As can be seen in the fist column of Table 2, although the ratio of the 99th to 10th quantiles grew by 10 percent, the increased employment rate (i.e. the explained component) partially offset this trend, subtracting nearly 1 percent. Changes in employment also had equalizing effects on other measures of inequality. Specifically, the explained component of employment contributed -0.7 percentage points to the 90/10 ratio and -0.001 to the Gini coefficient. All three of these negative contributions are statistically significant at standard significance levels. The equalizing contribution of employment to the distribution of net income can also be inferred from Figure 2. The downward sloping curve for the explained component indicates that employment gains contributed to much larger increases in net income for bottom quantiles than for top quantiles. Changes in employment contributed nearly 2.5 percentage points of growth to the 5th quantile and 1.3 percentage points to the 10th quantile. The contribution to median income growth was roughly 0.8 percent. By contrast, the contribution of higher employment to the net income of the top was much smaller. The explained component only increased the net income of the 90th quantile by around half a percentage point and even less for the 99th quantile.

A surprising result from the decompositions is that the unexplained component of employment – the contribution attributable to changes in the coefficient – has an ambiguous impact on inequality. Concretely, this means that the impact of changes in real wages on inequality depends on the particular measure of inequality. Real wages contributed over 8 percentage points to the growth of the 99/10 ratio but only around 0.002 to the Gini coefficient. Moreover, its contribution to the 90/10 ratio was actually negative.

Stock ownership appears to have dramatically increased the incomes of the very top of the distribution (see Figure 3). The main component of interest is the unexplained component, which can be interpreted as the increase in stock returns during the post-QE period. This component contributed a whopping 15

Figure 3: Contributions of financial assets returns



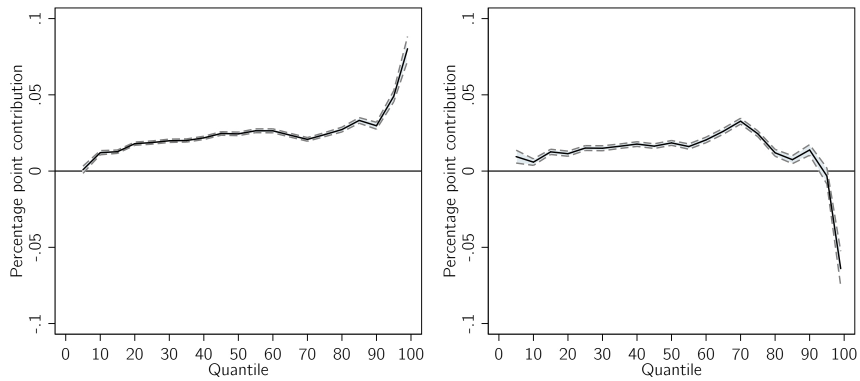
Note: This figure shows the unexplained component of various financial assets (Δ_γ) by quantile. The vertical axes measure the percentage point change in each net income quantile that is attributable to the change in the return on the given financial asset. The decomposition corresponds to the same specification presented in Tables A.3 through A.5. The range represents the 99% confidence interval based on bootstrapped standard errors with 100 repetitions.

percent to the 99/10 ratio and thus was highly disequalizing, dwarfing the comparatively modest equalizing impact of increasing employment. This 15 percent contribution is actually larger than the observed growth of the 99/10 ratio, suggesting that this positive contribution was offset by other equalizing factors, such as a declining skill premium and the impact of mortgage refinancing. Nevertheless, the large contribution of stock returns is limited to the very top of the distribution. Indeed, the unexplained component of $STOCK$ was much smaller for the 90/10 and 90/50 ratios, 2.2 and 1.6 percent, respectively. As result, the overall contribution of stock returns on inequality will depend on what measure of inequality one examines. For instance, stock returns appear to have contributed to a very modest, though statistically significant, *decrease* in the gini coefficient. This is likely due to the properties of the gini coefficient, which places more weight on observations from the middle of the distribution than on the tails.

Other financial assets had a mixed contribution to inequality. As expected, the return on short-term financial assets, which consist of checking accounts, certificates of deposit, and ordinary savings accounts,

Figure 4: Contribution of mortgage refinancing

(a) Explained component (Δ_X) (b) Unexplained component (Δ_γ)



Note: This figure shows both the explained (Δ_X) and unexplained (Δ_γ) components of mortgage refinancing by quantile. The vertical axes measure the percentage point change in each net income quantile that is attributable to refinancing. The decomposition corresponds to the same specification presented in Tables A.3 through A.5. The range represents the 99% confidence interval based on bootstrapped standard errors with 100 repetitions.

disproportionately decreased the income of poorer households while having a nearly neutral effect on richer households. As a consequence, the contribution of short-term asset returns to inequality was sizable – nearly 17 percent – and this was driven primarily by sharply falling returns for the 10th quantile. Changes in bond returns had an ambiguous impact on inequality. The return on directly held bonds ($BOND$) was modestly disequalizing, with small positive contributions to the 99/10, 90/10, and 90/50 ratios, as well as on the Gini coefficient. Nevertheless, none of these contributions are statistically different from zero at standard significance levels except for the Gini coefficient. On the other hand, returns on bond-based mutual funds contributed to a decrease in the 99/10 ratio while modestly contributing to *increases* in the 90/10 and 90/50 ratio, as well as the Gini coefficient. The explained component of $STOCKS$, $BOND$, and $MFBOND$ was negative for all quantiles and equalizing, with larger negative contributions at the top of the net income distribution. This is due to a fall in the stock of financial assets owned by households and the greater foregone rate of return for wealthier households.

