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The Taylor Rule and its Aftermath: Elements for 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 price inflation. After an overview of the origin and use of the Taylor rule, the paper stresses some difficulties in its implementation according to the modern theory of central banking and the limits of its interpretation by the New Consensus models. Finally, an alternative interpretation of this rule along Classical-Keynesian lines is advanced. In this context, it has to be interpreted, as it is in actual fact, as a flexible and non-mechanical benchmark for monetary policies which are seen to affect income distribution between wages and profits.

Keywords: Monetary policy; Taylor rule; Cost-push inflation

JEL Code: E11; E12; E52; E58

1. Introduction

Over the last two 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 (Woodford, 2003) 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. In this framework, the reaction of central banks to price inflation by changing their policy interest rates on the basis of the Taylor rule would ensure that the economy moves on average along a path of full utilisation of resources and of price expectations which are anchored to the inflation target of the central bank. On the contrary, discretionary monetary policies would be associated with price instability and long-run inefficiencies.

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 price inflation when following an approach that differs from the New Keynesian models. Sections 2 and 3 provide an overview of the origin and use of the Taylor rule in the form advanced by the modern theory of central banking and stress some difficulties in its implementation by central banks. We then move on in Section 4 to underline some limits of its interpretation by the New Consensus models. Finally, in Sections 5 and 6, some arguments for an alternative interpretation of the Taylor rule along Classical-Keynesian lines are advanced. In this context, 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 income distribution between wages and profits.

2. The origin and use of the Taylor rule

Before Taylor (1993), in order to achieve specific policy targets, several rules for central banks were advanced in terms of monetary aggregates or interest rates (see Asso, Kahn and Leeson, 2007). Considering the case of the United States, to which this analysis mainly refers, the most famous previous monetary rules were those advanced by Snyder (1935), Simons (1936), Friedman (1960)[1] and McCallum (1988). Here, emphasis was placed on the control of monetary aggregates (see Orphanides, 2003).[2] In particular, starting from the equation of exchange according to which

$$\frac{\Delta m}{m} + \frac{\Delta v}{v} = \frac{\Delta p}{p} + \frac{\Delta q}{q}$$

Simon proposed changing the money supply m in order to stabilise the price level p or a certain targeted rate of inflation π^* in response to cyclical changes in the velocity of money circulation v and the real output q. Alternatively, based on the assumption that v is relatively stable and q tends to its potential value, both Snyder and Friedman proposed the "simple rule" of an increase of k-per cent in money supply in order to stabilise price inflation. Finally, with the same goal, McCallum proposed changing the monetary base in response to changes in the velocity of circulation of money and in the gap between the

[1] On Friedman's previous proposals based on automatic stabilisers and full reserve banking, see Levrero (1999).

[2] Influenced by the works of Wicksell and Keynes, there was more emphasis on setting of the interest rates in the United Kingdom and other European countries. Also in the United States, however, several studies before Taylor (1993) analysed the elements influencing the rate of interest set by the Federal Reserve. See, for instance, Dewald and Johnson (1963), Christian (1968) and Fair (1978), who regressed the Treasury bill rate or other short-term interest rates on variables such as their previous values, the real income, the unemployment rate, the deficit of the balance of payment, the inflation rate and the stock of money. According to Taylor and Williams (2011), these works were "descriptive" in nature rather than prescribing an optimal rule for central banks. The limits of this criticism will be apparent in the following sections.

nominal income z = pq and its planned value z* — with a coefficient of reaction equal to 0.5.

As a result of the work of Bryant, Hooper and Mann (1993), slightly earlier than Taylor (1993), a rule similar to that advanced by McCallum was proposed by the Brooking Institution according to which

$$i - i^* = \vartheta(z - z*).$$

However, unlike McCallum, this rule referred directly to the rate of interest rather than to money supply and prescribed to change the nominal interest rate i in response to discrepancies between the actual and targeted nominal income. If q is equal to potential output and i^* is interpreted as the nominal interest rate corresponding to the Wicksellian natural rate taking as given the expected rate of inflation (possibly equal to zero or constant over time), the rule is a kind of Wicksell's rule: price changes stem from discrepancies between the market and natural rate of interest and come to an end by changing the rate of interest, namely, when following the rule

$$\Delta i = \theta \Delta \pi$$

where π is the inflation rate.[3]

If, however, considering changes in z, a targeted inflation rate is introduced and q is assumed to fluctuate around a "targeted level" q_n identified with potential output, the Brooking Institution rule, where i is the policy instrument, can be changed into the rule

$$i - i* = \vartheta_\pi(\pi - \pi^*) + \vartheta_q(q - q_n)$$

which is similar to the "hypothetical but representative policy rule" advanced in Taylor (1993) in order to describe the behaviour of the Federal Reserve. Taylor's original rule was in fact

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

where $i^* - \pi = r^* = 2\%$ is the average real interest rate which is observable over a long-time horizon; $\pi^* = 2\%$ is the targeted inflation rate; $\vartheta_i = 0.5$ for $i = \pi, q$ are the reaction parameters of the central bank; $1 + \vartheta_\pi$ is the slope coefficient on inflation; $q - q_n$ is the deviation of quarterly output from its trend and π is the change in the GDP deflator.

