The Taylor rule and its aftermath: an interpretation along Classical-Keynesian lines

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Abstract: The aim of this paper is to assess to what extent the Taylor rule can be considered an appropriate representation of the tendency of central banks to react to inflation. After an overview of the origin and use of the Taylor rule, the paper stresses some difficulties in its implementation and the limits of its interpretation by the New Consensus models. Specifically, the inherent difficulties stemming from the notion and estimates of a benchmark interest rate determined by "productivity and thrift" are pointed out. We then move on to advance an alternative interpretation of the Taylor rule along Classical-Keynesian lines. In this context, inflation is fuelled by conflicting claims on income distribution and the rule will be interpreted, as it is in actual fact, as a flexible and non-mechanical benchmark for monetary policies which will be seen to affect the division of product between wages and profits.

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1. Introduction

Over the last three decades, several contributions have formalised the behaviour of central banks in terms of some variety of the Taylor rule. It has become a pillar of New-Keynesian DSGE models and prescribes an unobservable natural real rate of interest which is independent of the central banks' setting of interest rates as the benchmark rate for monetary policy. Any discrepancy between this natural rate and the rate fixed by the monetary authorities would in fact lead to an inflation rate which is different from the one targeted by central banks. Moreover, output fluctuations would occur in the presence of price rigidities or agents suffering from money illusion.

The aim of this paper is to assess to what extent the Taylor rule can be considered an appropriate representation of the behaviour of central banks and how to rationalise their tendency to react to inflation when following an approach that differs from the New Keynesian models. After providing an overview of the Taylor rule, Sections 2 and 3 stress that it does not fit the data well and describe some difficulties in its implementation. We then move on in Section 4 to underline the limits of its interpretation by the New Consensus models. Specifically, the inherent difficulties stemming from the notion and estimates of a benchmark interest rate determined by "productivity and thrift" are pointed out. Finally, in Sections 5 and 6, an alternative interpretation of the Taylor rule along Classical-Keynesian lines is advanced. In this framework, inflation is fuelled by conflicting claims on income distribution and the rule will be interpreted, as it is in actual fact, as a flexible and non-mechanical benchmark for monetary policies which will be seen to affect the division of product between wages and profits. Broadly speaking, it is not a rule but a "structural" relationship which is affected by changes in the factors shaping the workers' strength in wage bargaining and the real interest rate targeted by central banks according to their policy objects and constraints.

2. A variety of Taylor rules

The original rule advanced by Taylor (1993) is:

$$i = 2\% + \pi + 0{,}5(\pi - 2\%) + 0{,}5(q - q_n)$$

where i is the nominal policy interest rate; $2\% = r*$ is the average real interest rate observable over a long time horizon; π is the rate of change in the GDP deflator; $\pi^* = 2\%$ is the targeted inflation rate; $\vartheta_i = 0.5$ for $i = \pi, q$ are the reaction parameters of the central bank; q - q_n is the deviation of quarterly output from its trend.

In its original version, the rule only needs to know the current rate of inflation and the output gap as measured by the deviations of gross domestic product from its trend. It prescribes to vary the rate of interest to «lean against the wind» in the presence of demand shocks. Moreover, it embodies what

has been called the Taylor principle, namely, an increase in the nominal rate of interest that is greater than the increase in the inflation rate. In fact, the rule can be written as:

$$i = 1.5\pi + 0.5(q - q_n) + 1\%$$

where di/dπ = 1+$\vartheta_\pi = 1.5$. A value which is greater than 1 of the slope coefficient on inflation would avoid hyperinflation or hyperdeflation in the presence of an accelerationist Phillips curve.

According to Taylor (1999), changing values of the parameters ϑ_i would reflect the progressive shift from discretionary and Keynesian policies towards rules that fulfil the "Taylor principle" and fight price instability. To assess when and to what extent central banks follow his principle, Taylor (1999) compares the actual course of the Federal Fund Rate with the rate of interest that would have been prescribed by his rule according to two possible values of the parameter ϑ_π, namely $\vartheta_\pi = 0.5$ and $\vartheta_\pi = 1$. Furthermore, considering the percentage deviations of inflation and real output from their trends, he estimated the values of the parameters ϑ_i during the gold standard and the Bretton Woods and post-Bretton Woods eras using the method of ordinary least squares. Finally, taking as given the trend rate of inflation π^* and assuming $q - q_n = 0, namely\ that$ the economy is operating at full employment (see Taylor 1999, p. 330), he compares his monetary policy rule in different periods as stemming by the estimated parameter ϑ_π under these latter assumptions, with the line 2% = $r^* = i - \pi$ which has a slope equal to one in the space (π, i). If the former estimated line has a slope (the value of ϑ_π) which is lower than that of the latter (equal to one), the actual reaction parameter to inflation of the Federal Reserve would have been too low[2] to maintain or bring the real rate of interest back to its equilibrium level.

On the basis of this analysis, Taylor (1999) concluded that the monetary authorities were too accommodative in the years 1960-1979 and too restrictive in the 1980s, which also means that the Fed's reaction to the output gap was too slow in this last decade. The Federal Reserve only followed his rule in the years 1987-1995, whereas in the years 1995-1999, the monetary policy turned out again to be too restrictive.

This suggestion by Taylor that his rule does not fit the data well is widely recognised in the literature (Orphanides 2003; Rudebusch 2006; Poole 2007; Taylor and Wieland 2016). In other words, the literature has stressed the instability of the Fed's reaction to price inflation over the last 50 years and the switch to more aggressive monetary conduct at the beginning of the 1980s (Clarida, Gali and Gertler 2000; Lubick and Schorfheide 2004). It has also been pointed out that only during the era of the Great Moderation (from the mid 1980s to the mid 1990s) the rule worked well and was

[2] Since in this case the constant term is given by $c = r^* + (1 - \vartheta_\pi)\pi^*$, when the value of the intercept of the estimated line with the ordinate axis is greater than 2% (and therefore, ϑ_π is lower than 1) there is bound to be increasing inflation since the real interest rate will not increase when the nominal interest rate increases.

associated with a reduction in output and inflation volatility, both in the US and in other advanced countries.