Nearly all quantiles benefitted from both higher refinancing rates – reflecting easier access to credit – as well as a greater return on refinancing – reflecting lower interest rates on refinanced mortgage debt (Figure 4). Nevertheless, the contribution of mortgage refinancing to changes in the distribution of net income is nuanced. Ignoring the very top of the distribution, both the explained and unexplained components were modestly regressive. For instance, changes in the number of households who refinanced contributed to a 1.8 percent increase in the 90/10 ratio and a 0.5 percent increase in the 90/50 ratio. The unexplained component of refinancing – the returns to refinancing – contributed to a 0.8 percent increase in the 90/10 ratio but a 0.5 percent decline in the 90/50 ratio. The story is quite different when the 99th quantile is considered. The explained component significantly larger for the 99th quantile due to its larger return on refinancing during the pre-QE period. However, this was almost completely offset by the unexplained component for the 99th quantile, which is strongly negative at around -6.4 percent, reflecting the fall in the coefficients on RF_3yr during the post-QE period. Overall, refinancing had a nearly neutral impact on the 99/10 ratio and modestly regressive impact on other distributional statistics.

Taking a step back, the decomposition results support the proposition that the disequalizing effects of increasing stock returns outweighed the equalizing effects of falling unemployment during the post-QE period. Although mortgage refinancing appears to have benefitted nearly all quantiles, its overall impact on the distribution of net income was modestly regressive due both to constrained access to credit at the bottom and more favorable refinancing terms near the top. Netting out the equalizing impact of declining unemployment, the estimated impact of increasing stock returns on the 99/10 ratio is still around 15 percent. Adding the contributions of returns on other financial assets we arrive at a total contribution of financial asset returns of nearly 29 percent. If this were the end of the story the unavoidable conclusion would be that QE, and expansionary monetary policy more generally during this period, greatly contributed to rising inequality. However, this conclusion is incorrect since the decomposition results only account for the *observed* changes in the explanatory variables and are completely silent on the counterfactual changes in these variables that would have been observed in the absence of QE. We address this issue in Section 6 below.

5.1 Contribution to growth of real median income

Although the combined contributions of all three channels – financial returns, declining unemployment, and mortgage refinancing – appear to have increased inequality between the two periods, it is important to emphasize that these channels nevertheless boosted real median income. Indeed, while median income growth was flat during the post-QE period, as reported in the second to last column of Table 2, the three QE channels contributed a net 4 percentage points to median real income. Put differently, the contribution of the three QE channels offset a 4 percent decline of median income.

Mortgage refinancing played the biggest role, contributing 4.3 percentage points. This reflects both changes in the volume of refinancing (the endowment or explained component) and reduced borrowing costs (the returns to refinancing). Assuming that the demand for credit has remained more or less constant between the two periods, the increase in refinancing rates implies an improvement in credit availability. These improved credit conditions contributed nearly 2.5 percentage points to median income growth. At the same time, a fall in mortgage rates boosted median net income by lightening households' debt burden. This effect contributed nearly 2 percentage points to median income growth.

In contrast, financial asset returns were a drag on median income growth during this period. The combined contribution of financial asset returns on median net income was -2.2 percentage points, led by the falling returns on short-term / liquid financial assets. Curiously, stock returns had an essentially neutral effect on median income: although its contribution is -0.002, it is not statistically significant at standard significance levels.

Increased employment contributed nearly one percentage point to real median income growth. However, this positive contribution was offset by sharp declines in real median wages between the two periods. Indeed, declining returns on employment subtracted 14 percentage points from real median income during this period. This latter figure is quite large and exceeds the declines in real median wages reported elsewhere (see, e.g. Gould, 2015). One possible explanation for this discrepancy is that our estimates are based on a dummy for employment status, which does not take hours worked into account. Thus, falling working hours would be picked up as declines in the return on being employed.[11]

[11] Another possible explanation is that this is due to the well-known "omitted group" problem in Oaxaca-Blinder decompositions. See Fortin et al. (2011).

6 Counterfactual scenarios

As already noted, while our decomposition provides a detailed picture of the contribution of each channel to the actual change in the distribution of net income between the two periods, it lacks a causal interpretation. This is because the decomposition was carried out using the observed changes in the independent variables and not the counterfactual changes that would have prevailed had the Federal Reserve abstained from intervening to boost employment and prop up financial markets. In other words, our decomposition estimates do not answer the question: "what would the distribution of income look like if the Federal Reserve had not undertaken QE?" Nevertheless, it is possible to use the decomposition estimates to provide a precise framing of the relative magnitudes of each causal channel under alternative counterfactual scenarios. This requires making assumptions about the path of, say, unemployment in the hypothetical absence of QE; or about changes in stock returns had QE not taken place.

