

The Practical Application and Marginal Expansion of Keynesian Model

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Abstract. Recently, there have been a lot of discussion about how variable change will affect output, real wages, and the nominal values of stock in certain assumptions. This paper describes improved new Keynesian model in closed economy for showing the adjustment of different component. Firstly, it will discuss the condition when an increase in tax by using mathematical derivation and examine the change when a rise in nominal wage through the use of macroeconomic analysis, then it will analyze the process when changing the target interest rate. Lastly, it will provide some evaluations of these several conditions. The results of the studies indicate that while an increase in tax, the real wages will rise, output will decline and the nominal money stock will do the same. Besides, the analysis has revealed that when a growth in nominal wages will result in a boost in price level and nominal money stock, and production remains constant. Additionally, when the target interest rate is raised, output will fall, real wages will rise as a result of a declining price level and a fixed nominal wage, and the nominal money stock will drop. All these preliminary results throw light on real life scenarios of central banks and countries.

Keywords: Output; Real Wages; Nominal Money stock; Rigid Wage.

1. Introduction

The proposed French Finance Bill for 2022, which was published on September 22, 2021, is now being debated. The corporate income tax rate will drop from 26.5% to 25% as planned in the last finance bill. Meanwhile, there is another news shows the most recent Employment Cost Index (ECI) figures from the Bureau of Labor Statistics show that over the last three months, nominal wages and compensation for all civilian workers slowed marginally but continued to rise at a brisk 4.4 percent annual rate (BLS). The nominal growth in earnings and salaries since December 2020 has been 4.5 percent, which is the fastest increase since 1983. With these raises, nominal earnings and salaries are now 1.2% higher than their pre-pandemic average. Also, in July 2022, the Federal Reserve of the United States increased its base interest rate by 0.75 percentage points, as part of a continuing effort to rein in the greatest economy in the world's surging consumer prices, which means consumers will purchase more foreigner goods and services. These news items show real-life initiatives in various countries which, at the same time, have some impacts on economy, such as output, nominal money stock, and real wage. This paper will demonstrate how, in a closed economy, when one of the factors (taxation, nominal wage, interest rate) is changed, the other elements in economy change. The study of closed economy provides the basis for the study of open economy, which leads to the authentic conclusions. There are two innovations in this paper, the first is the identification of the problem from real life and the derivation using a model of a closed economy, and the second is the validation with real data, leading to conclusions that are confirmed in real life. The rest of this essay is divided into 5 parts: Literature review and research method, and analyzing three conditions respectively, the first one is in a closed economy, an increase in tax leads to the change of output, nominal wage, and nominal money supply. Then, the assumption is a boost nominal wage. Finally, the condition is that the central bank set a higher target interest rate. Also, using real data to verify the correctness of the conclusions. Additionally, mentioning the limitations of this paper and giving an outlook for the future.

2. Literature review

2.1 The development of Keynesian model

The General Theory of Employment, Interest, and Money by John Maynard Keynes was originally released in 1936, marking the beginning of the history of contemporary macroeconomics. John Maynard Keynes mentioned about the relationship between income and consumption and provide the reasons how external shock will affect output. Besides, he introduced the reasons why monetary policy affect interest rate which provide the guidelines for central bank. Lastly, he emphasis the importance of expectation. The "golden age" of macroeconomics can be defined as the years between the early 1940s and the early 1970s. The theories of money demand, portfolio selection, consumption, and investment, as well as growth theory and large macroeconomic models, were among the most significant advancements. Supporters for Keynes believed the model provided a framework of how economics operate. They thought the model help improved the efficiency of policy and able to eliminate the recession. One of the main debates about Keynesian economics theory is ignoring expectation. Robert Lucas (1972,1976) has brought raiton expectation assumption into macroeconomics theory (Taylor, 2001) . Based on the John Maynard Keynes' General Theory of Employment, Interest, and Money and rational expectation theory, new Keynesian has been developed from the late 1980s to the crisis (Blanchard, 2020) . It was examined there was no government interaction and operated at disequilibrium condition in the short run (Hiç, 2019) . New Keynesian economists believe that they should learn about nature of imperfection in different markets (Blanchard, 2020) . For instance, they developed nominal rigidities and the perfect competition conditions and perfect elasticity of prices and wage have been ignored (Hiç, 2019) . Through the new Keynesian model, menu cost has been derived. By using menu cost, it provides the guideline for multiproduct firm to set price for their firms (Alvarez and Lippi, 2014) . Through developing the new Keynesian, efficiency wage has been mentioned. It provides the relationship between efficiency wage and unemployment, layoffs, wage dispersion and created an incentive model to explain the reason why firms prefer not to decrease the wage when the labor supply is greater labor demand (Weiss, 2014) . Through reading more articles and book related to Keynesian economics model and new Keynesian economics, new Keynesian economics theory has already been used in many different fields. In macro, the new Keynesian improve the effectiveness of policies whereas in micro, it provides the idea of how to set price in specific industry. However, most of articles discuss the new Keynesian model in an open economy whereas there are only limit articles about implication of Keynesian model in closed economy. This article is going to explore about implication of Keynesian model in closed economy based on research has been done.

