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Quantitative Easing's Relationship with Unemployment: A Linear Regression Study

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Abstract: In recent years, with the development of the economy and society, quantitative easing (QE) has received increasing attention from scholars. The international community is gradually realizing the importance of QE. As a monetary tool, the impact of QE on social unemployment is receiving increasing attention. The author of this paper will investigate the relationships between QE and unemployment in the UK through the application of a Linear Regression model. The analysis will focus solely on the period from 2008 to 2024 to encompass the two big economic challenges the UK experienced and the changes that Quantitative Easing brought since it was first embarked as a monetary tool by the Bank of England. This study aims to provide insights into the effects of Quantitative Easing on Unemployment that could be further used by both policymakers to evaluate the policy and future research. This study has practical significance for fully understanding the importance of QE in society.

Keywords: Quantitative Easing, Unemployment, Correlation, Linear Regression.

1. Introduction

Since the Bank of England (BoE) first embarked on Quantitative Easing (QE) in 2009, the UK has gone through economic challenges such as the Global Financial Crisis and the COVID-19 pandemic. Unlike traditional Open Market Operations, QE has the central bank purchasing long-term securities as a part of its asset purchase programs [1, 2]. According to Khemraj and Yu, QE's transmission mechanism influences long-term interest rates by either reducing the term premium or increasing inflation expectations; this reduction in real interest rates is expected to stimulate business investment and household spending [3]. Given the notable influence of QE on economic growth and its international recognition as a monetary tool, there is growing interest in comprehending its effects on inequality and unemployment. Therefore, this paper aims to delve into the growing interest in the field, offering insights that could be utilized in policy evaluation and guide future research.

A recent labour market review published in August 2024 by the Office of National Statistics (ONS) highlights that the number of vacancies continues to decrease even though it is still 11.0 percent higher than in 2020 quarter one, the unemployment rate is lower than the same time last year whilst there was a slight increase in both in both total employment and pay rolled employees in the most recent quarter [4]. Additionally, in March 2022, the BoE's Monetary Policy Committee unanimously voted to expand its asset purchase by two hundred billion pounds [5]. This raises the question: could

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this recent fall in unemployment be related to previous QE measures? To address this question, the author of this paper will explore the relationships between QE and the Unemployment rate (UER) in the UK using a Linear Regression model. The detailed analysis will focus solely on the period from 2008 to 2024, encompassing the two major economic challenges the UK experienced during the twenty-first century and subsequent changes that QE brought since it was first adopted as a monetary tool by the BoE.

2. Method

To begin with, the data for the independent variable QE, spanning from 2008 to 2024, is sourced from and derived from the Public Use Summary File (PUSF), representing the total gilts purchased by the Asset Purchase Facility (APF). This data selection is predicated on how England's asset purchases were mainly focused on UK government gilts [6]. Figure 1 illustrates the total gilts purchased between 2008 and 2024. The time series shows an obvious upward trend, peaking in the 2021 quarter-four at nearly eight hundred seventy-five billion. This substantial incline of total gilts purchased may be attributed to the BoE's aim of using QE to maintain low interest rates to accommodate economic shocks brought by the COVID-19 pandemic [7]. However, from 2021 quarter four to the first quarter of 2024, the total gilts purchased fell to a similar level comparable to 2020 quarter four. This reduction likely reflects the economic recovery phase following the COVID-19 pandemic.