But how has this failure of the rule to account for the course of monetary policy in several periods been interpreted? A first explanation has been in terms of mistakes in the conduct of monetary policy, as offered by Taylor (2012) for the years before and after the 2007 crisis. However, if systematic errors did occur, they reveal that other factors influenced the monetary policy, namely, that central banks followed a different rule the optimality of which should be discussed in comparison with the Taylor rule – possibly, also in terms of their effects on the *average* amount of labour unemployment in addition to output volatility. Second, it has been emphasised that there is uncertainty over the true values of some variables included in the rule and on the lags in the effects of monetary policies. For example, it has been stressed that the output gap and the natural (or benchmark) rate of interest are unknown and change over time (Kohn 2012). Moreover, it has been maintained that the estimates of the natural rate are sensitive to the central banks' reaction parameters and that an independent estimate of this rate is needed because it and the central bank's inflation target are combined in the constant term of the Taylor rule and therefore, they "cannot be identified separately" (Judd and Rudebusch 1998).

A consequence of these problems and lack of identification has been a variety of specifications of the Taylor rule (table 1) according to the hypotheses that have been made on the parameters ϑ_i and the unobservable variables that appear in the rule – a variety that signals a difficulty in interpreting it as a mechanical or definite policy rule. For instance, the smoothing of interest rates and the forward-looking behaviour of central banks that react to changes in the expected rather than the current inflation rate have been introduced in the rule. Moreover, a *variable* natural rate of interest that shifts the constant term over time has been considered.

This variety of the Taylor rule questions, however, its prescriptive role and implies several difficulties for monetary policy implementation. How sensitive the results are to different values of the parameters ϑ_i and measures of inflation is shown by Bernanke (2015) in response to Taylor's criticism of the conduct of the monetary policy by the Federal Reserve over the last decades. He argued that a modified rule in which a weight of 1 on output gap is assigned and inflation is measured by the core consumer price index rather than the GDP deflator would indicate that the Federal Funds Rate (FFR) has followed the rates prescribed by the Taylor rule before reaching the zero lower bound in 2009. A similar conclusion is achieved by Koenig (2004) who estimated the rule with both the weights ϑ_i and r_n changing over time. In both these and other similar cases, the risk is that the rule is derived by adjusting the values of the parameters and the unobservable variables in order to fit the data better, losing any prescriptive role.

Table 1: Different specifications of the Taylor rule

The original Taylor rule	$i_t = r_n + \pi_t + 0,5(\pi_t - \pi^*) + 0,5(q_t - q_n)$	**Taylor (1993)**
The 1999 rule	$i_t = r_n + \pi_t^{core} + 0,5(\pi_t^{core} - \pi^*) + (q_t - q_n)$	**Taylor (1999)**
The inertial rule	$i_t = \varrho i_{t-1} + (1-\varrho)[r_n + \pi_t^{core} + 0,5(\pi_t^{core} - \pi^*) + (q_t - q_n)]$	**Rudebusch and Svensson (1999)**
The rule with a variable r_n	$i_t = \varrho i_{t-1} + (1-\varrho)[r_n^{var} + \pi_t^{core} + 0,5(\pi_t^{core} - \pi^*) + (q_t - q_n)]$	**Laubach and Williams (2003)**
The forward looking rule	$i_t = r_n + \pi_{t+3}^{F\,core} + 0,5\left(\pi_{t+3}^{F\,core} - \pi^*\right) + (q_t - q_n)$	**Clarida, Gali and Gertler (1999)**
The first differential rule	$i_t = i_{t-1} + 1,74\left(\pi_{t+3}^{F\,core} - \pi^*\right) - 1,19(u_{t-1} - u_{t-2})$.	**Orphanides and Williams (2008)**
	π_t^{core}= core inflation; r_n^{var}= variable natural rate of interest; $\pi_{t+3}^{F\,core}$ = the forward core inflation; u_{t-i}= the unemployment rate at time *t-i*	

With regard to the problems posed by a variety of the Taylor rules for monetary policy implementation, there is widespread recognition of them. Considering the weight given to interest rate smoothing in the inertial rule he himself proposed, Rudebusch (2006) observed that the presence of serial correlation in the disturbance term, if ignored, could spuriously indicate that the Federal Reserve was smoothing interest rates, whereas it is actually reacting to economic factors which are not considered in the Taylor rule equation. Yellen (2012, p. 7), on the other hand, pointed out that a "wide variety of simple rules" creates difficulties for the monetary policies because "their policy implications can differ significantly depending on the particular specification." Her suggestion to take into consideration various rules when setting the policy interest rate acknowledges the discretionary nature of the monetary policy.

3. The obstacle set by estimates of the natural rate of interest

However, the most serious drawback in the Taylor rule is its reference to an unobservable natural interest rate that must be estimated and is affected solely by real factors such as productivity growth, the growth of the workforce, the time preference of households, and changes in government expenditure. This is clearly shown by the recent debate on the stance of monetary policies where the sign of the monetary policy appears very different according to the estimate values of this rate.

The New Keynesian models are at the base of this debate. In these models, the LM curve is substituted by the Taylor rule in the belief that changes in the price level do not stem from changes in the money supply, but from exogenous shocks that lead to a discrepancy between the natural rate of interest and the real interest rate settled by the central banks. Any such discrepancy leads to a change in the inflation rate and in the level of output relative to its steady state value because some kind of nominal price rigidities have been introduced to the model. Therefore, in order to stabilise prices and output, monetary policy authorities should credibly commit themselves to following the natural rate of interest and reacting to unfavourable situations. The monetary policy reaction function that is usually advanced is the Taylor rule as described above.

The core of these models can be summarised by 6 equations. The first two are represented by a New-Keynesian expectation-augmented Phillips Curve (PC) and an IS curve. A discrepancy between the real interest rate r_t and the natural one $r^* = r_n$ will lead to a level of output[3] q_t that is different from its long run natural value q_L and therefore to a discrepancy between actual and expected inflation rates (respectively, π_t and $E_t(\pi_{t+1})$), where λ in the PC curve reflects the degree of price rigidity. The third equation sets the relation between the nominal and real interest rates. Since the latter is seen to be determined by the marginal product of capital, it coincides with the Fisher equation. We have:

$$q_t = q_L + \lambda\big(\pi_t - E_t(\pi_{t+1})\big) + \epsilon_t \qquad \text{PC [1a]}$$

$$q_t - q_L = -\sigma(r_t - r_n) \qquad \text{IS [2a]}$$

$$i_t = r_t + E_t(\pi_{t+1}) \qquad \text{FE [3a]}$$

where i_t is the nominal interest rate.

