Texto para Discussão 017 | 2018

Discussion Paper 017 | 2018

The (dampened) wage-price spiral: conflict, endogenous markups and inflation

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November, 2018

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Abstract

We develop an inflation model in which firms' desired markups are determined through a bargaining between employees and employers, whose outside option is the interest rate on costs - that is, the interest rate is an opportunity cost for investing production through employing labor and, thus, becomes a source of markup shock. Firms set a nominal price targeting this real desired markup but only some firms are able to fully protect real profits from expected inflation. Nominal wages are determined by an indexation to expected inflation coefficient, autonomous wage pressures and unemployment level. Endogenously, real profits, real wages and inflation are determined. Outcomes will differ with respect to the possibility of permanent changes in distribution and which economic regime will prevail: 'accelerationist' or steady-state inflation. The objective is understanding the relation between the wage inflationary structural pressure, real profits and price inflation and answering the following questions: do wages growing above productivity cause steady-state inflation or accelerating inflation? Do real profits return to any equilibrium level? Does exist a NAIRU?

1 Introduction

In this paper, we develop a model in which conflictual and inconsistent claims between workers and firms through nominal wages and prices is shown to be the general cause of inflationary pressures. Desired markups are determined through a bargaining between firms and workers. Firms' outside option is the interest rate on costs – i.e., the interest rate is an opportunity cost for investing in production employing labour. Nominal outcomes, however, are not necessarily consistent with the desired bargained markup target. Through nominal wage setting, workers will target a real wage that is not in general consistent with the bargained outcome. On the nominal price setting side, firms will target their desired markup, determined by the bargaining outcome, by taking into account the *expected* variation of inflation, but only some will be able to protect their target real profitability completely to inflation.

Due to these inconsistent and conflicting nominal claims, inflation occurs. The size of the real product is not enough to make all income earners satisfied, because the different parts ask, in nominal terms, for an amount of product that in real terms is not feasible to make all the claims consistent. Inflation is the outcome of this struggle, making compatible nominal and real claims [Rowthorn, 1977, Tobin, 1981, Lavoie, 2014].

The model determines endogenously real profits, real wages and inflation. In general, the real outcome will be neither firms desired markups nor workers' desired real wage growth, but a middle position between both. The main cause of positive inflation, as will be argued, is the growth of nominal wages exceeding labour productivity due to structural factors (i.e., non-cyclical factors), if indexation of nominal wages is not complete. In this 'regime' the model may generate pro-cyclical real wages and a non-'accelerationist' Phillips Curve. The 'accelerationist' regime will be shown to be a particular case of the model.

The main novelty of the present model compared with other articles in the conflict inflation literature is the fact that, rather than supposing that real profits do not change or that they change only due to price rigidity, the control variable of the firms here is the adjustment of the nominal mark-ups to changes in costs, in line with studies on industrial price setting. A second contribution of the present study is modelling the desired markup

by firms as the outcome of a bargaining between firms and workers, introducing the risk-free interest rate as an outside option for firms.

2 Stylised facts

Inflation has traditionally been understood in economic theory as a purely nominal ("monetary") phenomenon. In classical economics, technology and the socially determined real wage bundle alone are sufficient to determine relative prices, real wages and real profits. Money, normally a synonym for gold, determines only absolute prices and wages, without any permanent effect on the distribution and size of the net product.

In neoclassical economics, a similar result is obtained: supply and demand schedules – derived from the technology set, preferences and endowments of production factors – determine relative prices and relative quantities produced. In the absence of nominal rigidities on wages and prices, money will only determine absolute prices and wages but will have no influence on relative prices and quantities. The national product also is not affected, since it will be the one correspondent to full employment of production factors. Persistent inflation is always a purely monetary phenomenon. Real wages and profits are determined by a 'purely real' theory – classical theory of value or general equilibrium theory – with a completely passive role for nominal variables that simply adapt in order to generate the theoretically determined real variables.

Since Keynes's seminal contribution to the theory of output determination, the idea that nominal variables play a purely passive role has been challenged. In Keynes's view, workers negotiate nominal wages in order to keep relative wages constant across different groups of workers. Effective demand determines output and employment, and the neoclassical labour demand function will determine, endogenously, the real wage. After Keynes [1936], traditional macroeconomics has absorbed the Phillips curve – an empirical relation between the growth rate of nominal wages and unemployment pointed out by Phillips[1956] – as one of its main building blocks, consolidating the importance of nominal wages as a fundamental variable.

However, the supply and demand explanation for employment and real wages has never been abandoned in the macroeconomic literature and its coexistence with the Phillips Curve has always been a conflictual relation. More traditional 'real theories' of the labour market quickly substituted the Keynesian elements of the orthodoxy of the profession. In

fact, the so-called 'non-accelerating inflation rate of unemployment' (NAIRU) is nothing but the denial of any relevant role for nominal wages.

Nominal "frictions" – either price or wage rigidities, depending on the model – generate non-neutrality of money in the short run such that real output and unemployment can deviate from their supply and demand determined levels. In this case, excess aggregate demand over the purely supply determined equilibrium output and unemployment will cause 'acceleration' of inflation. Only at the equilibrium level of output and unemployment will inflation be stable. It is not surprising that although originally presented in a neoclassical context, this idea has been also derived from models in which the labour market is not in full employment [Gylfason & Lindbeck, 1984, Layard, Nickell & Jackman, 1991, Galí, 2011]. Notwithstanding its different foundations, the NAIRU is still a core element of orthodox macroeconomics.

According to the Quantity Theory of Money (QTM), the growth rate of money supply above the growth rate of potential output should be the cause of inflation in the long run. That is, an increase in *x*% of money supply (above the potential output) should cause an increase of approximately *x*% on prices. In Fig. 1 and 2 we can see the empirical correlations predicted by the QTM for the United States. Shaded areas represent the recessions according to the definition of the National Bureau of Economic Research. Since QTM does not say which monetary aggregate represents money, both M1 and M2 correlations are presented.