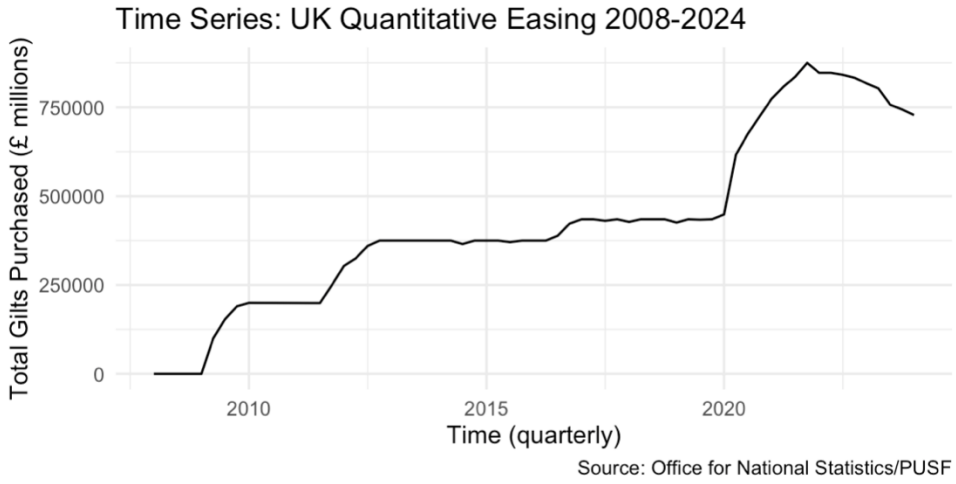

Figure 1: Time Series: UK QE from 2008 to 2024.

The data for the dependent UER is also provided by the ONS sourced from the Labour Market Statistics (LMS) and covers individuals aged 16 and above. Figure 2 presents the time series of UER in the UK between 2008 and 2024. This specific data selection aligns with ONS's emphasis on the significant impact of COVID-19 on youth unemployment [8]. As depicted in Figure 2, contrary to the trend observed in Figure 1, this time series shows a clear downward trend, with the highest UER occurring between 2009 and 2013, likely due to the UK's response towards the Financial Crisis. Following the onset of COVID-19, the UER took exactly a year to climb up again, peaking at 5.3 percent in 2020 quarter four. However, it took more than a year for the UER to gradually fall and return to its state in early 2019 at 4.2 percent.

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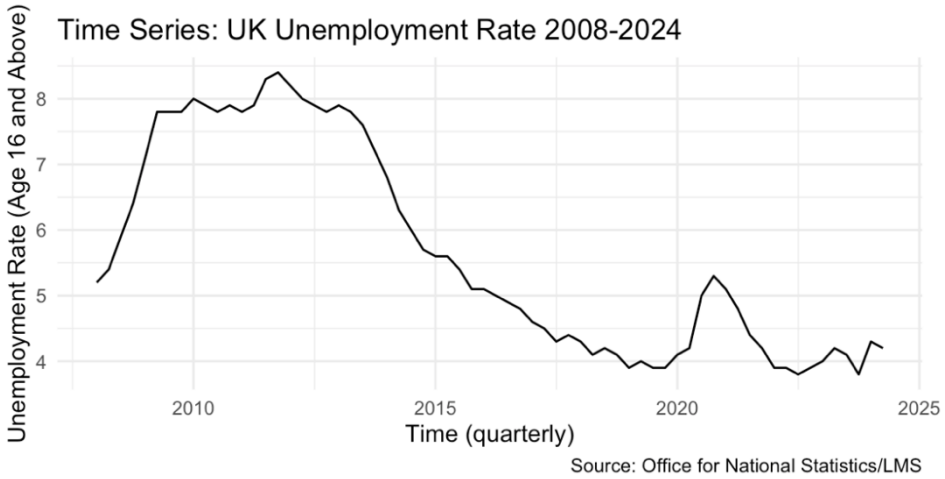

Figure 2: Time Series: UK UER from 2008 to 2024.

The first controlled variable, real Gross Domestic Product, has been previously utilized as an observation variable to evaluate the impact of QE on household income and wealth in European areas [9]. The quarterly data for real Gross Disposable Income (rGDI) between 2008 and 2024 has been sourced from the Federal Reserve Bank of St Louise. As illustrated in Figure 3, the UK's rGDP exhibited an upward trend until the COVID-19 pandemic, during which the economy experienced a major contraction that persisted for nearly a year.

