

STOCKHOLM SCHOOL OF ECONOMICS
Department of Economics
659 Degree project in economics
Spring 2017

The Effects of Quantitative Easing on Wealth Inequality in Great Britain

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Abstract

In this paper, wealth development in Great Britain is observed from 2006 to 2014 as well as the potential correlation between quantitative easing and this development. This, in order to analyse the implications of such a policy on wealth inequality. A database containing information on wealth at the household level is used to carry out the study. The analysis of two different inequality measures is first conducted as to display the trend in the development of wealth inequality during this period of time. Then, a difference-in-differences model is built to estimate to what extent quantitative easing has affected the wealth of the different economic classes in Great Britain, thus showing if it has had an effect on wealth inequality. Our findings indicate that wealth inequality has increased between 2006 and 2014. Moreover, we find that quantitative easing has explanatory power for this increase. The results suggest that it is mainly explained by the middle classes gaining disproportionately from quantitative easing compared with the lower class.

Keywords: wealth inequality, quantitative easing, monetary policy, Great Britain

JEL: E21, E43, E52, E58

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Date submitted:	15 May 2017
Date examined:	8 June 2017
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Acknowledgments

We want to express our gratitude to our supervisor, Federica Romei, for her guidance, patience and aptitude to appease us in stressful moments during the writing of this thesis. Moreover, we would like to thank Örjan Sjöberg and Erik Lindqvist for their advice and valuable feedback. Lastly, we would like to thank Veronica, Agnes, Erik and Edward for their help and support.

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1. INTRODUCTION

Central banks have long been an integral part of modern societies and their main objectives have, through time, remained the same – stability. The means through which they achieve and maintain stability, however, has evolved with time. The relative importance and role of price stability, financial stability and economic stability has alternated. We are currently in a paradigm of inflation targeting, a practice in which central banks seek to control the general rise in price levels. This price stability paradigm has lasted for approximately thirty years, but the most recent global financial crisis has highlighted the importance of other factors as well. More emphasis is now put on analysing the macroeconomic effects of central bank policies, in addition to its effectiveness in achieving the inflation target and avoiding financial crises.

Another consequence of the financial crisis is the expanded toolkits central banks now use to achieve the inflation target. One of these new tools is quantitative easing, a monetary policy that consists of purchasing assets using central bank money. Despite the new discussions regarding the economic effects of monetary policy, the effect of quantitative easing is still ambiguous as it is quite recent. It is, however, believed to have helped boost the economy by stimulating financial markets and thus increased wealth. The distribution of this increase in wealth is, however, spoken very little of. As Yves Mersch, member of the Executive Board of the ECB, said in his keynote speech in 2014: “Indeed, inequality has been largely ignored in discussions of monetary policy. But this might be changing.” Our aim is therefore to investigate if quantitative easing has an effect on inequality with the following research question: *how has the Quantitative Easing programme in use by the Bank of England affected wealth inequality in Great Britain?*

In order to answer the research question we have procured a data set consisting of household wealth over the period 2006–2014. The data enables an analysis of how wealth has evolved from the starting point, prior to the initiation of quantitative easing, throughout the initiation and during the following years. In addition, it enables an analysis of the evolution of wealth inequality. Consequently, the data facilitates a study of the potential correlation between wealth and quantitative easing.

The results from our empirical study show that there indeed is a correlation between wealth and quantitative easing in Great Britain. Furthermore, the results establish

that this correlation is positive: quantitative easing has increased the level of wealth in the British economy. Looking at the distribution, however, shows that this increase in wealth is unevenly distributed across the population. The middle classes¹ have gained more from quantitative easing, with the upper middle class having benefited the most. From our study, the conclusion can thus be drawn that quantitative easing has led to an increase in wealth inequality in Great Britain.

The paper is organised as follows: the second section gives a background to why quantitative easing was employed. The current state of knowledge of monetary policy, monetary policy in the United Kingdom and types of inequality is presented in the third section. The fourth section outlines our method, while the data and results are presented in section five and six respectively. The implications of the results are then discussed in section seven and the paper is rounded off with a conclusion in the eighth and last section.

2. BACKGROUND

This year marks the ten-year anniversary of the beginning of the financial crisis that we know of as The Great Recession. The causes of the recession are many, one being oversized mortgage lending in the United States which led to people buying homes with a large amount of debt. These mortgage loans were in turn sold to financial institutions around the world who then found themselves exposed to potential losses in the United States housing market. When the housing bubble that had grown during the 2000s – due to high lending and high confidence – burst in 2006, mortgage default rose and banks around the world realised they had lost a large amount of money. The shortage in liquidity that followed obliged banks to reduce loans and mortgages, making it difficult for people to obtain credit. This, in addition to the fact that consumer and investor confidence was harmed by liquidity shortage, led to lower spending and investment which resulted in a worldwide recession.

At times like these, monetary policy is introduced in hope of achieving economic recovery. The usual role of monetary policy is to control liquidity in order to create economic growth, the ultimate goal being to keep a low and stable inflation. This is achieved by for example adjusting the interest rate and changing the amount of money

¹ Middle class here defined as wealth quartiles one and two, that is the mid 50% of the wealth distribution

banks are required to keep in the bank reserves. However, during the most recent recession, central banks did not manage to boost the economy by these conventional means as they had already pushed down interest rates to what is called the “zero lower bound”. Pushing them down further would have led to negative interest rates which, in theory, is possible but highly risky.

Central banks were therefore facing a challenge as monetary policy is effective when recovery has begun, but they had to aid the economy in its recovery so as to actually reach that point. This is why they turned to unconventional monetary policy. This type of monetary policy takes many forms. The easiest way to describe it is the use of all monetary tools that do not concern changing the interest rate at which a nation’s central bank lends money to domestic banks. This includes suspension or changes to the inflation target as well as massive expansion of central banks’ balance sheets. The most widespread type of unconventional monetary is Quantitative Easing which implies that a central bank creates new money to buy financial assets, like government bonds, from banks. The aim of Quantitative Easing is to stimulate the economy by encouraging banks to buy assets to replace the ones they have sold to the central bank, raising stock prices and lowering interest rates which in turn boosts investment. Unconventional monetary policy is rather new as it was first introduced in Japan in 2001. The Bank of Japan aimed at purchasing government securities from the banking sector in order to boost the level of cash reserves the banks held in the system.

3. CURRENT STATE OF KNOWLEDGE

In this section, we analyse previous theoretical as well as empirical studies in order to first explain conventional monetary policy and its effect on inequality. Secondly, studies on quantitative easing are presented to give a better insight into its mechanism and its effect on inequality. At last, we describe both conventional and unconventional monetary policy used in the United Kingdom as well as the different types of inequality that can be measured.

3.1. Conventional Monetary Policy and Inequality

The Mechanism

The Bank of England (BoE) is tasked with delivering monetary and financial stability to the nation. This includes keeping price levels stable and maintaining confidence in the currency but also to support the Government's targets for economic growth and employment. Stable prices are defined by the Government’s inflation target, and how

to reach that target is determined at Monetary Policy Committee Meetings. The most common tool for controlling inflation, in the United Kingdom (UK), is through the interest rate – called the Bank Rate. By setting the Bank Rate, the BoE influences a range of other borrowing and lending rates, such as interest on mortgage, and hence controls spending in society and, with it, inflation. A lower interest rate makes borrowing more, and saving less, attractive thus stimulating spending, while a higher interest rate has the opposite effect (BoE, nd.a).

Changes in the Bank Rate also have an effect on asset prices and the exchange rate, which in turn has an effect on consumer and business demand (BoE, nd.a). One example of this is housing prices. Lower interest rates tend to push up housing prices, enabling existing homeowners to extend their mortgages, financing higher consumption. The exchange rate affects inflation directly to the extent that imported goods are consumed directly in the economy, but it may also affect inflation indirectly through other channels (ECB, nd).

In addition, monetary policy can guide economic agents' expectations on future inflation. If the BoE is credible, agents will not increase prices in fear of high future inflation or decrease prices in fear of deflation (ECB, nd). Thus, the BoE can, if credible, control the rate at which economic agents' increase their prices by simply setting an inflation target.

Implications on Inequality

Although the topic of monetary policy and inequality is not new, no ultimate conclusion has been reached regarding their correlation. Prior work have contrasting views regarding both the importance of monetary policy's effect on economic inequality as well as the sign of the potential effect.

Coibion, Gorodnichenko, Kueng and Silvia (2012) summarises five channels through which a decrease in interest rate and an increase in inflation can potentially affect income and consumption inequality. The first is the *income composition channel* which highlights the heterogeneity of households with regard to their primary sources of income. The effect of expansionary monetary policy on the individual household will vary depending on their composition of labour, business and financial income. If the policy shock raises business profits more than wages, households with primary income from business will benefit disproportionately from this type of monetary policy. The

paper concludes that these households tend to be wealthier to begin with, resulting in that the income composition channel should lead to higher inequality in response to monetary policy shocks. Coibion et al. (2012) argues, however, that the income composition channel could have an opposite effect on inequality. This since transfers such as food stamps and social security tend to be countercyclical and therefore increase with expansionary monetary policy. As the main recipients of transfers are low-income households, this increases their income and dampens, if not reverses, the income composition channels effect on inequality.

