The New Keynesian Phillips curve: a critical assessment

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ABSTRACT

Two main versions of the Phillips curve can be found nowadays in the New Keynesian literature. The first, which is called the "triangular model" (Gordon, 1997), is based on a inertial component, a given (and exogeneous) long-run NAIRU and supply shocks. This version of the Phillips curve was dominant, until the mid nineties, and also present in the New Consensus Model (Blinder, 1997; Taylor, 2000). More recently, the second version, the so-called New Keynesian Phillips Curve, which includes a forward-looking expectations component and another based on deviations from the current markup of firms in relation to its optimum value, has become more dominant. This specification for the Phillips Curve belongs to the New Neoclassical Synthesis model (Goodfriend; King, 1997; Clarida; Galí; Gertler, 1999). This paper evaluates both these recent interpretations of the Phillips Curve through a simplified model aiming to clarify the central theoretical foundations of these models. It shows the very special assumptions that are required to generate a unique NAIRU in the New Consensus Model and a single long-run equilibrium rate of unemployment in the New Neoclassical Synthesis. In both versions, the long-run neutrality of money are seem to be subject to different serious theoretical problems and, in addition, the empirical evidence does not really corroborate their predictions relating to the tradeoff between inflation and unemployment in the long-run. From this critical assessment of the neoclassical approaches to the Phillips Curve, the paper concludes in favor of a return to older non-neoclassical interpretations of the non neutral long-run Phillips Curve.

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1) Introduction

Phillips (1958) found and later named the curve that describes the negative relationship between the rate of unemployment and the rate of change of nominal wages. According to Palumbo (2008), his work was mainly interpreted as an empirical exercise by the authors that followed the work done by Lipsey (1960) and Samuelson and Solow (1960). These authors, who were part of the so-called Neoclassical Synthesis, gave a theoretical explanation for the Phillips Curve (PC) based on an analysis of the labor market in terms of supply and demand curves.

The neoclassical interpretation of the PC went further with the introduction of the natural rate of unemployment and the Expectations Augmented Phillips Curve by Friedman (1968) and Phelps (1967). In this context, the Monetarist School claimed that in the long-run the PC become vertical and, hence, any attempt by the political economy of manipulating the aggregate demand in order to reduce the unemployment rate below its natural level would only cause an acceleration of the inflation rate. The New Classical "revolution", with Lucas's defense of a vertical PC even in the short-run (Lucas, 1972), reinforced the view on the impossibility of the government to explore the tradeoff between unemployment and inflation.

The "Keynesian" reaction, brought forward by the New Keynesian School in the eighties and nineties, tried to restore the tradeoff between inflation and unemployment and the non-neutrality of money in the short-run after Lucas criticized the "Keynesian" PC (Lucas, 1972). Nevertheless, this was done in the context of the long-run vertical PC based upon the existence of a unique Non-Accelerating Rate of Unemployment (NAIRU). Gordon (1997) called it the "triangular model", once the inflation is explained by an inertial component, the unemployment gap and supply shocks. This specification of the PC is the one used in the simplified New Keynesian model known as the New Consensus Model (NCM) discussed, for example, by Blinder (1997) and Taylor (2000).

Also in the nineties, it emerged inside the New Keynesian literature the so-called New Neoclassical Synthesis (NSN) (Goodfriend & King, 1997), which tried to combine the NCM and the microfoundations of the Real Business Cycle (RBC) School. In this new tradition, it is found a specification of the PC (also called the New Keynesian Phillips Curve (NKPC)) that claimed to have abandoned the relation between unemployment and inflation – replacing the unemployment gap by a mark-up gap – and introduced a forward-looking expectation component.

This paper will assess critically some of the theoretical foundations (or microfoundations) of both New Keynesian versions of the PC. It tries to build a simple model with the goal of showing which are the main features in both New Keynesian models that generate a vertical PC and a unique equilibrium rate of unemployment (or NAIRU). It is then argued that the evolution of these models consists of a constant effort to adapt its microfoundations in order to combine the short-run non-neutrality and long-run neutrality of money – through the existence of a single equilibrium rate of unemployment – and to react to the theoretical and empirical puzzles faced by the New Keynesian models. Furthermore, the article tries to demonstrate, based on the work previous done by Stirati (2001) and Serrano (2007), that a unique equilibrium unemployment rate is not a trivial result for any model of the Phillips Curve, as argued by Stockhammer (2008). More specifically, this result stems from two assumptions: the exogeneity of the firms' real markup and full incorporation of expected and/or past inflation in the Phillips curve.

