To QE or not to QE

A Tool in Times of Crisis

Gunavanth Mahendra Duremanthi - 402

Rohil Goyal - 423

5th February 2022

Table of Contents

1. <u>Abstract</u>

Economists around the world have had varied opinions about this policy and we are yet to know the true efficacy of QE since this policy is relatively new. QE has been carried out in different scenarios and countries using different channels.

This paper in particular focuses on the general constructiveness of QE and evaluates how effective it has been in achieving its goals in the past. To remove any bias of any abnormality of a particular instance of QE, we have taken 2 distinct instances of QE as a part of our evaluation.

The instances that we have taken are:

- Federal Reserve (2008), also popularly known as QE1

- Bank of England (2016)

We have built a VAR model that analyses certain macroeconomic variables and illustrates how successful this monetary policy has been in improving a state's economic position. Firstly, our model shows that QE has been successful in reducing interest rates, mainly short-term, and giving the economy an immediate boost. However, it hasn't been able to create major long-term impact. Secondly, our model clearly indicates that this monetary policy has a negligible impact on unemployment.

2. **Introduction**

Quantitative Easing (QE) was a word rarely used in the 20th century but in recent years it has come into the limelight. Quantitative Easing is a monetary policy that has gained traction across the globe in the last few decades. QE involves the government purchasing bonds and similar securities, from either institutions or the open market, to inject money into the economy and to stimulate growth and inflation. As interest rates started to near the Zero Lower Bound (ZLB) and even become negative in some countries, the central banks had to resort to QE because reducing the interest rates to stimulate growth was no longer an option. As the government purchases bonds, their prices rise hence the yield on these bonds automatically falls. Thus, it also helps lower the long-term interest rates of an economy which further promotes the idea behind QE i.e., to encourage businesses and households to borrow money and increase the money supply. This undoubtedly also helps reduce the cost of borrowing for the government in case they plan to raise debt in the future, but this is not a primary objective of this policy.

Japan was the first country to ever execute this monetary policy. In 1991, Japan entered into a major financial crisis and the economy started contracting. Interest rates were practically zero and there was no other possible way of getting out of the crisis. Hence, in March 2001, the Bank of Japan (under the leadership of Mr. M Hayami) carried out QE. It was a very controversial decision back then as this monetary policy had never been carried out before and there was extreme uncertainty as to how effective it would be.

However, in the next few years, a lot of countries adopted the policy. To cope with the 2008 financial crisis, the Federal Reserve of the USA began repurchasing bonds in November 2009 under the leadership of Ben Bernanke, who has held an important role in the uprise of this monetary policy. The Bank of England soon followed. The European Central Bank (ECB) conducted QE for the first time in 2015, led by President Mario Draghi. During the Coronavirus pandemic, many economies implemented this policy to avoid severe contraction of their economies.

With time, QE has become the go-to monetary policy to dampen the impact of a crisis. Supporters of QE say that it is an effective tool to trigger inflation and the expansion of an economy. In fact, it has historically been observed that even the mere announcement of such a policy sends the stock markets soaring. This is known as the signalling effect. However, critics believe that the pros to this policy are limited, and they tend to fade away with time.

Irresponsible and miscalculated use of QE can send an economy into runaway inflation which is a much bigger problem. This is what makes this policy so risky.

Initially, as a part of QE, the governments bought back the long-term bonds that they had themselves issued. Eventually, they also started purchasing mortgage-backed securities, asset-backed securities, and even a small percentage of corporate bonds. Already being a pioneer for QE, Japan shocked the world by including equities (in the form of exchange-traded funds) and Real Estate funds in their asset-purchase program.

To date, QE remains a heavily controversial and highly debatable monetary measure. This is beautifully expressed by Ben Bernanke as he says (Haldane, 2016), "The problem with QE is that it works in practice, but it doesn't work in theory."

In this research paper, we have used a VAR model to evaluate the effectiveness of the policy over two instances – the USA (2008) and the UK (2016). The United States QE of 2008 was executed to support the economy after the Financial Crisis while the UK carried out QE in 2016 to control the economic turmoil caused by the announcement of 'BREXIT'. We chose these instances as they were unique in terms of the time of execution, the country, and the type of crisis that the country was in.

3. Related Literature

3.1. Bank of Japan

Japan was the first economy ever to adopt this unconventional monetary policy. The country suffered endless economic problems in the 1990s, which is now popularly known as 'The Lost Decade' and they used QE as a last-resort policy. A BoJ research (Naohiko Baba, 2006) shows that QE has been successful in reducing the risk premium in the economy. However, a report by Ueda (Ueda, 2011) indicates that most of the positive effects of this monetary policy fade out in the medium to long term.

3.2. Federal Reserve

The financial crisis of 2008 led to the most prominent countries of the world performing quantitative easing. Since this was the first time the USA ever adopted this monetary policy, it was highly debated and heavily researched after the execution. Research by the Federal Reserve Bank of New York (Joseph Gagnon, 2011) concludes that QE had a positive long-term impact in lowering interest rates. However, this was due to lower risk premiums, including term premiums, rather than lower expectations of future short-term interest rates. Benati and Baumeister (Luca Benati, 2013) conclude that compressions in the long-term yield spread exert a powerful effect on both output growth and inflation.