The other three equations refer to the monetary side of the economy and substitute the traditional LM curve. They describe the behaviour of the monetary authorities under the assumption of money endogeneity.[4] Equation [4a] is a loss function of the central bank. Under the constraint of the Phillips curve, a monetary policy rule equation MPR is derived from it (equation [5a]). Finally, the reaction function [RF] of the central bank is calculated from this rule and equations [2a] and [3a] where $\vartheta_\pi^* = \frac{\psi}{\lambda\varphi\sigma}$, ψ and φ are the weights assigned by the central bank to inflation and the output gap in its loss function, and $\pi *$ is the targeted inflation rate which, in equilibrium, must coincide with the actual and expected inflation rate $E_t(\pi_{t+1})$:

[3] In some models the interest sensitive element of aggregate demand is only consumption. In this case, σ is the intertemporal elasticity of substitution.

[4] More precisely, it is "short run" money endogeneity. In these models, the monetary policy instrument is the rate of interest and central banks accommodate the monetary base. However, in the long run, credit and money supply are bounded by the tendency of the interest rate towards its natural value. See Rochon (1999).

$$minL_t = \psi(\pi_t - \pi^*)^2 + \varphi(q_t - q_L)^2 \qquad \text{LF [4a]}$$

$$q_t = q_L - \frac{\psi}{\lambda\varphi}(\pi_t - \pi^*) \qquad \text{MPR [5a]}$$

$$i_t = r_n + \pi + \vartheta_\pi^*(\pi_t - \pi*) \qquad \text{RF [6a]}$$

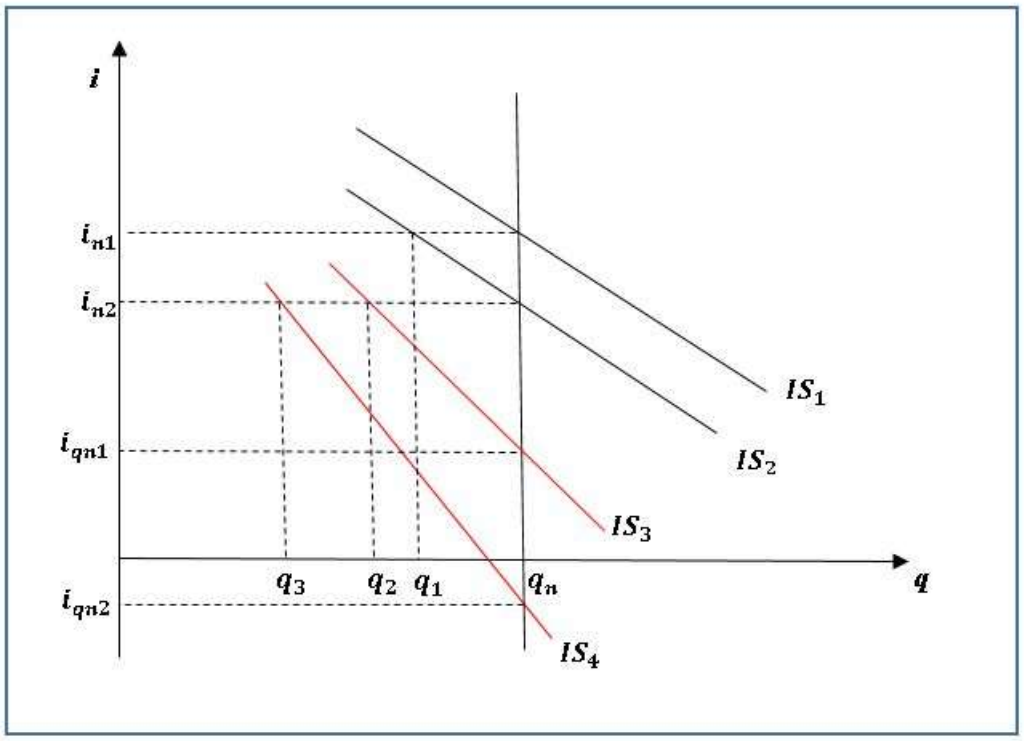
This model makes it clear that the modern theory of central banking eventually restates the main theses of the loanable funds theory (see Seccareccia 1998) where the market rate of interest is determined by the supply of and demand for credit and the natural rate by the supply of and demand for savings when output is at its potential level (see Robertson 1962, pp. 64-74). As in Robertson (1962, p. 23), after a disturbance, the real rate of interest will in fact adjust to the *equilibrium* marginal product of capital and guarantee full employment. Nominal price rigidities may lead to deviations in output from its potential value, but these will be temporary in nature insofar as the monetary authorities follow the Taylor rule and avoid destabilising attempts to maintain the unemployment rate at a level which differs from its natural value.

Below we will briefly deal with the loanable funds theory as criticised by Keynes. Looking at the above equations, however, a problem immediately arises for the monetary authorities. Their benchmark rate r_n should be clearly identified and computable from observable economic data, but its counterfactual nature leads to a variety of estimate methods that provide central banks with different possible benchmark rates. Second, these different methods are associated (see Smets and Wouters 2003; Woodford 2003; Curdia et al 2015) with different notions of the natural rate of interest based on the hypotheses made according to the degree of market imperfections and the time span considered (Levrero 2021). The natural rates may in fact range from Wicksell's *long run* "efficient" natural rate (that is, the equilibrium rate that would occur on average in conditions of perfect competition) to the *short run* rate which would prevail when the effects of temporary shocks are not averaged out and the output is at a level at which inflation does not accelerate taking *market imperfections* into consideration. In this case, central banks have the additional problem of defining and measuring these imperfections in the labour, credit and goods markets.

To give an example of these different notions of the natural interest rate, consider in Figure 1 a permanent shift of the IS curve from IS_1 to IS_2. If the monetary authorities do not change the interest rate, output will fall to q_1 below its potential level q_n. If, at this point, a temporary shift of the IS curve on the left occurs (see lines IS_3 and IS_4) due to an increase in the propensity to save and a decrease of firm willingness to invest during the crisis, the settlement of the rate of interest to the new *normal* rate i_{n2} will not guarantee output that returns to its potential level. As already suggested by Robertson (1962), the benchmark of the monetary authorities should be what we can refer to as the quasi-natural

rates of interest i_{qn1} and i_{qn2}, taking into account the *temporary* shifts of the IS curve due to temporary shocks (see also Woodford 2003, pp. 152 and 251). On the other hand, the work of the monetary authorities may be complicated further by the fact that the potential output can also change during the crisis which is another factor that can shift the natural rate of interest - a possibility usually neglected in New-Keynesian models, at least until the 2007 crisis.[5]

Figure 1: **Natural and quasi-natural interest rates in the traditional approach**



As shown by recent experience, the different notions and methods of estimation of the natural interest rates lead to a different judgment of the stance of monetary policy. In actual fact, those who, like Taylor&Wieland (2016), referred to a long-run notion of the natural rate that would be around 2.5-3 per cent in the US tended to criticise Fed monetary policy after 2010 for being too expansionary. On the contrary, those who referred to a quasi-natural rate of interest and considered that it fell sharply during the crisis due to low expected productivity and a rising propensity to save evaluated the stance of monetary policy as still being not expansionary even when the policy rates were brought towards zero.[6]

[5] On this point, see Section 4 and Reifschneider et al (2013).
[6] For instance, according to Curdia (2015), the natural rate became negative after 2008.