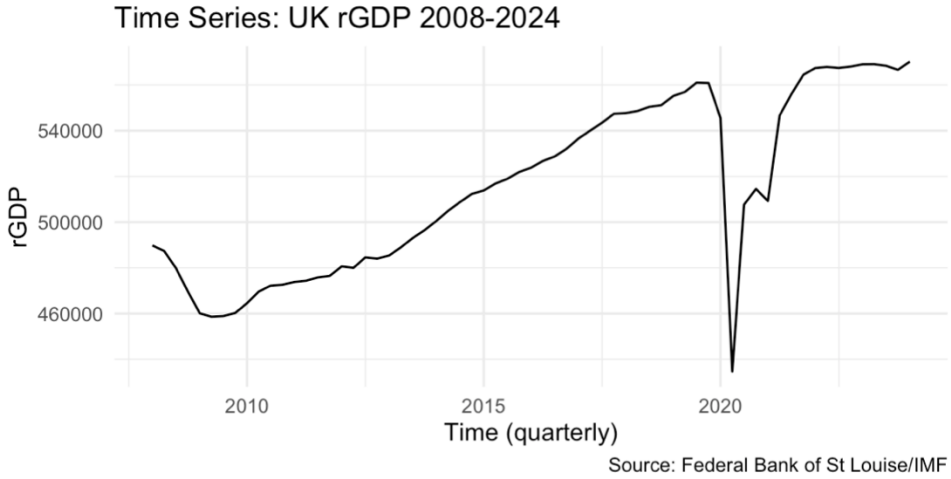

Figure 3: Time Series: UK rGDP from 2008 to 2024.

The selection of rGDI as the second controlled variable is inspired by its relevance in evaluating the impact on household income and wealth, with unemployment serving as a related observation variable [9]. The rGDI data is calculated using Gross Disposable Income (GDI) and Consumer Price Index (CPI), both sets of data are provided by the ONS. The adjustment of rGDI for inflation is intended to maintain consistency with the controlled variable rGDP. The deriving formula of rGDI is shown in (1), it follows the standard macroeconomic procedure for inflation adjustment. The time series for UK rGDI, shown in Figure 5, reveals a general increasing trend beginning in 2012, along with strong cyclicity every four quarters. The unique seasonality of this time series could be likely to reflect seasonal holidays throughout the year.

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$$rGDI = \left(\frac{GDI}{CPI}\right) \times 100 \quad (1)$$

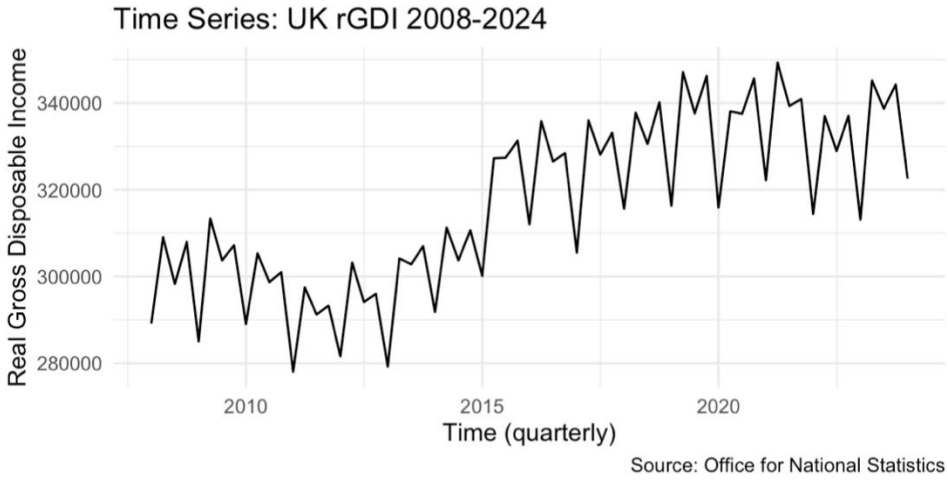

Figure 4: Time Series: UK rGDI from 2008 to 2024.

The third controlled variable selected is Business Investment, based on its relevance to the transmission mechanism through which QE enhances borrowing opportunities for creditworthy debtors, thereby increasing their expenditures, stimulating investment and reducing unemployment [10]. Including this controlled variable in the model allows for a more comprehensive examination of the relationship between QE and UER by accounting for the transmission mechanism. The data for Business Investment is sourced from ONS and is represented by the quarterly Business Investment Index (BII), with 1997 as the base year. As depicted in Figure 5, There is a general upward trend from 2010 to 2019, followed by a significant decline due to the impact of COVID-19. This downturn persisted for over a year, after which BII gradually returned to a positive trend.

Figure 5: Time Series: UK BII from 2008 to 2024.