The paper is organized as follows. Section 2 presents a simple version of New Keynesian model that tries to conciliate rational expectations with a PC similar to the Friedman's accelerationist version based on a unique NAIRU – the "triangular model" (Gordon, 1997). It is shown how the firsts New Keynesians use the combination of nominal rigidities and real rigidities in order to produce the same results of the Neoclassical Synthesis in the context of rational expectations. It is also discussed some puzzling empirical evidence to the "triangular model" and its New Keynesian reactions that discuss the validity of the model based on a single NAIRU. Section 3 addresses the microfoundation of the NKPC and its effort to build a model that is capable both to deal with the theoretical and empirical puzzle of the NAIRU model and to generate an equilibrium rate of unemployment. Section 4 summarizes the criticisms to the NCM and NSN models and highlights the difficulty confronted by the New Keynesian tradition of defending the neutrality of money in the long-run, through a vertical PC, and the tradeoff between inflation and unemployment in the short-run. Section 5 briefly concludes.

2) New Keynesian Economics and the Phillips Curve

Lipsey (1960) and Samuelson and Solow (1960) are responsible for what is called the neoclassical interpretation of the PC (Palumbo, 2008). Before the neoclassical interpretation, the PC was predominantly seen as an empirical relation between nominal wages and

unemployment. Moreover, the explanation for the relation between these two variables was based on the idea that whenever the unemployment declined, workers' bargaining power strengthened and, then, nominal wages tended to grow even before the economy reached the full employment. Lerner (1951), for example, argues that there exists a low full employment level – which does not correspond to the full employment of labor – below which the decline in unemployment can be inflationary. Additionally, there is a high full employment level – which is the "real" full employment level – below which the PC becomes vertical and the decline in unemployment provokes a hyperinflation. Indeed, these arguments can explain the non-linearity in the estimated PC and are very similar to the explanation found in Phillips (1958) that provides theoretical elements for his estimated PC. In short, this first approach interpreted the PC as an institutional theory of nominal wage determination, which is based on the bargaining power of the labor force (Palumbo, 2008).

Nonetheless, the relationship between nominal wages and unemployment, presented in the first neoclassical interpretations of the PC (Lipsey, 1960; Samuelson; Solow, 1960), is derived from an analysis of supply and demand forces in the labor market. In other words, whenever the rate of unemployment is below (above) the equilibrium rate of unemployment – which corresponds to the full employment – nominal wages tend to increase because of excess demand (supply) for labor.

In particular, Samuelson and Solow (1960) are the first ones to substitute the nominal wage rate of change for the price inflation. This interpretation of the PC was incorporated into the IS-LM model and became part of the Neoclassical Synthesis model. Whereas the IS-LM model dealt with the aggregate demand, the PC defined the aggregate supply and, hence, defined the menu of choice between unemployment and inflation. Specifically, there is a permanent tradeoff between inflation and unemployment that the political economy could explore manipulating the aggregate demand.

Friedman (1968) and Phelps (1967) criticized the argument that the disequilibrium in the labor market would provoke changes in the nominal wages. They claim that an excess demand (supply) for labor actually cause an increase (decrease) in the real wages. In other words, if workers only regard the nominal wage in case of disequilibrium between demand and supply in the labor market, they will permanently suffer from "money illusion". Therefore, in order to take into account the real wage, the workers have to form their expectations about future inflation, and this is a major change of the previous interpretation of the PC (Friedman, 1968).