4. Inside the black box: the IS and price puzzles

If this variety of estimates of the natural interest rates further complicates the specification of the Taylor rule as discussed in Section 2, the course of the output gap and prices can differ from the one expected with New-Keynesian models and this in turn, further weakens the traditional interpretation of the Taylor rule and its implementation according to the modern theory of central banking.

In this theory, an increase in the rate of interest should lead to a fall in aggregate demand (especially, consumption and investment) thus allowing monetary policy to «lean against the wind.» Moreover, through this "demand" channel, the increase in the rate of interest would be accompanied by a lower rate of inflation. If this does not occur, this would be due to a contemporaneous increase in the natural rate of interest that would determine a scant elasticity of output to the interest rate.

This view on monetary policy has been questioned on both empirical and theoretical grounds. A fundamental criticism concerns the existence itself of a natural rate of interest which is determined by "productivity and thrift" and is independent of monetary factors. In his *General Theory,* Keynes argued that savings equalise investments by means of changes in income and deemed the notion of the natural rate of interest to be not useful (see Keynes 1936, p. 243) stressing that the rate of interest is a monetary phenomenon to which capital profitability will adjust.[7]

This criticism of the traditional theory has been reinforced by the capital debate of the 1960s. The dependence of the value of the capital endowment on relative prices and thus on the rate of interest makes it impossible to take the supply of capital as a single magnitude as given when determining relative prices, which entails that potential output, and therefore the amount of full employment savings, cannot be precisely defined like the full employment marginal product of labour which requires a given amount of capital to be calculated. Moreover, as the capital controversy has shown, a decreasing supply curve of firm bonds (namely, a decreasing demand curve for investment) with regard to the interest rate cannot be obtained due to the phenomena of re-switching and reverse capital deepening. Indeed, in the full employment saving-investment market there may be multiple equilibria, a capital-labour ratio that in equilibrium is not necessarily higher for a lower interest rate, and changes in the rate of interest out of the equilibrium that are so strong that they question the validity of the theory (Garegnani 1990). This undermines the foundations of the idea of a natural rate of interest determined by "productivity and thrift" found by the monetary policy.[8] It also questions

[7]However, see Garegnani (1978-1979) on some weaknesses in Keynes's arguments due to the presence in his theory of traditional elements.

[8]It should also be noted that *multiple* equilibria by itself would undermine the idea of the natural interest rate as a benchmark rate for monetary policy. In this case, in fact, central banks would not only be uncertain over its estimates; even if they knew the possible equilibria, they would also have to select the one the policy interest rate should be moved towards based on subjective ordering of these equilibria.

the neoclassical mechanism guaranteeing the tendency of actual to potential output which is based on the inverse relation between the rate of interest and the amount of investment (see Garegnani 1978-79).[9]

On more empirical grounds, the view of the Taylor rule to "lean against the wind" by changing the policy interest rate in order to stabilise inflation is challenged by several factors. First, although central banks can shape average market expectations, in the short run the short-term and long-term interest rates may not necessarily move in the same direction. Second, a low and asymmetric elasticity of aggregate demand to the latter has been pointed out several times (see, for example, Goodhart 1984) especially with regard to consumption (Hall 1988; Campbell and Mankiw 1989; Lawrance 1991) and investment (Chirinko, Fazzari and Meyer 1999). Finally, the same estimates of the IS curve have been puzzling. Although Peersman and Smets(1999) and Rudebusch and Svensson(1999) found a significant negative elasticity of output to the real interest rate for the United States and the euro area respectively, Nelson (2003) for the UK and Goodhart and Hofmann (2007) for the G7 countries did not, unless other variables are introduced into the regressive equation such as exchange rates and property prices.

This does not mean that monetary policy does not have an effect on output. It suggests, however, that it varies according to circumstances and passes through channels which are less "mechanical" than those based on substitution mechanisms shaping the neoclassical demand for and supply of savings. Output elasticity to the interest rate will depend on the effects that the change in the interest rates will have on income distribution, the exchange rate and therefore the net exports, the cost of public debt service and credit conditions for durable consumption goods and residential investments.[10] Moreover, non-residential investments will be affected mainly indirectly, that is, due to the changes in aggregate demand driven by those initial effects. This is also suggested by the lag with which investments in equipment and machinery react to a change in the interest rate (Bernanke and Gertler 1995).

[9] For an analysis of why these criticisms apply also to the New-Keynesian models although they refer to intertemporal or temporary equilibria, see Dvoskin and Petri (2017). Indeed, great ambiguity is present in these models with respect to the notion of capital. For example, Woodford (2003, pp. 167 and 353) refers to short run capital goods as specific inputs with different real rental rates. However, in these models, capital is often introduced into the production function as a single magnitude, firms are said to borrow at a rate equal to the value of the marginal product of capital, and Woodford himself treats capital as a single value magnitude when writing that there is a tendency of it to shift towards sectors with higher capital returns and that investments goods are perfect substitutes for savers (Woodford 2003, p. 166). As in the case of Marshall's short run equilibrium or Hicks's temporary equilibrium, a notion of capital as a single magnitude also reappears in the investment functions with adjustment costs that in the New-Keynesian models drive the out-of-equilibrium process of convergence of the "market" interest rates towards the natural rate. It is also implicit in the assumption of a single benchmark natural interest rate independent of the numeraire chosen.

[10] While the wealth channel is usually estimated as weak (see for instance Lettau et al, 2002), the housing market is an important channel of monetary policy.

Another problem with the traditional interpretation of the Taylor rule concerns the relation between the interest rate and the price level. According to New-Keynesian models, there should be a higher inflation rate associated with a lower interest rate. The Gibson paradox and its modern version of the price puzzle suggest that this may not be the case because *on impact* a direct relation between prices and the interest rate may exist. Rather than stemming from the market interest rate moving to its natural level as suggested by Wicksell, in a fiat money economy, this may stem from prices adjusting to the monetary costs of production that include the pure remuneration of capital, namely interest costs (see Panico 1987; Pivetti 1991).[11] This shows a cost channel of monetary policy that can overwhelm its demand channel so that, if the monetary authorities face a higher increase in prices by increasing the interest rate as prescribed by the Taylor rule, they can determine on impact a higher, and not a lower, inflation rate.