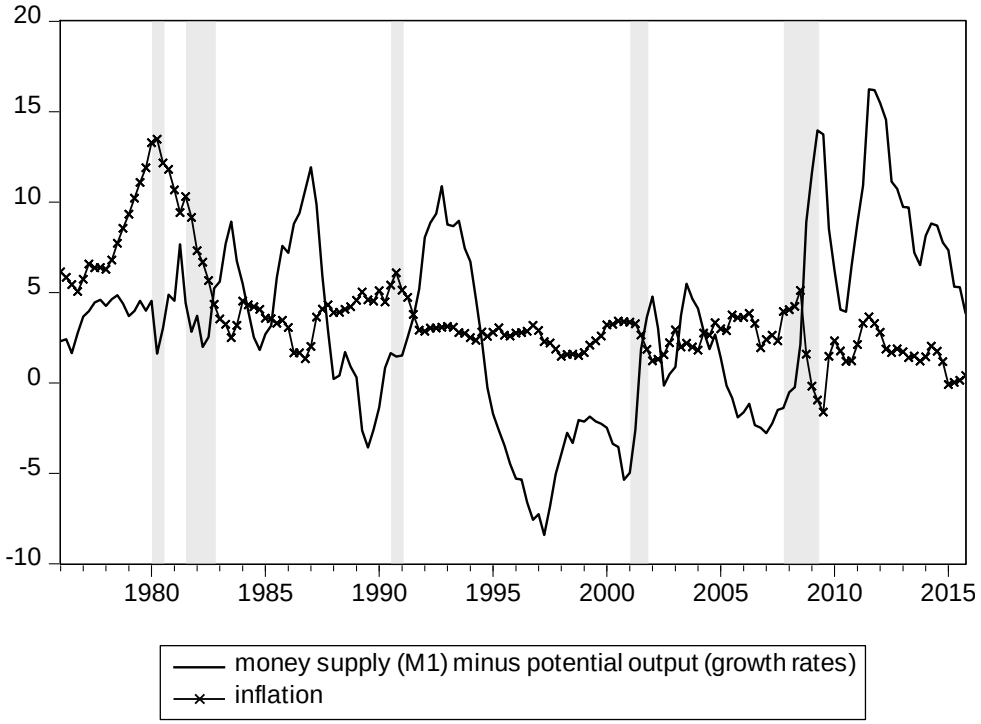

Fig. 1: Inflation and Money Supply (M1)

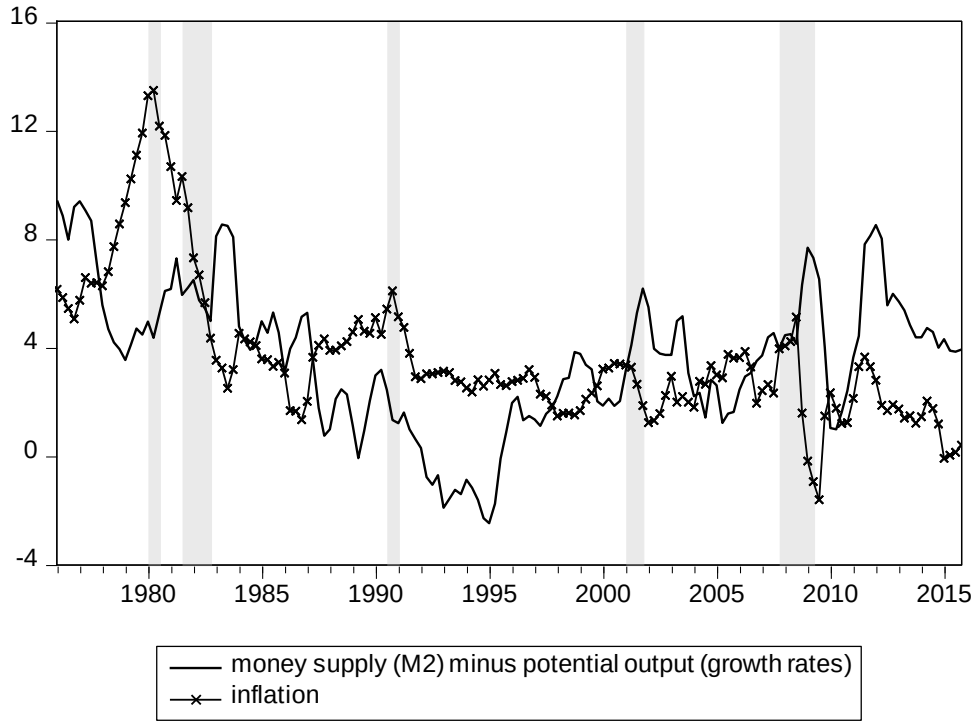

Fig. 2: Inflation and Money Supply (M2)

As the reader can see either from the M1 evidence and M2 evidence, the QTM correlations do not track very well the inflation series[1]. This lack of correlation is especially striking for the post-2008 period. No relevant differences emerge from the M2 series, as we can see from Fig. 2.

The theories based on the idea of a (unique) 'non-accelerating inflation' activity level state that there is only one activity level (unemployment rate or real output level) that is consistent with a stable rate of inflation. In the case of using unemployment to represent the aggregate activity level variable, this equilibrium level is the NAIRU. If the unemployment rate is permanently below the NAIRU we should observe increasing rates of inflation ("accelerating inflation"), in the case of unemployment above the NAIRU for many periods, we should observe decreasing inflation or cumulative deflation ("accelerating disinflation"). In Fig. 3, we can see the unemployment gap[2] and inflation series, which corresponds to the NAIRU correlation described above.