In its original version, the Taylor 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 change the rate of interest to "lean against the wind" in the presence of

[3] If the expected inflation rate is equal to zero, the rule would be $\Delta i = \theta \Delta p$ as in Wicksell, who only prescribed changing the 'market' interest rate when the price level p changes, without any estimate of the natural rate of interest as in the more recent interest rate policy rules. Wicksell's emphasis on price inflation rather than on its *acceleration* when the rate of interest is different from the natural rate arose from the absence in his analysis of the idea of a natural rate of unemployment for which inflation does not accelerate which would imply an adjustment of expected to actual price inflation and the full passing of expected inflation on actual price changes (see Serrano, 2019).

demand shocks and a balanced approach in the presence of supply shocks. It also 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, it can be written as

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

where $di/d\pi = 1.5$. Therefore, according to Taylor, it can represent an anchor to bring the inflation rate back to its targeted level (see also Woodford, 2003).[4]

The relation of this rule with the previous ones is analysed by Taylor himself (1999) based on the assumption that *v* is a function of the interest rate. If, for the sake of simplicity, money supply is assumed to be constant or growing at a constant rate, *v* will change when *z* changes. For instance, if there is an increase in inflation, this will lead to a decrease in real money balances and a rise in the interest rate. Alternatively, if q increases, the demand for money increases and therefore the rate of interest rises. In the words of Taylor (1999, p. 325),

> a constant growth rate of the money stock, an international gold standard, an informal policy of leaning against the wind, and an explicit quantitative policy of interest rate setting, all will tend to generate positive responses of the interest rate to changes in inflation or real output […].

According to Taylor, however, different monetary regimes can be identified that correspond to different values assumed over time by the coefficients ϑ_π and ϑ_q. They were larger in the Bretton Woods and post-Bretton Woods periods than in the international gold standard era.[5] Moreover, the coefficient on real output tripled in size and that on inflation doubled in size by the period 1987-1997, thus becoming close to the values suggested by Taylor (1993). Taylor also noted that another change occurred regarding the monetary policy instrument: according to him, only in the latter 1987-1997 period, the Federal Reserve started to set the rate of interest directly rather than money supply because the elasticity of the velocity circulation of money to the interest rate became so large that the interest rate would have responded by too small an amount to an increase in output under a policy rule that targeted money supply.[6]

These changing values of the parameters ϑ_i would reflect, according to Taylor, the progressive shift from discretionary and Keynesian policies towards rules fulfilling the

[4] Without fulfilment of the Taylor principle, in the case of an exogenous interest rate, you would have hyperinflation or hyperdeflation in the presence of an accelerationist Phillips curve.

[5] Taylor also rightly emphasised that the exchange rate regime is another monetary factor to be taken into account when classifying monetary regimes. The gold standard kept the long-run inflation rate stable (possibly, equal to zero) and the same can be said of the Bretton Woods system until the early 1960s. Another factor to be taken into account is the relationship with the Treasury. In the first years after the Second World War, the overriding objective of keeping Treasury borrowing costs low led to an accommodative monetary policy. According to Taylor, only after 1951, the Fed once again needed a policy rule for conducting monetary policy, but it was influenced by the idea of a long run trade-off between inflation and unemployment.

[6] Taylor's statement can be reversed by saying that only during Volcker's period there was an attempt by the Federal Reserve to strictly control the monetary base — an attempt that could have entailed the loss of control of interest rates if it had been kept since the velocity of money was changing.