The second channel through which interest rates affect inequality is the *financial segmentation channel*. This channel looks at the heterogeneity in households' presence on financial markets. It argues that individuals who are active on financial markets should be affected by changes in money supply prior to individuals who are not as active. This means that a shock in money supply has a skewed wealth effect towards individuals who have a high presence on financial markets. Although Coibion et al. (2012) points out the difficulty of retrieving data on individual actors' access to financial markets, we expect individuals with higher than average income and consumption to more actively participate in financial markets. Thus, the financial segmentation channel should increase inequality after an expansionary monetary policy shock.

The third channel that increases inequality with an expansionary monetary policy shock is the *portfolio channel*. Low-income households tend to hold relatively more currency than high-income households. Poorer households are therefore not as well protected against the so-called inflation tax. As an expansionary monetary policy aims to increase inflation, it will transfer some of the wealth from low-income households to high income-households thus increasing inequality.

The two remaining channels, the *savings redistribution channel* and the *earnings heterogeneity channel*, have the opposite effect and tend to decrease inequality in response to an expansionary monetary shock. The savings redistribution channel reduces inequality as interest rates decrease, lowering the cost of borrowing for net debtors and decreasing the return for net savers. Hence redistributing wealth from net savers, who are generally wealthier, to net lenders.

The last channel discussed in Coibion et al. (2012) is the earnings heterogeneity *channel*. Even though most households primarily depend on labour earnings as a source of income, the wages for high- and low-income groups respond differently to monetary policy. There are numerous explanations to why this might be. For example, a contractionary monetary policy shock will increase unemployment disproportionately, falling essentially upon low-income groups. In addition, Heathcote, Perri and Violante (2010) found that the sensitivity to business cycles are greater for low-income groups than high-income groups.

As the channels move in different directions, the aggregated effect of monetary policy on inequality is ambiguous. Thus, to properly assess the effects, one should turn to empirical data. Coibion et al. (2012) continues by looking at the dynamic responses of income and consumption inequality to monetary policy shocks in the United States. To enable this, they use household data from the Consumer Expenditures Survey (CEX). A statistically significant increase in inequality across households was identified following contractionary monetary policy (Coibion et al., 2012). However, the authors highlight some limitations to their study. Though the CEX contains household level data on consumption and income, it does not include reliable information on households' cash holdings nor which households are connected to financial markets. This limitation in data makes it impossible to analyse the redistributive effects of the portfolio and financial segmentation channels, as well as limiting the study to consumption and income inequality. The authors still believe in the validity of the study as these channels, if present, must be weaker than the saving redistribution and earnings heterogeneity channels which work in the opposite direction.

A study based on a New Keynesian business-cycle model in Gornemann, Kuester and Nakajima (2016), reaffirms the empirical results presented in Coibion et al. (2012). In their model, the authors take into account not only heterogeneity in income across households but also differences in wealth, patience, productivity and employment status. This enables them to look at wealth inequality and at how contractionary monetary policy shock effects vary between different wealth deciles. Although the authors found that all households were negatively affected by a contractionary monetary policy shock, the size of the impact, measured in lifetime consumption, varied greatly between the wealth deciles. While the 0.1 per cent wealthiest households experience a negative lifetime consumption of 0.01 per cent from a one-standard-

deviation contractionary monetary policy shock, the bottom 30 per cent experience a welfare loss of 0.12 per cent. This means that contractionary monetary policy shocks are “less costly for wealthier households than for the wealth poor” (Gornemann et al., 2016, p 35), thus resulting in rising inequality.

Not only does Gornemann et al. (2016) confirm, in agreement with Coibion et al. (2012), that contractionary monetary policy increases consumption and income inequality, it also states that wealth inequality, measured by a Gini index, increases with a contractionary monetary policy shock. However, in contrast to consumption and income inequality, whose effects decrease with time, wealth inequality continues to increase with time.

3.2. Unconventional Monetary Policy: Quantitative Easing

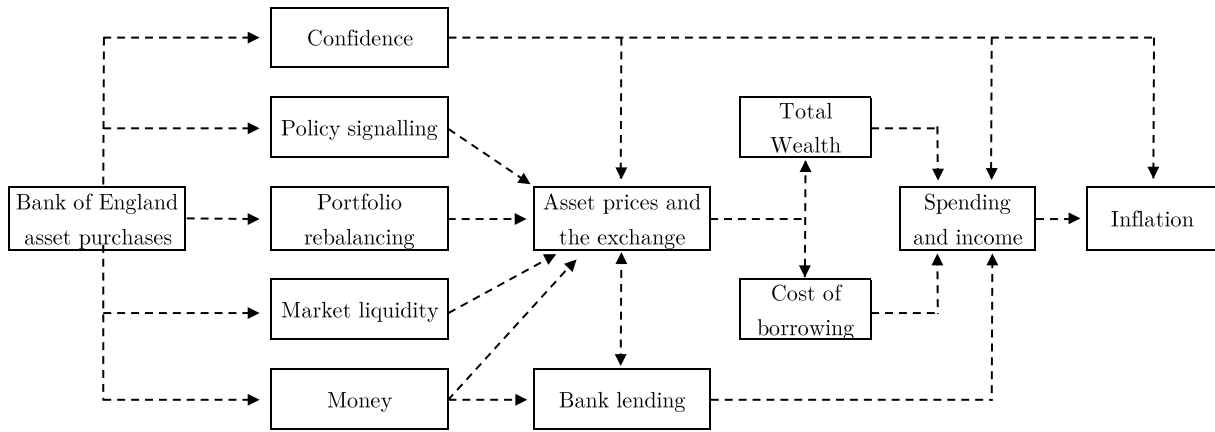
The Mechanism

Joyce, Miles, Scott and Vayanos (2012) describes and explains quantitative easing (QE) as well as the reason why central banks have made use of it following the financial crisis. They point out that while pre-crisis theory suggests that the main aim of monetary policy is to contain inflation, that view was challenged after the financial crisis and central banks realised that they should have a greater focus on financial stability in addition to targeting inflation. This in order to control asset market bubbles.

Joyce, Tong and Woods (2011) defines QE as the policy of purchasing assets using central bank money. It is achieved through the creation of new reserves and purchases are made from market actors with the aim to boost liquidity of the banking system (Green & Lavery, 2015). QE thus injects money into the economy to boost nominal spending –consequently helping to reach the two per cent inflation target. In other words, the aim of QE is to allow central banks to affect interest rates through open market operations without directly manipulating them.

Joyce et al. (2011) provides an overview of the United Kingdom’s QE policy, starting with the transmission channels for asset purchases and how they affect spending and inflation. The figure below shows a pictorial representation of the identified channels.

DIAGRAM 1: The Mechanism of Quantitative Easing



Source: Joyce et al. (2011) p. 201.

The authors distinguish between the channels that work through asset prices and other channels. The first channel through which QE affects the economy by asset prices is *policy signalling effects*. Here, the authors explain that policy announcements on asset purchases is a mean for central banks to inform agents about their views on the economy. This gives agents news about the underlying state of the economy which, in turn, can lead to more spending as agents are ensured that the central bank is still determined to meet the inflation target.

The second channel is the *portfolio rebalancing* channel. By purchasing assets from the private sector, the BoE reduces the supply of those assets, thus creating a new equilibrium with higher prices and lower yields. Market actors then find themselves holding money instead of financial assets, and assuming money is not a perfect substitute, they seek other financial assets with similar characteristics as a mean to rebalance their portfolio. This puts further upwards pressure on the price of the financial assets purchased in the QE programmes as well as their substitutes. The QE programme in use by the BoE was mainly targeted at purchasing Treasury Gilt and per the bank's own assessment gilt yields were significantly depressed (Joyce et al., 2011). This incentivises market actors to purchase higher yielding assets such as equities or corporate bonds. As a result, there is a broad asset-price inflation with lower yields, lowering the borrowing costs for firms and households which in turn stimulates investment and expenditure.

The third and last channel that works through asset prices is *liquidity premiums effects*. By purchasing long-term securities and increasing bank reserves, central banks boost liquidity for investors. Liquidity refers to the degree to which an asset or security can

be quickly bought or sold in the market without affecting its price. As Joyce et al. (2011) explains it, increased liquidity and improved market functioning due to QE lower the premium for illiquidity, and thus increase asset prices.

Joyce et al. (2011) further identifies two other channels that affect spending and inflation. The first one through *confidence effects*. The authors argue that as QE leads to improved economic outlook, it could directly boost consumer confidence and thereby people's willingness to spend. The confidence effects might also further increase asset prices by reducing risk premiums. The last channel that is mentioned in the article is *bank lending effects*. As QE leads to banks having more liquid assets it encourages them to finance more new loans which stimulates the economy. The authors however state that this channel is expected to make little impact because of the strains in the financial system following the crisis, implying that banks are more likely to hold the central bank injections of money than to pass liquidity onto the real economy through lending.