2.2 Macroeconomic Effects of Tax Increases

In open economy, most of the countries have a high government spending and therefore lead to a high national debt. In order to reduce the national debt, government may increase the taxation. Changing in tax lead to a huge effect on output. When tax increases every one percent of GDP can result in almost 3 percent decrease of the real output (Romer and Romer, 2010) . In the monopolistic competition, model from Rajit Biswas and Vandana Thandassery Ramakrishnan shows that using the tax can decline the real wage and in the condition of a strong economics scale and high fixed cost, increase in unit and ad valorem tax can lead to more employment (Rajit Biswas and Vandana Thandassery Ramakrishnan, 2022) .

2.3 Change in Nominal Wage

Nominal wage is the real wage times the price level. A reduction in nominal wage may lead to deflation which can result in increase in unemployment (Napoletano, Dosi, Fagiolo and Roventini, 2012) .

2.4 The Effects of Interest Rate Rises

Interest rate represents a whole class of rate of return related to fixed-income instruments (Wu, 2019). Through the Keynes's standard neo-macroeconomic models, a upturn in the interest rate lead to a decrease in consumer spending and therefore output can be affected (Huong Thi, 2019). Different from changing interest rate in open economy which increasing interest rate can lead to appreciation in currency, this essay assumed changing in interest rate in closed economy.

3. Research Method

To gain further insight into the involvement of this model, the new Keynesian model was the powerful paradigm in macroeconomic when the first indications of the world's worst financial catastrophe since the Great Depression started to appear. It merely aids economists in learning the basic framework for understanding changes in commercial activities, inflation, and their link to monetary and fiscal policy across all economics curriculum worldwide. It was extensively embraced by academics as a core model that could be adaptably used to study a range of macroeconomic occurrences. There are three compelling adjustments added in the traditional real business cycle apparatus which is enhanced by new Keynesian economics. It begins by formally introducing nominal variables such as prices, wages, and an interest rate. Second, it does not assume perfect competition on the commodities market, allowing for price markups that are in favor. Third, it incorporates nominal rigidities, typically utilizing the framework put forward by Calvo (1983), whereas only a certain number of businesses randomly selected from the population are allowed to change the price of their product. With the establishment of wage rigidities, the idea of imperfect competition is widely extended to the labour market at the same time (Galí, 2018). With regard to labour markets and macroeconomic performance, wage rigidities are the fact that wages cannot be reduced. The labour market's outcomes are significantly influenced by how wages respond to the economy. Involuntary unemployment may occur if wages are higher than the market clearing level and inflexible downward, that is, when they do not change to reflect changes in supply and demand (Goette et al., 2007). The well-known IS-LM approach only considers the impacts of shocks on an economy (Smith, 1980). IS curve representing the good market while LM curve represents the financial market. These two curves show the relationship between the production and the rate of interest. This essay assumes the new Keynesian model in a close economy, which means a nation that doesn't engage in any trade or other financial dealings with other countries. That indicates that neither imports nor exports enter the country. Meanwhile, the assumption sets central bank has a target interest rate, which means a change in interest rate happens, central bank is going to take action to keep interest rates at the same level; therefore, in this case, LM curve is a horizontal line.

4. Theoretical Analysis

Based on the underlying assumptions of the Keynesian model, this part will using economic derivation and data analysis to demonstrate the changes of different variables.