3.3. Bank of England

The Bank of England initially joined the Federal Reserve following the economic crisis in the buyback of bonds. Later it participated in this monetary policy again after the announcement of 'BREXIT' to save the economy from short-term shocks. Research by the Bank of England (Lena Boneva, 2013) found that firms' price and wage inflation expectations increase by 0.22 percentage points in response to £50 billion of QE, implying that inflation expectations are part of the transmission mechanism of QE. Another research by the University of Oxford (George Kapetanios, 2012) shows that QE has been successful in reducing interest rates and has helped stimulate inflation when interest rates were near the ZLB.

4. Modelling Process

4.1. Technical Outline

A Vector Autoregressive (VAR) model was used to analyse the response of the following variables to QE:

- Short-term (1Yr) interest rate. (STR)
- Long-term (10Yr) interest rate. (LTR)
- Consumer Price Index (Inflation). (CPI)
- Unemployment Rate. (UR)
- Money Supply. (MS)

The following reduced-form VAR model was used to estimate the impact of QE:

$$Y_t = A(L)Yt - 1 + c + \mu_t$$

Where, Y_{t-1} is a matric of the lagged values of the variables, $A(L)$ is the vector of autoregressive coefficients, c is the intercept term and μ_t is the vector of residuals.

$$Y_t = [STR, LTR, CPI, UR, MS]$$

Two instances of QE were examined as outlined in the sections below:

4.2. Assumptions

- The data used in the modelling process is stationary.
- The error term follows a white noise process i.e., $\mu_t \sim N(0, \sigma)$.
- There are few large outliers in the dataset.
- There is no perfect multicollinearity between variables.

4.3. Model Methodology

Given empirical evidence, we see that QE almost instantly has an impact on the money supply (Figure 1 and Figure 2). In our further assessment of the model, we assume that an increase in money supply is a given outcome of QE and analyse the effect that the increase in the supply of money has on the various other factors outlined in the sections above.
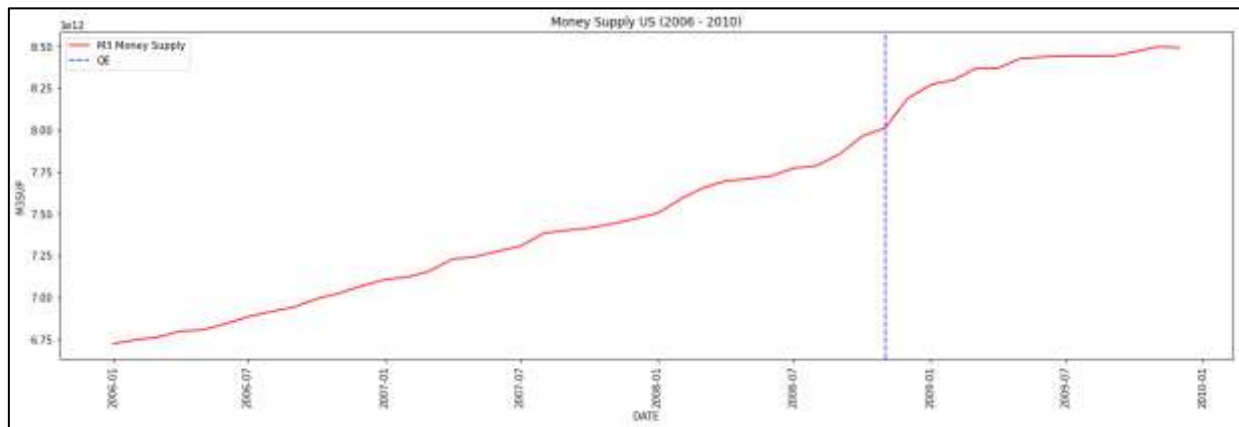
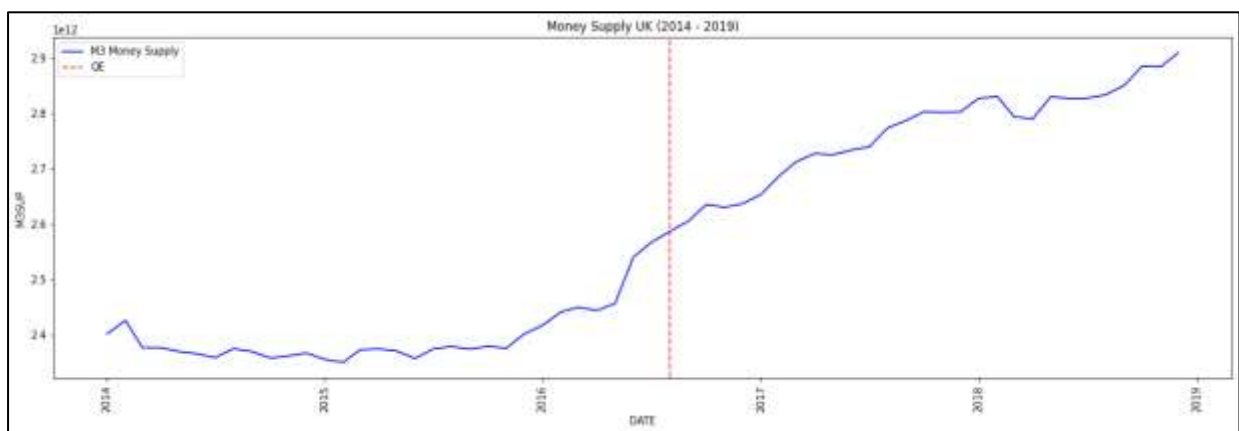*Figure 1: Money Supply in the US (2006 - 2010)*

Figure 2: Money Supply in the UK (2014 - 2019)

We use impulse response functions to gauge the impact this increase and draw our final conclusions after analysing graphs and how the variables react to a change in money supply.