Though not settling the issue of causality, this exercise places well defined upper and lower bounds on the effects of QE, as well as the net tradeoff between stock returns – which, as we have seen, led to dramatic increases in inequality – and changes in employment, which modestly decreased inequality. What emerges from this exercise is that for QE to have actually decreased inequality relative to a hypothetical counterfactual, it is necessary to either strongly downplay the potential impact of QE on stock returns or assume very large employment effects. In other words, it is necessary to either assume that the large disequalizing impact of stock returns was mostly not due to QE but a "normal" feature of the economic recovery, or that the Federal Reserve prevented an implausibly large increase in the unemployment rate.

Consider the "causal" effect of QE on channel k for a given inequality statistic,

$$\tilde{\Delta}_k = \Delta_k - \Delta_k^C$$

where Δ_k^C denotes the counterfactual change of channel k (e.g. the change in employment that would have taken place without QE). To focus on the most controversial channels, let's consider the contribution of changes in the return of owning stocks ($\Delta\gamma_S$) and changes in employment ($\Delta\bar{X}_E$). For simplicity, let's assume that counterfactual stock returns can be modeled by replacing the estimated change in the return on stocks ($\Delta\gamma_S$) with a parameter θ that stands for the percentage increase in stock prices due to QE. That is, we assume that the "causal" contribution of stock returns is given by:

$$\tilde{\Delta}_{\gamma,S} = \theta\hat{\gamma}_{0,S}\bar{X}_{0,S} \tag{9}$$

where $\hat{\gamma}_{0,S}$ is the return on stocks during the pre-QE period.[12] Intuitively, equation (9) yields the causal contribution of QE to inequality through stock returns if one assumes that QE was responsible for a θ percent increase in stock prices.

Turning next to the employment channel, it is extremely likely that unemployment would have continued to increase, instead of slowly coming down, in the absence of QE. We do not take a stand on precisely how much employment would have hypothetically decreased but instead present a range of estimates for the effect of QE via employment based on counterfactual levels of employment. Below we will discuss estimates reported in the literature and how these translate into contributions to inequality in our framework. Specifically, starting with the definition of the endowment component for employment in the Oaxaca-Blinder decomposition, we replace the change in mean endowments, $\Delta\bar{X}_E$, with the hypothetical change causally

[12] Algebraically, this follows from the definition of the change in the return on stocks and of θ, which is the percentage change. Since $(\hat{\gamma}_{1,S} - \hat{\gamma}_{0,S})/\hat{\gamma}_{0,S} = \theta$, it is easy to see that $\Delta\gamma_S = \theta\hat{\gamma}_{0,S}$.

attributable to QE, $\Delta\bar{X}_E - \Delta\bar{X}^C_E$. The causal contribution of QE to inequality via employment is thus given by:

$$\tilde{\Delta}_{X,E} = \tilde{\Delta}\bar{X}_E\hat{\gamma}_{0,E} \tag{10}$$

where $\hat{\gamma}_{0,E}$ is the RIF regression coefficient for employment during $t = 0$. Combining the effects of stock returns and employment, we arrive at the net effect QE relative to the counterfactual:

$$\tilde{\Delta} = \tilde{\Delta}_{X,U} + \tilde{\Delta}_{\gamma,S} \tag{11}$$

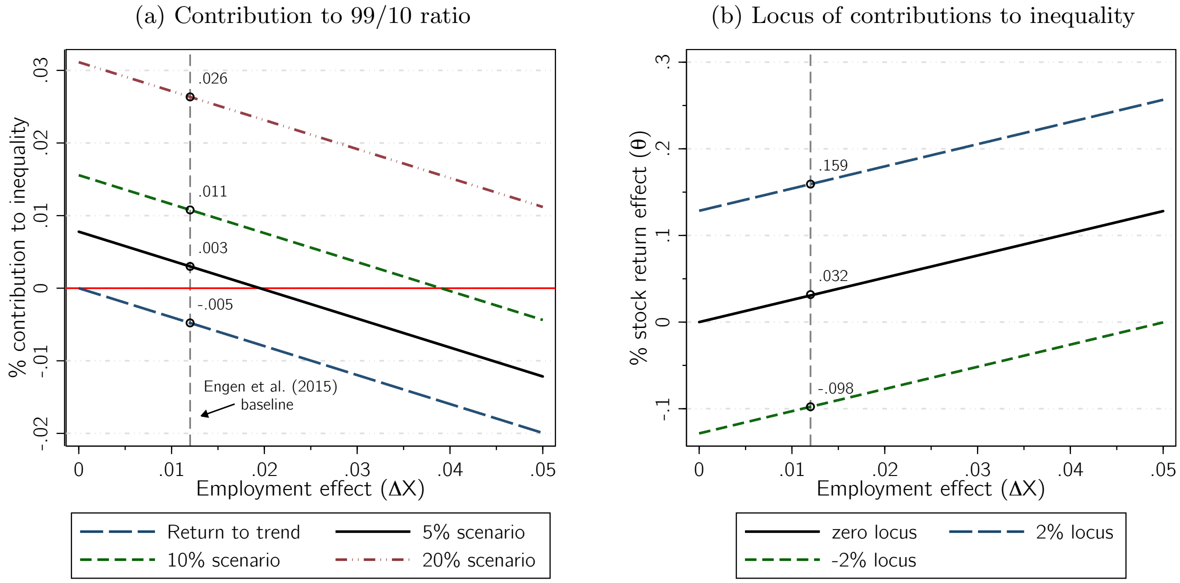
Using the decomposition results, we consider two counterfactual exercises to assess the plausibility that QE may have decreased or increased inequality given these well defined impacts on employment and stock returns. Specifically, we take the coefficients from the RIF regressions and combine them with alternative assumptions about changes in endowments and returns to calculate the hypothetical contribution of QE to inequality under various counterfactual scenarios.