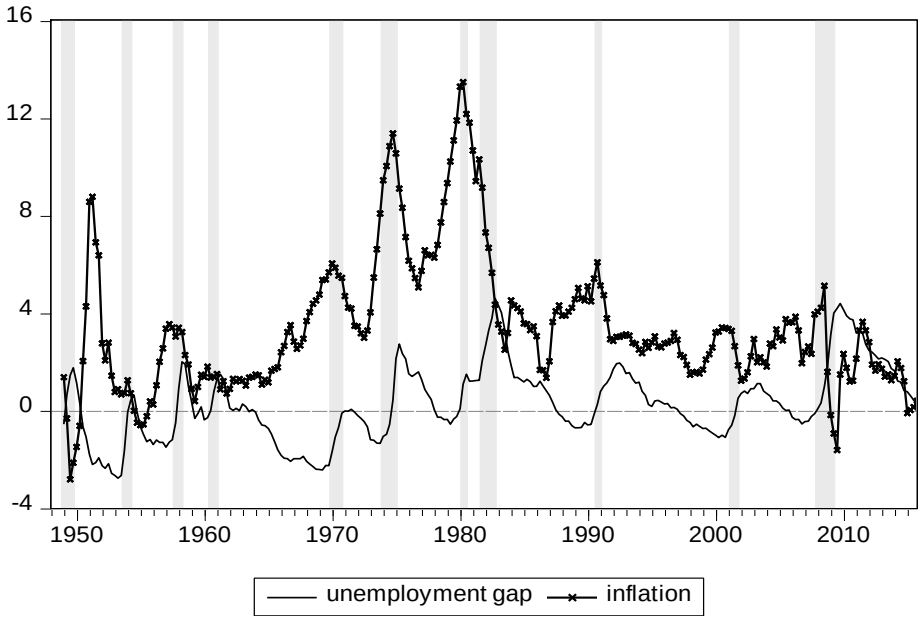

Fig. 3: Inflation and Unemployment gap

[1] As pointed out by De Grauwe & Polan [2005, p. 257] with respect to US and other low inflation countries, "inflation and output growth seem to be exogenously driven phenomena, mostly unrelated to the growth rate of the money stock."

[2] For the non-observable variables of the QTM and NAIRU correlations, it was used the US Congressional Budget Office estimates for potential output and 'natural' rate of unemployment.

Just like the QTM correlations, the NAIRU correlation also fails to capture the dynamics of inflation in the United States. The post 2008 observations make this fact easier to be seen, with an enormous positive unemployment gap (i.e., very high unemployment) followed by no cumulative deflation.

Fig. 4 shows the correlations between the growth rate of unit labour costs (i.e., the average growth rate of nominal wages minus the average growth rate of labour productivity), which is another theoretical way to explain inflation, derived from the markup price equation, that states that nominal prices are determined by a nominal markup over nominal labour costs (nominal wage divided by labour productivity). Unlike the QTM, this view is coherent with the widespread acceptance of the fact that the interest rate is the monetary policy instrument (rather than the money supply).

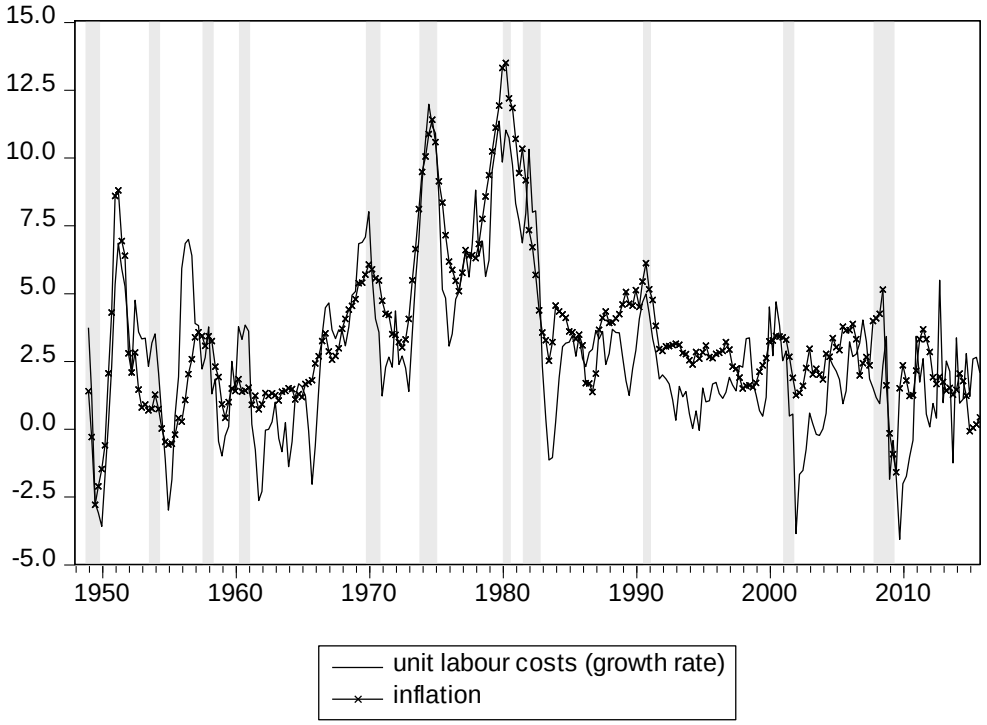

Fig. 4: Inflation and Unit Labour Costs

As the reader can see, this is the theoretical correlation that works better with "raw" data. Like the QTM, the explanation of inflation based on the unit labour costs (ULC) states that both series should move together. However, unlike the QTM, the ULC tracks inflation very closely. Thus, rather than the money supply, the dynamics of nominal ULC that seems to be the fundamental variable in order to understand inflation.