"Taylor principle" and fighting price instability.[7] To assess when and to what extent central banks follow his principle, Taylor (1999) compares the actual course of the Federal Fund Rate (viewed as the rate settled by the Federal Reserve) 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 and putting $a = r^* + \pi^a = 2\% + \pi^a$ and $\pi^a = \pi^*$, where π^a is the expected inflation rate, he estimated with the method of ordinary least squares the values of the parameters ϑ_i for $i = \pi, q$, in the equation

$$i = a + \vartheta_q(q - q_n) + \vartheta_\pi(\pi - \pi^*)$$

during the gold standard and the Bretton Woods and post-Bretton Woods eras. Finally, taking as given the expected trend rate of inflation π^* and assuming that the economy is operating at full employment (see Taylor, 1999, p. 330), he compares the monetary policy 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) according to which the nominal interest rate adjusts to different inflation rates in order to maintain a constant natural real interest rate of 2 per cent, the actual reaction parameter to price inflation of the Federal Reserve would be too low to maintain or bring the real rate of interest back to its equilibrium level. In this case, the monetary policy would be too accommodative because the increase in the inflation rate would be associated with a decrease in the real interest rate.[8]

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. According to Taylor, 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.

The fact that the original Taylor rule does not fit the data well in various periods such as the 1960s and 1970s or the 2000s is widely recognised in the literature (Orphanides, 2003; Meltzer, 2011; Poole, 2007; Rudebusch, 2006). 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, Galí and Gertler, 2000; Lubick and Schorfheide, 2004). It has also been stressed that only during the era of the Great Moderation (from the mid-1980s to the mid-1990s) the rule

[7] The values of the reaction parameters to the inflation rate and the output gap are influenced not only by the central bank's preferences but also by the lag structure in the effects of monetary policy and the "constraint" represented by the Phillips curve. See Carlin and Soskice (2005, p. 13).

[8] If the value $r^* + (1 - \vartheta_\pi)\pi^*$ 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. Note also that, according to different specifications, the actual or expected inflation rate is taken into account in order to calculate the real interest rate that must be compared with the natural interest rate.

worked well and was associated with a reduction in output and inflation volatility, both in the US and in other more industrialised countries.[9]

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 and underemployment beside 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) real rate of interest are unknown and must be estimated and that they can change over time (Kohn, 2012). Similarly, it has been maintained that the estimate results are sensitive to the central banks' reaction parameters to price inflation and the output gap, and that an independent estimate of the natural rate is needed because this rate and the inflation target are combined in the constant term of the Taylor rule and therefore, they "cannot be identified separately" (Judd and Rudebusch, 1998).

Table 1: Different specifications of the Taylor rule

The original Taylor rule	$\boldsymbol{i_t = r_n + \pi_t + 0,5(\pi_t - \pi^*) + 0,5(q_t - q_n)}$	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 & 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 & Williams (2003)
The forward looking rule	$i_t = r_n + \pi_{t+3}^{F\,core} + 0{,}5\left(\pi_{t+3}^{F\,core} - \pi^*\right) + (q_t - q_n)$	Bernanke (2003); Clarida, Galí & Gertler (1999); Orphanides & Wieland (2008)
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 & Williams (2008 and 2013)
$\boldsymbol{\pi_t^{core}}$: core inflation; $\boldsymbol{r_n^{var}}$: variable natural rate of interest; $\boldsymbol{\pi_{t+3}^{F\,core}}$: the forward core inflation; $\boldsymbol{u_{t-i}}$: the unemployment rate at time $\boldsymbol{t-1}$		

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,

[9] Meltzer (2011) and Taylor (2012) distinguished between a "rules-based era" — from 1985 to 2003 — and an "ad hoc era" from 2003 onwards and for the 1960s and 1970s. These latter eras would have been characterised by a lower degree of economic stability. For a critical analysis of this narrative, see Fontana and Palacio-Vera (2002).

the smoothing of interest rates (Clarida, Galí and Gertler, 1999; Rudebusch and Svensson, 1999; Orphanides and Wieland, 2008) 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 (Bernanke, 2003; Clarida, Galí and Gertler, 1999; Orphanides and Wieland, 2008). Moreover, a *variable* natural rate of interest that shifts its constant term over time has been considered (Laubach and Williams, 2003).

This variety of the Taylor rule questions, however, its prescriptive role and implies several difficulties for monetary policy implementation highlighting its discretionary nature.

How sensitive the results are to different hypotheses on the parameters of the Taylor rule and the measures of price 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. Contrary to what has been shown by the original Taylor rule, Bernanke 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 as variables arguing that the FFR set by the Federal Reserve would precisely reflect the rate prescribed by the Taylor rule. 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.

About 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 the difficulties that a "wide variety of simple rules" creates for the implementation of monetary policies by observing that "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 once again 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. 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 (see Levrero, 2021).

The usual interpretation of the Taylor Rule has been clarified by Greenspan in his 1993 Humphrey Hawkins testimony to the Congress: the stance of monetary policies should be judged by comparing actual interest rates with "an equilibrium interest rate", specifically the real rate level that, if maintained, would keep the economy at its production potential over time. This natural rate of interest is seen to be affected solely by real factors such as productivity growth, the growth of the workforce, the time preference of households, and movements in government expenditure, mirroring over time the dynamics of these driving forces.