First, we examine the net causal contribution to inequality as a function of the causal effect of QE on employment ($\Delta\bar{X}_E - \Delta\bar{X}^C_E$) holding constant the effect on stock returns at different levels. This exercise is intended to answer the question: "how much would QE have contributed to inequality if its causal impact on employment had been x points and we assume that QE was responsible for a y percent increase in stock prices?" Thus, panel (a) of Figure 5 graphs the net contribution to the 99/10 ratio ($\tilde{\Delta}$) as a function of the hypothetical causal effect on the employment rate ($\tilde{\Delta}_{X,U}$), holding constant the causal effect of QE on stock returns ($\theta\hat{\gamma}_{0,S}\bar{X}_{0,S}$). As in the decomposition figures presented above, the vertical axis measures the percentage point change in inequality due to the factors under consideration. We consider four alternative scenarios for stock prices in this exercise. The "return to trend" scenario makes the extreme assumption that none of the stock price growth observed during the recovery is causally attributable to QE and instead simply reflects the stock prices returning to their pre-crisis trend. This scenario is broadly compatible with Bernanke's views (cited above) and corresponds to setting $\theta = 0$. We then consider three intermediate scenarios where QE was causally responsible for 5, 10, and 20 percent increases in stock prices.

Second, we consider the locus of combinations of employment and stock returns effects necessary for the contribution of QE to inequality to equal zero. This second exercise answers questions of the type: "If QE had a zero causal impact on inequality, what combinations of stock returns and employment effects are consistent with this zero impact?" Phrased differently, this exercise answers: "If we assume that QE was only responsible for a y percent change in stock prices, how big does the effect on employment need to be to ensure a zero net impact on inequality?" Concretely, this exercise simply consists of setting $\tilde{\Delta} = 0$ from equation (11) and graphing the zero locus in $(\tilde{\Delta}\bar{X}_E, \theta)$-space. This is shown in panel (b) of Figure 5.

Although the jury is still out on the overall macroeconomic impact of QE, there have been a number of studies quantifying its effects on employment and stock prices. These are thoroughly reviewed in Bivens (2015). A general reading of this literature is that QE had non-trivial effects on the unemployment rate and relatively modest effects on stock prices. Using estimates of the effect of QE on the term-premium and simulations based-on the Federal Reserves' FRB-US model, Chung et al. (2012) report that QE likely lowered the unemployment rate by 1.5 percentage points. Engen et al. (2015) reports estimates ranging from a 0.8 percentage point decrease to an upper bound of 1.5 points, with a baseline impact of 1.2. Estimates of the impact of QE on stock prices come from event-style studies measuring the response of stock prices to surprise monetary policy announcements related to QE (Rosa, 2012; Rogers et al., 2014; Kiley, 2014; Engen et al., 2015). In these types of studies, stock prices are estimated to have grown between 3 percent to around

Figure 5: Impact of QE relative to various counterfactual scenarios



Note: Panel (a) shows the net contribution of QE to the 99/10 ratio through its effect on employment and stock returns under alternative scenarios about the causal impact of QE on these two channels. The "return to trend" scenario assumes that all observed stock returns were due to stock prices returning to their trend level ($\theta = 0$). The "5 percent" scenario assumes that QE increased stock prices by 5 percent. The 10 and 20 percent scenarios are defined analogously. Panel (b) reports the combinations of stock return and employment effects that yield a zero net impact on inequality. In both panels, "employment effect" refers to the hypothetical causal impact of QE on employment relative to the counterfactual absence of QE ($\Delta \bar{X}_E - \Delta \bar{X}_E^C$). In panel (b), "stock returns effect" refers to the percentage increase in stock prices causally attributable to QE.

9 percent because of QE.[13]

Considering these estimates for the employment and stock prices effects, QE would have mildly increased inequality or have had an approximately neutral effect. Taking the 5 percent causal effect on stock prices scenario as the baseline (the solid black curve in panel (a) of Figure 5), it is evident that the net contribution of QE to inequality through employment and stock returns is positive for a substantial range of effects on employment. For example, let's consider the net contribution to inequality assuming that the causal effect of QE on employment was 1.2 percentage points. This change in employment is consistent with the baseline estimates reported by Engen et al. (2015). As can be seen in panel (a), this corresponds to a 0.3 percentage point increase to the 99/10 ratio under the 5 percent stock returns scenario, a 1.1 percentage point contribution under the 10 percent scenario, and as high as 2.6 percentage points under the 20 percent scenario. Indeed, under the 10 percent stock returns scenario, the contribution to the 99/10 ratio only becomes negative for assumed employment effects exceeding 4 points. Making the less conservative assumption that 20 percent of the change in stock returns was due to QE, the employment effects necessary to yield a neutral or negative impact on inequality become highly implausible. Perhaps the easiest way to appreciate the tradeoff between the equalizing effects of employment and the disequalizing effects of stock

[13] One limitation of these estimates is that event-studies, by design, only capture the response of stock prices during the immediate time-period of the policy announcement and as such may not capture the full effect of QE, via, for example, general financial market conditions. Due to this uncertainty, event-studies may understate the full effect of QE on stock prices.

returns is by looking at panel (b) of Figure 5. There, the solid black curve plots the combinations of stock return effects and employment effects that are consistent with a neutral QE impact on inequality. A 1.2 percentage point employment effect would only result in a zero net impact on inequality if as little as 3.2 percent of the change in stock prices were attributable to QE.