The fourth controlled variable is the interest rate. It is included to maintain logical consistency with the transmission mechanism mentioned in the previous paragraph. Since QE influences interest rates, varying levels of interest rates, in turn, have differential effects on business investment and unemployment. Previous research indicated that interest rate has a direct and positive impact towards

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unemployment, meaning that higher interest rates may raise unemployment, while lower rates may reduce unemployment [11]. The quarterly data for the UK interest rate on ten-year long-term government bonds is also sourced from the Federal Reserve Bank of St. Louise. The time series indicates a clear downward trend until 2020 when the UK interest rate began to incline again. This trend may be attributed to the economic disruptions caused by COVID-19, resulting in reduced economic activity and confidence. As shown in Figure 6, the lowest interest rate after 2020 approached near zero levels, thereby making QE a viable policy tool.

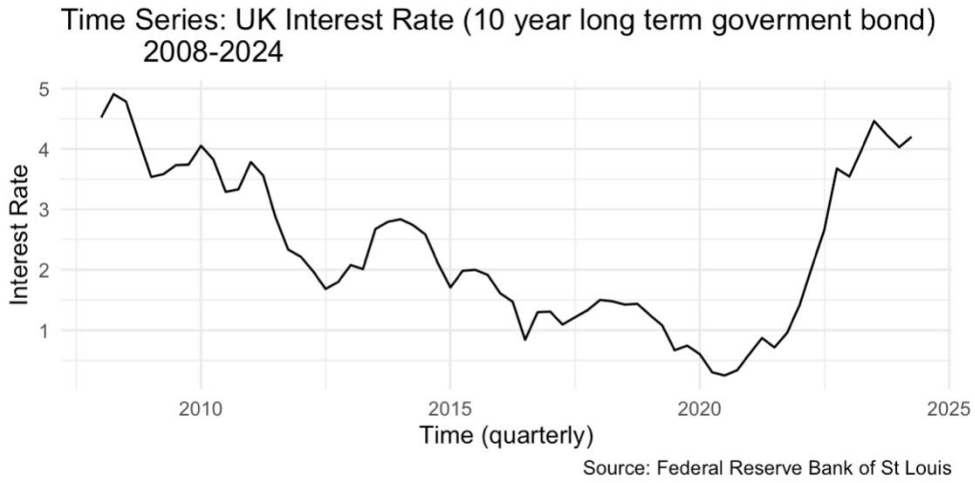

Figure 6: UK Interest Rates from 2008 to 2024.

The final controlled variable is house prices. It is also selected due to its previous use as an observation variable in assessing the impact of QE on household income and wealth [9]. The data for this variable is sourced from the ONS and pertains to quarterly all dwelling prices of houses in the UK. This specific data choice aims to exclude properties not used for residential purposes, which are less likely to be influenced by increasing demand for dwelling houses. Figure 7 provides a visualization of the quarterly UK house prices as a time series, revealing a clear upward trend that peaks in 2022 at nearly three hundred sixty thousand.

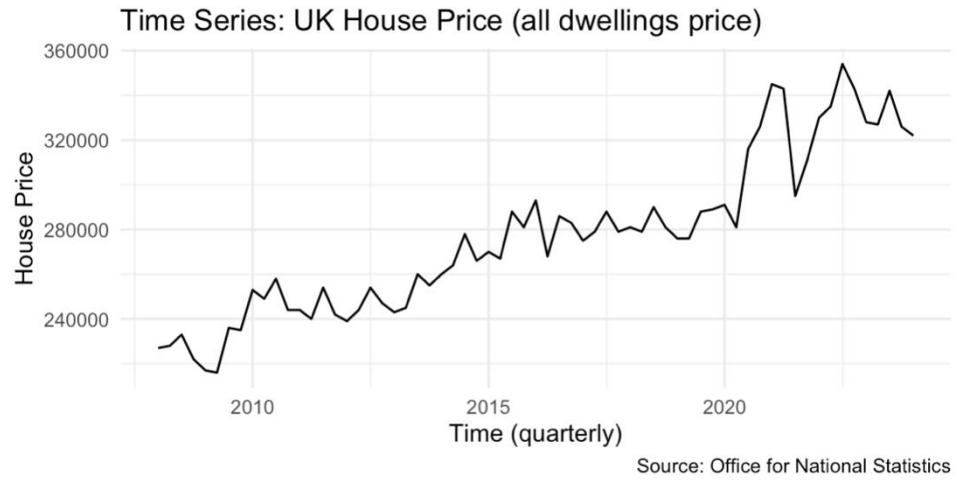

Figure 7: Time Series: UK House Prices (all dwelling) from 2008 to 2024.