4.4. <u>**US QE 1 (Post 2008 financial crisis)**</u>

The 2008 financial crisis was one of the worst economic meltdowns that the world has seen in the past 200 years. The burst of the housing bubble, the market crash and subsequent economic turmoil led to rising unemployment, reduced economic output and a devastating recession. In the aftermath of the crisis, as the Fed tried to restore the American economy to its formal glory, it adapted several economic policies, some unconventional – like QE.

4.4.1. <u>**Data**</u>

The data used consists of 47 monthly observations of the variables mentioned in section 4.1, ranging from 1st January 2005 to 1st December 2009. The following data was collected:

- <u>DGS1</u>: Short term interest rates (1 Year), daily, unadjusted. The daily rates were adjusted to match the monthly frequency by taking an average. (Board of Governors of the Federal Reserve System (US), 2022)

- <u>DGS10</u>: Long term interest rates (10 Years), daily, unadjusted. The daily rates were adjusted to match the monthly frequency by taking an average. (Board of Governors of the Federal Reserve System (US), 2022)

- <u>UNRATE</u>: Unemployment rate, monthly, seasonally adjusted. (U.S. Bureau of Labor Statistics, 2022)

- <u>CPIAUCSL</u>: Consumer Price Index, monthly, seasonally adjusted. CPI is used as a tool to gauge inflation in the model. (U.S. Bureau of Labor Statistics, 2022)

- <u>M3SUP</u>: The M3 money supply, monthly, seasonally adjusted. M3 money supply was considered as it a broader measure of money supply and is a readily available data format, given that M4 was discontinued in many countries in recent times. (Organization for Economic Co-operation and Development, 2022)

4.4.2. **Empirical Data Analysis**

Based on the data collected the following graphs were plotted and inferences made. The yellow line indicates the start of QE1 in both cases.

We can clearly infer form Figure 3, the onset of QE caused a steep rise in the money supply and a decline in inflation. However, in the longer term, money supply stabilises and inflation rises, which is expected as money in the economy moves from institutions to consumers who are then able to spend causing inflation in the economy.
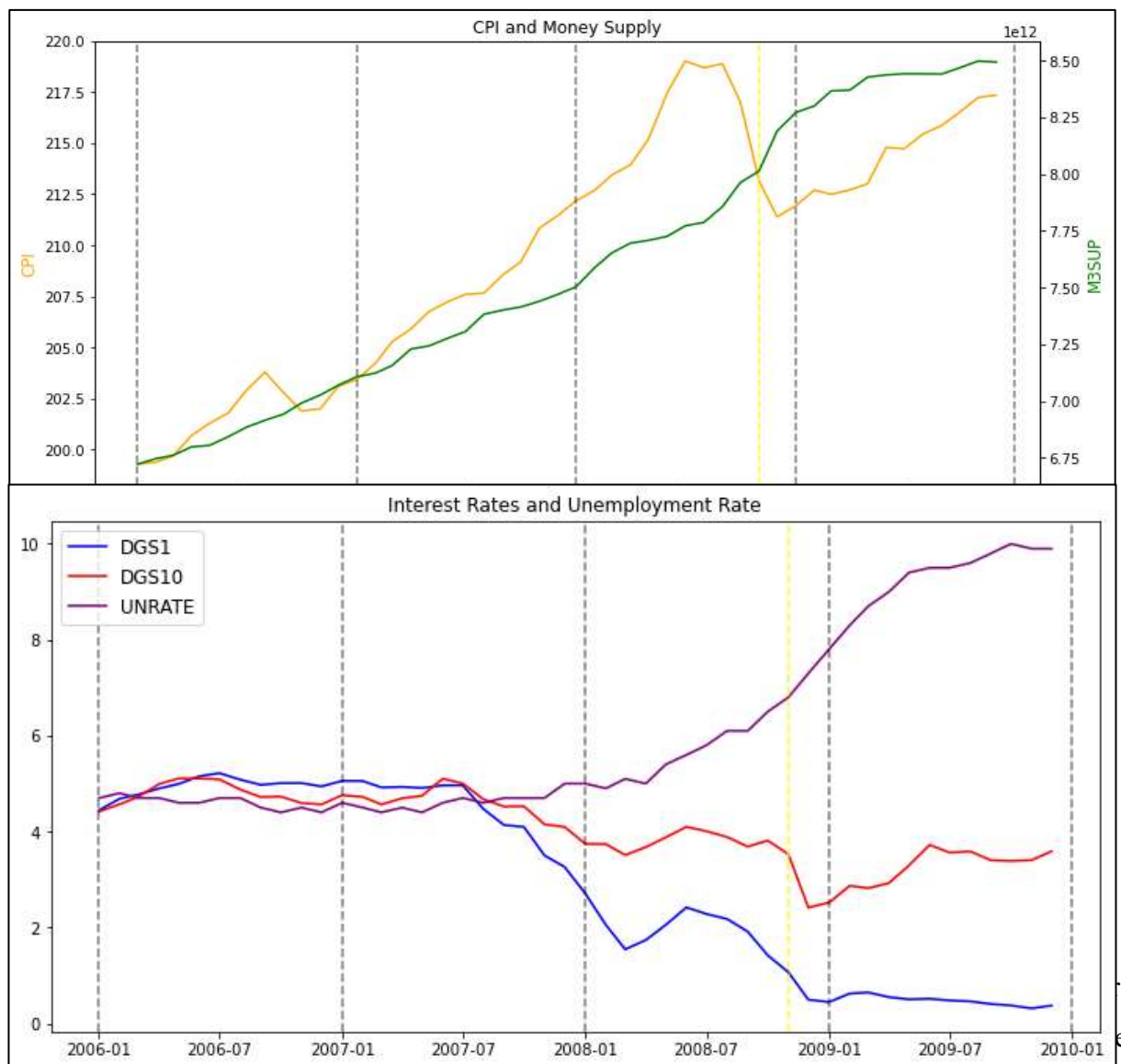