7 Conclusion

Utilizing the Federal Reserve's Survey of Consumer Finances (SCF) we show that between the two periods we study (2008-2010 "Pre QE"; and 2011-2013 "Post-QE") there was a sizeable increase in over-all inequality in net income the US, as measured by the 99/10 ratio. We identify three main channels – the employment channel, the financial returns channel and the mortgage financing channel – and use a decomposition approach to "explain" this increase in inequality in terms of the contribution of each channel. Overall, these three channels combined contributed over 14 percentage points to the increase in the 99/10 percentiles ratio and 4 percentage points to the 90/10 ratio. Perhaps surprisingly, even the employment channel is disequalizing according to this exercise because of the large declines in real wages and/or hours worked over this period, despite large increases in employment levels. In addition, equity price increases and drops in returns on short term assets, which strongly affect those at the lower rungs of the income distribution, have a strong dis-equalizing impact. Only mortgage refinancing has a small equalizing impact.

These results do not imply that QE was itself disequalizing because this is an accounting and not a causal framework. To try to focus in on a causal understanding we employ a set of counter-factual scenarios. Drawing on our estimates and the estimates of channel impacts in the literature, we conclude that the likely impact of QE was to increase employment by 1.2 percentage points over this period, and cause an increase in equity prices by anywhere from 5 percent to 10 percent. We show that, under these conditions, QE likely increased the 99/10 ratio by 1.1 percentage points. This is roughly 13 percent of the total 8.3 percent increase in the 99/10 ratio over this period.

These dis-equalizing impacts were due to both policy choices and deep seated structural problems. Policy wise, the Federal Reserve and Treasury Department did not design effective mechanisms to clear away obstacles for lower income households to refinance loans at lower rates. As Bair (2012) and Barofsky (2012) show, helping underwater homeowners refinance their mortgages or stay in their homes was not a top priority of the Treasury Department. Nor did the Federal Reserve try to implement any regulatory programs to do so. In addition, the Federal Reserve did not try to develop innovative programs to use its lending facilities to lend directly state and local governments or others who would preserve or expand employment. This direct lending could have lessened the Fed's dependence on bidding up asset prices in an attempt to generate employment and wage increases.

In terms of structural obstacles over which the current Federal Reserve officials had little leverage, are the long-term deterioration in labor market opportunities for many workers due to globalization and legal and political reductions in labor bargaining power that have contributed to long term wage stagnation (See Bivens et al., 2015; Bivens and Mishel, 2015).

Finally, while our results tend to support the critics who argue that QE did increase inequality, there is nothing in our analysis which supports those who argue that raising interest rates will have a desirable, equalizing impact. An increase in interest rates would likely reduce employment growth, and make mortgage refinancing more expensive. While it might reduce asset prices and raise returns on short term assets, the employment and refinancing impacts are likely to be dominant as earlier work on monetary policy and income distribution has demonstrated (e.g. Coibion et al., 2012).

This suggests a paradox. Given the current structure of the economy and monetary policy strategies, both loose and tight monetary policy are likely to be dis-equalizing. Future research should focus on better understanding the reason for this paradoxical situation. It is likely that more direct tools of monetary policy are needed. Perhaps more importantly, fiscal policy, and labor market policies such as changes in labor laws, tax laws, and minimum wage legislation will be needed to reduce the massive levels of inequality that we are experiencing today.