The New Keynesian models are at the base of this interpretation. 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[10] 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.[11] 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. Equation [4a] is a loss function LF 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

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

[11] In the New-Keynesian models, the PC reflects the intertemporally optimal price setting decisions by monopolistically competitive firms. In an empirical application, these forward-looking relations are often substituted by backward-looking specifications in order to match the lagged and persistent response of inflation and output to monetary policy measures and the consequent empirical failure of the forward-looking PC curves (see Rudebusch, 2002).

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 π^{*} is the targeted inflation rate which, in equilibrium, must coincide with the actual and expected inflation rate $E_t(\pi_{t+1})$:

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

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

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

Even with money endogeneity, 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 was 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 would in fact adjust to the value assuring full employment and since profit expectations govern the demand for credit, the *equilibrium* value of the marginal productivity of capital would eventually shape the interest rate. 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. Therefore, the monetary policy is neutral in the long run, even if it can have effects in the short run.

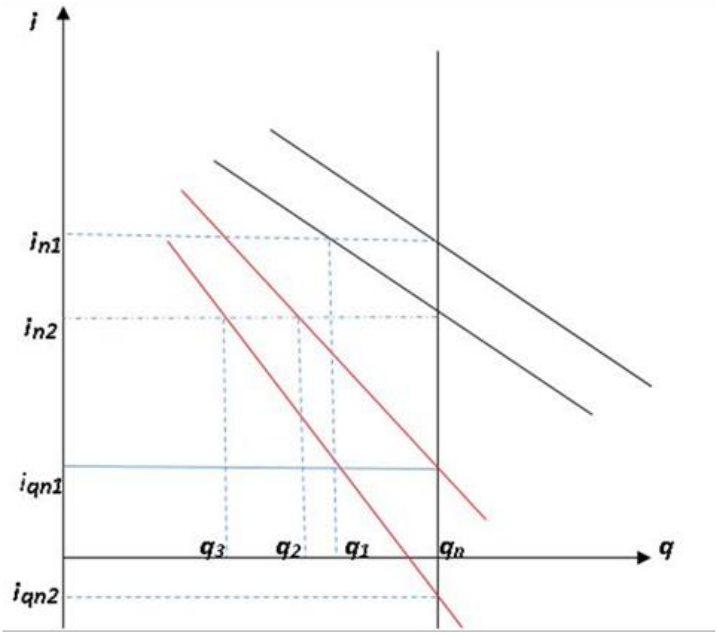
Below we will briefly deal with the loanable funds theory as criticised by Keynes. Looking at the above equations, however, a problem immediately arises for the monetary authorities. Their benchmark rate r_n should be clearly identified and computable from observable economic data but its counterfactual nature leads to a variety of estimate methods and results that recall the early criticism by Myrdal and Lindahl that Wicksell's natural rate is not an operational notion in the sense that it is incapable of practical application (see also Svensson, 2003).

Two elements undermine its operational application. First, there is the variety of its estimate methods — whose usual ones are the time series approach, the semi-structural econometric models with r_n as a latent variable, and the fully-fledged equilibrium models with microeconomic foundation[12] — that provide central banks with different benchmark rates. Second, these different methods are associated (see Curdia *et al*., 2015; Smets and Wouters, 2003; Woodford, 2003) 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 that is 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

[12] As examples of these different methods, see Hamilton *et al*. (2015); Laubach and Williams (2003); Smets and Wouters (2003).

which inflation does not accelerate when *market imperfections* are taken into consideration. In this case, central banks have the additional problem of defining and measuring these imperfections in the labour, credit and goods markets. It is for these difficulties that Blinder (1998, p. 33) stated that the natural rate of interest would be more a concept than a number, a way to think about monetary policy rather than a rule.[13]

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



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 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 indeed 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, p. 152 and p. 251). On the other hand, the work of the monetary authorities may be complicated further by the fact that the potential output may also change during the crisis which is another factor that can shift the natural rate of interest — a possibility usually neglected in the New-Keynesian models, at least until the recent 2007 crisis.[14]

[13] In his opinion, monetary authorities should estimate different models and compute the average ex post real interest rate for long time periods in order to have an idea of the stance of monetary policy assuming that lags and causal shocks average out.