The expectations augmented PC is the innovation brought forward by the Monetarist School. This formulation also highlights the role of the equilibrium rate of unemployment in the labor market, which Friedan (Ibid) labels the Natural Rate of Unemployment (NRU) – which corresponds to what Lerner (1951) called the high full employment position. On the basis of a rhetorical argument, the author claims that the NRU is determined by the "Walrasian system of general equilibrium" – hence implying no involuntary unemployment – and this is the only equilibrium point where the economy will necessarily rest in the long-run. According to his argument, in the short-run, the aggregate demand can be manipulated in order to generate an actual rate of unemployment lower than the NRU. This is possible only because workers may suffer from money illusion in the short-run and accept to work more with an increase in their nominal wages. Nevertheless, to the extent that their expectations about prices are adaptively corrected in the medium-term, the aggregate demand excess will cause an inflation increase and the economy will be driven back to the NRU through the traditional Keynes and Pigou effects. In brief, the actual unemployment rate, according to the augmented PC, can solely differ from the NRU in case of non-adjusted expectations. As a result, any attempt to stimulate the aggregate demand above its "natural" level will only provoke an acceleration of inflation in the long-run moving along a vertical PC. To sum up, this is how the Monetarist School postulates a vertical PC in the long-run and abandons the permanent tradeoff between unemployment and inflation.

Lucas (1972, 1973, 1975) goes further with the Monetarist argument[1] arguing that the PC may be vertical even in the short-run. Introducing a model with rational expectations and, more importantly, with an equilibrium theory of business cycle, Lucas (1973) presents a model where wages and prices adjust automatically due to deviations of the output from its natural level – which can be translated into the unemployment rate by the Okun's law under the hypothesis that productivity is constant. Consequently, price and wage flexibility ensure that markets will always clear and the economy will be in equilibrium in every point of the business cycle. In terms of the PC, Lucas (Ibid) replaces the backward-looking expectations component from the Friedman's accelerationist PC, with a forward-looking expectation component – based on the rational expectations. This change implied in a vertical PC even in the shor-run, i.e., there is no tradeoff between inflation and unemployment even in the short-run. Furthermore, there is no involuntary unemployment according to this model, since the unemployment rate always equals the NRU. Therefore, the neoclassical interpretation of the

[1] The New Classical School is considered a "monetarism mark II" (Tobin, 1981).

PC, presented initially by the Neoclassical Synthesis, resulted ultimately in the complete dismissal of any attempt to manipulate the aggregate demand in order to reduce the unemployment rate[2] (Palley, 2011).

In this context, the "Keynesian" resurgence in the eighties, led by the New Keynesian School, challenged the New Classical models of price and wage flexibility. Mankiw (1990) recognizes that the consensus on the Neoclassical Synthesis's PC weakened for two reasons: first for its empirical failure to explain the stagflation of the seventies; second for its lack of microfoundations. Therefore the critics to the "Keynesian" PC raised by Lucas (1972, 1973, 1975)[3], in particular the rational expectations argument, was promptly incorporated into the microfounded New Keynesian models, such as Fischer (1977), Taylor (1979), Mankiw (1985), Blanchard and Kyotaki (1987) and Ball and Romer (1990).

The three main "Keynesian" results of these models are the adoption of imperfect competition, the persistence in the long-run of involuntary unemployment[4] and, finally, the non-neutrality of money in the short-run – or the tradeoff between inflation and unemployment – due to price and wage rigidities (Romer, 1993). More specifically, markets do not clear during the business cycle, due to nominal wage or price rigidities – generating then the non-neutrality of money[5]. Additionally, the labor market does not clear in the long-run, due to real wage rigidities. Therefore, "(…) price-setting behavior is the essence of Keynesian economics (Gordon, 1990, p. 1136)".

In order to grasp the different kind of rigidities presented in New Keynesian microfounded models, table 1 represents the different classes of rigidities in terms of a four-entry matrix: the two rows represent the rigidities in the goods market (price) and labor market (wages); and the two columns show if there is a nominal or a real rigidity in each market. The main New Keynesian models for each entry of the matrix are indicated according to Gordon (Ibid):

[2] Lucas (Ibid) accepts that only in the case of surprise, the monetary authority can succeed, in the short-term, in increasing the real output. For a discussion of the differences between the Monetarists and New Classical adjustments of prices and quantities, see Hoover (1984).
[3] Of course this critic is part of a broader criticism to the "Keynesian" models made by Lucas (1976).
[4] It is worth noting that involuntary unemployment in New Keynesian theory is associated with imperfections in the labor market that prevents its clearing (such as real wage rigidity). This involuntary unemployment definition, hence, is different from the one based on the principle of effective demand.
[5] As in the Neoclassical Synthesis, the New Keynesian models assume nominal price or wage rigidity to prevent the Keyne's and Pigou's effects in the short-run and, thus, to allow for the non-neutrality of money.