Figure 4: Interest Rates and Rate of Unemployment

After running tests and simulations, it was decided that a model with 6 lags best suits the data.

4.4.3. **Testing Underlying Assumptions**

S.No	Assumption	Test	Level of Significance	P-Value	Conclusion
1	The data used in the modelling process is stationary	ADF Test	5%	• DGS1: 0.004 • DGS10: 0 • UNRATE: 0.63 • CPIAUCSL: 0.005 • M3SUP: 0	All variables are stationary.
2	The error term follows a white noise process i.e., $\mu_t \sim N(0, \sigma)$	Jarque Bera Test	5%	0.08	The error terms follow a white noise process.
3	Money supply has a causal effect on other variables	Granger Causality Test	5%	0.083	Money supply granger causes other variables

Table 1: Testing Results (US QE1)

4.4.4. **Results**

This section of the paper outlies the results and inferences that have been made as a part of the modelling process. The results obtained from our model is then compared with empirical evidence to finally arrive at a conclusion of how effective QE was.

4.4.4.1. Effect on Short – Term Rates

From the graph in Figure 5 we see that, the rates initially decrease, followed by an increase as rates finally stablise as the time horizon gets longer. The overall effect is one of a decrease in rates. In the first quarter following QE, we see a decrease of 44bps with the effect rising to around 70bps a year after QE was performed. This is in line with the empirical data and a favourable outcome for the economy.
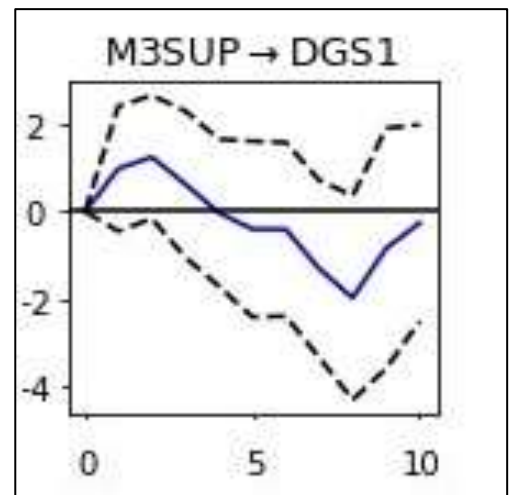

Figure 5: Effect on Short Term Interest Rate

11

4.4.4.2.   Effect on Long-Term Rates

The graph in Figure 6 shows us that QE has the effect of lowering the long term interest rates in the short run as well. In the aftermath of the unconventional policy we see that long term rates decrease by 66bps. However, in the medium term and long term, the rates decrease only by 12.4bps. QE seems to have a mild impact on longer term interest rates.The empirical evidence also outlines a gentler decline in long-term borrowing rates when compared to the 1 year rates.

Figure 6: Effect on Long Term Interest Rate

4.4.4.3.   Effect on Unemployment Rate

We see QE effect unemployment the least out of all the variables considered in this paper (Figure 7). Unemployment increases in the short run and long run by the monetary policy decision. Increasing by 1.6% in the short run and by a further 2.2% in the medium term. QE does not seem to combat unemployment in the short to medium term, given the negligible impact it has on the movement of the unemployment rate. Unemployment continued to rise in the aftermath of the crisis. However, on further inspection of longer-term data, we see unemployment begin to fall.