The overall effect of asset purchasing on the macro-economy can be broken down into two stages: an initial impact phase, which is of most interest to us, and an adjustment phase (Joyce et al., 2011). The portfolio rebalancing channel will, in the initial phase, bid up asset prices until equilibrium in money and asset markets is restored. The signalling channel along with the other effects of asset purchases will in turn reinforce this, further raising asset prices. Higher asset prices will then boost nominal spending of companies and individuals on the one hand by increasing the net wealth of asset holders, on the other hand by reducing the cost of borrowing. Increased demand, and hence spending, will help achieve the inflation target, stimulate the economy and reduce unemployment rate.

Implications on Inequality

If the effects of conventional monetary policy on economic inequality have been largely ignored, the effects of unconventional policy, and QE in particular, have been even more so. Green and Lavery (2015) however mentions this, describing Britain's economic recovery from the recession as a 'recovery through regressive redistribution'. The authors identify a mean through which the recovery works: asset-price inflation driven by QE. They argue that QE is a monetary policy that intentionally privileges members of society that hold assets. Those who rely exclusively upon wages for increases in income and wealth are thus disadvantaged. They further comment that those who hold

assets are predominantly wealthier and older households. This was confirmed by the BoE which concedes that the benefits of increased asset prices are ‘heavily skewed’ towards the top 5 per cent of households that own 40 per cent of these assets (Joyce et al., 2011). According to Green and Lavery (2015), it then seems that unconventional monetary policy in the form of QE would increase economic inequalities as it privileges a part of society that already has better economic conditions to begin with.

This point of view is however offset by Blot, Creel, Hubert, Labondance and Ragot (2015) that argues that there is a lack of research on the effect of QE on inequality. Although there is literature on the impact of monetary policy on inequality, it has not dealt with unconventional monetary policy, and there is, in fact, no theoretical or empirical study on that issue. The authors argue that the effect of QE is similar to that of conventional monetary policy. Through the portfolio channel, for example, QE lowers return and reduces financial incomes, hurting low-income households that tend to hold more currency, but no more than standard monetary policy. In their opinion, it is therefore wrong to suggest that QE would have a particularly worse effect on inequality.

Another argument mentioned in the paper is that QE, as any other type of expansionary monetary policy, is expected to reduce unemployment which in turn reduces inequality. In addition to this, they explain that as the aim of expanded asset purchase programmes is to bring the inflation rate closer to the 2 per cent target, QE would have a positive effect on inequality by avoiding the deflation trap. This as inflation transfers wealth from old and rich households to young and poor households —and therefore reduces inequality.

Finally, the authors state that the increase in asset prices is temporary, meaning that asset holders’ permanent income is little affected and thus consumption inequality – a key measure of inequality – remains unaffected.

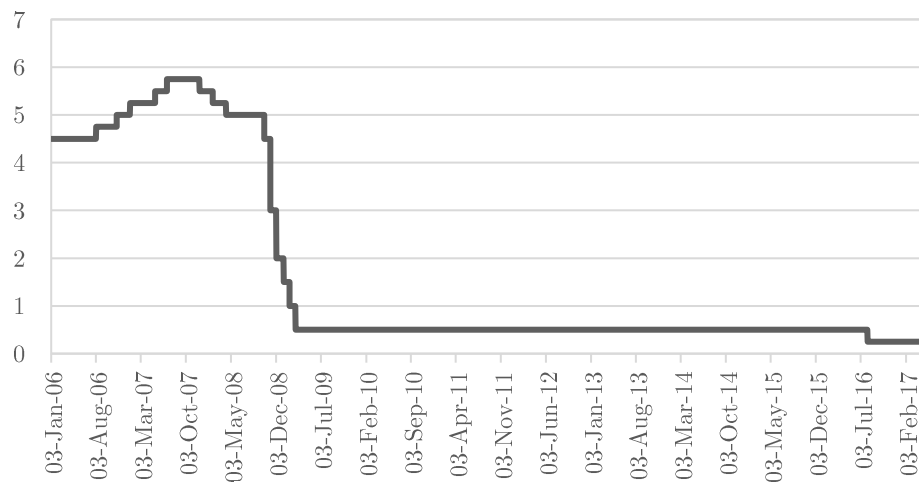
These contradictory views of QE’s effect on inequality make it difficult to assess its real effect. On the one hand, it seems that since QE works through an increase in asset prices, which benefits the already privileged members of society, it should increase inequality. On the other hand, one can argue that this only is a temporary effect and

that there are counterbalancing effects that speak in favour of QE when considering inequality.

3.3. The United Kingdom

Conventional Monetary Policy

DIAGRAM 2: Official Bank Rate

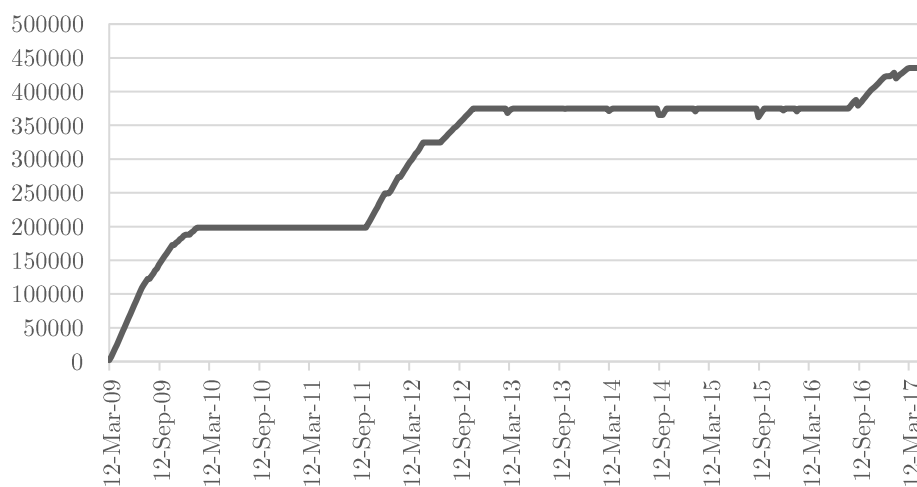


Source: BoE (nd.b)

During the first decennia of the 21st century, the Bank Rate has fluctuated between 3.5 per cent and 6 per cent. When the United Kingdom officially entered the recession in January 2008, the BoE was reactive and immediately began to cut the Bank Rate. It was changed five times during that year, dropping from 5.25 per cent to 1.5 per cent. It was then lowered continuously until March 2009 when it reached 0.5 per cent and stayed at this level for seven years during which the BoE employed other means to fight the recession (BoE, nd.b).

Unconventional Monetary Policy: Quantitative Easing

DIAGRAM 3: Bank of England's Holdings of Gilts



Source: BoE (nd.c)

In the first round of QE, initiated in March 2009, the BoE purchased a total of £200 billion of assets from mainly non-bank market actors. However, in October 2011 the UK's economy was still flat lined and with growing fears of a Eurozone crisis the BoE decided to expand the QE programme. They consequently initiated the second round of QE with an additional £125 billion of asset purchases. As the second round did not achieve the desired effects, a third round was initiated shortly after the second. The effects of the three rounds on asset yields, prices and the sterling exchange rate index are summarised in Appendix 1. Apart from the announcement of the second round, we can see that all announcements – as well as asset purchases – led to a drop in yield across asset classes, with a particular decrease in high-yield corporate bond yields. This meaning that the QE programme has led to an increase in demand for riskier assets, which is in line with the predictions of the portfolio rebalancing channel (BoE, nd.c).

What is not included in Appendix 1 are the effects of the more recently announced fourth round. Shortly after the UK referendum, in which the people voted for the country to leave the European Union, the BoE decided to pre-emptively expand the QE programme to offset possible negative economic effects. The fourth round is still undergoing and the BoE is authorised to purchase a total £60 billion, of which £10 billion in corporate bonds (Haldane, Roberts-Sklar, Wieladek & Young, 2016).

3.4 Types of Inequality

There are various approaches to analysing inequality, whereof the most well-known are income and wealth inequality. Lately, greater emphasis has also been placed on consumption inequality as it is expected to not necessarily conform to the two previously-mentioned types of inequality. For instance, Coibion et al. (2012) seeks to study the effects of monetary policy shocks to consumption and income inequality in the United States. The authors consider two forms of inequality for both income and consumption which give us a better insight into what is included in them.

For income inequality, they construct a first measure of labour earnings inequality. It is argued that given the survey nature of the data used in their paper, this measure is likely to be known with the highest precision. One can presume that this argument holds for most data and therefore gives labour earnings inequality measures an advantage. However, as labour income only represents one component of households' income, the authors also construct a more complete measure of total income inequality in which financial income, business income and transfers also are accounted for in addition to labour earnings.

Consumption inequality is divided into two different measures as well, one narrow and one broad. The authors refer to the narrow one as consumption inequality which includes non-durables, services and some durable goods such as household appliances and entertainment goods. The broader one is referred to as total expenditures and includes consumption inequality as mentioned above but also mortgage payments and purchase of cars – large durable goods –, medical supplies and services as well as tuition and books for schooling etc.

In contrast, Doepke and Schneider (2006) looks at wealth inequality. The authors determine the nominal wealth positions as directly held nominal assets and liabilities and indirect nominal positions such as claims on the ownership of firms and shares in investment intermediaries (Doepke & Schneider, 2006). A similar approach is partaken by the Office for National Statistics, that have a strictly economic definition of wealth as the value of accumulated assets. However, they point out the difficulty in assessing wealth as data is sparse (ONS, 2016).