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A Appendix

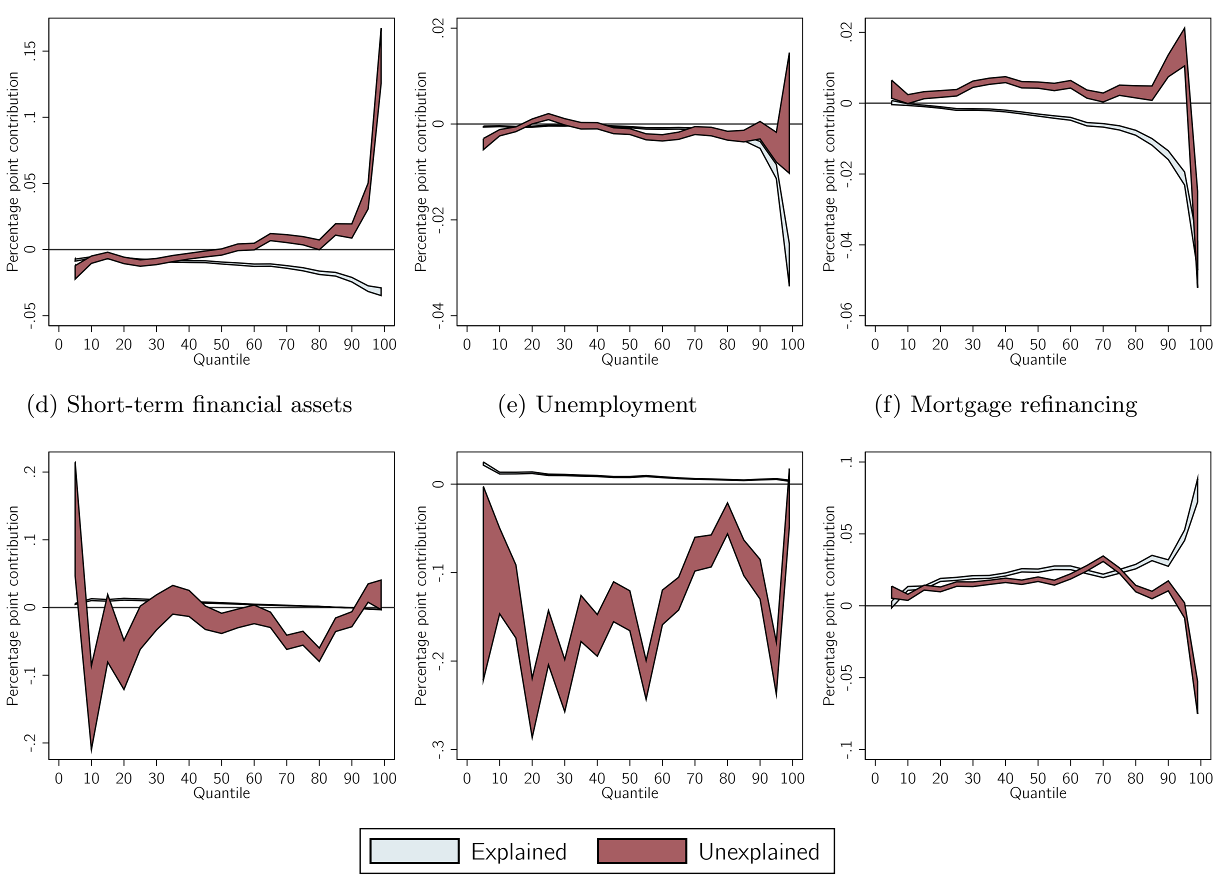
Table A.1: Description of covariates

	Definition
Employment (EMP)	Indicator variable for the employment status of the head of the household, as defined by the SCF.
Stock ownership ($STOCK$)	Indicator for whether or not the household directly owns any stocks.
Bonds, directly held ($BOND$)	Indicator for whether or not the household directly owns any bonds.
Bond mutual funds ($MFBOND$)	Indicator for whether or not the household owns a non-zero amount of bond-based mutual funds.
Short-term / liquid assets ($SHORT$)	Indicator for owning any short-term or liquid assets. These include checking accounts, cash, certificates of deposit, and other liquid assets.
Mortgage refinancing (RF)	Indicator for whether or not the household obtained refinancing for their primary mortgage during the previous three years.
Education ($EDUC$)	Maximum years of education completed by the head of the household.
Age (AGE)	Age, in years, of the household head.
Credit denial / fear of denial ($TURNFEAR$)	Indicator for whether or not the household has been denied or feared being denied credit during the previous 5 years.
Bankruptcy ($BNKRUPLAST5$)	Indicator for whether or not the household filed for bankruptcy during the previous 5 years.
Race ($RACE$)	Categorical variable indicating the stated race of the household head.

Table A.2: Covariate means – before and after QE

	Pre-QE (2010-08)	Post-QE (2013-11)
Employment	0.9295	0.9413
Stocks	0.1509	0.1375
Bonds, directly held	0.0163	0.0142
Bond mutual funds	0.0397	0.0335
Short-term / liquid assets	0.9263	0.9319
Mortgage refinancing	0.0927	0.1248

Figure A.1: Detailed decomposition results by quantile and explanatory variable



(a) Stocks (b) Bonds, directly held (c) Mutual funds invested in bonds

(d) Short-term financial assets (e) Unemployment (f) Mortgage refinancing

Note: These figures show the results of the detailed decomposition by quantile and covariate. The decomposition corresponds to the same specification presented in Tables 6 and 7. For each component, the range represents the 99% confidence interval based on bootstrapped standard errors with 100 repetitions.

Table A.3: Detailed decomposition results by inequality measure.