In this view, money is endogenous [Kaldor, 1970, Goodhart, 1984, Lavoie, 2014], which is in line with the fact that central banks use nominal interest rates as the monetary policy instrument, such that monetary aggregates play a pure passive role under our working hypothesis, such that the QTM becomes an identity rather a theory of inflation. We will investigate theoretically and empirically the possibility of an explanation of inflation based on nominal wages as its fundamental force, in line with Keynes's original idea and the seminal contributions of, among others, Phillips [1956], Baumol [1967] Rowthorn [1977], Frenkel [1979], Bhaduri [1982], Dutt [1993] and Lavoie [1992, 2014].

As pointed out by Tobin [1982], *tautologically* inflation can always be seen as a monetary phenomenon – since it is defined as the increase of nominal prices. As it will be argued, this apparently 'monetary phenomenon' is actually the result of conflictual relations between decentralized groups making inconsistent nominal claims in an attempt to raise their real incomes. In some cases, inflation will occur simultaneously with permanent changes in real incomes. The general conditions for a purely neutral inflationary process (in distributive terms) will be presented. Independently of the outcome (distributive neutrality or not), in none of the cases does inflation follow the QTM causality claims.

3 Firms' desired markup determination

Following a long tradition of empirical studies on prices – Hall & Hitch [1939], Nordhaus, Godley & Coutts [1978], Blinder [1990] and Fabiani et al. [2007] - the starting point of the model is the assumption that firms target on average a real *desired* markup on costs, given by the wages and labour productivity, when nominal prices are set. This desired markup will be determined by a bargaining between firms and workers, that will determine the distribution of surplus and, hence, the desired markup that will be the reference for price setting.

As in Sraffa [1960] and Bhaduri [1986], this process occurs with both sides taking production and technology as given. The outside option for firms is the risk-free (real) interest rate, with the amount of interest payments on the wage bill acting as an opportunity cost for firms' internal funds or, if they use external funds, is the minimum amount of real profits that must be received in order to repay interest on invested capital[3]. In both cases, the desired markup on costs must be greater than the risk-free interest rate. By how much will the markup exceed the interest rate? It will depend on workers' bargaining power and outside options available to them. Let w_0 be workers' outside option – either the minimum wage or the unemployment benefit[4]. Thus, the surpluses for firms and workers will be

$$S_K = pY - wE - rwE \tag{1}$$

$$S_L = w - w_0 \tag{2}$$

[3] This idea is freely inspired by Sraffa [1960], although in a different form, because the author raises the possibility of the *nominal* interest rate as the reference for profits. In the version developed here, it is the *real* interest rate that is both an opportunity cost and a minimum profitability for productive investment. For an extension of Sraffa's suggestion, see Serrano [1995]. See Lima & Setterfield [2012] for an exhaustive analysis of the many supply side channels through which interest rates can affect prices.

[4] Of course this concept has many other dimensions that cannot be captured by minimum wages or unemployment benefits. Other elements of workers outside options will be discussed later on this work. For instance, non-monetary benefits like universal health care and the educational system may play a very important role.

Where S_K and S_W are the surpluses from firms and workers respectively, Y is the real output level, p is the output nominal price (in this macroeconomic model, also it is also the price level), w is the nominal wage, w_0 is the (nominal) workers' outside option, r is the risk-free interest rate and E is the employment level, given by production and technology

$$E = \frac{Y}{a} \tag{3}$$

Where a is the labour productivity. The problem is to find the real wage in which the joint surplus is maximized, which is given the solution of following Nash program

$$\max_{w} S_K^{1-\eta} S_L^{\eta} \tag{4}$$

Where η is the bargaining power of workers (an index between zero and one). Normalizing the price level as equal to unity, the solution gives the following bargained real wage

$$w^b = \frac{\eta}{1+r} a + w_0(1-\eta) \tag{5}$$

The bargained real wage has the following properties

$$\frac{dw^b}{d\eta} = \frac{a}{1+r} - w_0 > 0 \tag{6}$$

$$\frac{dw^b}{dr} = (-1)\frac{\eta}{(1+r)^2} a < 0 \tag{7}$$

Thus, a higher (lower) bargaining power of workers increases (decreases) the real wage[5]. A higher interest rate will decrease the real wage because it increases the outside option of firms. Hence we have the following (real) desired markup μ^b that firms will set on prices

$$\mu^b = \frac{a}{w^b} - 1 = \frac{a}{\frac{\eta}{(1+r)}a + w_0(1-\eta)} - 1 \tag{8}$$

There is an inverse relation between the desired markup and the bargained real wage:

$$\frac{d\mu^b}{dw^b} = (-1)\frac{a}{(w^b)^2} < 0 \tag{9}$$

And a positive relation between the interest rate and the desired markup by firms:

$$\frac{d\mu^b}{dr} = (-1)\frac{a}{(w^b)^2}\frac{dw^b}{dr} > 0 \tag{10}$$

That is, the variation of interest rate, if the bargaining power of workers does not change, may be a source of markup shock, causing a positive – but temporary, as will be seen in the next section – effect on price inflation. Thus, firms target this markup, given what they expect on average that will prevail for the bargaining power of workers, the risk-free interest rate and workers' outside option. This markup corresponds to a real wage that is sufficient for workers to accept wage offers, since it is above the minimum they could get if they did not accept the wage offer.