4. RESEARCH DESIGN

The purpose of this section is to detail the frame of our research. We begin by identifying the gap in the current state of knowledge before defining the scope of the research. This is done in order to formulate our specific research question. We then specify the hypotheses that are tested to answer our question and finally describe the method through which these hypotheses are tested.

4.1 Specification of Detailed Research Focus

Although we know the effect of conventional monetary policy on inequality is ambiguous, empirical studies in the United States indicate that contractionary monetary policy shocks increase income and consumption inequality. By reversing this argument, we expect expansionary monetary policy to have the opposite effect and decrease inequality.

Moreover, we note that expansionary conventional monetary policy and QE have the same end goal: boosting inflation. What differentiates these two policies is the mean by which they attain that goal. Conventional monetary policy works through changing the short term interest rate while QE works through increased asset prices. This leads us to question whether they have the same expected effect, and thus reduce inequality, or if the effect differs.

We can, however, not answer this question given the current state of knowledge as there is a gap between previous research and what we are seeking to answer. Indeed, there is no empirical nor theoretical research on how unconventional monetary policy affects inequality. Nor is there any empirical research on how conventional monetary policy affects inequality in the UK. For this reason, new empirical research is conducted to make an attempt at answering whether QE has had an effect on inequality.

Scope

In order to analyse this matter, we have to frame the scope of the paper as to have a delimited research question that we are able to investigate.

First, we decide to focus on the UK. This because we believe the UK initiated the QE programme sufficiently early to be able to analyse both short- and long-term effects it may have had on inequality. In addition, the BoE has not used any other unconventional monetary policy other than QE, which hence enables an isolated

evaluation of its effects. When searching for adequate data to use for our analysis, we were however only able to find data for Great Britain that corresponds to our criteria. Although the BoE's policies apply to the whole of the UK, we consider the data set to be sufficient as Great Britain does not include any region that is not under the BoE's influence.

Secondly, our analysis is done within a specific time frame covering the years from 2006-2014. This because we estimate that it represents a large enough time span, with good margins both before and after the start of the QE programme, to allow for an analysis that will give us relevant results (more recent data is not yet available).

Thirdly, we decide to evaluate wealth inequality and exclude other types of inequality such as income or consumption. This because we presume that it will give a more exhaustive view of the effects of QE since it includes pension and property wealth, that otherwise would not be accounted for. Furthermore, it has become increasingly important to look beyond income when assessing household well-being as a household's resources can be influenced by its stock of wealth and wealth has, over the years, become more complex (ONS, 2016). Moreover, we focus on the direct effect of QE on wealth inequality, without looking specifically at the channels through which it has operated. Henceforward, wealth inequality will be referred to as inequality.

Lastly, we decide to look at gross wealth rather than net wealth to capture the full effect of QE on asset price inflation. The reason for this is that an expected effect of expansionary monetary policy is that households and individuals take advantage of the lower cost of borrowing and the increased liquidity in bank lending, thus increasing their level of debt. This re-levering could cancel out some of the increase in household wealth if looking at net wealth.

Hypotheses

In order to investigate how the Quantitative Easing programme in use by the Bank of England has affected wealth inequality in Great Britain, we identify two alternative hypotheses that will be tested against each other. As they are mutually exclusive, it will suffice to prove that either one of them is true to be able to state that the other one does not hold. The two hypotheses are the following:

Hypothesis 0:

Quantitative Easing has had no effect on wealth inequality in Great Britain.

Hypothesis 1:

Quantitative Easing has had an effect on wealth inequality in Great Britain.

- 1.1. Quantitative Easing has had the same effect on wealth inequality as conventional expansionary monetary policy and has thus reduced wealth inequality.
- 1.2. Quantitative Easing has had the reverse effect and has thus increased wealth inequality.

4.2 Method

Based on a deductive approach, the two competing hypotheses are tested against each other with empirical data.

Measuring Wealth Inequality

The first step in our analysis is to measure inequality over time to see how it has evolved. This is done by adopting the approach used in Coibion et al. (2012). In their paper, the authors focus on three ways of measuring consumption and income inequality: Gini coefficients, cross-sectional standard deviations of log levels and differences between individual percentiles of the cross-sectional distribution of log levels. We apply two of these methods as to measure wealth inequality, the Gini coefficients and the differences between individual percentiles. However, we will not be looking at the log levels.

The Gini coefficient, which has long been used to measure inequality, gives us a single number between 0 and 1 that has a clear interpretation. It can also be seen as a percentage. The coefficient thereby summarises the extent to which wealth is equally allocated across the population. It is calculated at different points in time to observe its evolution. Although the Gini coefficient is clear and simple to interpret, there are downsides to using it in this case. It cannot count values equal to zero which will lead to a skewed result downward. Furthermore, we expect that there will be outliers in the sample and as we analyse gross wealth, these outliers will only be at the upper end of the distribution, thus skewing the results upward.

In addition to the coefficient, we use a Lorenz curve to give a graphical representation of the wealth distribution. It shows what percentage of the population possesses what percentage of that nation's wealth. At perfect equality, the Lorenz curve is linear with a 45 degree angle from the x-axis, since each per cent of the population possesses one per cent of the total wealth. If the wealth distribution is unequal, however, the Lorenz curve arches away from the perfect equality line towards the x-axis. For example if ten per cent of the population possesses two per cent of the wealth, this point is below the perfect equality line. The degree of inequality is thus represented by the curvature of the plotted wealth distribution.

The differences between individual percentiles of the cross-sectional distribution, also called the 90/10 ratio, gives the ratio between the wealthiest 10 per cent of the population – the 90th percentile – and the poorest 10 per cent of the population – the 10th percentile. Similarly to the Gini coefficient, the 90/10 ratio is calculated separately at different points in time in order to observe how it has evolved over time. The advantages of the percentile differential are that it conforms more closely to the behaviour of individual percentiles and that it is less sensitive to extreme observations in the tails of the distribution (Coibion et al., 2012). Nevertheless, it ignores the middle classes as it only allows for a comparison between the top 10 per cent and bottom 10 per cent of the population. We therefore also look at the 75/25 ratio in order to account for the middle classes.

Analysing the development of these two measures of inequality between 2006 and 2014 enables us to identify the general trend of inequality. Once this is identified we want to discover whether QE is the reason for this potential change in inequality.

Quantitative Easing's Potential Effect on Wealth Inequality

To analyse if QE has had a different marginal effect on households depending on their initial level of wealth, the data set of 10,096 households is divided into four wealth quartiles. The division is dependent upon the wealth in the first wave, where the first quartile includes the households with the lowest level of wealth and the fourth quartile the households with the highest level of wealth. Thereafter, the wealth level, and QE's potential marginal effect, is tracked over time by looking at these quartiles.

To enable an analysis of the marginal effects of QE on the quartiles, a difference-in-differences model is estimated with wealth as the dependent variable and QE as well

as the wealth quartiles as independent variables. Interaction terms between QE and the quartiles are then added to the regression model, whose coefficients represent the average marginal effect of QE on households in a specific quartile.

The regression, however, diverges from a conventional difference-in-differences. Firstly, because the regression model does not include a control group in the sense of a group who has not been affected by the treatment. In our regression, all groups have been affected by QE. Instead, the first quartile is considered as a control group to which the three other quartiles are compared with based on the marginal effect that QE has had on them. Secondly, our regression looks at the difference between three treatment groups, with regard to the control group, instead of the conventional difference-in-differences where one control group is compared with one treatment group. As a result, if we for example find that the coefficients for the interaction terms are nonzero and increasingly positive, then a household in quartile two, three and four has gained with regard to a household in quartile one due to QE. The distance between the quartiles' wealth level thus increases, increasing inequality.

A potential issue of perfect multicollinearity arises when regressing with multiple dummy variables and the observations can only belong to one category, represented by the dummy variables. This phenomenon is called the dummy variable trap and can be resolved by excluding one of the dummy variables in the regression (Stock & Watson, 2015). In our model, this problem arises with the four quartiles and is resolved by excluding quartile one.

The regression model that we use to analyse if QE has had an effect on inequality is thus the following:

$$Wealth_{ij} = \beta_0 + \delta_0 QE + \beta_i Q_i + \delta_i QE Q_i + \varepsilon_{ij}$$

TABLE 1: Variable Description Main Regression

Variable	Description
$Wealth_{ij}$	Gross wealth of household j in quartile i
QE	Dummy variable coded 1 if QE has been employed, 0 otherwise
Q_i	Dummy variable coded 1 if the household belongs to wealth quartile i, 0 otherwise
δ_i	Coefficient for the interaction term indicating the average marginal effect of QE on a household in quartile i

Robustness Tests

To verify the validity of the result given by the regression, we consider a set of robustness tests. Because we believe that the level of wealth of the four quartiles may have been affected differently by factors other than QE, we first check if the results are driven by fiscal policy in use in the UK during the period. This is done by controlling for tax revenues collected by the government as a percentage of the gross domestic product – the total tax burden – as well as government expenditure and government borrowing in the form of government debt. Secondly, we control for the level of education as it plays an important role in income inequality, and therefore indirectly in wealth inequality (Dabla-Norris, Kochhar, Ricka, Suphaphiphat & Tsounta, 2015).