Figure 7: Effect on Rate of Unemployment

4.4.4.4.   Effect on Inflation

Figure 8 shows us that as QE was performed, the CPI and inflation subsequently decreased. Decreasing by around 1 point since QE was done in the short run. However, in the long run the index reverts back to the mean. In the short term, QE has an undesirable impact on inflation, and this shows that it does not immediately impact the demand and consumption drivers behind the economy. A reversion to the mean and a further upward trend in the long run signals that QE has the desired effect although it takes some time for the economy to adjust to this greater influx of cash.
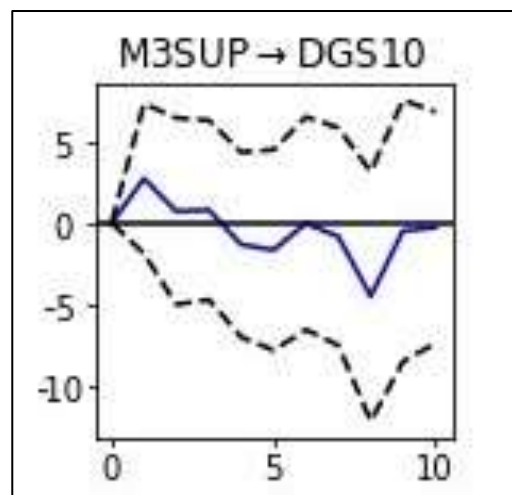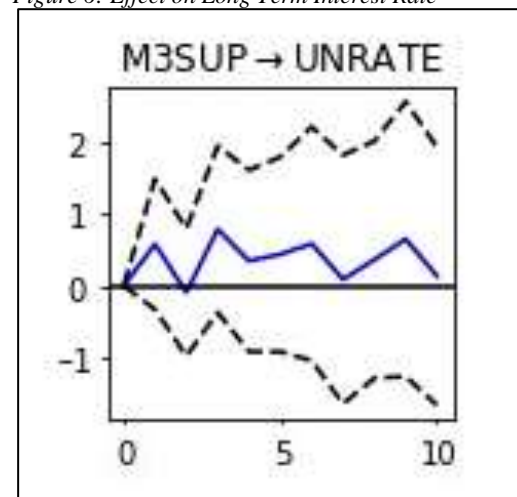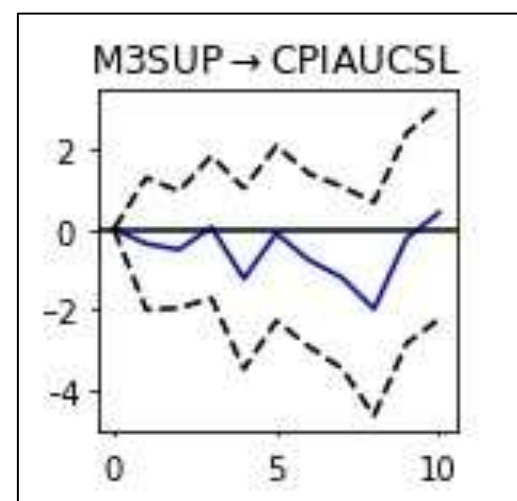
Figure 8: Effect on Inflation.

4.5. UK QE (Post 2016 United Kingdom EU membership referendum)

The aftermath of the 2016 referendum resulted in the UK deciding against staying a part of the European. This process has since been termed as 'Brexit'. This vote had a negative impact on the English economy and sent political shockwaves across the globe. As a result, the Bank of England decided to extend its QE program. The scale of QE in this instance compared to our previous analysis is relatively small. However, it gives us an insight into how effective QE is on a smaller scale.

4.5.1. Data

The data used consists of 60 monthly observations of the variables mentioned in section 4.1, ranging from 1st January 2014 to 1st December 2018. The following data was collected:

- STR: Short term interest rates (1 Year), monthly, unadjusted. (Organization for Economic Co-operation and Development, 2022)

- LTR: Long term interest rates (10 Years), monthly, unadjusted. (Organization for Economic Co-operation and Development, 2022)

- UR: Unemployment rate, monthly, unadjusted. (Organization for Economic Co-operation and Development, 2022)

- CPI: Consumer Price Index, monthly, unadjusted. CPI is used as a tool to gauge inflation in the model. (Organization for Economic Co-operation and Development, 2022)

- M3SUP: M3 money supply, monthly, seasonally adjusted. M3 money supply was considered as it a broader measure of money supply and is a readily available data format, given that M4 was discontinued in many countries in recent times. (Organization for Economic Co-operation and Development, 2022)