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This paper aims to utilise the Linear Regression model to investigate the relationships between QE and the UER in the UK. To empirically assess this relationship, the null and alternative hypotheses for the testing process are stated below:

$$H_0: \rho = 0 \tag{2}$$

$$H_1: \rho \neq 0 \tag{3}$$

The null hypothesis (H0) posits that there is no significant relationship between QE and UER. Conversely, the alternative hypothesis (H1) asserts that a significant relationship does exist between QE and UER. If the p-value of this hypothesis test is less than 0.05, then there is sufficient evidence to reject the null hypothesis. The Linear Regression model follows the formula shown in (4). Here, the dependent variable y represents UER and the independent variable x_1 represents QE. The additional variables x_2, x_3, x_4, x_5 and x_6 correspond to rGDP, rGDI, Business Investment, Interest Rate, and house prices, respectively. The coefficients β_1 through β_5 represent regression coefficients associated with the independent variable and the four controlled variables. The literal format of the Linear Regression formula is (5). Figure 8 displays a scatter plot drawn using the data for six variables introduced earlier. The scatter plot indicates a relatively weak negative correlation between UER and QE. The next section will analyze the results of the Linear Regression and evaluate whether the null hypothesis should be rejected.

$$y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 \tag{4}$$

$$UER = \beta_1(QE) + \beta_2(rGDP) + \beta_3(rGDI) + \beta_4(Business\ Investment + \beta_5(Interest\ Rate) + \beta_6(House\ Price) \tag{5}$$

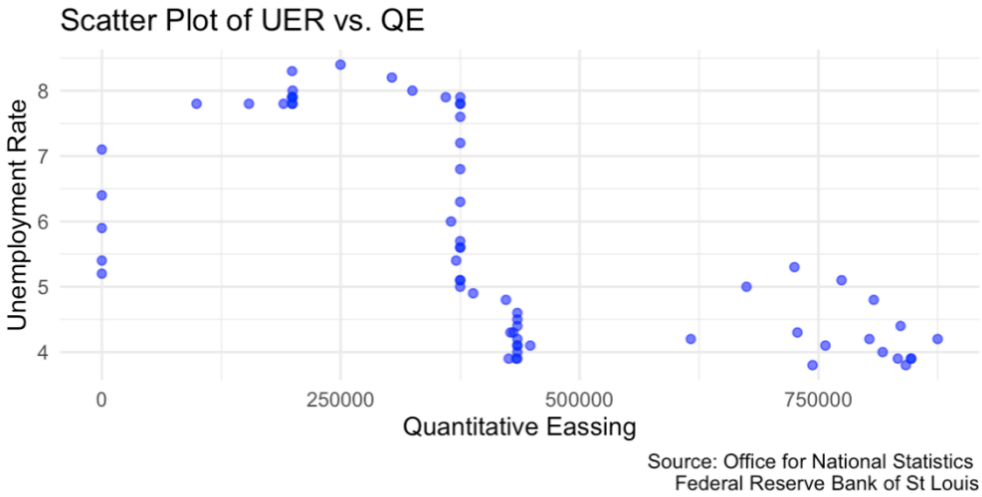

Figure 8: Scatter Plot of UER Vs. QE.

3. Result

Following the application of Linear Regression, the scatter plot, now depicted in Figure 9, included the line of best fit illustrating a negative relationship between QE and UER. The results of the Linear Regression are shown in Table 1. The p-value for the linear regression model is close to zero as shown in Table 1 therefore it is smaller than 0.05, proving that the model is significant. The adjusted R-squared represents the percentage of the total variance that the model explains, in this case, Table 1 shows that this Linear Regression model covers 94.58 percent of the total variance.

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Table 1: Key Results of the Linear Regression.