The control variables are incorporated in the model using interaction terms with the quartiles. This in order to evaluate the potential effect of the control variables on each quartiles' wealth development. The model including the control variables is as follows:

$$Wealth_{ijk} = \beta_0 + \delta_0 QE + \beta_i Q_i + \delta_i QE Q_i + \gamma_0 C_k + \gamma_{ik} C_k Q_i + \varepsilon_{ijk}$$

TABLE 2: Variable Description Robustness Tests

Variable	Description
C_k	Control variable for tax burden, Government debt, Government expenditures and level of education
Tax	Average percentage change of tax burden
$GovtDebt$	Average percentage change of government debt
$GovtExp$	Average percentage change of government expenditures
Edu	Education level of household reference person
γ_{ik}	Coefficient for the interaction term between given control variable and quartile i

5. DATA

In this section, we describe the origin and nature of the data that has been collected in order to carry out the research. We begin by explaining the data set and its origin. We then describe the measures that were taken to adjust the data set so as to be suitable for our analysis. At last, we introduce the additional data that is necessary for our robustness tests.

5.1. The Wealth and Asset Survey

In accordance with the previously-defined scope, microdata for Great Britain from 2006 to 2014 is needed in order to answer our research question. We were able to obtain such data from the Wealth and Asset Survey (WAS), conducted by the Office for National Statistics, which we consider is appropriate for our research. This because it aims to fill gaps in data about the economic well-being of households by gathering information on the ownership of assets (financial assets, physical assets and property), pensions, savings and debt.

From Household to Individual Level

The WAS is a longitudinal sample survey of private households that is conducted in different waves, whereof four are reported at the moment. The questionnaire is divided into two parts. The first part completed by one person in the household, the ‘household reference person’, and collecting household level information². The second part administered to each adult in the household and asking more specific questions on individual level.

Four Waves

The data has, as mentioned above, so far been retrieved in four different waves, each representing a time span of two years, presented in Table 1. In each new wave, the WAS attempted to return to consenting respondents from the previous wave in order to build a panel data set that would allow to track the same individuals over time. However, as too many respondents dropped out from one wave to another, they were forced to introduce new cohorts in waves three and four in order to maintain and improve the sample size. A summary of the sample sizes, response rate and longitudinal survivors are presented in Table 2.

² The household reference person is defined as the adult in the household with the highest income. When the adults in the household have the same income, the oldest individual is assigned as the household reference person.

TABLE 3: Wealth and Asset Survey Data Collection Timeline

	Jul-06	Jul-07	Jul-08	Jul-09	Jul-10	Jul-11	Jul-12	Jul-13	Jul-14
Wave 1	→								
Wave 2			→						
Wave 3					→				
Wave 4							→		

TABLE 4: Wave Description

	Sample Size	Response rate	Longitudinal survivors
Wave 1	62,800	30,600	
Wave 2	32,200	20,000	18,900
Wave 3	37,900	21,450	13,500
Wave 4	35,300	20,200	10,100

A characteristics analysis was performed to ensure the four waves of observations as well as the longitudinal survivors were of a similar nature. This to confirm that the results from the data sets are comparable and that potential differences in wealth development are not due to external factors. The analysis indicates that the data sets have similar characteristics with regard to the number of people in the household, the type of accommodation as well as the employment status and education level of the household reference person. The age of the household reference person, however, is slightly more centred on the age span 55-64 among the longitudinal survivors than in the four separate waves. Nevertheless, the data sets are similar enough to enable a comparison. Full results from the analysis are presented in Appendix 2.

Sampling and Weighting

The sample for wave 1 was chosen to be representative of the population of Great Britain at the time it was selected. Nevertheless, WAS was designed to give households that were predicted to have higher wealth (based on their addresses) a higher chance of selection than others, due to the fact that they were expected to have a lower response-rate. They therefore created a first weight to avoid estimates of wealth being biased upwards. It compensates for the different probabilities of each household and individual being included in the dataset through a ‘design weight’. A second weight was then calculated to help reduce the random variation in survey estimates, and hence adjust for non-response bias. This in case there was a systematic trend in the types of

households that accepted to take part in the study. The ‘non-response weight’ thus avoids estimates of wealth to be biased downwards.

The two weights were then multiplied to produce an initial weight that, in turn, was adjusted to create a final weight. This was done through calibration and ensures that the survey estimates of the population match the population projections —regularly published by the Office of National Statistics. The final weight, once applied to the sample, enables adequate estimations of wealth across the whole of Great Britain for the period of time covered in the wave (ONS, 2016).

For the following waves, attrition weights were calculated to capture the share of the previous wave’s sample that dropped out of the survey. The product of the wave one weight and the attrition weights creates the longitudinal base weight for each wave which is the foundation for the development of cross-sectional weights that we will use (ONS, 2016).

Data Modification

To enable an analysis of QE’s effect on inequality we choose to construct our wealth variable based on financial, property, pension and physical wealth. This to ensure all channels, and thus all effects, of QE are captured. Since the analysis is on gross wealth, full property values, excluding mortgages, are included along with gross financial wealth exempting non-mortgage debt (to see the full composition of the Gross Wealth variable see Appendix 3).

Information on financial, pension and property wealth – excluding value of main residence – was asked for in the individual level questionnaires while information on physical wealth was gathered on a household level. Due to the composition of the survey, it is not possible to derive physical wealth and value of main residence at an individual level. Since they are deemed necessary to capture the effects of the *bank lending* channel, we instead choose to look at wealth at a household level. To enable this, we aggregate individual wealth from all household members. However, this reduces the number of observations in the data set which possibly could reduce the level of significance.

The analysis is divided into two parts, one part looking at inequality in Great Britain from 2006 to 2014 and the next part identifying if the possible change can be explained

by the QE programme. Our method to analyse the two parts are quite different, resulting in different requirements of the data.

To look at inequality the data sets for all four waves, including all observations, are analysed separately to get a clear view of the underlying distribution and the change in inequality over time. The number of observations in each wave is presented in the second column in Table 2. To enable conclusions to be drawn for Great Britain as a whole, each data set is weighted using the wave specific cross-sectional weights pre-calculated by the WAS. The chosen inequality measures are then calculated based on the weighted data.

To study the possible effect of QE on inequality, an analysis of wealth development over time is preferred. The data sets are thus cleared to contain only the households who participated in the survey in all four waves – the fourth wave longitudinal survivors – presented in the third column in Table 2. Their wealth development is then studied in a regression analysis. Due to the pre-calculated weights from the WAS being cross-sectional, they are inapplicable to this longitudinal analysis of panel data. The regression is thus estimated using the unweighted merged data set.

The QE programme was first initiated in March 2009, hence in the middle of the data collection for wave 2. This makes it impossible to identify whether the households had been affected by QE at the time of data collection. Furthermore, the second wave includes noise from the Great Recession and the many fiscal, as well as conventional monetary policy actions that were undertaken. To control for the effect of the recession and the ambiguity in time of data collection the observations from the second wave are dropped. The regression analysis is thus conducted on a limited data set, cleared from households that have not been present in all waves as well as for wave 2.

As to control for education, a way to determine the household educational level need to be established. The household is assigned an educational level from one to three, depending on the household reference person's qualifications. One represents a bachelor degree or higher, two represents another level of qualification such as a high school degree and three represents no formal qualifications.

5.2. Additional Data

Data Collection

In order to test the robustness of our model, additional data on tax revenues, government expenditures and government debt is needed. Although our main data set is on Great Britain the additional data collected is on the United Kingdom. This because the required data is more easily accessed for the United Kingdom than for the individual countries or regions. The data is thus collected from the United Kingdom's executive statistical authority, the Office for National Statistics (ONS, nd).

Data Modification

To determine our model's ability to predict wealth development we follow the method in Roine, Vlachos and Waldenström (2007) when studying the long-run determinants of inequality. The authors use the average percentage change when controlling for gross domestic product, government spending and tax as well as other factors in their model. We will follow the same procedure and calculate a value for each control variable per wave by taking the average percentage change of the years included in that wave. However, for the third wave the average percentage change has been calculated based on the years included in wave two and three, as wave two is excluded from the data set.

5.3. Potential Issues

We acknowledge three main potential issues with our data set that may debase our results. Firstly, we recognise that it would be more favourable to use data at the individual level. Partly because this would allow a larger sample size which is desirable in order to obtain better estimates, and also because inequality is underestimated when analysed at a household level. Indeed, we calculated a Gini coefficient at the individual level for the first wave in our data set and observed considerably higher inequality than that for households for the same period.