Table 1

	Nominal Rigidity	Real Rigidity
Goods Market	Menu Cost, Input-Output	Customer Market
Labor Market	Staggered Wage Contracts	Insider-Outsider ,Efficiency Wage, Implicit Contracts

The PC version used by the first generations of New Keynesian models, and by the NCM, is basically the long-run vertical version of the Monetarist School, which includes an inertial component[6], an unemployment gap and supply shocks – the so-called "triangular model" (Gordon, 1990; Blinder, 1997; Taylor, 2000; Snowdon; Vane, 2005, ch. 7). For the short-run tradeoff between unemployment and inflation – which in Friedman (1968, 1977) was attributed to the existence of money illusion – the New Keynesian put forth theories for the existence of nominal rigidities, such as the Staggered Wages model (Fischer, 1977; Taylor, 1979) or the Menu Cost model (Rotemberg, 1982; Mankiw, 1985; Blanchard; Kiyotaki, 1987). Regarding the NRU, the New Keynesian will replace its "competitive Walrasian General Equilibrium determination" with a unemployment theory of real wage rigidities that prevents the clearing of the labor market – and allows the existence of involuntary unemployment in the long-run (Blanchard; Katz, 1997).

2.1) The Menu Cost model and real wage rigidities

The Menu Cost model is based upon two crucial hypotheses: the monopolistic competition among firms in the goods markets and the existence of costs to adjust prices (the "menu costs"). Under monopolistic competition, firms are capable of setting its optimum price according to a negative slope demand curve. Moreover, in the presence of adjustment costs, firms may choose not to change their prices when the demand curve shifts due to variations in the aggregate demand. Thus, combining these two elements, the first Menu Costs

[6] However, while Friedman (1968) assumed adaptative expectations, deriving a backward-looking PC, the New Keynesians models are based on rational expectations and present an inertial component in the PC explained by price rigidities.

models were developed in the eighties (Rotemberg, 1982; Mankiw, 1985; Blanchard; Kiyotaki, 1987) seeking to generate, in the short-run, price rigidity and the non-neutrality of money.

Nevertheless, as it's shown by Romer (1993, 2005), menu costs alone cannot be high enough in order to compensate the firm's profit loss of not adjusting prices. That occurs because whenever the aggregate demand moves, causing a shift of the demand curve, the firm's costs – such as wages – also change increasing the firm's profit losses of not adjusting prices. Consequently, it is necessary, in order to generate price rigidity, that a real wage rigidity be added to the Menu Cost model (Blanchard; Kiyotaki, 1987; Ball; Romer, 1990). Thus, the firm's costs also become rigid against changes in aggregate demand because real wage rigidity, when combined with price rigidity, makes the nominal wage also rigid[7]. In addition, the adoption of real wage rigidity, through New Keynesian unemployment theory[8], also helps to explain the persistence of involuntary unemployment in the long-run, once the labor market fails to clear – giving a different meaning to the NRU (Carlin; Soskice, 1990, ch. 6; Blanchard; Katz, 1997).

In the simplified version of the Menu Cost model presented here, it is assumed that labor is both homogeneous and the only factor of production. In addition, the marginal productivity of labor is considered constant in order to simplify the analysis of the firm's marginal cost. So, according to the model, the economy is formed by N different sectors, being each one of them monopolized by a single and homogeneous firm[9]. Additionally, following Rotemberg (1982), each firm maximizes its objective function taking the price set by the others as given, which turn the model into a partial equilibrium analysis. Equation (1) summarizes the maximization problem faced by each one of the N firms:

$$Máx\ L = \frac{P_i}{P} Q_i\left(\frac{P_i}{P}; Y^D\right) - \frac{W}{P} e_i(Q_i) \qquad (1)$$