The first condition is when there is an increase in tax. Tax is the amount of money that government received from residence according to their income, the value of their property. In the close economy, it simplifies the output only related to consumption, Investment, and government spending. As the consumption is only affected by the disposable income. Here is the induction of IS equation.

$$Y = C + I + G \quad (1)$$

In equation 1, Y represents output, C stands for consumption, I is investment, and G for government spending.

$$I = I_0 \quad (2)$$

In equation 2, I represents expenditure on new capital, I_0 represents initial expenditure on new capital

$$G = G_0 \quad (3)$$

In equation 3, G represents government spending, G_0 represents initial government spending

$$T = T_0 \quad (4)$$

In equation 4, T represents taxation minus transfer, T_0 represents initial taxation

$$C = c + bY_d = c + b(Y - T) \quad (5)$$

In equation 5, c represents exogenous consumption, b represents marginal propensity to consume

$$Y = c + b(Y - T_0) + I_0 + G_0 \quad (6)$$

$$Y(1 - b) = c - bT_0 + I_0 + G_0 \quad (7)$$

$$Y = \frac{1}{1 - b} [c - bT_0 + I_0 + G_0] \quad (8)$$

$$E_0 = c - bT_0 + I_0 + G_0 \quad (9)$$

Because the taxes are endogenous variable of E_0 . According to the IS function $Y = 1/(1-b)(E_0 - g_1 \cdot r)$, since taxes increase, by calculating, E_0 will go down. The output is going to decrease as well. From figure 2, IS curve shifts to left due to the decreasing output whereas LM curve has no change. One of the core macroeconomic equilibrium models is the IS-LM model. In this view, the aggregate equilibrium is the simultaneous equilibrium of the goods market and the market for financial assets (Volná, 2015). From the righthand side graph, the equilibrium point moves from A to C. Output will decrease when in the same price level which leading to a right shift of the aggregate demand curve while the aggregate supply curve stays same. The aggregate supply curve is upward sloping due to the rigid money wage. the aggregate demand curve is vertical line because this curve demonstrates the connection between pricing and output, when price level increased central bank will take action to fix the interest rate at the same level, so no matter how price level change output does not change. From figure 1, at the original price level p , there is no equilibrium point between the new aggregate demand curve and the upward sloping curve in figure 1. Thus, the balance point moves along the new upward sloping curve to the point c. The aggregate demand less than aggregate supply, so that price level decline.