4.5.2. **Empirical Data Analysis**

Based on the data collected the following graphs were plotted and inferences made. The vertical, yellow dotted line indicates the start of QE in both cases. We can clearly infer form (**Error! Reference source not found.** and Figure 10), the onset of QE trigerred a steep rise in the money supply and in inflation and this upward trend continues in the medium term as well. In the longer term, money supply stabilises whereas inflation continues to increase.
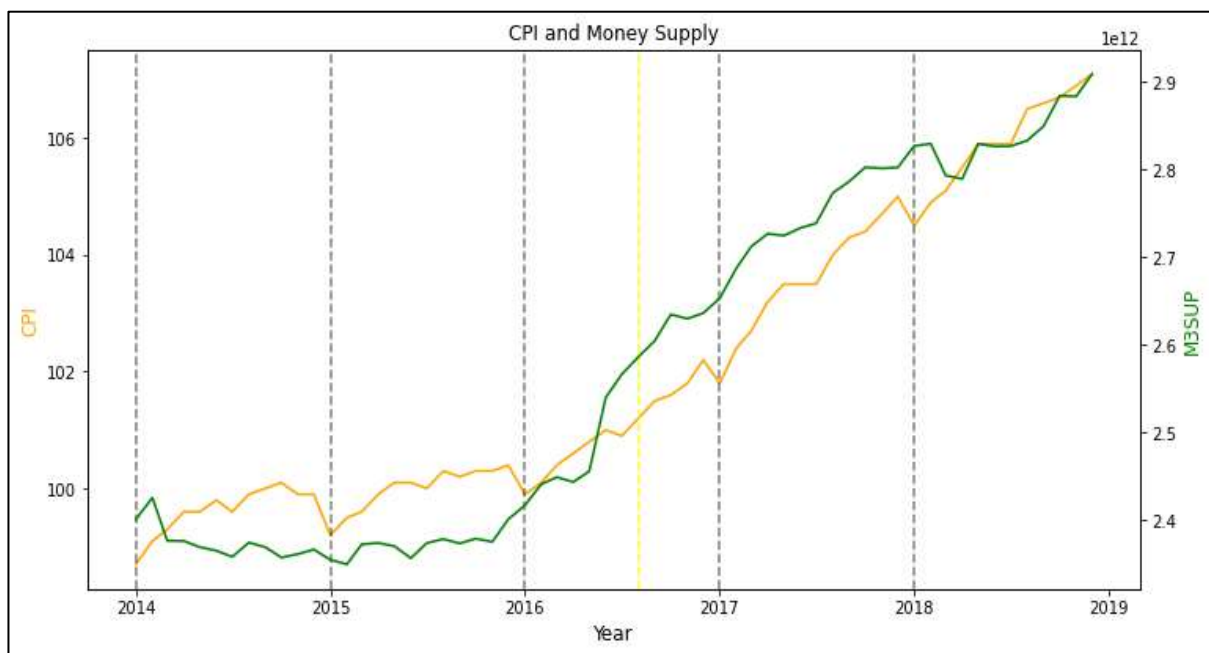
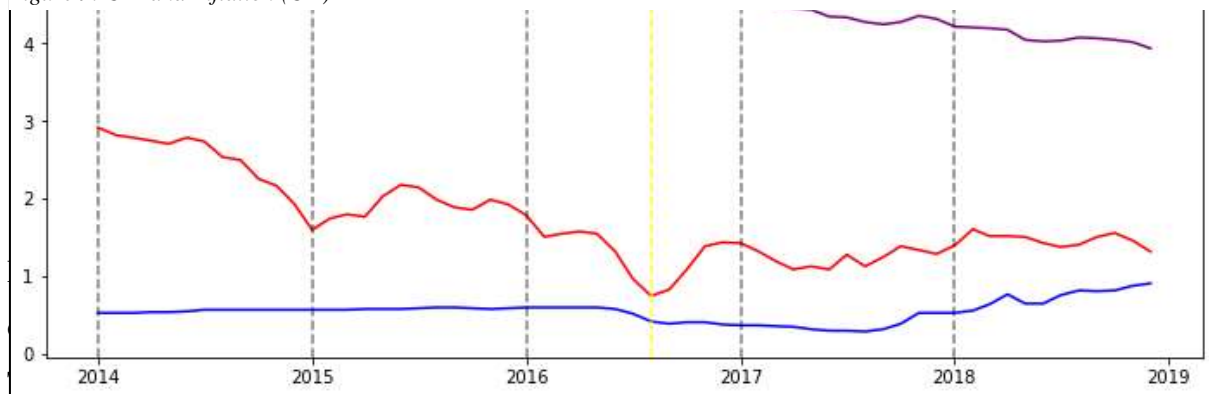

Figure 9: CPI and Inflation (UK)

Figure 10: Interest Rates and Rate of Unemployment (UK)

4.5.3. __Testing Underlying Assumptions__

S.No	Assumption	Test	Level of Significance	P-Value	Conclusion
1	The data used in the modelling process is stationary	ADF Test	5%	• STR: 0.00 • LTR: 0.0001 • UR: 0.00 • CPI: 0.03 • M3SUP: 0	All variables are stationary.
2	The error term follows a white noise process i.e., $\mu_t \sim N(0, \sigma)$	Jarque Bera Test	5%	0.753	The error terms follow a white noise process.
3	Money supply has a causal effect on other variables	Granger Causality Test	5%	0.04	Money supply granger causes other variables

Table 2: Testing Results (Brexit QE)

4.5.4. __Results__

This section of the paper outlies the results and inferences that have been made as a part of the modelling process. The results obtained from our model is then compared with empirical evidence to finally arrive at a conclusion of how effective QE was.