	99/10 ratio		90/10 ratio		90/50 ratio		Gini	
	Δ	*se*	Δ	*se*	Δ	*se*	Δ	*se*
Change	0.0830	0.0093	0.0189	0.0045	0.0273	0.0035	-0.0063	0.0005
Endowments								
EMP	-0.0086	0.0004	-0.0073	0.0004	-0.0029	0.0002	-0.0010	0.0000
STOCK	-0.0259	0.0010	-0.0167	0.0005	-0.0126	0.0004	-0.0003	0.0000
BOND	-0.0289	0.0018	-0.0039	0.0002	-0.0037	0.0002	-0.0000	0.0000
MFBOND	-0.0426	0.0017	-0.0143	0.0005	-0.0113	0.0004	-0.0002	0.0000
SHORT	-0.0145	0.0006	-0.0121	0.0006	-0.0069	0.0003	-0.0002	0.0000
RF	0.0682	0.0030	0.0177	0.0009	0.0053	0.0008	0.0009	0.0001
EDUC	0.0117	0.0005	0.0117	0.0004	0.0051	0.0002	0.0005	0.0000
AGE	-0.0049	0.0004	-0.0026	0.0003	0.0053	0.0003	0.0001	0.0000
TURNFEAR	0.0028	0.0002	0.0030	0.0002	-0.0001	0.0001	-0.0003	0.0000
BNKRUPLAST5	-0.0041	0.0003	-0.0052	0.0003	-0.0034	0.0002	0.0000	0.0000
_IRACE_2	-0.0013	0.0002	-0.0014	0.0002	-0.0001	0.0001	-0.0001	0.0000
_IRACE_3	0.0002	0.0001	0.0004	0.0001	-0.0001	0.0001	0.0000	0.0000
_IRACE_5	0.0003	0.0003	0.0003	0.0002	0.0002	0.0001	0.0000	0.0000
Total	-0.0477	0.0039	-0.0304	0.0016	-0.0251	0.0012	-0.0007	0.0001
Coefficients								
EMP	0.0831	0.0225	-0.0093	0.0196	0.0356	0.0101	0.0022	0.0028
STOCK	0.1541	0.0075	0.0217	0.0023	0.0159	0.0022	-0.0011	0.0002
BOND	0.0042	0.0045	0.0005	0.0007	0.0003	0.0006	0.0007	0.0000
MFBOND	-0.0396	0.0051	0.0094	0.0012	0.0055	0.0012	0.0007	0.0001
SHORT	0.1665	0.0197	0.1304	0.0208	0.0062	0.0059	0.0142	0.0014
RF	-0.0698	0.0043	0.0080	0.0015	-0.0046	0.0013	-0.0005	0.0001
EDUC	-0.2205	0.0406	-0.0631	0.0269	-0.1745	0.0180	-0.0221	0.0022
AGE	0.0979	0.0236	0.1873	0.0144	0.0315	0.0099	-0.0074	0.0012
TURNFEAR	-0.0108	0.0037	0.0075	0.0029	-0.0349	0.0020	-0.0023	0.0004
BNKRUPLAST5	0.0009	0.0007	0.0071	0.0007	0.0040	0.0005	0.0000	0.0001
_IRACE_2	0.0270	0.0022	0.0309	0.0020	0.0208	0.0012	0.0017	0.0002
_IRACE_3	-0.0160	0.0020	-0.0126	0.0016	0.0134	0.0011	0.0006	0.0002
_IRACE_5	-0.0335	0.0024	-0.0086	0.0011	-0.0094	0.0009	-0.0002	0.0001
_cons	0.0228	0.0532	-0.2273	0.0382	0.1359	0.0241	0.0080	0.0036
Total	0.1663	0.0094	0.0819	0.0045	0.0456	0.0033	-0.0055	0.0004

Table A.4: Detailed decomposition results by quantile, bottom half of the distribution.

	Q=10		Q=20		Q=40		Q=50	
	Δ	*se*	Δ	*se*	Δ	*se*	Δ	*se*
Change	0.0092	0.0037	-0.0094	0.0029	-0.0115	0.0024	0.0009	0.0024
Endowments								
EMP	0.0125	0.0004	0.0130	0.0003	0.0092	0.0002	0.0081	0.0002
STOCK	-0.0060	0.0002	-0.0066	0.0002	-0.0091	0.0003	-0.0102	0.0003
BOND	-0.0004	0.0000	-0.0006	0.0000	-0.0003	0.0000	-0.0007	0.0000
MFBOND	-0.0004	0.0001	-0.0012	0.0001	-0.0022	0.0001	-0.0034	0.0001
SHORT	0.0116	0.0005	0.0122	0.0005	0.0078	0.0003	0.0064	0.0003
RF	0.0121	0.0005	0.0180	0.0004	0.0218	0.0004	0.0244	0.0004
EDUC	0.0124	0.0004	0.0137	0.0004	0.0179	0.0005	0.0190	0.0005
AGE	0.0035	0.0003	-0.0038	0.0002	-0.0038	0.0002	-0.0043	0.0002
TURNFEAR	0.0007	0.0001	0.0009	0.0001	0.0026	0.0002	0.0038	0.0002
BNKRUPLAST5	0.0014	0.0002	0.0012	0.0001	-0.0001	0.0001	-0.0004	0.0001
_IRACE_2	-0.0016	0.0002	-0.0028	0.0002	-0.0033	0.0002	-0.0028	0.0002
_IRACE_3	-0.0004	0.0001	-0.0002	0.0001	0.0000	0.0000	0.0001	0.0000
_IRACE_5	-0.0001	0.0001	-0.0001	0.0001	-0.0001	0.0001	-0.0000	0.0000
Total	0.0452	0.0012	0.0437	0.0011	0.0404	0.0011	0.0399	0.0011
Coefficients								
EMP	-0.0981	0.0188	-0.2530	0.0130	-0.1710	0.0091	-0.1431	0.0088
STOCK	-0.0077	0.0011	-0.0082	0.0010	-0.0050	0.0009	-0.0019	0.0009
BOND	-0.0018	0.0003	0.0005	0.0002	-0.0004	0.0003	-0.0016	0.0002
MFBOND	0.0011	0.0005	0.0026	0.0004	0.0067	0.0003	0.0051	0.0003
SHORT	-0.1477	0.0241	-0.0848	0.0141	0.0060	0.0075	-0.0234	0.0058
RF	0.0059	0.0008	0.0114	0.0007	0.0177	0.0006	0.0185	0.0006
EDUC	-0.0544	0.0254	0.1651	0.0203	0.0062	0.0149	0.0569	0.0113
AGE	-0.1673	0.0139	-0.0478	0.0111	-0.0081	0.0080	-0.0116	0.0076
TURNFEAR	-0.0082	0.0026	-0.0039	0.0019	0.0140	0.0015	0.0342	0.0014
BNKRUPLAST5	0.0014	0.0007	-0.0024	0.0006	0.0051	0.0004	0.0044	0.0004
_IRACE_2	-0.0307	0.0018	-0.0203	0.0013	-0.0114	0.0010	-0.0206	0.0009
_IRACE_3	0.0066	0.0014	-0.0067	0.0011	-0.0196	0.0009	-0.0195	0.0009
_IRACE_5	-0.0037	0.0009	-0.0049	0.0006	0.0012	0.0005	-0.0029	0.0005
_cons	0.4483	0.0418	0.2003	0.0294	0.1272	0.0213	0.0852	0.0172
Total	-0.0564	0.0035	-0.0522	0.0029	-0.0314	0.0023	-0.0202	0.0022