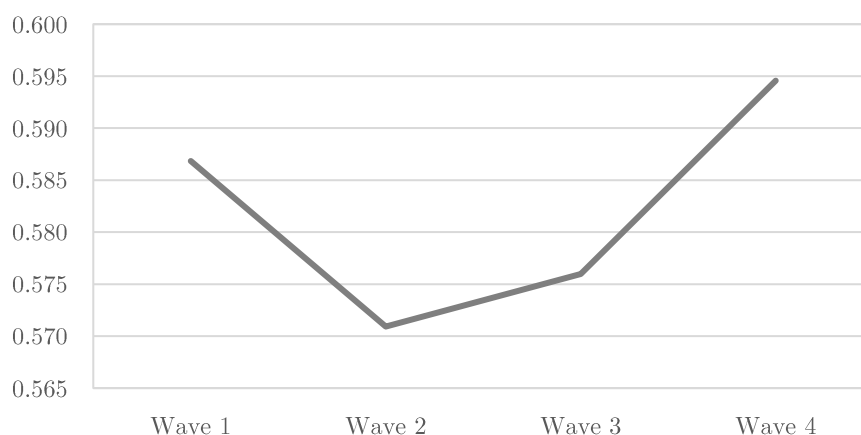
Secondly, the fact that the data is collected in waves, each representing two years' time, may pose a problem. Yearly or quarterly data would be preferable to better track wealth development over time. Furthermore, this would enable a more accurate adjustment for external factors as it would not necessitate an average over time.

Lastly, there are two potential sources of error for which no adequate adjustments can be made. These are made at the time of the data collection and are known as sampling and non-sampling errors. As nothing can be done about this, it should simply be kept in mind when interpreting the results (ONS, 2016).

6. RESULTS

6.1. Measuring Wealth Inequality

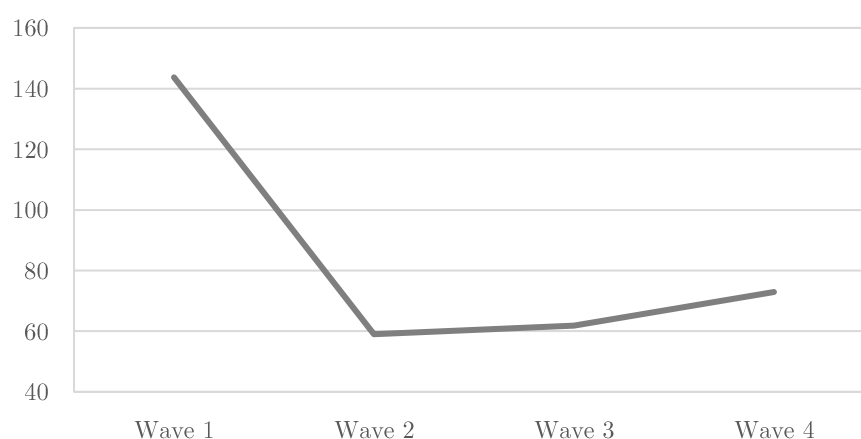
DIAGRAM 3: Gini Coefficient



Source: calculations presented in Appendix 4

Gini coefficients have been calculated for the four waves in order to get a first overview of inequality's development over the defined time span. The above graph, based on Appendix 4, indicates that inequality was relatively high during the first wave before decreasing during the second wave. From the second wave onwards, we observe a total increase of 2.4 percentage points, making the Gini coefficient reach a level of 59.5 per cent in the last wave. Despite the decrease between the first and second wave, inequality still has increased by 0.8 percentage point overall between 2006 and 2014. The plotted Lorenz curve gives a graphical representation of the increased inequality. Indeed, we see that the curves gradually shift away from the perfect equality line after the second wave (Appendix 5).

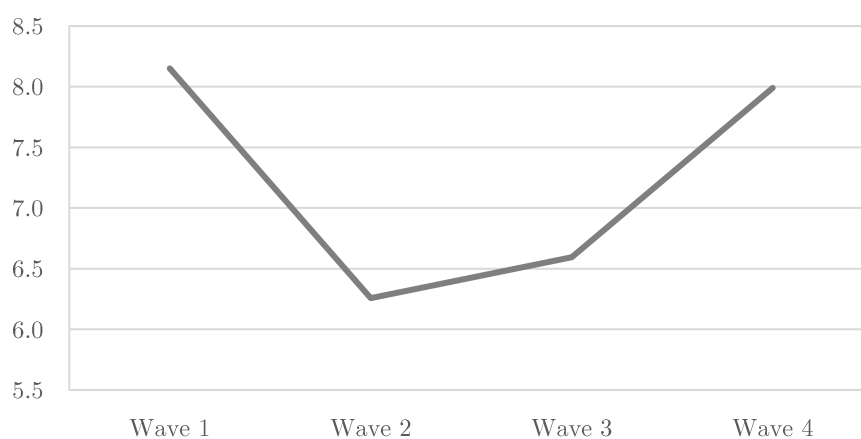
DIAGRAM 4: 90/10 ratio



Source: calculations presented in Appendix 4

As an additional mean of analysing inequality, we look at the ratio between the 90th percentage wealthiest household and the tenth percentage poorest household. Similar to the Gini coefficient, the ratio – and thus inequality – drops from the first to the second wave. Thereafter the ratio is relatively stable with only a slight increase from 59 in the second wave to 73 in the fourth wave, staying way below pre-recession levels. The two measures of inequality thus exhibit different trends.

DIAGRAM 5: 75/25 ratio



Source: calculations presented in Appendix 4

As the increase in inequality identified with the Gini coefficient is not entirely explained by the 90/10 ratio, we turn to the 75/25 ratio. In accordance with the Gini coefficient and the 90/10 ratio, we observe a decrease in inequality from the first to the second wave. However, unlike the 90/10 ratio, the ratio between the 75th percentage wealthiest and the 25th percentage poorest households returns to its initial pre-crisis level in the fourth wave.

6.2. Quantitative Easing's Potential Effect on Wealth Inequality

TABLE 5: Wealth Development and Quantitative Easing

	Wealth	
QE	53,764***	(3,103)
Quartile 2	186,487***	(1,436)
Quartile 3	418,003***	(20,081)
Quartile 4	1,313,420***	(26,898)
Interaction quartile 2	38,943***	(4,559)
Interaction quartile 3	90,138***	(6,608)
Interaction quartile 4	-14,110	(31,750)
Constant	47,997***	(960)
Observations	29,361	
Adj R-squared	0.3731	

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In our regression of the model outlined in the research design, the goodness-of-fit (R-squared) is at a level of 0.3733, indicating there are other factors not included in the model that affect the wealth development. However, in social sciences lower R-squares are expected due to the inability to predict human behaviour, so the model is considered to fit reality quite well. The p-value is below 0.01 resulting in the null hypothesis being rejected at the 1 per cent significance level. QE thus has explanatory power for wealth in Great Britain.

The average marginal effects of QE on households in the second and third wealth quartiles, with regard to households in the first quartile, are statistically significant at the 1 per cent level. We can see that both quartiles have a positive coefficient and thus have gained from QE, confirming that the wealth effect of QE differs between groups. The households in the second quartile have, on average, gained £38,943 more than the households in the first quartile due to QE. The households in the third quartile have gained £90,138 more. Hence, the magnitude of the gain is greater for the households in the third than those in the second quartile. Meaning that the third quartile, in addition to having gained with regard to the first quartile, has also gained with regard to the second quartile.

In contrast to the results presented above, the marginal effect of the households in the fourth quartile does not show any significance. With zero being within the 95 per cent

confidence interval for the coefficient, the effect of QE on the wealth discrepancy between the households in the fourth and first quartiles is ambiguous.

6.3. Robustness Tests

TABEL 6: Wealth Development and Quantitative Easing Robustness Tests

	Wealth				
	(1)	(2)	(3)	(4)	(5)
QE	53,764*** (3,103)	36,889*** (5,488)	52,889*** (2,920)	50,371*** (5,541)	53,764*** (3,089)
Interaction QE Q2	38,943*** (4,559)	21,431** (9,327)	38,035*** (4,420)	21,273** (9,404)	38,943*** (4,543)
Interaction QE Q3	90,138*** (6,608)	43,977*** (14,252)	87,744*** (6,487)	43,560*** (14,364)	90,138*** (6,582)
Interaction QE Q4	-14,110 (31,750)	-144,471*** (48,010)	-20,872 (31,692)	-145,644*** (48,266)	-14,111 (31,546)
Tax		-4,066,234** (1,594,172)			
Government Debt			-137,511** (53,912)		
Government Expenditure				-518,283** (203,193)	
Education					-33,291*** (2,745)
Constant	47,997*** (960)	4,121,144** (1,596,883)	202,839*** (60,713)	598,765*** (215,932)	123,625*** (6,333)
Observations	29,361	29,361	29,361	29,361	29,361
Adj R-squared	0.3731	0.3744	0.3744	0.3744	0.3853

Robust standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1

After conducting robustness tests, it can be said that the general trend observed in our initial model is valid. After controlling for fiscal policy and educational level, the households in the second and third quartiles have still gained from QE with regard to households in the first quartile. Those in the third quartile even more so than those in

the second. When controlling for taxes and government expenditure, the fourth quartile's coefficient becomes statistically significant at the 1 percent level and negative, meaning that QE has had a marginal positive effect on households in the first quartile in comparison to those belonging to the fourth quartile. The full results of the robustness tests are presented in Appendix 6 and insure that our initial model is sufficient to answer our research question. The following section will therefore be based on this model.