The first component on the right hand of the equation is the real revenue of the firm, which is determined by its relative price $\frac{P_i}{P}$ and from the quantity sold in the market Q_i. This quantity, in turn, is negatively affected by the relative price and positively affected by the aggregate demand Y^D. The firm's real costs are defined by the real wage $\frac{W}{P}$ and the quantity

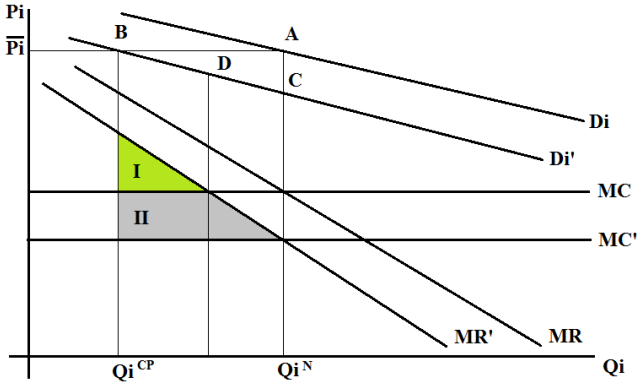
[7] It is worth noting that nominal wage rigidity is basically the same mechanism used by the Neoclassical Synthesis to demonstrate the non-neutrality of money in the short-term (Modigliani, 1944).
[8] For a discussion of the New Keynesian unemployment theories, see Gordon (1990) and Romer (2005, ch. 9).
[9] For a broader variety of imperfect competition, see Carlin and Soskice (2006, ch. 15)

of labor e_i employed in order to produce Q_i. Because the general price level is taken as given by each firm, it can be equal to unity in (1). Therefore, the first order condition for this problem is:

$$P_i^* = \left(\frac{\epsilon}{\epsilon-1}\right)\frac{W}{MPL} \qquad (2)$$

Where P_i^* is the optimum price set by each firm, ϵ is the price-elasticity of demand and MPL is the marginal productivity of labor. It's worth noting that the price set by each firms equals a mark-up over the labor unity cost, and the mark-up is a decreasing function of price-elasticity of demand. Figure 1 represents, now, what happens to each firm if the aggregate demand decreases in terms of a partial equilibrium analysis under monopolistic competition:

Figure 1



In Figure 1, MC and MR stands for, respectively, the marginal cost curve and the marginal revenue curve. The marginal cost curve is flat because of our assumption that the marginal productivity of labor is constant. So, a decrease in aggregate demand causes a shift to the left of individual demand curve of each firm and its marginal revenue curve. Conversely, the fall in aggregate demand, in terms of the labor market, provokes a reduction in labor demand, decreasing real wages – which means that real wages are pro-cyclical in the short-run –, and moves down the marginal cost curve. Therefore, the initial equilibrium point to the firm shifts from A to C. Nevertheless, if there are price adjustment costs, the firm may choose not to change its price and accepts a profit loss. In this case, the firm has to compare the adjustment cost with the profit loss, which in Figure 1 corresponds to the areas I and II. As it can be seen both in equation (2) and in Figure 1, the profit loss area is determined by the price-elasticity of demand and by the change in wages. Romer (2005) points out that, under

several assumptions for the parameters determining the areas I and II, an extremely high adjustment cost would be necessary to compensate the profit loss – given the fall in real wages.

As a result, the Menu Cost model shows that it is necessary to combine real wage rigidity with adjustment costs in order to generate price rigidity in the goods market. The need for real wage rigidity was met by the unemployment theories developed by the New Keynesian School in the eighties that pointed to the existence of imperfections in the labor market. At the same time that these theories provided a theoretical argument for real wage rigidity, they also explained the persistence of involuntary unemployment in the long-run.

Assuming now that real wages do not necessarily decrease when the aggregate demand is reduced, or that they do not decrease as if there were no imperfections in the labor market[10], the marginal curve in Figure 1 does not move down. In this case, the profit loss of not adjusting price only corresponds to the area I. If the adjustment cost is higher than this new profit loss, the firm will have incentives to keep its price fixed for a given decrease in the aggregate demand. Romer (Ibid) then shows that under these new circumstances a small menu cost can be higher than the profit loss, and thus the model generates microfoundations of the firm's price rigidity.