Table A.5: Detailed decomposition results by quantile, top half of the distribution.

	Q=60		Q=80		Q=90		Q=99	
	Δ	*se*	Δ	*se*	Δ	*se*	Δ	*se*
Change	0.0011	0.0024	0.0383	0.0029	0.0282	0.0038	0.0923	0.0096
Endowments								
EMP	0.0078	0.0002	0.0049	0.0001	0.0052	0.0002	0.0039	0.0003
STOCK	-0.0118	0.0004	-0.0175	0.0005	-0.0228	0.0007	-0.0319	0.0011
BOND	-0.0009	0.0001	-0.0021	0.0001	-0.0043	0.0003	-0.0294	0.0017
MFBOND	-0.0044	0.0002	-0.0084	0.0003	-0.0147	0.0005	-0.0431	0.0016
SHORT	0.0044	0.0002	0.0015	0.0001	-0.0004	0.0000	-0.0029	0.0001
RF	0.0264	0.0005	0.0272	0.0006	0.0297	0.0009	0.0802	0.0031
EDUC	0.0210	0.0006	0.0204	0.0006	0.0241	0.0007	0.0242	0.0008
AGE	-0.0032	0.0001	-0.0005	0.0001	0.0009	0.0002	-0.0014	0.0004
TURNFEAR	0.0042	0.0002	0.0039	0.0002	0.0037	0.0002	0.0035	0.0002
BNKRUPLAST5	-0.0004	0.0001	-0.0019	0.0001	-0.0038	0.0001	-0.0027	0.0001
_IRACE_2	-0.0029	0.0002	-0.0024	0.0001	-0.0030	0.0002	-0.0029	0.0002
_IRACE_3	0.0001	0.0000	0.0002	0.0001	-0.0000	0.0000	-0.0002	0.0001
_IRACE_5	0.0000	0.0000	0.0002	0.0001	0.0002	0.0001	0.0002	0.0002
Total	0.0403	0.0012	0.0256	0.0013	0.0148	0.0017	-0.0025	0.0045
Coefficients								
EMP	-0.1393	0.0076	-0.0387	0.0068	-0.1075	0.0087	-0.0152	0.0127
STOCK	0.0022	0.0010	0.0036	0.0014	0.0140	0.0021	0.1465	0.0081
BOND	-0.0029	0.0003	-0.0024	0.0004	-0.0013	0.0007	0.0023	0.0049
MFBOND	0.0053	0.0004	0.0032	0.0007	0.0105	0.0012	-0.0385	0.0053
SHORT	-0.0101	0.0053	-0.0698	0.0038	-0.0173	0.0043	0.0187	0.0085
RF	0.0204	0.0007	0.0120	0.0009	0.0139	0.0014	-0.0639	0.0044
EDUC	0.0123	0.0125	-0.0618	0.0139	-0.1176	0.0202	-0.2748	0.0389
AGE	0.0011	0.0073	-0.0284	0.0071	0.0199	0.0104	-0.0691	0.0209
TURNFEAR	0.0378	0.0014	0.0072	0.0014	-0.0007	0.0018	-0.0189	0.0028
BNKRUPLAST5	0.0027	0.0004	0.0007	0.0003	0.0085	0.0004	0.0023	0.0003
_IRACE_2	-0.0195	0.0008	-0.0097	0.0008	0.0002	0.0010	-0.0037	0.0011
_IRACE_3	-0.0160	0.0008	-0.0035	0.0007	-0.0060	0.0008	-0.0093	0.0016
_IRACE_5	-0.0010	0.0005	-0.0094	0.0006	-0.0123	0.0009	-0.0372	0.0022
_cons	0.0792	0.0189	0.2213	0.0172	0.2213	0.0253	0.4708	0.0448
Total	-0.0277	0.0022	0.0242	0.0024	0.0255	0.0032	0.1099	0.0094