[14] On this point, see Section 4 and Reifschneider, Wascher and Wilcox (2013). Another element affecting the natural interest rate is fiscal policy. With the achievement, after the 2007 crisis, of the zero lower bound for the policy nominal interest rate, this effect has not been deemed, in the New-Keynesian models, an

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 and Wieland (2016), referred to a long-run notion of the natural rate that would be in the US around 2.5–3 % (see also Hamilton *et al*., 2015) tended to criticise Fed monetary policy after 2010 for being too expansionary — a thesis that Bernanke refuted due to the absence of accelerating inflation. 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 bringing the policy rates towards zero.[15]

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 judgement on the stance of monetary policy can also be hindered by a course of the output gap and prices which is different 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, the long-run trends of output and income distribution are determined by real factors as described by the Cass-Koopmans model of dynamic optimisation. Monetary policy is seen as simply looking for a natural rate of interest in order to minimise output fluctuations. In this framework, an increase in the rate of interest should lead to a fall in aggregate demand (especially, consumption and investment) thus allowing it 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, it 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

obstacle for the implementation of the monetary policy because the ineffectiveness of the latter after the crisis has been ascribed to a *real* rate of interest that is higher than the natural one. Therefore, an increase in the expected inflation rate or a rise in the natural rate due to an expansionary fiscal policy have been viewed as a way to overcome the failures in the transmission channel of the monetary policy. However, in normal times, public deficit spending has, in these models, negative effects on private capital accumulation and leads to an increase in the natural interest rate which has inflationary effects if central banks do not forecast it correctly and fail to adjust the policy interest rate accordingly.

[15] For instance, according to Curdia (2015), the natural rate became negative after 2008, whereas the estimate of Holston, Laubach and Williams (2016) made with the semi-structural approach suggests that it approximated zero after the 2007 crisis.

income changes 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.[16] He also specified that credit is a necessary preparation for savings (see Keynes, 1939) maintaining that investments are financed by the finance process and income changes rather than by any previous saving supply.

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 (a composite commodity of different capital goods) 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 (see Pasinetti, 1966; Garegnani, 1970), 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. It also questions 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, 1978-1979).[17]

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 price inflation is challenged by several factors. First, changes in risk elements and market expectations can affect the relation between the short and long-term interest rates. Although central banks can shape on average these expectations (see Deleidi and Levrero, 2021), in the short run, changes in the short-term interest rates may not be followed by changes in the same direction in the long-term interest rates. 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 (Campbell and Mankiw, 1989; Hall, 1988; Lawrence, 1991) and investment (Chirinko, Fazzari and Meyer, 1999). Finally, the same estimates of the IS curve have been puzzling. Although Rudebusch and Svensson (1999) and Peersman

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

[17] It should also be noted that, even if the results of capital controversy did not question the neoclassical theoretical approach, the possibility of *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 (Levrero, 2021). This problem is usually avoided in neoclassical macroeconomic models by introducing specific assumptions that arbitrarily guarantee uniqueness.

and Smets (1999) found a significant negative elasticity of output to the real interest rate for the United States[18] 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.[19]

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 and residential investments.[20] 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).

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).[21] This shows a cost channel of monetary policy that can overwhelm its demand channel[22] so that, if the monetary authorities face an increase in price inflation 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

[18] For the United States, see also Fuhrer and Moore (1995).

[19] In a similar vein, it is argued that an IS curve cannot be traced in Italy and Japan.

[20] While the wealth channel is usually estimated as weak (see for instance Lettau, Ludvigson and Steindel, 2002), the housing market results as an important channel of monetary policy.

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

[22] The total effect on inflation will depend on the effect of the change in the interest rates on the exchange rate and the level of employment and hence, on money wage growth.

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.[23]

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[24] 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 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, Summa and Garrido Moreira, 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 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. Rather than a definite rule that stabilises the inflation rate leaning "against the wind," it is a "structural" relation that *in some circumstances* may steer the monetary policy.

5. An alternative interpretation

Two elements stemming from the analysis carried out so far must be stressed before advancing an alternative interpretation of the Taylor rule. The first is that the uncertainty about 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) —

[23] Rewriting equation [1a] 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 $\pi = [q_t - q_L]/[\lambda(1-h)]$ 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).

[24] It breaks down the distinction between short-lived demand shocks, on the one hand, and supply shocks on the other. A simple way to introduce these effects is that suggested by Lavoie (2006) for whom $Y_{pt} = Y_{pt-1} + a(Y_{t-1} - Y_{pt-1}) + \varepsilon$. Note, however, that the discrepancy between actual and potential output should not be temporary in nature.

what has been called their "speed limit rule" — namely, it explains why they usually leave the interest rates unchanged until inflation accelerates. Second, it is admitted that "simple rules" neglect other factors that influence monetary policies explaining the variability over time and among countries of the central banks' reaction to price 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, [25] 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.[26] The underlining of these elements is important when acknowledging that no mechanical interpretation both of the behaviour of Central Banks towards inflation and the results of conflicting claims on income distribution can be advanced.