2.2) The Menu Cost model and the PC

So far, the Menu Cost model has explained the existence of price rigidity that allows the aggregate demand to affect the real output in the short-run. Additionally, the real wage rigidity plays a crucial role in order to justify the existence of involuntary unemployment in the long-run. Nevertheless, the passage from the partial equilibrium analysis to the general equilibrium is not simple in the Menu Cost model. As it has been said, the model assumes that firms maximize their objective functions for a given set of prices; otherwise they would not face a stable individual demand curve and it would be impossible to determine the area corresponding to the profit loss. Therefore, to move on to the PC derived from this model, it is assumed that the aggregate supply of this economy is given by the average mark-up of the firms $1 + \mu$ over the labor unit cost:

[10] This could be explained, for example, by the efficiency wage theory, or the insider-outsider model (Romer, 2005, ch. 9)

$$P_t = (1 + \mu_t)\frac{W_t}{MPL_t} \qquad (3)$$

Solving (3) for the real wage, the real wage paid by the firms is obtained:

$$\frac{W_t}{P_t} = \frac{MPL}{(1+\mu_t)} \qquad (4)$$

Equation (4) is the price-setting curve that is similar to the labor demand curve in the New Keynesian labor market. Carlin and Soskice (1990) points out that in the long-run, when prices are flexible, the mark-up is anti-cyclical, because it is a negative function of the price-elasticity of the individual demand curves. Nonetheless, they assume a decreasing marginal productivity of labor, which, in the end, offsets the positive effect of reducing mark-ups over the real wage. Hence, in the simplified version of the model, it is assumed a flat price-setting curve. Equation (4) also shows that the real wage is given by an exogenous mark-up and by labor productivity.

As previously noted, the New Keynesian model assumes that there are imperfections in the labor market. These imperfections are associated with a wage curve, which replaces the traditional labor supply curve of New Classical models (Lucas, 1975). These imperfections may be associated to the fact that labor productivity is a function of real wages or to a strong market power (or bargain power) of labor unions. Therefore, the wage curve is both flatter and above the traditional labor supply curve, that is, there is wage rigidity and the real wage equilibrium does not ensure the full employment of labor. Equation (5) shows the wage curve:

$$\frac{W_t}{P_t} = -bU_t + Z \qquad (5)$$

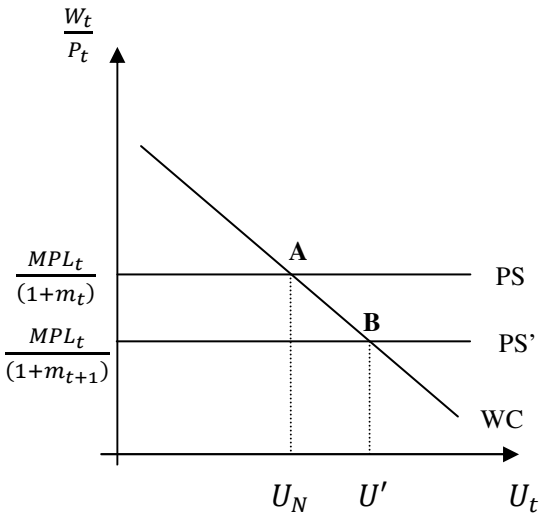
In (5), U_t is the unemployment rate, b is a positive parameter and Z represents institutional aspects that may affect the wage negotiation. Solving (4) and (5) for the unemployment rate:

$$U_N = \frac{Z}{b} - \frac{MPL_t}{b(1+\mu_t)} \qquad (6)$$

There is, thus, a unique equilibrium rate of unemployment U_N, which is a positive function of the (exogenous) mark-up and the institutional factors affecting the wage

negotiation[11]. The New Keynesian equilibrium rate of unemployment is different from the NRU presented by Friedman (1968), once it is explained by imperfections in the labor market and allows the existence of involuntary unemployment (Carlin; Soskice, 1990, ch. 6; Blanchard; Katz, 1997). Figure 2 presents the New Keynesian labor market described by equations (4) to (6):