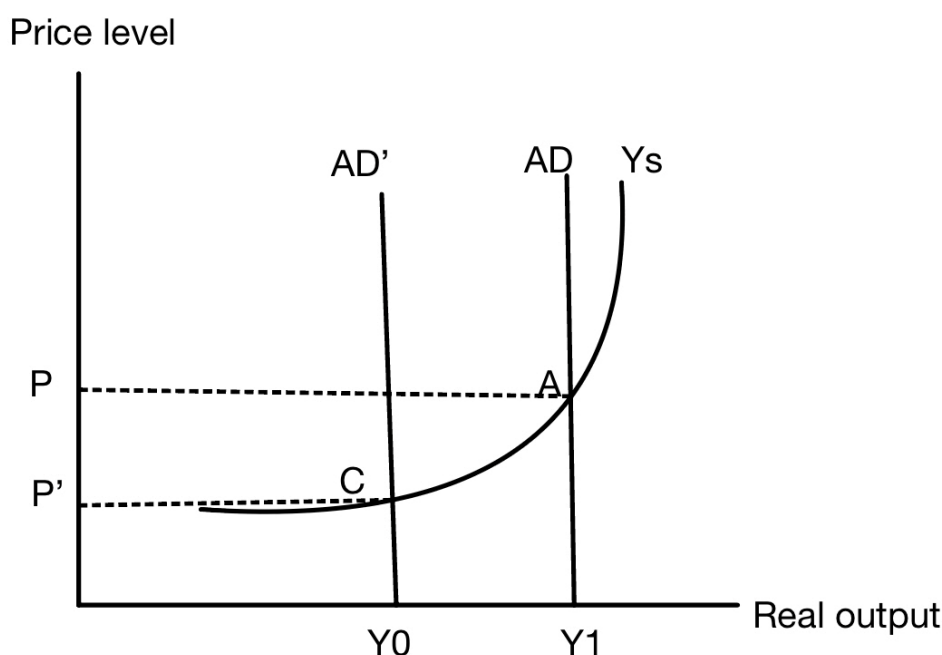
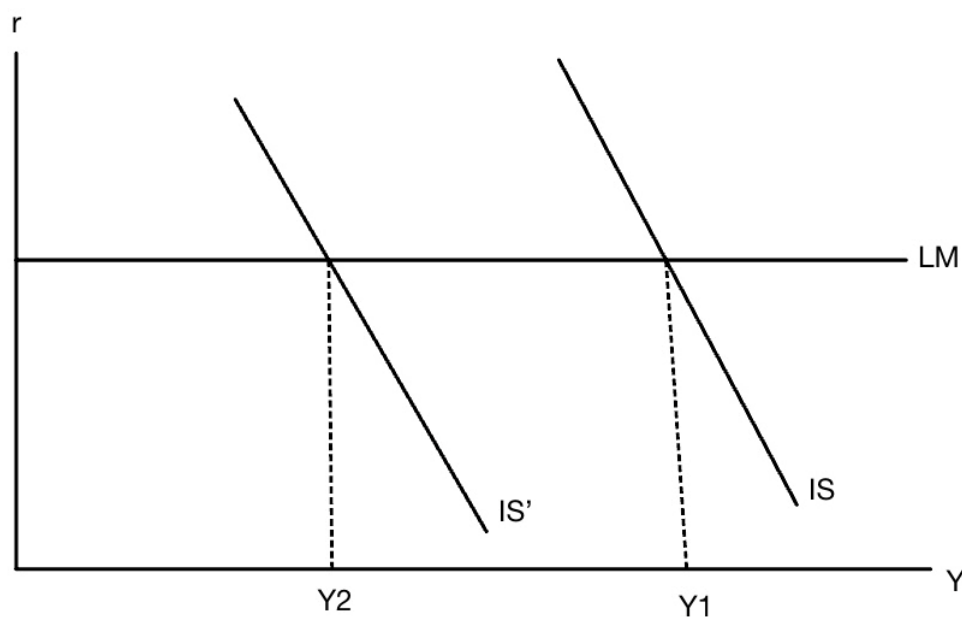


Fig. 1 Relationship between price and real output



Relationship between interest rate and real output

Fig. 2 Relationship between interest rate and real output

Real money supply is equal to M/p , real money supply will decrease when the price level declines, even while the nominal money quantity will stay unchanged. When there is an excess money supply which means people prefer to purchase more bond rather than money due to asset markets are in the same portfolio. Bond price will increase because the demand for bond increase. Bond price has a negatively correlation to the interest rate, therefore the interest rate decreases as the LM curve shifts downwards. From figure 3, as IS curve shifts to the left LM curve shift downwards, the new equilibrium point will move from C to B. However, the assumption is the central bank fix the rate of interest but in this case, interest rate is decreased. To reach the original interest rate the central bank is going to decrease the nominal money supply. As the demand for bond reduced, the interest rate is going to rise to increase the demand for band. The LM curve will shift back. To conclude the ideas, output is going to decrease, real wage is going to increase whereas the nominal money stock is going to decrease.