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, albeit with a different emphasis according to their historical relationships with the financial sector and the Treasury, as well as the specific conditions of each country. For instance, since 1995, the Taylor rule is part of the information set of the Federal Open Market Committee, and in the same year Yellen used it to justify why the Federal Reserve would not have raised interest rates. 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 Mihailov, 2006; Nelson, 2003). This has also been shown for the European Central Bank (see Gerlach and Schnabel, 2000; Peersman and Smets, 1999), although with a stronger accommodative stance after 2000 (see Hofmann and Bogdanova, 2012) and greater attention to the exchange rate than in the US (see Gerlach and Kristen, 2003; 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 manager of the bank club (see Goodhart, 1984) defending lenders against inflation and strengthening the international position of the domestic financial sector as stressed by Keynes when analysing the influence of the interests of the "City of London" on the English monetary policy. In this respect, they may try to defend a targeted *real* rate of interest by reacting to money wages and price increases (see Dullien, 2004) with an increase in their policy rate as suggested by the Taylor rule. As we will see, this can fuel a wage-price spiral and be in conflict with the goal itself of price stability (at least in the short run), as well as with other objectives and constraints of central banks which are at the root of the complex process by which the monetary policy is set. However, unlike Taylor (1993), the benchmark or targeted real rate of interest of the Central Bank has to

[25] See the Japanese experience in the 1990s (Orphanides and Weiland, 2000) and after the 2007 crisis, the quantitative easing adopted by the Federal Reserve and the European Central Bank.

[26] The weights of these different goals are influenced by historical circumstances and also by the institutional setting of central banks — for instance, by the presence of Government representatives on their board as in the case of the Bank of Japan or by internalising a dual mandate of price stability and full employment.

be recognised as a policy-determined variable which is only masqueraded by the central bankers as an objective feature of the economy (Lima and Setterfield, 2008; Levrero, 2021). In other words, as in Keynes, it is a conventional phenomenon[27] 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, 1978-1979; 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, given other elements influencing their respective bargaining power. 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 (Hein and Schoder, 2011; Rochon and Setterfield, 2012; Rowthorn, 1977; Stockhammer, 2008), 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 Levrero, 2013; Stirati, 2001). 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 thus assume that the targeted "surplus" real wage rate by the workers is determined by

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

where U is the unemployment rate;[28] n^{tu} is the trade union membership as a proxy of the workers degree of organisation; y^w is labour productivity[29] and ε_o measures the influence of other social and political factors.[30] Moreover, for the sake of simplicity, let us indicate the nominal mark-up with

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

[27] As stated by Keynes (1936, p. 203), the actual value of the interest rate "is largely governed by the prevailing view as to what its value is expected to be. Any level of interest which is accepted with sufficient conviction as likely to be durable will be durable; subject, of course, in a changing society to fluctuations for all kinds of reasons around the expected normal." According to Keynes, this "expected normal" is influenced by the monetary policy when coherent over time.

[28] More generally, labour unemployment and underemployment should be taken into account.

[29] This means that workers aim to receive a higher wage rate in the presence of higher labour productivity.

[30] A condition can be added that w_r^w cannot fall below the subsistence wage when the unemployment rate increases (which is implicit if w_r^w refers only to the surplus wage).

where np are the normal profits of enterprise that according to Smith and Ricardo remunerate "the risk and trouble" to make a productive investment[31] and i is the *nominal* rate of interest (on long-term riskless bonds) as influenced by central banks. As a further simplification, the normal profits of enterprise are taken as given and there is no change in labour productivity.

The first step for an alternative explanation of the Taylor rule is to clarify the effects of wage bargaining on the *real* interest rate. A 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 a *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 in fact be lower than before according to the relation $(1+r)(1+\gamma)=(1+\mu)$,[32] where γ is the money wage change rate and μ the *nominal* mark-up on prices.

More precisely, let $\mathbf{s}=1_n'$ be the sum vector. Considering the price system and assuming np to be a percentage of gross interest (see Levrero, 2013), we have

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

where $(\boldsymbol{A},\boldsymbol{l})$ 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 W_o/Q_o 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

$$\frac{dw_r}{w_r}=\frac{dw}{w}-\frac{dp}{p}=\gamma(1-\frac{W_o}{Q_o})^{33}$$

[31] The normal profits of enterprise usually differ among industries and are affected by the top-managers' remunerations and the degree of liquidity and the "real or fancied risk" of productive investments in the various sectors. 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).