[5] Inequality (6) will hold in general if the output is greater than the wage bill, at wages equal to w_0, plus the interest rate payment over the wage bill (at wages equal to w_0.) That is, the labour productivity must be such that allows to pay real wages and real profits above the outside options of capital and labour. This can be seen by rearranging (6) to get: $a = \frac{Y}{E} > w_0(1+r)$. This implies $Y > w_0E + r(w_0E)$

4 Nominal price and wage setting

Absolute prices by firms are set as a markup on nominal costs. That is, a single firm *j* will set the nominal markup on costs – the nominal wage *w(t)* divided by the productivity of labour *a(t)* - and its price will be:

$$p_j(t) = (1+\mu(t))\frac{w(t)}{a(t)} \tag{11}$$

However, the distribution determined by the bargaining between firms and workers in the previous section is the one that would prevail in the absence of inflation in the long run. In a monetary economy, the desired markup by firms – given by factors like bargaining power of workers, the risk free interest rate and workers' outside options – will be set in nominal terms in order to achieve a real profitability expecting a particular evolution of the price level. Following Frenkel[1979], firms set a nominal markup in the following way:

$$1+\mu(t) = (1+\mu^b)(1+\pi^e(t)) \tag{12}$$

Where $\pi^e(t)$ is the expected inflation and $\mu(t)$ is the nominal markup. The previous expression is an application of the Fisher equation for the markup price setting. In order to get the desired real markup, firms have to include also expected inflation when setting the nominal markup[6]. The explanation for this is straightforward: although the target is the real profitability, in an economy where prices and wages are set in nominal terms, the markup set on prices must but be a nominal variable too. However, at every point in time, only some firms are able to completely adjust the nominal markup to expected inflation. Some firms will only be able to adjust by ϕ (between 0 and 1) the markup to expected

[6] Frenkel (1979) seems to be the first to use the Fisher Equation for a markup price equation. Recently, Stirati (2001) has also used this formulation.

inflation. Suppose the fraction of firms that cannot adjust is θ, then the price level at every point in time will be

$$p(t) = (1-\theta)\left[(1+\mu^b)(1+\pi^e(t))\frac{w(t)}{a(t)}\right] + \theta\left[(1+\mu^b)(1+\phi\pi^e(t))\frac{w(t)}{a(t)}\right] \quad (13)$$

Simplifying (13) we obtain:

$$p(t) = (1+\mu^b)(1+\gamma\pi^e(t))\frac{w(t)}{a(t)} \quad (14)$$

where $\gamma \equiv 1-\theta(1-\phi)$. Thus, if all firms are able to fully adjust the nominal markup, then $\gamma = 1$, and the same would occur if the adjustment of markups is complete, i.e., if $\phi = 1$. In the general case, adjustment is incomplete for part of the firms, so $\gamma < 1$.

Applying logs to the expression (14) and using the approximation $\log(1+x) \approx x$, after taking the derivative with respect to time we obtain the following expression for price inflation

$$\frac{d\log p(t)}{dt} \equiv \pi(t) = \dot{\mu}^b + \gamma\dot{\pi}^e(t) + g_w(t) - g_a(t) \quad (15)$$

The first term on the right hand-side (RHS) of the equation is the desired markup variation, which can be caused by, among other forces, an increase in the interest rate. This would be the main cause of variations in firms' desired markups. This shock will be considered null on average such that we can suppose it is zero for the present analysis[7]. The next terms on the RHS are the adjustment of the nominal markups to expected inflation, wage inflation and the growth rate of productivity, respectively.

[7] In other words, changes in the desired markups by firms are not considered the general cause of inflation, but only the cause of temporary 'acceleration' of inflation. If this variation were positive for every period, the profit share would be constantly increasing, period after period.

Following Sargan [1964], workers negotiate nominal wage agreements *expecting* the nominal wage to provide a desired real wage, taking as given the expected price level,

$$w(t) = (p^e(t))^{\alpha} b^d(t) \tag{16}$$

where α between 0 and 1, is the fraction of the expected price level that workers are able to incorporate in the nominal wage contracts and b^d is the desired real wage implicit in nominal wage negotiations. If we apply logs and differentiate with respect to time we get the following expression for expected inflation:

$$g_w(t) = \alpha\pi^e(t) + g_{b^d}(t) \tag{17}$$

The desired real wage growth implicit in nominal wage negotiations depends partially on a cyclical element, the unemployment rate, and on a non-cyclical structural term *z*

$$g_{b^d}(t) = z - \delta U(t) \tag{18}$$

The structural component can be rationalized like in Baumol [1960], in which the workers of the most dynamic sectors generally obtain nominal wage increases in same rate of the relatively high (with respect to the average of economy) productivity growth of their sector but this behaviour spreads around the economy with other wages increasing at the same rate without connection with the average productivy growth of the whole economy, smaller than in the dynamic setors. This wage spillover is a consequence of 'fairness', i.e., social norms with respect to relative wages and real wages, that create upward pressures on nominal wages through the necessity of keeping relative wages trendless on average, but not downward, due to negative moral and motivational effects on workers, as explained theoretically by Keynes [1936] and Skott, [2005] and documented by a large body of empirical work on wage setting [Kahneman, 1986, Blinder & Choi, 1990, Bewley, 1995]. Hence the wage inflation expression will be:

$$g_w(t) = \alpha\pi^e(t) + z - \delta U(t) \tag{19}$$

From now on, the time index is dropped from the variables in order to let notation simpler. Price inflation, wage inflation, expected price inflation, nominal and real markups and real wages vary on time and they are endogenous equilibrium variables. Besides the parameters, target markup by firms and implicit real wage growth in nominal wage contracts (given by the structural term and the unemployment rate) are the exogenous variables here.