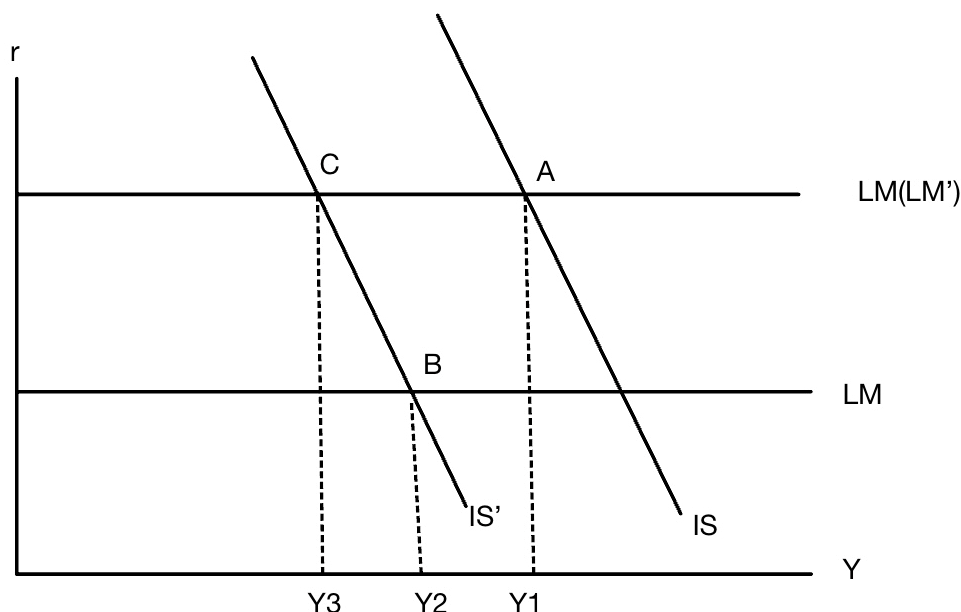


Fig. 3 The interest rate and real output

From figure 4, a rise in nominal wage means the curve swivels to the left, because at the same output level, a greater nominal wage causes the price level to rise. While the aggregate demand curve unchanged, the price level increases. So that the real money supply falls, the vertical curve shows in Figure 5 shifts to left, from figure 5, the new intersection point moves along the money demand curve which results in a rising interest rate from r_0 to r_1 . However, in this case, the central bank sets a target rate of interest, the central bank alters the nominal values of stock when an increase in pricing, so the real money supply curve is going to shift to the right, the interest rate remains at the target level. The result is that a rising in nominal wage will lead to a growth in pricing, an expansion in nominal money stock whereas the real income remains unchanged.