Adjusted R-squared	Model P-value:	QE Estimated Gradient:	QE Pr(> |t|):
0.9458	1.888×10^{-5}	-6.921×10^{-6}	0.00493

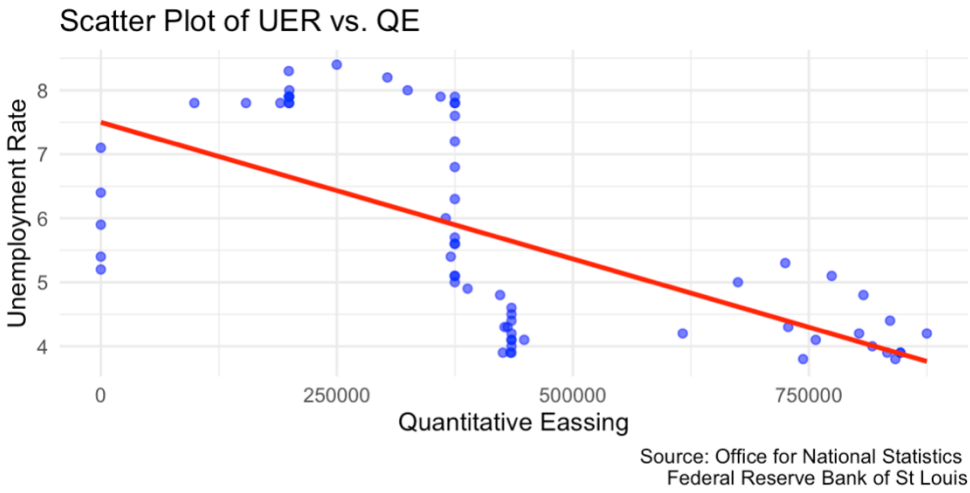

Figure 9: Scatter Plot of UER vs QE with Line of Best Fit.

As discussed in the previous section, there is sufficient evidence to reject the null hypothesis (H_0: $\rho = 0$) if the p-value of the test is less than 0.05. According to Table 1 as Pr(> |t|), the p-value for the correlation coefficient between QE and UER is 0.00493 which is significantly below the 0.05 threshold. Consequently, there is sufficient evidence to reject the null hypothesis, indicating that the correlation coefficient between QE and UER is statistically significant. The estimated gradient between QE and UER is negative, indicating that QE has an inverse relationship with UER. This is also supported by Figure 9, where the line of best fit on the scatter plot is negative. This inverse relationship means that QE increases (i.e., more gilts bought from the public and cash injected into the economy), the UER decreases.

4. Discussion

The findings of this research have the important implication of providing insights for policymakers. In the previous section, the author of this paper demonstrated how the linear regression model indicated an inverse relationship between QE and UER. Specifically, it was noted that an increase in the purchase of gilts from the public corresponds to a decrease in the UER. This inverse relationship between QE and UER may be attributed to the interest rate transmission mechanism mentioned in the method section: increased cash injection into the economy lowers the interest rate, making borrowing more affordable and thus encouraging household demand. This, in turn, will further stimulate business investment and expansion, leading to increased production and a gradual reduction in UER [12].

While the direct use of QE as a tool to reduce UER remains uncertain as correlation does not necessarily mean causation, QE can nevertheless enhance economic confidence and activity, with the reduction of UER as a potential side effect. Policymakers might therefore consider lowering interest rates during periods of high unemployment and raising interest rates during periods of low unemployment [13]. This approach aligns with the observed effects of QE on the economy and could provide insights for future policy decisions aimed at managing economic activity along with unemployment levels.

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5. Conclusion

This paper identified an inverse relationship between QE and UER through the application of Linear Regression, controlling five variables: rGDP, rGDI, Business Investment, Interest Rate, and house price. The results of the Linear Regression model indicate a statistically significant relationship between QE and UER, suggesting that an increase in QE (i.e., greater gilt purchases and increased cash injection into the economy), corresponds with a decrease in UER. However, this paper is subject to two major limitations: first, it provides only empirical evidence of a relationship between QE and UER without establishing causality; second, the dataset is relatively limited in scope, as QE was only embarked by BoE in 2009. These limitations introduced uncertainty regarding the viability of adjusting QE as a direct tool for reducing UER. The casual chain remains indeterminate at this stage of research, as a negative correlation between QE and UER does not necessarily imply causation. Nonetheless, what is clear is that recent QE measures have had a positive impact on economic activity and confidence by reducing interest rates, while potentially exerting a negative influence on UK unemployment as a side effect.

In future research, this study could be refined to further investigate the causal relationship between QE and UER more thoroughly, particularly as a larger dataset becomes available with the continued use of QE in the UK

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