Looking at equations [1a] and [2a] of the New Keynesian models, the idea that a positive output gap $(q_t - q_L)$ can have persistent and accelerating effects on inflation may also be questioned. The main emphasis in the Taylor rule is on demand pull inflation. It will accelerate in the absence of a reaction by central banks because it is assumed that expected inflation is fully passed on actual price changes. As stressed by Serrano (2019), if this hypothesis is removed, a long run or permanent trade-off between inflation and the unemployment rate occurs as in the old versions of the Phillips curve, that is to say, before Friedman's introduction of the notion of an unemployment rate with which inflation does not accelerate. This means that we will have different "neutral" interest rates with which inflation does not accelerate and policymakers therefore have the possibility of choosing the desired pair of inflation and output gap.[12]

However, in the absence of cost push inflation, this trade-off between output and inflation would also tend to disappear since potential output tends to adjust to actual output. The presence of these autoregressive effects and non-linearities is admitted nowadays also due to the fact that recent experience contrasts with the idea of a persistent and even accelerating inflation rate when there is a fall in the unemployment rate. The usual explanations refer, however, to supply rather than demand factors: the output gap is seen to affect population participation rates and the skill and expertise of workers, as well as productivity growth when considering the Kaldor-Verdoon law. The adjustment of potential output to the course of actual output can stem, however, from productive capacity

[11]The presence of the Gibson paradox in a fiat money economy has been widely recognised in the literature on the price puzzle. For a discussion of this literature, see Cucciniello, Deleidi and Levrero (2022).

[12] Rewriting equation [1] as a backward-looking Phillips curve $\pi_t = \frac{1}{\lambda}[q_t - q_L] + h\pi_{t-1} + \epsilon_t$, assuming that cost shocks averaged out $(E(\epsilon_t) = 0)$ and h<1, we will have $\pi = \frac{[q_t - q_L]}{\lambda(1-h)}$ when the expected and actual inflation rates π_{t-1} and π_t are equal. As we will see below, the possibility of accelerating inflation would thus stem only from an increasing cost-push inflation. In its absence, we may even have a flat Phillips curve. The possibility of a non-vertical long run Phillips Curve is nowadays recognised. See, for instance, Akerlof et al (2000).

adjusting to changes in the aggregate demand as implied by the tendency of firms to achieve a normal degree of capacity utilisation through changes in business investment. This suggests that there is no exogenously given unique stable equilibrium, but a path dependent system in which output fluctuations may influence the trend of output (Summers 2014; Serrano et al 2020). Moreover, it implies that any "monetary" rate of interest that persists may become a "natural" rate of interest in a Wicksellian sense, that is, a rate that guarantees "stable prices". Therefore, if, on average, an inflation rate persists and, in some circumstances, even accelerates, this must stem from cost inflation as fuelled by conflicting claims on income distribution. As we will see below, it is in this framework that an alternative (and not mechanical) interpretation of the Taylor rule can be advanced.

5. An alternative interpretation

Two elements stemming from the analysis carried out so far must be stressed before advancing this alternative interpretation. The first is that the uncertainty over the effects of monetary policy on prices and the level of output explains why central banks usually tend to react slowly to price inflation (see Bernanke and Mishkin 1992)—what has been called their «speed limit rule». Second, it is agreed that "simple rules" neglect other factors that influence monetary policies explaining the variability over time and among countries of the central banks' reaction to inflation. These factors refer to the conditions of the financial markets and the role of the central bank as a lender of last resort, the limits imposed by the zero lower bound on monetary policy when inflation is lower than the targeted rate, the adoption in some circumstances of an activist policy to ensure full employment, and finally, the minimisation of the cost of the service of public debt.

However, we cannot overlook the fact that one concern of central banks is price stability and that references to some version of the Taylor rule to achieve this goal can be traced in their official documents over the last decades. For instance, since 1995, the Taylor rule is part of the information set of the Federal Open Market Committee. Moreover, its role as a guide for monetary policy has been shown for the Bank of England in the form of «flexible inflation targeting» especially since 1997 (see Nelson 2003; Mihailov 2006), as well as for the European Central Bank (see Peersman and Smets 1999; Gerlach and Schnabel 2000) although with greater attention to the exchange rate than in the US (Ullrich 2003).

The goal to price stability can be explained by different factors. One is the consideration of the effects of inflation on rents and fixed income. More importantly, central banks act as managers of the bank club (see Goodhart 1984) defending lenders against inflation and strengthening the international position of the domestic financial sector. In this respect, they may try to defend a targeted *real* rate of interest by reacting to higher money wages and price increases with an increase in their

policy rate. However, unlike Taylor (1993), this benchmark or targeted real rate of interest has to be recognised as a policy-determined variable which is only masqueraded by the central bankers as an objective feature of the economy. In other words, as in Keynes (1936, p. 203), it is a conventional phenomenon that capital profitability eventually adjusts to.

An alternative interpretation of the Taylor rule can be put forward by combining this idea of the monetary nature of the rate of interest (Garegnani 1978-79; Panico 1987; Pivetti 1991; Smithin 2004) with the idea of a rate of unemployment that is needed to reconcile the conflicting claims of workers and capitalists on income distribution. Some key elements are behind this alternative interpretation. First, the wage rate must be above the subsistence level because if not, an "inflation barrier" will be set up for a given technique adjusting the real interest rate to the value that is *socially viable* with the maximum rate of profit. Second, at least on average, central banks must be able to affect both the short-term and long-term interest rates by means of their bank system refinancing and open market operations (Deleidi and Levrero 2021). Third, as in several works on conflicting claims on income distribution (Rowthorn 1977; Rochon and Setterfield 2007), the rate of unemployment has to be listed as one of the elements influencing workers claims in wage bargaining together with social-institutional factors (see Stirati 2001; Levrero 2013). Finally, unlike several works on conflict distribution, the nominal mark-up of firms on unit labour costs has to be seen as depending on the nominal rate of interest fixed by the central banks rather than being independent of it or being determined by the need to raise internal funds to finance the amount of investment.