4.5.4.1. Effect on Short – Term Rates

The impulse response function of Interest rates with respect to QE (Figure 11) shows that QE had an initial impact ot reducing short term borrowing rates in the UK – a similar outcome to the one seen in section 4.4.4.1. In this case we see a quicker reversion to the mean and rate fluctuations that are closer to the mean as compared to the upward trend seen earlier. However, the extent of the effects are a little less pronounced in this case, with rates dropping 10bps in the short term, reverting back to the mean in the medium term and forming an upward trend in the long term. We see that a

Figure 11: Effect on Short Term Interest Rate (UK)

smaller scale of QE still has the desirable effect, and as expected the effects on short term rates are not as extensive.
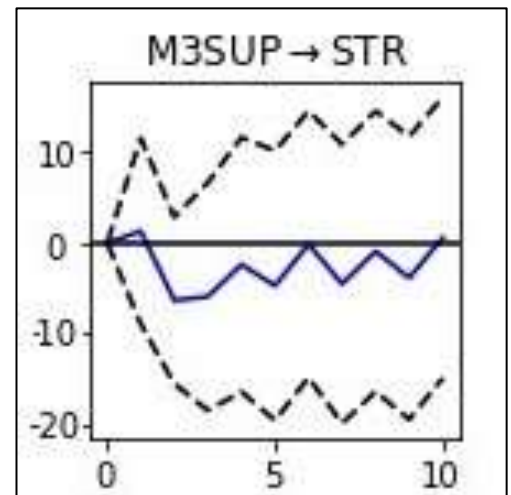
15

4.5.4.2.   Effect on Long-Term Rates

The graph in Figure 12 shows us that QE has the effect of lowering the long term interest rates in the short run. The long term borrowing rates decrease by 10bps immediately after QE is undertaken. In the medium and long run, long term interest rate exhibits an increasing effect post the initial shock and settles at around its pre-shock mean. The effect of QE on long term rates is not as well pronounced. Producing only a minor shock initially, the rates remain unaffected in the medium and long run.
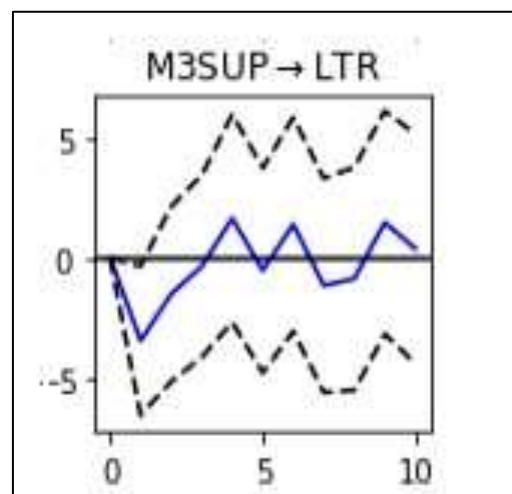

Figure 12: Effect on Long Term Interest Rate (UK)

4.5.4.3.   Effect on Unemployment Rate

We see that QE has a very minimal effect on the unemployment rate. The introduction of QE does not affect the unemployment rate in the short, medium, or long term. Unemployment follows its downward trend as was the case prior to the Brexit referendum. As seen in the impulse response function (Figure 13), there is no evidence to suggest that the shock affects unemployment; the function varies around its mean with a fairly constant variance. Although the trend followed by unemployment rates in the UK is positive, this reduction in unemployment cannot be attributed to QE.
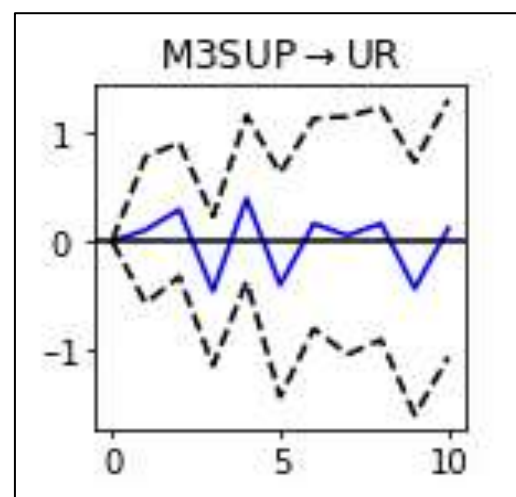

Figure 13: Effect on Rate of Unemployment (UK)

4.5.4.4.   Effect on Inflation

The smaller scale QE has a similar impact to that of the unemployment rate. The effect seems to be minimal given that the effect seems to revert to the mean in the short, medium, and long terms. There is no evidence that suggests this smaller scale of QE has a positive or negative impact on inflation metrics, as the fluctuations in CPI remain small although they are increasing.
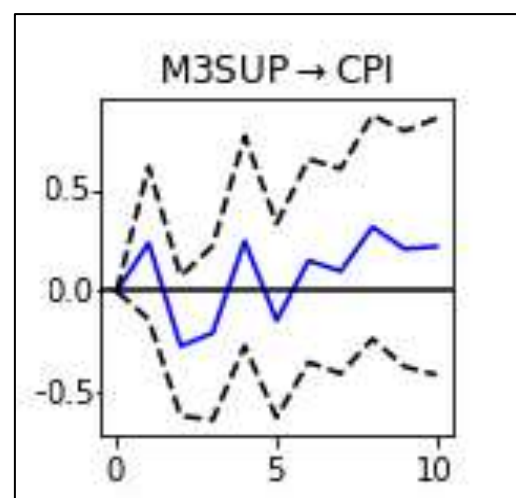

Figure 14: Effect on Inflation (UK)

5. Conclusion

Being an unconventional monetary policy, QE has always been looked at with a pinch of disdain. As outlined in our paper, the temporary and short-term nature of the policy has been criticised by economists. However, we must acknowledge that these asset purchases have seen some form of success given its increased adoption across the globe.