[32] In the New-Keynesian models the Fisher equation states that the nominal interest rate must adjust if there is a change in the expected price inflation in order to ensure a real interest rate equal to the marginal product of capital. Here, on the other hand, the real mark-up is the *result* of the nominal mark-up and the inflation rate.

[33] 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.

As said above, this increase will be temporary in nature if there is only a one-off increase in money wages.[34] If it is *continuous* over time, it will lead to a permanent increase in the real wages to the level corresponding to the real interest rate $i_r \cong i - \frac{\Delta p}{p}$, which is lower than before if the monetary authorities leave the *nominal* interest rate unchanged. 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

$$(1 + i) = (1 + i_r^T)(1 + \gamma).^{35} \qquad [5b]$$

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^T 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

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

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

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

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.[36] 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

[34] The increase in the input prices will eventually leave the prices-to-money wage ratio unchanged.

[35] As you can see by substituting in [4b] $(1 + i)$ with $(1 + i_r^T)(1 + \gamma)$, if the nominal interest rate increases simultaneously with the money wages, the real wage rate remains unchanged even before the adjustment of input prices towards their reproduction values, namely $\boldsymbol{sp_1/sp_o} = w_1/w_o$. After this adjustment, in the case of a one-off increase in money wages, you will have a higher price-to-money wages ratio; otherwise, with a continuous increase in money wages, a constant price-to-money wage ratio will be obtained.

[36] 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.

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.

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,[37] 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 $(w_r^w - w_r) > 0$,we get the relation

$$\pi_t = h + \pi_{t-1} + b(U_{na} - U_t) = f(k, b, U).^{38} \qquad [11b]$$

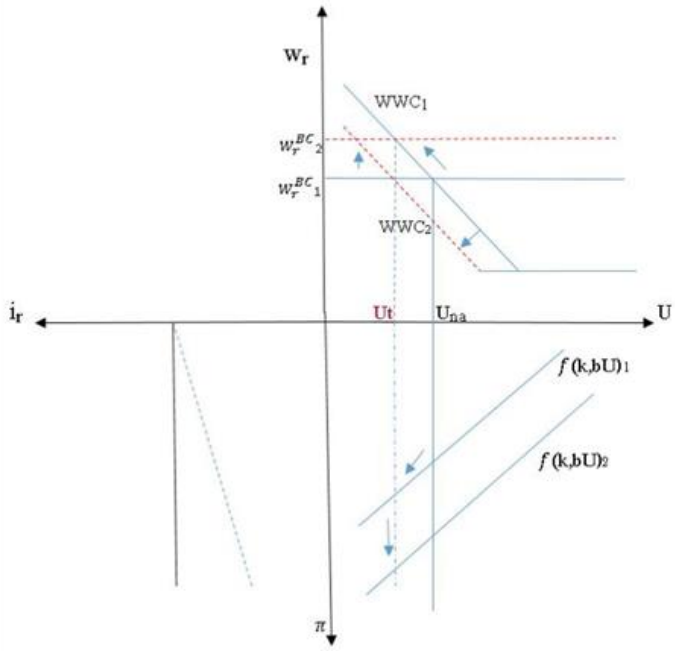
According to this, when U_t is lower than U_{na} an accelerating inflation will occur due to the continuous increase in the nominal mark-up driven by the increase in the nominal interest rate and the consequent growing wage demands by workers. It will only stop if the rate of unemployment rises or the 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 price 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 pursuing lower inflation rates 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. In particular, it will be higher the lower the speed with which central banks defend their targeted real rate of

[37] Two cases correspond to $\dot{\mu} > 0$. The first pertains to the one-off adjustment in the nominal rate of interest needed to leave the real interest rate unchanged when a continuous increase in money wages occurs at a certain growth rate. The second case concerns "autonomous" changes in the nominal mark-up on prices. These 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.

[38] The parameter h could also reflect changes in factors affecting the bargaining position of workers other than the unemployment rate. However, the influence of these factors on the course of money wages is already taken into account by their influence on 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 wage during the time period t. In turn, the latter and the value of h affect the inflation rate at time t.

interest and the lower the speed with which firms pass the increase in the nominal mark-up onto prices.[39] Of course, an increase in labour productivity or an improvement in the terms of trade can help to reduce the distributive conflict. This would determine a higher real wage rate w_r^{BC} corresponding to the same real interest rate targeted by the central bank.[40]

Figure 2: Conflict inflation and the "structural" unemployment rate



These last remarks suggests that the non-accelerating inflation unemployment rate must not be interpreted as an "equilibrium" unemployment 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 may 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 given degree of workers' organisation, a stable inflation rate and a certain *real* interest rate *when it is aimed at* by the Central Bank. It is also compatible with the recent flattening of the Phillips curve which is the result of

[39] Here, we do not consider the possibility that firms leave their nominal mark-up unchanged which would imply a fall in the normal profits of enterprise. An asymmetry may exist in this respect when considering an increase or decrease in interest rates.