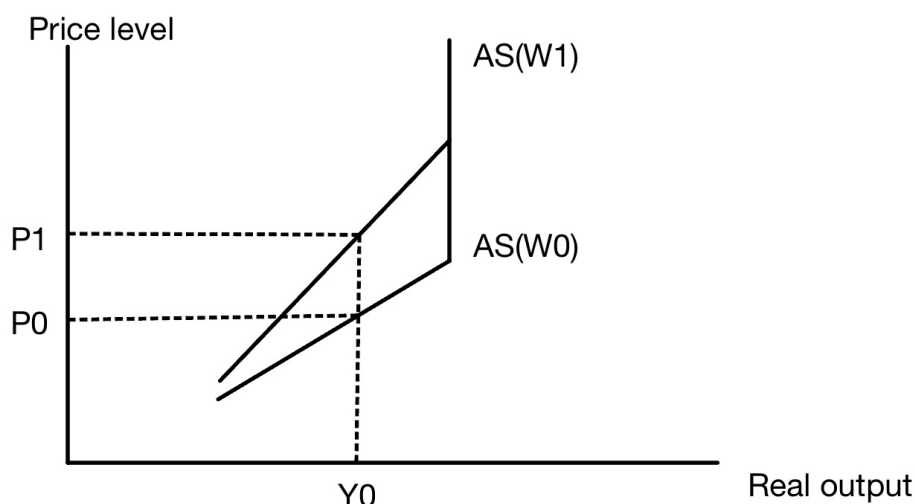


Fig. 4 The price level and real output

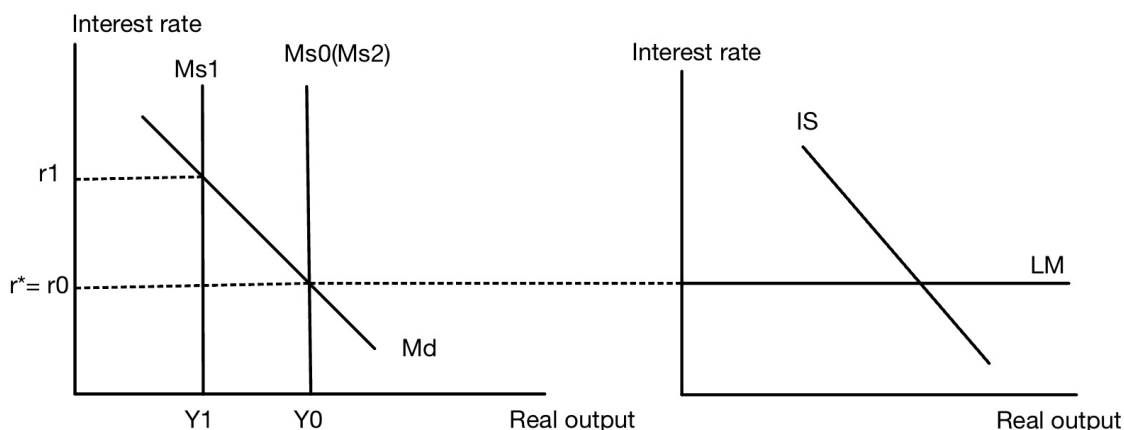


Fig. 5 The interest rate, real output

Another case of this question is when central bank rises the desired interest rate. When Central bank set a new interest rate which signifies the LM curve shifts upwards. Because of changing in LM curve shows on figure 6, there is a new equilibrium point which is point B. Thus, it leads to a decrease in output and it affects aggregate demand curve. From the previous analysis, we can draw the diagram 1. So that it can be proved in another way, due to the new aggregate demand is less than the aggregate supply, so the price level decreased. While the price level decreases, if the central bank has no action on nominal money stock, real money supply will increase which means bond demand increases, and bond price increases, therefore the interest rate decreases. The Central bank aims to keep the interest rate same; it will decline the nominal supply of money in order to shift LM curve to the expected level. To sum up, output is going to decrease, real wage rate increases and the nominal money stock declines.

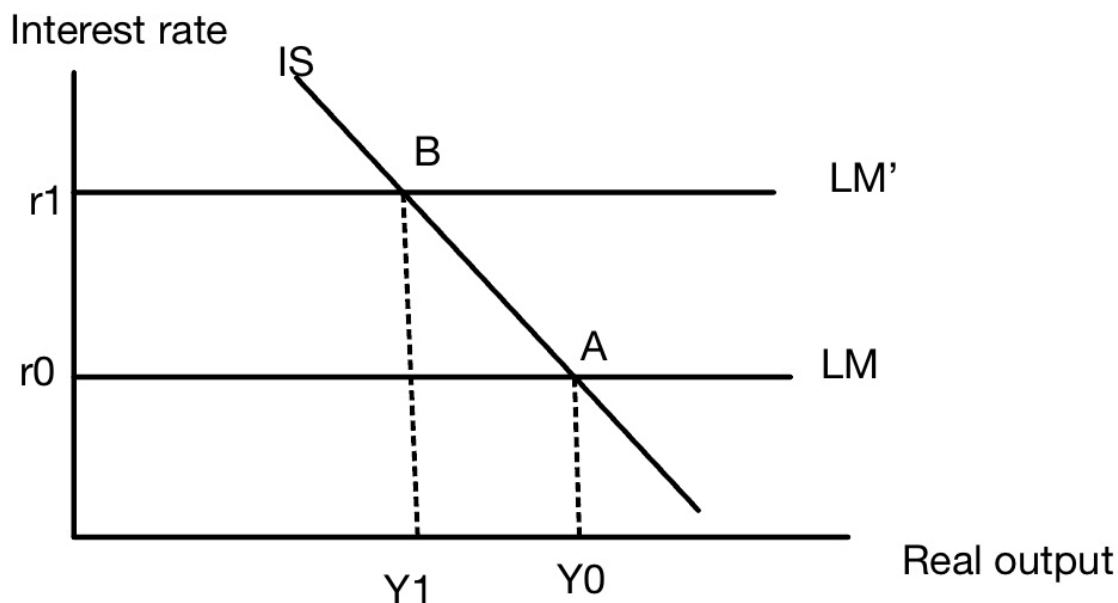


Fig.6 The interest rate and real output

5. Further Analysis

In United Kingdom, the GDP growth rate is -9.8 percent in 2020, on ninetieth March, the Bank of England set interest rate to 0.1 percent which boost the economy; thus, the GDP growth rate increase to 7.44 percent. In other words when the interest rate decrease, the GDP growth raises. On 16th December 2021 the Bank of England changes interest rate to 0.25 percent which therefore decrease the GDP growth rate to 3.75 percent. Thus, it can be improved that the conclusion made in closed economy also applied in open economy.