7. DISCUSSION

This section presents a discussion on the above-obtained results. We begin by discussing our findings and connecting them back to previous research mentioned in the “Current State of Knowledge”. We also give potential explanations to the results and conclude the section with thoughts on how to improve further studies on this subject.

7.1. Findings

Great Britain entered the Great Recession in early 2008 with a relatively high level of inequality, an observation made in our first wave of data. To fight the recession, the BoE slashed the Bank Rate from 5.25 to 0.5 per cent over a period of six months, commencing October 2008. This time period falls in our second wave of data, in which we observe an almost 2 per cent drop in inequality. The drop could, however, in reality be of a larger scale as the QE programme was initiated during the same wave and therefore may have had an offsetting effect. Nevertheless, a parallel can be drawn between the aggressive expansive monetary policy by the BoE and the drop in inequality.

The empirical study in Coibion et al. (2012) conducted in the United States and the theoretical study in Gornemann et al. (2016) found that contractionary monetary policy leads to an increase in inequality across households. By reversing this finding, conventional expansionary monetary policy should reduce inequality. Our study on inequality in Great Britain, as mentioned above, is thus in line with existing empirical findings on conventional monetary policy.

Following the drop in inequality in the second wave, the Gini coefficient progressively increases and finally rebounds above the pre-crisis level in the fourth wave. The time period over which this occurs, 2010 to 2014, corresponds to the asset purchases made by the BoE in the QE programme. The less significant increase in inequality between

the second and third wave compared to the third and fourth, could be explained by the interlude in asset purchases occurring in the third wave.

Furthermore, the observed increase in inequality may be a consequence of the findings in Gornemann et al. (2016) on inequality continuing to increase over time. In this case, the visible increase over the observed time period not only captures the direct effect of the second and third round of QE, but also the accumulated effect from the first round, initiated in 2009.

As evident from observations above, a correlation can be seen between an increase in inequality in Great Britain and an increase in asset purchases by the BoE. The results from our empirical study allows us to say that this correlation is a causal one. Indeed, the nonzero coefficients for the interaction terms between wealth quartiles and the QE variable prove that QE has not only had an effect on wealth, but also that this effect has differed between the quartiles.

However, as identified in the results section, not all wealth quartiles had a nonzero coefficient. The households in the fourth quartile experienced a non-significant effect of QE with zero being within the 95 per cent confidence interval. This observation is consistent with the 90/10 ratio analysis, which demonstrates that the wealth disparity between the 90th percentage wealthiest and 10th percentage poorest household has seen little change since the commencement of QE. Meaning that, in contrast to Green and Lavery (2016), the increase in inequality is not attributed to the wealth quartile holding the majority of wealth.

Instead of the wealthiest 25 per cent, it is the mid 50 per cent that have gained from the QE programme. The results from our difference-in-difference regression model show that the increase in inequality, post QE, can be derived from the positive marginal effect of QE on households in the second and third wealth quartile, with regard to the households in the first. This result is also in line with our ratio analysis when looking at the 75/25 ratio, which displays an increase in inequality between the upper and lower limit of the middle classes.

To summarise, our empirical study shows that QE increases inequality, thus differing from conventional expansionary monetary policy which is found to reduce inequality.

This result contradicts previous research presented in Blot et al. (2015) that states that the effects of conventional and unconventional monetary policy should be the same. Our findings are, however, in line with Green and Lavery (2016) that argues that unconventional monetary policy, in the form of QE, increases economic inequality by privileging a part of society that has better economic conditions to begin with. Nevertheless, our results differ with the authors' reasoning in that we do not find that the wealthiest households gain most from QE.

A possible explanation for the opposing effects of QE and conventional expansionary monetary policy is the difference in means through which they boost inflation. We look at the identified channels through which conventional monetary policy affects inequality to verify this. It is possible that the relative strength of the channels varies with QE, and therefore the final sign of the effect on inequality. Conventional expansionary monetary policy reduces inequality, implying that the savings redistribution and earnings heterogeneity channels have a larger impact than the channels who work in the opposite direction. QE, on the other hand, increases inequality which implies that the income composition, financial segmentation and portfolio channels should have a larger impact.

The fact that the strength of the income composition and financial segmentation channels are larger with QE than with conventional expansionary monetary policy could be explained by their dependency upon the development of asset prices. The impact of the income composition channel is dependent on the households' relative composition of labour, business and financial income. A policy shock such as QE raises financial profits and therefore benefits households with larger relative income share from financial assets disproportionately. This while conventional expansionary monetary policy affects transfers, labour- and business- income with the net effect being ambiguous.

As for the financial segmentation channel, households who are active on financial markets – wealthier households – should be affected faster by changes in money supply. Since QE injects money directly into financial markets, we expect the effect to take bigger proportions compared to conventional expansionary monetary policy.

As these two channels are relatively weaker in conventional expansionary monetary policy, the fact that they are important when using QE is a plausible explanation to why the effect of these two policies on inequality differ. However, the part of the population that, according to this reasoning, should gain most have in fact experienced a zero effect from QE compared to households with the lowest wealth level. This implies that there are other components of QE that have influenced the wealth distribution.

First of all, we suspect the bank lending effect, one of the channels through which QE affects inflation without directly increasing asset prices, to have slightly offset the effect of QE on inequality. The reason for this is that QE makes it easier to obtain loans by boosting liquidity in the banking sector. This is believed to benefit households with lower wealth levels the most. As we, in our research, look at gross wealth, it may be that these households' wealth have increased in our data due to increased expenditure enabled by increased debt. This would explain why the fourth quartile has not gained from QE with regard to the first quartile.

Finally, another factor that we believe may have dampened the effect of QE on increased inequality is the savings redistribution channel. This because QE lowers the cost of borrowing which redistributes wealth from net savers to net lenders thus disadvantaging the wealthiest households.

To conclude, based on the empirical results the null hypothesis can be rejected while the first hypothesis is accepted, with the implication that the Quantitative Easing programme in use by the Bank of England has influenced inequality in Great Britain. Furthermore, we can affirm that Quantitative Easing has had the reverse effect as conventional expansionary monetary policy and thus increased inequality.

7.2. How to Improve the Framework

As outlined in the current state of knowledge, there is no complete view on how unconventional monetary policy and QE affect inequality. Our empirical study aims to fill that gap, but further studies should be made to either confirm or dement our results. This, to reach a greater understanding of the economic consequences of monetary policy and enable central banks to make informed decisions when employing their array of monetary policy tools.

When conducting further studies, a number of alterations of the framework presented in this research should be considered. Firstly, the time period during which this study is conducted is limited to the availability of data. Future studies should consider a wider, as well as more specific, time series of data. This to enable an analysis of the two contradictory views on the time effect of QE on wealth inequality. Blot et al. (2015) argues that the increase in asset prices is temporary, and thus that the potential increase in wealth inequality should be temporary as well. The opposite argument is put forth in Gornemann et al. (2016) which finds an increasing effect of wealth inequality over time. This lag analysis could either be performed with a New Keynesian business-cycle model, as used in Gornemann et al. (2016), or with a vector autoregression, as used in Coibion et al. (2012), Huston and Spencer (2016) and Javedo, Sousa and Traverso (2016).

Secondly, our study evaluates the overall effect of QE on inequality, therefore conclusions cannot be drawn regarding the separate effects of the transmission channels. A study on the relative impact or effectiveness of the transmission channels might thus be relevant to get a more detailed view of QE and its implications. Another argument for conducting a study of the separate effects is to ensure that the full effect of QE is captured. There is a possibility that our regression model, due to its specification, excludes the effects of some transmission channels. Building a specific model to analyse the individual channels would eliminate this risk.

8. CONCLUSION

The aim of this paper has been to analyse how quantitative easing has affected wealth inequality in Great Britain. Based on the procured data set, we have first been able to state that wealth inequality has increased between 2006 and 2014. Thereafter, the results of our regression found that this increased wealth inequality is largely explained by the Quantitative Easing programme in use by the Bank of England since 2009. As these findings are not in line with previous research on the effect of conventional expansionary monetary policy on inequality, we have sought to find an explanation to how the two policies differ. We suggest that the difference might be a consequence of the fact that two of the channels through which conventional monetary policy increases inequality have a greater importance with quantitative easing. Considering the scope within which this research was conducted, as well as the limitation in data, we propose

that further studies should be done on this subject in order to verify the results obtained in this paper.

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Appendix 1: Summary of Asset Price Movements Around BoE QE 1, 2 and 3

	QE1: total of £200 bn purchases		QE2: total of £125 bn purchases		QE3: total of £50 bn purchases	
Asset	Change around QE1 announcements	Change 4 March 2009 - 22 Jan 2010	Change around QE2 announcements	Change 5 October 2011 - 2 May 2012	Change around QE3 announcement	Change 4 July 2012 - 8 Nov 2012
Gilts (5-25 year average)	-104	-6 (o/w -90 gilt-OIS spread)	+14	-18	-10	-3
Corporate yields (investment grade)	-70	-387 (o/w -41 gilt-OIS spread)	+5	-85	-11	-85
Corporate yields (high yield)	-150	-1944	-5	-215	-5	-189
FTSE All-Share	-3%	+47%	+5%	+14%	0%	+2%
Sterling Eri	-4%	+3%	0%	+5%	+1%	+1%

Basis points, unless specified

Source: Joyce et al. (2011) p. 206.