Figure 2



Source: Own elaboration

From the initial equilibrium, given by point A, a negative shock of the aggregate demand will affect the unemployment rate in the short-run, once firms in the Menu Cost model have incentives to keep prices fixed reducing the real output of the economy. So, the actual unemployment rate is U'. This is equivalent to a movement along a short-term PC – where there is a tradeoff between unemployment and wage[12] – and implies a mark-up increase. It is important to mention that when prices are rigid and the productivity is given, the actual mark-up is anti-cyclical and the real wages are pro-cyclical (corresponding to shifts

[11] This result is in line with the New Keynesian defense of the main determinants of the unemployment rate in the long-run, such as union density, labor protection, unemployment benefits, etc. (Nickell, 1997; OECD, 1994). For a critique of these studies, see Stockhammer and Klar (2011)

[12] It is worth noting that in this simple version of the model, real wage and price were considered fixed. The movement along involves price variation; this could be done if we consider that real wages are not fixed, but have only a weak response to aggregate demand changes

along the wage curve and a downward shift from the price-setting curve)[13]. Nevertheless, the PC presented by the New Keynesians of the NCM is vertical in the long-run (Blinder, 1997; Taylor, 2000), which means that the firms will eventually adjust prices and the economy will move back to its "natural" equilibrium. The dynamic of price adjustment, however, is not clear in the Menu Cost model. There is no explanation why firms will eventually start to adjust price. Hence, the lack of an explanation of the PC inertial component, together with the passage from partial to general equilibrium, poses some difficulties to a formal derivation of the PC from the Menu Cost micro model: "Unfortunately the menu-cost model does not translate into a Phillips curve (Carlin; Soskice, 2006, p. 634)". Ball and Mankiw (1994) claim that the Menu Cost model should be seen as a parable which captures the basic fact that firms have the incentives not to adjust price in the short-run.

So, according to this parable, when the economy is in point B, from Figure 2, firms will eventually (in the long-run) start to have incentives to reduce their prices, bringing back the economy to the NRU through the Keyne's and Pigou's effect or by a response, in terms of interest rates, of the monetary policy rule. Furthermore, the price adjustment initially slowed (or blocked) by the existence of menu costs will be complete in the next period. In other words, there is full inflation inertia in the NCM PC, which in Figure 2 will correspond to a rapid shift upwards of the price-setting curve[14]. So, if a positive unemployment gap persists over time through a recessive monetary or fiscal policy, the economy will face an accelerated deflation in the long-run. Equation (6) shows the NCM PC with its full inertia component:

$$\pi_t = \pi_{t-1} - \beta(U_t - U_N) + c_t \qquad (6)$$

In (6), π_t stands for the current inflation, c_t represents supply shocks and β is a parameter. Because in the NCM the supply shocks are random and zero on average over a longer period, c_t equals zero in the long-run (Serrano, 2007). Equation (6) can be solved in terms of the inflation rate resulting in:

$$\Delta\pi_t = -\beta(U_t - U_N) \qquad (7)$$

[13] This is a very important result for the New Keynesian tradition, since the (old) empirical evidence of pro-cyclical real wages (Dunlop, 1938) challenged the literature that maintained Keynes's first postulate, that is, the labor demand curve.

[14] Since Carlin and Soskice (1990) assumes a flat price-setting curve, the long-run real wage is acyclical. In this case, the mark-up, under flexible prices, is anti-cyclical because it is assumed decreasing labor productivity.

As equation (7) shows, the NRU is the Non-Accelerating Rate of Unemployment (NAIRU), the only equilibrium rate of unemployment compatible with stable inflation in the long-run. This strong result depends on two factors. First, the fact that the mark-up is exogenous to the real wage bargain in the labor market and, moreover, its variations are offset by changes in labor productivity (which is the same of a given mark-up combined with fixed labor productivity). For a given wage curve, this assumption is crucially for the determination of a unique equilibrium rate of unemployment as it can be seen in Figure 2. Second, the full inflation inertia assumption is responsible for making a positive unemployment gap in the long-run a potential source of hyperinflation. Again, it should be observed that, the full inertia component is not successfully derived from the Menu Cost model.