Table 1. GDP growth rate from 2019 to 2022

Year	GDP growth rate
2019	1.67%
2020	-9.27%
2021	7.44%
2022	3.75%

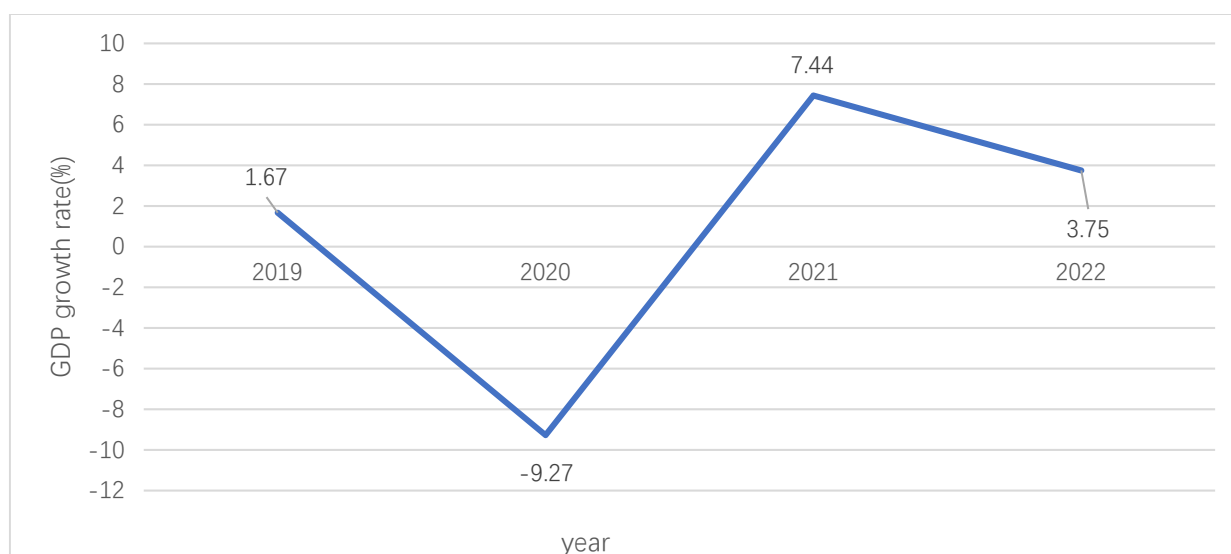


Fig.7 Gross domestic product (GDP) growth rate in the United Kingdom 2027

Table 2. The interest rate from 11 Mar 2020 to 16 Dec 2021

Date	Interest rate
11 Mar 2020	25%
19 Mar 2020	10%
16 Dec 2021	25%

(Bank Rate history and data | Bank of England Database, 2022)

6. Limitations and future outlook

One concern about this analysis is that all the derivation process using the closed economy background. The derivation may contradict the reality of the situation due to it does not consider the impact of real-world factors, such as covid-19 or national policies. A more comprehensive study would include not only closed economy but also open economy, so that it is able to draw a further conclusion. Meanwhile, such expositions are unsatisfactory because the lack of rigorous mathematical derivation. This analysis uses simplified equations to develop changes in variables which is not realistic. Considerably more work will need to be done to have a derivation which using a more accurate mathematical model.

7. Conclusion

The aim of this essay is how the output, nominal money stock and real wage will change when one of the exogenous variable changes in a closed economy. An increase in taxation lead to a drop in price level, a fall in output, an increase in real wage and nominal money stock is going to decrease. Rising the money wage will lead to a climb in price level, a boost in nominal money stock and the real income remains unchanged. When rising the target interest rate, output is going to decrease, real wage is going to increase due to the reducing price level and fixed nominal wage whereas the nominal money stock goes down. This thesis has provided a deeper insight into applying new Keynesian economics theory in closed economy. Different from previous research related to new Keynesian, this paper is mainly focused on closed economy rather than open economy. An implication of this is the possibility that governments are able to design a more effective policy and provide a framework how to achieve macroeconomics objectives in a closed economy. Theoretically, this report enriches current research on new Keynesian theory. Rather than only applied new Keynesian into open economy, it can also apply to closed economy. Through mathematical induction and previous research related to new Keynesian theory, this report provides the guideline for government to achieve macroeconomics objectives. To firms and individuals in closed economy, it helps firms to have rational expectation when government publish a new policy. Besides, applied new Keynesian in closed economy can get a basis of the economy switch to open economy.

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