Appendix 2: Characteristics Analysis

		Longitudinal				
		Wave 1	Wave 2	Wave 3	Wave 4	Survivors Wave 1
Number of people in household	Mean	2.327	2.296	2.303	2.292	2.304
	Standard Deviation	1.261	1.240	1.247	1.233	1.201
	Min	1	1	1	1	1
	Max	9	9	9	9	9
Type of Accomodation	Owned	71%	73%	72%	73%	78%
	Rented	29%	27%	28%	27%	22%
Occupation of HRP	In employment	58%	55%	55%	*	57%
	Unemployed	2%	2%	2%	*	1%
	Student	1%	1%	1%	*	0%
	Retired	30%	34%	34%	*	32%
	Economically Inactive	9%	8%	7%	*	9%
Age of HRP	0-15	0%	0%	0%	0%	0%
	16-24	3%	2%	2%	2%	1%
	25-34	12%	10%	9%	8%	9%
	35-44	20%	18%	17%	15%	17%
	45-54	18%	19%	19%	19%	19%
	55-64	19%	20%	20%	20%	24%
	65-74	15%	18%	18%	20%	19%
	75-84	10%	12%	12%	13%	9%
	85+	3%	3%	3%	4%	1%
Highest Level of Education for HRP	Degree level or above	24%	25%	25%	28%	27%
	Other qualification level	53%	54%	51%	53%	54%
	No qualification	23%	21%	24%	19%	19%

* No available data

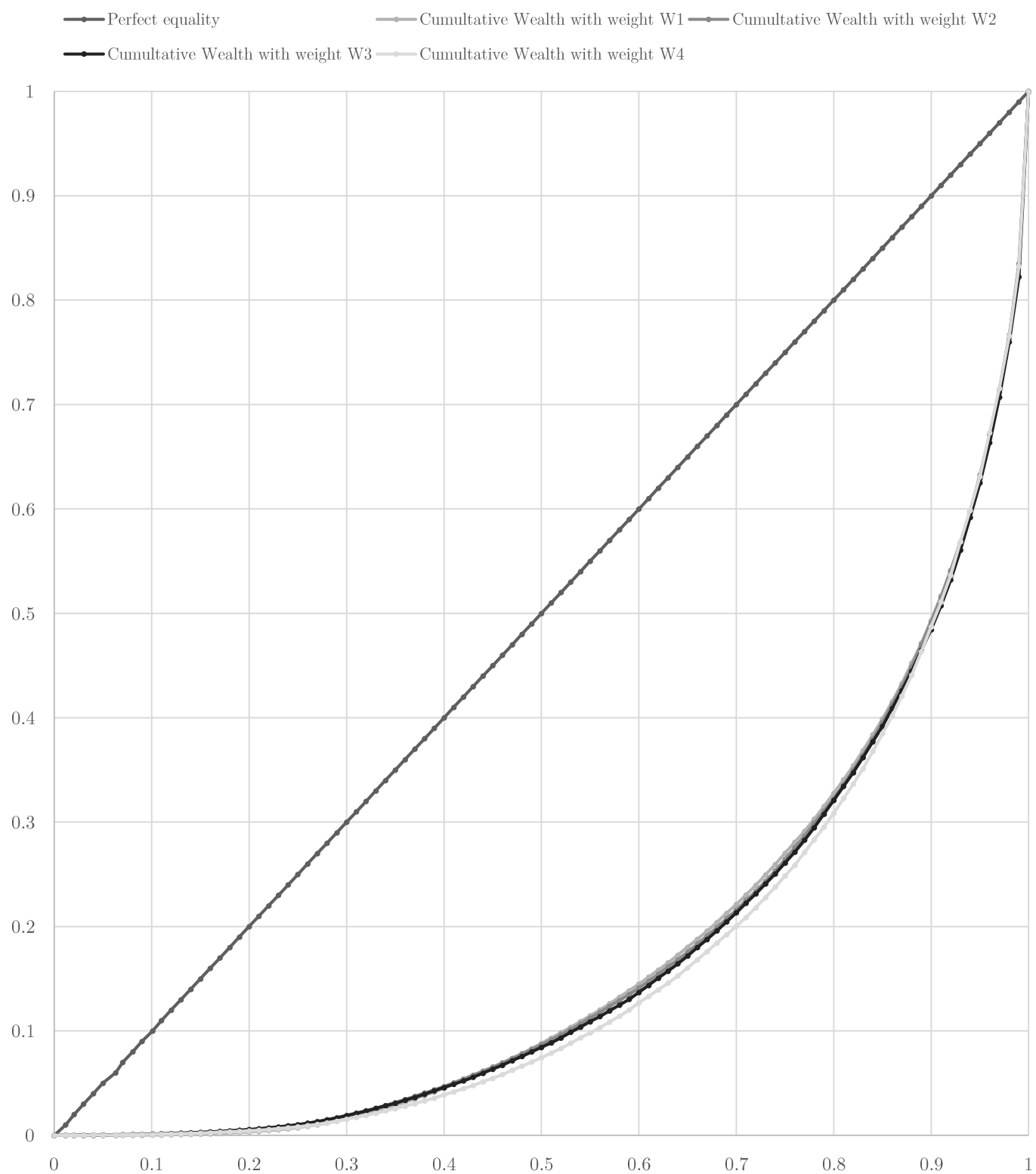
Appendix 3: Description of Gross Wealth

Financial Wealth	Pension Wealth	Property Wealth	Physical Wealth
Total value of current accounts in credit	Total value of defined benefit occupational scheme (new method)	Value of main residence*	Value of all household goods and collectables*
Total value of savings accounts	Total value of current defined contribution pension wealth	Total value of other houses	Total value of all vehicles*
Total value of ISAs	Total value of AVCs scheme	Total value of buy to let houses	
Value of National Savings Product	Total value of current personal pension scheme	Total value of buildings	
Value of UK Shares	Value of total retained DB pension wealth	Total value of UK land	
Value of insurance products	Total value of retained rights in DC scheme	Total value of overseas land	
Value of fixed term investment bonds	Total value of retained rights for drawdown	Total value of other property	
Total value of employee shares and employee options	Value of pensions in payment		
Value of Unit and investment trusts	Value of pensions expected from former spouse/partner		
Value of overseas shares			
Value of UK bonds/gilts			
Value of overseas bonds/gilts			
Value of other investments (formal financial assets)			
Value of informal financial assets			
Value of Child trust funds			
Value of other childrens Assets			

Appendix 4: Measures of Inequality

	Gini	90/10	75/25
Wave 1	0.587	143.711	8.151
Wave 2	0.571	59.007	6.257
Wave 3	0.576	61.791	6.594
Wave 4	0.595	72.896	7.991

Appendix 5: Lorenz Curve



Appendix 6: Wealth Development and Quantitative Easing Robustness Tests

	Wealth				
	(1)	(2)	(3)	(4)	(5)
QE	53,764*** (3,103)	36,889*** (5,488)	52,889*** (2,920)	50,371*** (5,541)	53,764*** (3,089)
Quartile 2	186,487*** (1,436)	4,413,290* (2,339,052)	347,170*** (88,932)	758,034** (316,289)	199,964*** (9,624)
Quartile 3	418,003*** (20,081)	11,600,000*** (3,388,863)	841,578*** (128,846)	(,924,647*** (458,246)	480,114*** (11,693)
Quartile 4	1,313,420*** (26,898)	32,800,000*** (9,120,802)	2,509,577*** (347,771)	5,568,120*** (1,233,598)	1,667,839*** (48,964)
Interaction QE Q2	38,943*** (4,559)	21,431** (9,327)	38,035*** (4,420)	21,273** (9,404)	38,943*** (4,543)
Interaction QE Q3	90,138*** (6,608)	43,977*** (14,252)	87,744*** (6,487)	43,560*** (14,364)	90,138*** (6,582)
Interaction QE Q4	-14,110 (31,750)	-144,471*** (48,010)	-20,872 (31,692)	-145,644*** (48,266)	-14,111 (31,546)
Tax		-4,066,234** (1,594,172)			
Government Debt			-137,511** (53,912)		
Government Expenditure				-518,283** (203,193)	
Education					-33,291*** (2,745)
Interaction control-variable Q2		-4,219,630* (2,335,082)	-142,699* (78,968)	-537,836* (297,631)	-10,141** (4,434)
Interaction control-variable Q3		-11,100,000*** (3,383,111)	-376,167*** (114,410)	-1,417,780*** (431,213)	-41,621*** (5,906)
Interaction control-variable Q4		-31,400,000*** (9,105,283)	-1,062,278*** (307,921)	-4,003,749*** (1,160,562)	-244,741*** (22,389)
Constant	47,997*** (960)	4,121,144** (1,596,883)	202,839*** (60,713)	598,765*** (215,932)	123,625*** (6,333)
Observations	29,361	29,361	29,361	29,361	29,361
Adj R-squared	0.3731	0.3744	0.3744	0.3744	0.3853

Robust standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1