Let us assume that the targeted "surplus" real wage rate by the workers is determined by:

$$w_r^{TW} = \varepsilon_o - \varepsilon_1 U + \varepsilon_2 n^{tu} + \varepsilon_3 y^w \qquad [1b]$$

where U is the unemployment rate; n^{tu} is the trade union membership as a proxy of the workers degree of organisation; y^w is labour productivity and ε_o measures the influence of other social and political factors. Moreover, for the sake of simplicity, let us indicate the nominal mark-up with:

$$\mu = i + np \qquad [2b]$$

where *np* are the normal profits of enterprise that according to Smith and Ricardo remunerate «the risk and trouble» to make a productive investment and *i* is the *nominal* rate of interest (on long-term riskless bonds) as influenced by central banks.[13]

[13] The normal profits of enterprise are taken as uniform but usually differ among industries. They are affected by top-managers' remuneration, the degree of liquidity of productive investments in the various sectors and their "real or fancied risk". They can also embody oligopolistic elements, as affected also by the period of validity of the patents rewarding the risk and trouble of developing and applying new knowledge (Pivetti 1991, p. 32).

The first step for an alternative explanation of the Taylor rule is to clarify the effects of wage bargaining on the *real* interest rate. An one-off increase in money wages could bring about an increase in real wages since prices initially adjust to the historical costs of capital (see Pivetti 1991) and the *real* interest rate (that is the opportunity cost of any capital invested in production) will happen to be lower than the initial given nominal interest rate. However, this increase in real wages is temporary in nature if there is only an *una tantum* increase in money wages because input prices will eventually adjust to their reproduction values. A permanent change in the real wage may occur only if workers obtain *continuous increases* in their money wages (Stirati 2001), provided that the monetary authorities leave the *nominal* interest rate on long-term riskless financial assets unchanged. In this case, the real rate of profit *r* will be lower than before according to the relation $(1+r)(1+\gamma) = (1+\mu)$,[14] where γ is the money wage change rate and μ the *nominal* mark-up on prices.

More precisely, let **s** = $1_n'$ be the sum vector. Considering the price system and assuming *np* to be a percentage of gross interest (on the meaning of this "trick" see Levrero 2013), we have:

$$\boldsymbol{p} = \boldsymbol{Ap}(1+i)(1+np) + \boldsymbol{l}w \qquad [3b]$$

where (**A, l**) represents the given technique and *w* the money wage rate. Initially, the sum of prices at t = 1 $\boldsymbol{sp}_1$ relative to prices at t = 0 $\boldsymbol{sp}_o$ will be:

$$\frac{\boldsymbol{sp}_1}{\boldsymbol{sp}_o} = \frac{\boldsymbol{sAp_o}(1+i)(1+np)+\boldsymbol{sl}w_o(1+\gamma)}{\boldsymbol{sAp_o}(1+i)(1+np)+\boldsymbol{sl}w_o} = 1+\gamma\frac{W_o}{Q_o} \qquad [4b]$$

where Wo/Qo is the wage share *on gross product* at time t = 0 and γ is the rate of change of money wages. It follows that:

$$\frac{\boldsymbol{sp}_1}{\boldsymbol{sp}_o} - 1 = \frac{\Delta p}{p} = \gamma\frac{W_o}{Q_o}$$

and real wages increase by:

$$\frac{dw_r}{w_r} = \frac{dw}{w} - \frac{dp}{p} = \gamma\left(1-\frac{W_o}{Q_o}\right).$$[15]

As said above, this increase will be temporary in nature if there is only a one-off increase in money wages. However, if wages increase *continuously* over time and the monetary authorities leave the *nominal* interest rate unchanged, there will be a permanent increase in the real wage and a fall in

[14] Unlike the New-Keynesian models, here the real mark-up is the *result* of the nominal mark-up and the inflation rate.
[15] We abstract here from the fact that the increase in money wages may not be uniform across sectors and that in the short-run the market prices may diverge from the natural ones for factors other than the initial adjustment to the historical costs of capital.

the *real* interest rate $i_r \cong i - \frac{\Delta p}{p}$. This increase in real wages, namely the fall in the prices-to-money wage ratio, will only not occur if monetary authorities increase the nominal rate of interest to maintain a targeted *real* rate of interest i_r^T, namely, if they set *i* with the relation

$$(1 + i) = (1 + i_r^T)(1 + \gamma). \qquad [5b]$$

The second step for an alternative explanation of the Taylor rule is to consider that an "aspiration gap" can arise (see Rowthorn 1977) between the central banks' goal and workers' claims, thus determining a wage-price spiral. Let us suppose that workers and their organisations react to the rise in the nominal rate of interest which has kept the *real* interest rate at the value i_r^T by asking for an increase in money wages greater than γ in order to achieve a targeted w_r^{TW} which is greater than the rate w_r^{BC} that corresponds to the real interest rate i_r^T aimed at by the central bank, namely that:

$$\frac{dw}{w} = \Omega(w_r^{Tw} - w_r) + \gamma = \varphi \qquad [6b]$$

Let us also suppose that, after this stronger increase in money wages, the central bank reacts in turn again by setting:

$$i^* = \varphi + (1 + \varphi)i_r^T \qquad [7b]$$

Under these conditions, there will be increasing inflation.

Figure 2 shows the line WWC of the real wage rates claimed by workers for different unemployment rates according to [1b], and the line CBW of the real wage corresponding to the real interest rate targeted by the central bank

$$\frac{w}{p} = \frac{y}{1+\mu^*} = w_r^{BC} \qquad \text{CBW} \qquad [8b]$$

where y is labour productivity and μ^* is the mark-up on prices that stems from this targeted real interest rate taken as given the normal profits of enterprise.[16] The intersection between these two curves provides us with a value of the unemployment rate that may be labelled as a non-accelerating inflation unemployment rate U_{na}. This rate is higher the higher the real interest rate targeted by central banks is or the higher the real wage claimed by workers in wage bargaining for a given unemployment rate is. On the contrary, it will be lower if an increase in labour productivity occurs.

[16] For the sake of simplicity, we use this formulation which derives from the accounting of the price as determined by the cost of labour per unit of product plus a margin that covers all other costs and profits on capital advanced in production.