5 Equilibrium properties of the model: endogenous markups and steady state inflation

In this section we determine from the wage and price inflation equations the endogenous variables of the system. Let us begin with the equilibrium inflation rate. Substituting the wage inflation in the price inflation expression and supposing that desired markup variations are zero on average

$$\pi = \gamma\dot{\pi}^{e} + \alpha\pi^{e} + z - \delta U - g_{a} \tag{20}$$

Suppose the economy is in equilibrium – or that agents have 'perfect foresight', if one prefers - that is, expected and actual inflation are equal, there is no 'acceleration'of expected inflation and, hence, the nominal markup does not change. Then, steady-state (equilibrium) inflation will be:

$$\pi^{*} = \frac{z - \delta U - g_{a}}{1 - \alpha} \tag{21}$$

That is, the model generates steady-state inflation in the case of wage indexation not being complete. Higher growth of the structural component of the desired real wage growth, lower unemployment rates and lower growth of labour productivity will cause higher steady-state inflation – and vice-versa. The higher (lower) the indexation of wages to expected inflation the higher the steady-state inflation will be (ceteris paribus). In equilibrium, real wages grow at the same rate as productivity's growth and markups are constant. But what happens to distribution when there is a change in the growth rate of the desired real wages implicit in the nominal wage contracts? In equilibrium, the actual real markup will be the (equilibrium) nominal markup minus the steady-state inflation

$$\mu - \pi^{*} = \left(\mu^{b} + \gamma\pi^{*}\right) - \pi^{*} = \mu^{b} + (\gamma - 1)\frac{z - \delta U - g_{a}}{1 - \alpha} \tag{22}$$

If there are changes in the desired markup and indexation of wages is not complete, it will trigger a *temporary* acceleration of inflation, because the *steady-state* inflation will not be affected, with permanent reduction real wages and real profits increase. If there are changes in the autonomous component of wage inflation, the effects on real markups will be respectively:

$$\frac{d(\mu - \pi^*)}{dz} = \frac{\gamma - 1}{1 - \alpha} \leq 0 \tag{23}$$

That is, if the adjustment to expected inflation of markups is not complete, real profits fall with increases in the autonomous components of wage inflation. If the adjustment is complete, the effect will be zero: steady state inflation will increase but there will be no changes in income distribution[8]. For the unemployment rate the effect is analogous:

$$\frac{d(\mu - \pi^*)}{dU} = (-\delta)\frac{\gamma - 1}{1 - \alpha} \geq 0 \tag{24}$$

Thus, if the adjustment of real profits is not complete, lower unemployment decreases real profits and increases real wages – if the effect of unemployment on wage inflation is significant. That is, real wages can be pro-cyclical or acyclical. Summing-up: if wage indexation is not complete, the structural component of wage inflation will generate steady-state inflation and, provided that markups are not fully indexed to expected inflation, wage inflation will affect the distribution between wages and profits. If unemployment has any impact on wage inflation, then, it will also affect income distribution.

[8] This asymmetry of importance for the steady-state inflation of the different indexation parameters will be discussed in detail in the next section.

6 Dynamic properties of the model

After deriving with respect to time the inflation equation it is possible to obtain the following "law of motion" for the inflationary process:

$$\dot{\pi} = \gamma\ddot{\pi}^e + \alpha\dot{\pi}^e \tag{25}$$

Expected inflation adjusts following an error-correction process:

$$\dot{\pi}^e = \beta(\pi - \pi^e) \tag{26}$$

That is, every time there is a positive (negative) forecast error expectations are revised upwards (downwards), where beta is a positive parameter. Substituting the second derivative with respect to time of the expected inflation and solving the law of motion for the variation of inflation, it is possible to obtain

$$\dot{\pi} = \frac{\beta(\alpha - \gamma\beta)}{1 - \gamma\beta}(\pi - \pi^e) \tag{27}$$

After substituting the inflation equation in the law of motion for the expected inflation and solving the expression for the expected inflation variation the following expression is obtained

$$\dot{\pi}^e = \left(\frac{\beta}{1 - \gamma\beta}\right)[(\alpha - 1)\pi^e + z - \delta U - g_a] \tag{28}$$

Thus the model generates a two-equation linear differential equations system for inflation and inflation expectations. The coefficients' matrix of the system is

$$\begin{bmatrix} \frac{\beta(\alpha-\gamma\beta)}{1-\gamma\beta} & \frac{-\beta(\alpha-\gamma\beta)}{1-\gamma\beta} \\ 0 & \frac{\beta(\alpha-1)}{1-\gamma\beta} \end{bmatrix} \tag{29}$$

Its eigenvalues are

$$\lambda_1 = \frac{-\beta(\alpha-1)}{\beta\gamma-1} \tag{30}$$

$$\lambda_2 = \frac{\beta(\beta\gamma-\alpha)}{\beta\gamma-1} \tag{31}$$

In order to have stability, both must be negative. This condition will hold in general, as the following inequalities (respectively derived from the previous ones) show

$$\beta\gamma < 1 \tag{32}$$

$$\alpha < \beta\gamma \tag{33}$$

Hence, the stability condition is

$$\alpha < \beta\gamma < 1 \tag{34}$$

Which has a clear economic meaning: besides wage indexation being less than complete (a classic condition in wage-price inflation models[9]), the expectations adjustment needs

[9] See, for instance, Modigliani & Tarantelli [1973], Rowthorn [1977] and Barbosa-Filho [2012], for example.

to be slower (faster) for a relatively fast (slow) markup adjustment. Thus, besides the traditional requirement that wage indexation is not complete, constraints on expectations and markup adjustment are necessary for stabilizing the system. The markup adjustment coefficient, hence, plays no role in the steady state level of inflation, but is important for the stability of the system. Prices and expectations reacting too fast to inflation may undermine the stability of the system, as one would expect.

Why should the wage indexation parameter be smaller than one? The reply to this question can be made by asking another question: why should it be equal to one? Historically, economic theory has taken real wages as determined independently of nominal ('monetary') elements. For example, the classics' exogenously determined real wages or the neoclassical supply and demand approach for the labour market. This seems to be the reason why nominal variables have historically played minor and passive roles with respect to distribution and why full indexation of nominal profits and wages is considered, implicitly, to be the general rule from a theoretical perspective despite the large empirical evidence pointing to the opposite case. The popularity of the expression 'money illusion' seems to be a consequence of it, despite the empirical evidence pointing out that being 'illuded' is the general rule for wage and price setting.