[40] The wage rate w_r^{BC} is also affected by a change in the normal profits of enterprise due to a change in the elements outlined in note 31. Central banks also take into account these changes and their effect on capital accumulation and can be forced to change the average stance of the monetary policy especially when those elements tend to drive the actual real wage rate towards the subsistence level for relevant sectors of the working population.

"traumatized workers" and their weakening in wage bargaining, implying a change in the parameters of relation [1b] and therefore a scant reactivity of wages and prices to changes in the unemployment rate.[41]

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 was 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 shifted the Phillips curve and the real wage rate targeted by the trade unions and the monetary authorities, thus guaranteeing 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 the nominal rate of interest 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 an 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 $i_r^T = r_T$ together with a stable targeted inflation rate. The Central Bank may try to fulfil these goals by raising the nominal interest rates. Specifically, its increase 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, only when $U_t = U_{na}$, we will have $\Delta\pi = 0$.[42] 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}[43] 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 and the "Taylor principle" should be satisfied, i.e., the change in the nominal

[41] For an admission at the Central Bank level of the relevance of the erosion of worker bargaining power in explaining the flattened Phillips curve in the last decade, see Ratner and Sim (2022).

[42] 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.

[43] 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.

interest rate must be associated with a change in the real interest rate (see Dvoskin and Libman, 2014).[44]

There are, however, three essential differences that must be stressed with regard to 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.[45] Second, the targeted real rate r_T is not determined by real factors as in the New Consensus models but is seen as a monetary phenomenon. 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 changes in it may lead to different unemployment rates, namely, the monetary policy is not neutral but affects income distribution and the number of unemployed workers.[46] 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 moving in the same direction, that is, the former operates as a signal for the stance of the latter.[47]

6. Conclusions

About 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

[44] As outlined in Section 4, these two conditions cannot occur and the monetary authorities, in the absence of a coordination with fiscal policies, can be forced to accept a change in the real interest rate.

[45] Lavoie (2014) calls it the Post-Keynesian Phillips Curve and expresses it as $\pi = a(k - k_m) + b(k - k_f) + \pi_n$, where k indicates the degree of capacity utilisation and π_n the "normal" inflation rate within a certain output range. We have $a = 0$ for $k > k_m$; $a > 0$ for $k < k_m$; $b = 0$ for $k < k_f$; $b > 0$ for $k > k_f$. So, for $k_m < k < k_f$, π is constant.

[46] Moreover, a range of inflation rates and nominal interest rates may correspond to the same real interest rate so that income policies can help to achieve a desired inflation rate. On the other hand, equality between U and U_{na} does not ensure an inflation rate equal to the one targeted by the central bank. On average, a lower inflation rate may require a higher unemployment rate or a lower real interest rate targeted by the central bank, or an appropriate change in price expectations of workers and firms.

[47] Such elements also conflict with those "alternative" interpretations of the Taylor rule where it has only a "stabilising role" and the rate of profit (and thus the "natural" rate of interest) is determined by the wage rate and the technical conditions of production as in Ricardo, or by a given "degree of monopoly" (see Dumenil and Levy, 1999; Franke, 2017; Stockhammer, 2008). For a criticism of Dumenil and Levy, see Kriesler and Lavoie (2005). As regards Stockhammer's model, monetary policy is not neutral because the natural employment rate can change during the convergence process towards it due to a change in the workers' reserve wage under the assumption of an inverse relationship between wages and employment. However, no solid basis exists for this inverse relation as shown by the capital debate of the 1960s.

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[48] 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 been usually interpreted in terms of mistakes in the conduct of the monetary policy or uncertainty over the true values of some variables included in the rule. Following this route, different specifications of the rule have been advanced which question its prescriptive role and acknowledge the discretionality of monetary policy. Moreover, this overlooks the monetary nature of the interest rate and the inherent difficulties in the idea of a benchmark rate for the monetary policy 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" and not mechanical relation can be advanced, showing the rate of interest that central bank should pursue in order to achieve a targeted inflation rate. It is based on a long-run non-vertical Phillips curve and the idea of an unemployment rate which is needed to ensure, 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 is part of the process in which income distribution is eventually determined and can affect the growth rate of the economy.

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[48] In crisis situations, central banks can be guided to lower the interest rates also by the need for debt restructuring, thus avoiding an increasing amount of non-performing loans (see Brancaccio and Fontana 2013).

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