If we now consider that, taking y as given, absolute prices may change for a change in the nominal wage rate w and the nominal mark-up μ,[17] namely:

$$\pi \cong \dot{w} + \dot{\mu} \qquad [9b]$$

and that:

$$\dot{w} = \pi_{-1} + b(U_{na} - U) \qquad [10b]$$

where π_{-1} is the expected inflation rate and $\dot{w}$ = dw/w is a positive function of $(U_{na} - U)$ because according to [1b], the lower the unemployment rate U is, the greater the workers' aspiration gap $(w_r^{TW} - w_r)$, we get the relation:

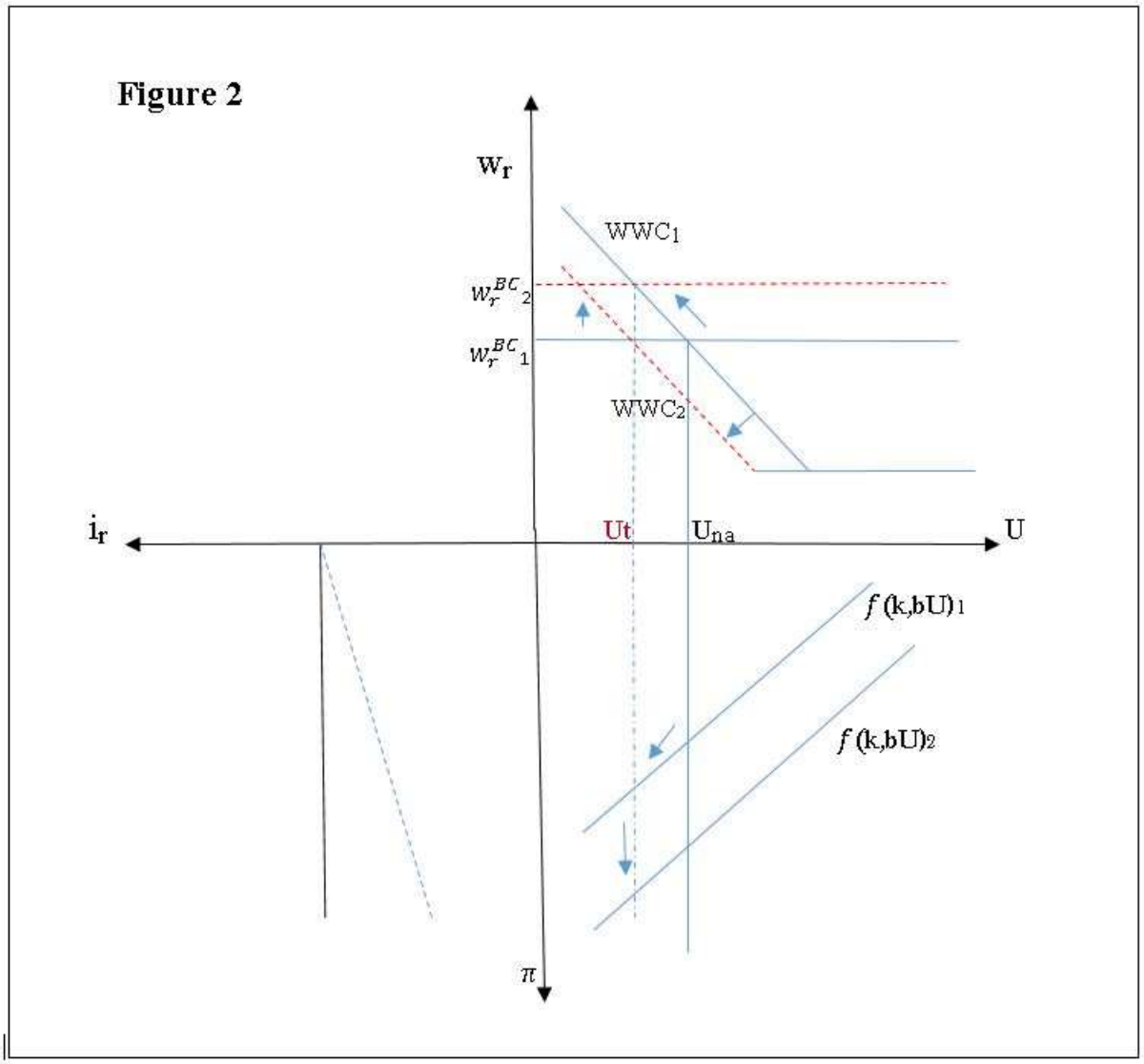
$$\pi_t = h + \pi_{t-1} + b(U_{na} - U_t) = f(\text{k,bU})^{18} \qquad [11b].$$

According to this, when U_t is lower than U_{na}, an accelerating inflation will occur driven by the continuous increase in the nominal interest rate and the consequent growing wage demands by workers. It will only stop if the rate of unemployment rises or the central bank lowers its targeted real interest rate, or if there is a shift on the left of the curve WWC, namely if workers accept lowering their claims on income distribution (see the red line in Figure 2). The monetary authorities can be pushed to change their targeted real interest rate due, for instance, to a given inflation target and the effect of increasing inflation on real savings, fixed incomes and the external constraint. For their part, the workers and their organisations may reduce their targeted real wage rate for each unemployment rate due to the negative effects of inflation on the real earnings of the less organised workers and other sectors of society as well as the fear that restrictive fiscal and monetary policies will be implemented. In turn, the actual implementation of these policies will lower workers' claims due to the consequent increase in the rate of unemployment (a movement along the WWC curve), as well as because this increase will affect the workers' degree of organisation and the social-political context (a shift in the WWC curve). It is also worth noting that the «average real wage» will be influenced by the "reaction functions" of workers and central banks, namely, by the speed with which wage bargaining adjusts nominal wages and central banks change the nominal rate of interest. It will also be influenced by the

[17] Two cases correspond to $\dot{\mu}>0$. The first pertains to the adjustment in the nominal rate of interest needed to leave the real interest rate unchanged when a continuous increase in money wages occurs. The second case concerns "autonomous" changes in the nominal mark-up on prices. This will lead to one-off increases in prices that are greater than money wages, and therefore to a rise in the prices-to-money wage ratio.

[18] The parameter h could also reflect changes in factors affecting the bargaining position of workers other than the unemployment rate. However, these factors already affect the "aspiration gap" and therefore the value of the unemployment rate U_{na}. This gap, together with the expected inflation rate by workers π_{t-1}, affects the increase in money wages during the time period t. In turn, the latter and the value of h affect the inflation rate in t.

speed with which firms pass the increase in the nominal mark-up onto prices. Of course, an increase in labour productivity or an improvement in the terms of trade[19] can help to reduce the distributive conflict by determining a higher real wage rate w_r^{BC} for the same i_r^T.