In fact, economic agents are not fooled or 'illuded', but are simply following social conventions that cannot be altered by atomistic individual decisions. As the interviews by Kahneman [1985] and by Blinder & Choi [1990] point out, both managers and workers consider real wage reductions due to inflation less unfair than if it were through nominal wage reductions. A real cut through nominal wage reduction is perceived by workers as a direct gain to the employer, but inflationary real reductions by the whole price system not, as Kahneman [1985] pointed out. This same principle is true for the relations between among firms. Of course, no economic agent enjoys real cuts in its income, but if it will happen it is preferred to be due to other agents' prices. Thus, it seems to be more realistic to consider this behaviour as the rationality benchmark than to treat it as a deviation of rationality by economic agents[10].

[10] This is the main reason why the concept of 'nominal rigidity' is not used here.

The phase diagram of the stable case is presented in Fig. 5, in which the singular point is a node.

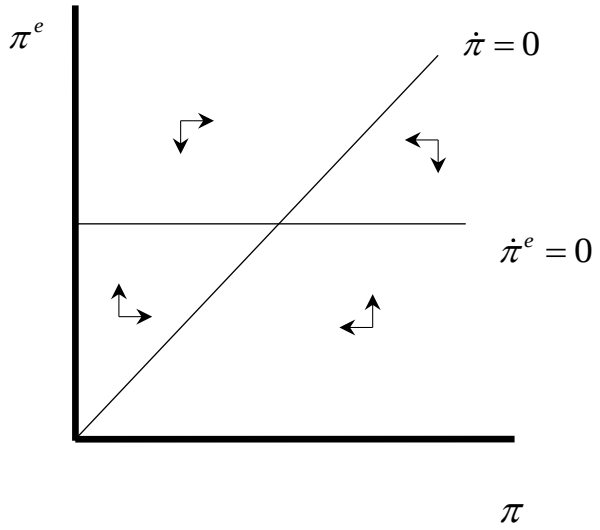

Fig. 5: Phase diagram

The 'NAIRU regime' – i.e., when the wage indexation parameter equals one -corresponds to one of the unstable cases. It will occur if indexation *of wages* is complete as can be seen from the law of motion of expectations (equation 28), if one sets the variation of expectations equal to zero and solve for the unemployment rate:

$$NAIRU = \frac{z - g_a}{\delta} \tag{35}$$

Any other unemployment rate in this regime will trigger unstable wage-price spirals. In this regime, aggregate demand management is constricted to keep the unemployment rate at the NAIRU level.

7 COMPARISON WITH THE LITERATURE

Keynes [1936] provides one of the first theories in which the nominal wages are not passively determined by an exogenously given real wage, explained by another theory - at his time, the supply and demand model of real wage and employment – and, hence, the real wage is endogenously determined by the level of production, given by effective demand. Nominal wages can move upwards in order to keep relative wages constant, but not downwards. However, due to decreasing marginal products for labor, it follows from Keynes's assumptions that during booms real wages decrease because of price increases and nominal wages are given. As is well known, empirical studies have since established that real wages are either acyclical or pro-cyclical, discrediting this representation of the relation between unemployment and real wages.

In Friedman [1968], also due to decreasing marginal returns, the temporary effect of the decrease in unemployment is to decrease real wages – as long as employed workers don't perceive that. Firms will hire more workers knowing exactly what is going to happen with the real variables according to their optimality conditions, but workers suffer 'money illusion'. After understanding they have been fooled by the price system, some workers voluntarily quit their jobs and those who remain employed will receive a higher real wage, with the unemployment rate stabilizing in its equilibrium level. This parable is based on incomplete knowledge of workers but not of firms [Gordon, 2011].

Besides the already mentioned contribution by Frenkel [1979], Godley & Cripps [1982] provide one of the first discussions of the possibility of real profits being different from the ones associated with the desired markup due to inflation, but the authors consider it only as disequilibrium phenomenon. More recently, Serrano [2010] has revisited these concepts, providing a more general picture of the interactions between nominal and real profits with inflation.

Though this distinction is crucial in order to understand the dynamics of inflation and distribution in an economy which wages, prices, debts, rents and contracts are fixed in nominal terms, it seems to have been largely neglected. In an economy with positive inflation, in order to keep the real profitability constant, the price setters must vary the nominal margin by more than the variation of inflation (as stated by the law of motion of

nominal mark-ups)[11]. However, this fact is rarely mentioned in inflation models based on markup pricing, which generally suppose that price inflation is determined only by wage inflation. The models by Layard et al. [1991, 2000] and Carlin & Soskice [2006] correspond to this characterization. Besides exhibiting complete distributive neutrality, these contributions can be classified as being of a pure NAIRU regime. On this point, the models developed by Rowthorn [1977], Dutt [1987], Lavoie [1992, 2014] and Serrano [2010] can be seen as exceptions, by explicitly discussing the conditions for distributive neutrality and for the existence of NAIRU and non-NAIRU regimes.

In Rowthorn [1977] the positive 'aspiration gap'[12] generates steady-state inflation and permanent changes in the income shares if inflation is below a certain threshold. However, if inflation is higher than the threshold, the economy becomes fully indexed and enters in a NAIRU regime. Dutt [1987] explains wage inflation as caused by the workers' "aspiration gap" – difference between desired and actual real wage – and the price inflation as caused by firms' "aspiration gap" – the actual real wage minus the one implied by their desired mark-up. Time is continuous. In steady-state price inflation equals wage inflation. The conclusion of the model is similar to one presented here: conflict (due to a change in the desired mark-up or real wage) changes income distribution. The general outcome will be an average between the firms' and workers' desired share. Lavoie [2014] extends this framework to include indexation and gets similar results to the ones presented here. The main differences are the same as in Rowthorn [1977]: the unobservable variable "aspiration gap" is the proxy for conflict and there is no explicit distinction between nominal and real profit margins.