An economy is a dynamic machine, that has ever-changing inputs and numerous variable outputs. The economy also reacts to public and political sentiments that are near impossible to quantify. A major challenge with macroeconomic forecasting has been this dynamic nature of global and national economies. QE has majorly been adopted in times of economic crisis, and economies have seen strong recoveries post these crises. However, this may not be purely down to the effect that it has had on the economy as several other qualitative and quantitative measure were employed by governments to overcome these crises.

On further inspection of the effect QE has on macroeconomic factors studied in this research, we see that it is effective in lowering the short-term and long-term interest rates. The effect on long-term rates is milder and relatively short-lived. Lower interest rates would enable cheaper access to loans for businesses and enable them to recover from the effects of a recession at a faster pace.

Out of all the macroeconomic factors analysed in this paper, QE has the least impact on the rate of unemployment. Our model gives us enough evidence to suggest that the policy measure does not have a significant impact on the rate of unemployment in the economy.

QE does not have an immediate impact on inflation, unlike what we saw with interest rates. The benefits of the asset purchases take some time to manifest. This is only natural as the economy is in a state of shock, and firms and housetholds take some time to psychologically recover and start spending again.

Finally, we conclude that QE is effective in times of crises. However, it is not a magic pill that rids the economy of all its financial illnesses, rather a supplement that aids in the process to recovery and provides short-term relief.

6. <u>References</u>

Board of Governors of the Federal Reserve System (US), 2022. *Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity (DGS10) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/DGS10
[Accessed 25 January 2022].

Board of Governors of the Federal Reserve System (US), 2022. *Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity (DGS1) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/DGS1
[Accessed 25 January 2022].

George Kapetanios, H. M. S. T., 2012. *Assessing the Economy-wide Effects of Quantitative Easing,* Oxford: The Economic journal.

Haldane, A. G., 2016. *QE - The story so far.* [Online]
Available at: https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2016/qe-the-story-so-far-slides
[Accessed 27 January 2022].

Joseph Gagnon, M. R. J. R. B. S., 2011. *The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases.* [Online]
Available at: https://www.ijcb.org/journal/ijcb11q1a1.pdf
[Accessed 2 February 2022].

Lena Boneva, J. C. M. W. a. T. W., 2013. *The Effect of Unconventional Monetary Policy on Inflation Expectations: Evidence from Firms in the United Kingdom.* [Online]
Available at: https://www.ijcb.org/journal/ijcb16q3a4.pdf
[Accessed 1 February 2022].

Luca Benati, C. B., 2013. *Unconventional Monetary Policy and the Great Recession: Estimating the Macroeconomic Effects of a Spread Compression at the Zero Lower Bound.* [Online]
Available at: https://www.ijcb.org/journal/ijcb13q2a9.pdf
[Accessed 1 February 2022].

Naohiko Baba, M. N. Y. S. K. U., 2006. *The Bank of Japan's Monetary Policy and.* [Online]
Available at: https://www.ijcb.org/journal/ijcb06q1a3.pdf
[Accessed 1 February 2022].

Organization for Economic Co-operation and Development, 2022. *Consumer Price Index of All Items in the United Kingdom (GBRCPIALLMINMEI) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/GBRCPIALLMINMEI
[Accessed 25 January 2022].

Organization for Economic Co-operation and Development, 2022. *Harmonized Unemployment Rate: Total: All Persons for the United Kingdom (LRHUTTTTGBM156S) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/LRHUTTTTGBM156S
[Accessed 25 January 2022].

Organization for Economic Co-operation and Development, 2022. *Leading Indicators OECD: Component series: Short-term interest rate: Original series for the United Kingdom (GBRLOCOSTORSTM) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/GBRLOCOSTORSTM
[Accessed 25 January 2022].

Organization for Economic Co-operation and Development, 2022. *Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for the United Kingdom (IRLTLT01GBM156N) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/IRLTLT01GBM156N
[Accessed 25 January 2022].

Organization for Economic Co-operation and Development, 2022. *M3 for the United Kingdom (MABMM301GBM189S) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/MABMM301GBM189S
[Accessed 25 January 2022].

Organization for Economic Co-operation and Development, 2022. *M3 for the United States (MABMM301USM189S) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/MABMM301USM189S
[Accessed 25 January 2022].

U.S. Bureau of Labor Statistics, 2022. *Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCSL) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/CPIAUCSL
[Accessed 25 January 2022].

U.S. Bureau of Labor Statistics, 2022. *Unemployment Rate (UNRATE) | FRED | St. Louis Fed.* [Online]
Available at: https://fred.stlouisfed.org/series/UNRATE
[Accessed 25 January 2022].

Ueda, K., 2011. *Japan's Deflation and the Bank of Japan's Experience with Nontraditional Monetary Policy,* Tokyo: Wiley.

7. **Appendix**

- VAR Model – A Vector Auto Regression model is a form of multi-variate time series modelling that generalises the Auto Regressive model and accounts for the relationship between multiple variables as they change over time.

- Impulse Response Functions – These functions measure the reaction of any dynamic system in response to an external change