These last remarks show that U_{na} must not be interpreted as an "equilibrium" rate as in the new-Keynesian models and is not in contrast with what was argued at the end of Section 4. Indeed, since central banks do not usually speedily adjust the nominal interest rate and their "targeted" real interest rate is influenced by several factors, different (average) unemployment rates will be able to avoid accelerating inflation, determining a long-run trade-off between unemployment and wage inflation which is similar to the one originally advanced by Phillips. The "non-accelerating inflation unemployment rate" only shows the unemployment rate that is "structurally" needed to ensure, for a

[19] The analysis carried out so far refers mainly to a closed economy but can easily be extended to an open economy taking into account the effects on domestic prices of changes in the exchange rates.

given degree of workers' organisation, a stable inflation rate and a certain *real* interest rate *when it is pursued* by the Central Bank. It is also compatible with the recent flattening of the Phillips curve which is the result of "traumatized workers" and their weakening in wage bargaining.

As the result of workers' strength in wage bargaining and the objectives of monetary authorities, different *monetary regimes* can be identified in this framework. Gradualism in the reaction of central banks to price inflation and low average real interest rates were typical of the 1970s when monetary and fiscal policies still aimed to maintain low unemployment rates, also under the pressure of workers' organisations. In some cases, such as in Germany, it materialised in a cooperative game or corporative regime where income and industrial policies guaranteed a low inflation rate compared with those prevailing in other countries. "Cold turkey" occurred, on the other hand, in the 1980s with a sharp rise in interest rates and the adoption of restrictive fiscal policies.

With these caveats in mind, the rationalisation of wage bargaining in terms of the "aspiration gap" combined with inflation targeting by the Central Bank may lead to a reaction function which is formally similar to the one advanced by Taylor but different in its economic meaning. Assume that, for a certain degree of workers' organisation, the unemployment rate is too low to ensure a targeted real interest rate $i_r^T = r_T$ as well as a stable targeted inflation rate. The Central Bank may try to fulfil these goals by raising the nominal interest rates. Specifically, an increase in these rates must not only be able to "defend" the targeted real interest rate, but also ensure an increase in the unemployment rate that puts workers' wage claims under control. In fact, we will only have $\Delta\pi = 0$ when $Ut = Una.$[20] Moreover, only an appropriate level of U can guarantee an inflation rate which is equal to the one desired by the central bank π^*. Therefore, the difference between the actual real interest rate pursued by the central bank and its *initial* targeted real value r_{T0}[21] and consequently, the required change Δi in the nominal interest rate, can be viewed as a function of $(U_{na} - U_t)$ and the difference between the actual inflation rate and the one targeted by the central bank, namely a relation can be written as:

$$(i_t - \pi_t - r_{To}) = \varphi_\pi(\pi_t - \pi*) + \varphi_u(U_{na} - U_t) \qquad [12b]$$

which is a kind of Taylor rule. It also implies that, if a targeted inflation rate is to be achieved, the reactivity of aggregate demand to a rise in the interest rate must be sufficiently high (see Dvoskin and Libman 2014).

[20] In this case, in fact, there will no need to further change the nominal interest rate in order to ensure a given targeted real interest rate. Therefore, with h = 0, $\pi_t = \pi_{t-1} = \pi^a$ where π^a is the expected inflation rate.

[21] The pursuit of a higher real interest rate may affect the workers' "aspiration gap" and therefore the same process towards the targeted inflation rate which ultimately rests on the direct and indirect effects of a higher unemployment rate on workers' bargaining power and on what is the *final* targeted real interest rate by the central bank.

There are three essential differences between this relation and the "New-Keynesian" Taylor rule. The first is that here the main concern is cost-push inflation. Indeed, changes in the degree of utilisation of productive capacity do not usually imply *per se* a change in the inflation rate.[22] Second, the targeted real interest rate is not determined by real factors as in the New Consensus models, but is a policy-determined variable. Of course, the monetary authorities do not decide their policy rates in a vacuum. They will take the course of money wages and the conditions of the labour and commodity markets into account. The rate targeted by the central bank does not ensure, however, any optimal configuration of the economy and its changes affect income distribution and the number of unemployed workers. Finally, the sensitivity of aggregate demand to the rate of interest can be low and varies according to circumstances. This is the reason why a change in the sign of monetary policy is often accompanied by fiscal policies that move in the same direction.

6. Conclusions

With regard to the Taylor rule Bernanke (2015, p. 2) observed:

> «Originally John did not seem to believe that this eponymous rule should be more than a general guideline. Indeed, in his 1993 article, he took pains to point out that a simple mechanical rule could not take into account the many factors that policy makers must consider in practice».

Among these factors, there is the effect on financial market stability of unexpected changes in the rates of interest. Moreover, central banks take into account the effects of their policies on prices and income distribution, the balance of payment, the conditions of the bank system and the cost of the service of public debt. This explains why they do not necessarily react to short-lived demand-pull inflation stemming from deviations of capacity utilisation from its normal degree. It also explains why the "rule" does not fit the data well.

This "empirical failure" of the Taylor rule has usually been interpreted in terms of mistakes in the conduct of the monetary policy or uncertainty regarding the true values of some variables included in the rule. Following this path, different specifications have been advanced which, however, question any prescriptive role for the rule and acknowledge the discretionality of monetary policy. Moreover, this path overlooks the monetary nature of the interest rate and the inherent difficulties in the idea of a benchmark rate determined by "productivity and thrift" which is at the heart of the modern theory of central banking.

However, when recognising the monetary nature of the interest rate, a "structural" relation can be advanced which shows the rate of interest that the central bank should pursue in order to achieve a targeted inflation rate. It is based on the idea of an unemployment rate which is needed to ensure,

[22]Lavoie (2014) calls it the Post-Keynesian Phillips Curve.

for a given degree of workers' organisation, a stable inflation rate and a certain *real* rate of interest *when this is aimed at* by the Central Bank. In this framework, the reaction of central banks to price inflation is not seen as the way in which they try to adjust the actual growth rate of the economy to the normal one but can affect the growth trend of the economy and is part of the process in which income distribution is eventually determined.

Following the classification by Rochon and Setterfield (2007) between an activist and a parking-it approach to monetary policy, this view departs from any "short run" monetary policy *rule* that mechanically aims to "lean against the wind."[23] However, while sharing the emphasis on the distributive effects of the monetary policy with the parking-it approach, it also departs from the latter because no attempt is made to define the "proper" value of the long-run rate of interest to be set by the central banks. The rate of interest is assumed to be the result of their objects and constraints as influenced by institutional and social-economic factors.

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[23] This explains the reference to different "monetary regimes" and time periods with several wage bargaining rounds. Of course, in the short run, the central banks change their short-term interest rates according to their ultimate goals. However, these goals may conflict and there may be uncertainty over the future state of the economy and the responsiveness of output to changes in interest rates.

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