The analytical advances presented here with respect to these models are the desired markups determined by the bargaining between workers and firms, the possibility of the risk-free real interest rate to generate markup shocks, the formalization of the price setting

[11] This idea has some similarity with the so-called "Taylor Principle", which states that the nominal interest rate must vary by more than inflation in order to keep the real interest rate unchanged. In fact, both rules come from the Fischer equation.

[12] The difference between wage share bargained by workers at every wage settlement, which in the present model corresponds to the structural wage inflation exceeding productivity gains, and the wage share implied by price setting policy of firms (determined here by the bargaining)

policy of the firms using as control variable the nominal profit margins and the use of empirically observable variables like wage inflation and productivity growth as proxies of the conflicting-claims – rather than the unobservable 'aspiration gap'.

Palley [2003] and Akerlof, Perry & Dickens [2000] have argued that if inflation is below a certain threshold, the indexation of nominal wages in the economy will not be 100% and there will be an inverse relation between unemployment and steady-state inflation. Palley[2003] argues that markups are given so, it would correspond to the case where inflation is not 'accelerationist' but income distribution is given in the present model. Thus, the model corresponds to the case of partial wage indexation and full mark-up indexation. Akerlof et al [2000] argue that if inflation is low, individuals are 'near-rational' and suffer 'money illusion', if inflation is relatively high, wage indexation is complete and the 'accelerationist' result occurs.

Nowadays, the 'New Keynesian Phillips Curve' (NKPC) [Roberts, 1995], is the most common inflation theory. It can be derived from different models of nominal price setting with intertemporal optimization and some form incomplete nominal price adjustment – either Rotemberg [1982] quadratic adjustment costs or Calvo [1983] random price adjustment. On average this nominal adjustment constraints over the economy generate a 'sluggish' adjustment of relative prices and quantities because there is always some firm that is not able to obtain the desired (real) mark-up due to the constraint. In the terms of the model developed here the NKPC can be said to exhibit - implicitly, because this variable is not directly discussed in these models - incomplete indexation of the desired mark-up, with the latter being given by the elasticity of substitution of the demand due to product differentiation. This is the price Phillips curve version, in which wages are completely flexible, determined by the traditional labour supply function (in an intertemporal version). These models do not have unemployment, and the labour market can be characterized as an equilibrium between a completely vertical demand for 'working hours' (given by aggregate demand) and a positively slopped 'working hours' supply function. Wage flexibility combined with price rigidity generates pro-cyclical real wages. Some assumption on the behavior of central bank is necessary in order to stabilize

the economy at the potential ouput level, that is, the aggregate supply level in which the average markup of the economy is at its desired level[13].

Using the same principle for wage setting, Galí (2011) derives a New Keynesian Wage Phillips Curve (NKWPC). In this model, heterogeneous workers are able to obtain wages above their marginal products due to their differential skills, receiving a 'wage mark-up', determined by the elasticity of the demand by their type of labor, over their marginal productivity, generating an equilibrium unemployment rate above the one that would prevail without workers' market power. Due to the assumption of Calvo nominal rigidity for wage setting, nominal wages do not guarantee endogenous convergence to the NAIRU equilibrium. Differently from its price analogous, the NKWPC, without price rigidity like in Galí [2011], generates anti-cyclical real wages because of the traditional labour demand curve. Thus increases in employment reduce the actual 'wage mark-up' during booms.

[13] In Roberts [1995] the output gap is the activity gap variable. However, according to Galí & Gertler [1999] the correct gap variable should be the 'real marginal cost' (RMC) gap, the deviation of the real marginal costs from its flexible price level (given by the elasticity of demand), and the best empirical proxy for the latter is the wage share in national income.

8 Conclusions

We developed an inflation model in which firms adjust nominal prices in order to get a desired real markup and workers are able to negotiate increases in nominal wages above the average growth rate of labour productivity. Firms set prices according to an expected inflation component and may be able or not to protect their desired profitability to expected inflation; workers bargaining nominal wages according to past inflation and a desired real wage increase, being able or not to adjust nominal wages to expected inflation. From this struggle different outcomes may occur. The inconsistency between the desired markup implicit in the nominal price setting and the real wage negotiated in the nominal wage settlements is the *cause* of inflation.

The main novelty of the model was to formalize the price setting dynamics by taking into account that a *nominal* markup is set over nominal costs in order to obatin a desired real markup. Very often in the literature, there is an implicit assumption that firms are able to set their desired relative price (i.e., that the real mark-up equals the desired one).

A second contribution was the determination of the desired markup by firms as the result of a bargaining between workers and firms, including the risk-free interest rate as the outside option for profits. This raises the possibility that increases in the risk-free interest rate, the minimum rate of return necessary to induce firms to produce, cause markup shocks and generate temporary accelerations of inflation.

Differently from the traditional literature of inflation mentioned above, the general result of the model is the following: provided that the indexation of nominal wages is not complete, the autonomous claims of growth of nominal wages above the growth of productivity will create a permanent and stable rate of inflation – i.e., at a steady-state level, and not the 'acceleration' of inflation, as it is the case in the contributions quoted above. Moreover, since not all the firms at every point in time have complete capacity to adjust the nominal margins and, hence, prices, in order to get the desired *real* profitability, workers do have incentive to ask for increases in nominal wages above productivity growth – differently from the traditional literature, where income distribution does not change – and the real wage is endogenous, as suggested, in a different theoretical context,

by Keynes [1936]. The conventional NAIRU result has been shown to be a particular case of the model.

The present model provides a theoretical explanation for the empirical results of Jayadev (2007), who presented evidence that low income groups prefer low unemployment rather than low inflation. In a typical NAIRU model this result cannot be rationalized because unemployment rate can only be the one that does not increase inflation and there is distributive neutrality. In this case it makes no sense to prefer low unemployment to low inflation, since none of them can be achieved. In the model presented here, a permanent reduction in unemployment is able to affect real wages and inflation will be higher but stable, thus providing explanation of why low unemployment is preferred to low inflation since workers care about real wages and employment.

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