In summary, the first New Keynesians try to reconcile mainstream macroeconomics after Monetarism and New Classicism with the "Keynesian" results of the Neoclassical Synthesis, combining real wage rigidity with price rigidity. The simplified model stressed that the combination of Menu Cost model and real wage rigidity generates price and nominal wage rigidity. This result is crucial to restore, in the short-run, the non-neutrality of money, even in the presence of rational expectations. Furthermore, it was also highlighted that assuming full inertia in inflation and considering that the mark-up is exogenous to the real wage bargain in the labor market, the vertical PC based on a single NAIRU is obtained. Hence, the model combines short-run non-neutrality with long-run neutrality of money. Indeed, according to the PC presented in the NCM, the persistence of an increase in aggregate demand, which causes a negative unemployment gap over a longer period of time, will only bring an accelerated inflation in the long-run.

Nevertheless, it was indicated that the Menu Cost model, associated to real wage rigidity, was unable to generate the proper microfoundations to price adjustment in the long-run. Moreover, as it will be shown in the next section, the New Keynesian model based on a unique NAIRU was subject to empirical criticism because it failed to explain the low inflation both in Europe and in the USA.

2.3) Some Puzzling Evidences to the NAIRU and its Reactions

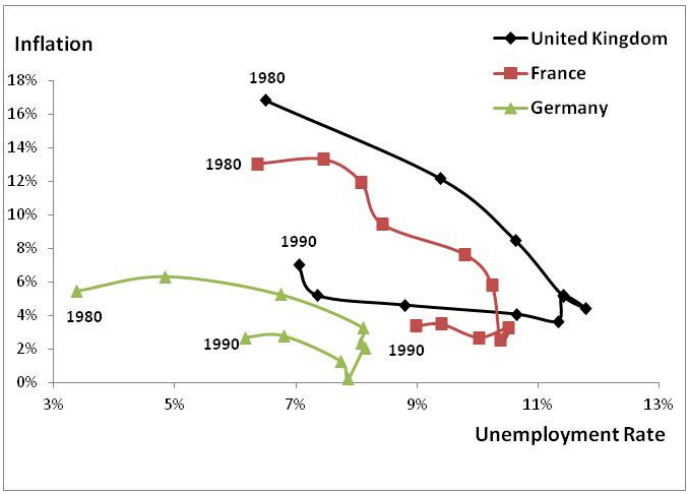
Despite its wide adoption in simplified versions of the NCM, the New Keynesians do not hold a unified view on the strictly vertical PC based upon a unique NAIRU. The empirical evidence raised by the macroeconomic literature during the eighties and nineties show that the

NAIRU model failed to explain the observed relationship between unemployment in some European countries and in the US (Blanchard; Summers, 1986; Gordon, 1997; Stirati, 2001). The reactions inside the New Keynesian literature varied from the adoption of the hysteresis model (Lindbeck; Snower, 1985; Blanchard; Summers, 1986) to a modified version of the NAIRU, the so-called Time-Varying NAIRU (TVNAIRU) (Gordon, 1997). In both cases, the New Keynesians had to face the empirical evidence rejecting the validity of the main argument in favor of the long-run neutrality of money, that is, the existence of a single NAIRU over time.

Specifically for the European unemployment, Figure 3 shows that between 1980 and 1987, there was a substantial increase in unemployment in the United Kingdom, France and Germany. However, the persistent growth in unemployment during this period was not followed by an accelerated process of price deflation, as it would have been predicted by the vertical PC based on a unique NAIRU. The New Keynesian authors, Blanchard and Summers (1986) state the following:

> " (…) to the extent that aggregate demand shocks do not affect the equilibrium or natural rate of unemployment, one would expect sustained high unemployment to be associated with rapid declines in the rate of inflation. More generally, standard models of the effects of aggregate demand shocks would not predict that previous estimates of the relationship between inflation and unemployment would break down. There is substantial evidence however that this relation has broken down and that there has been a much smaller decline in inflation than would have been predicted by past relationships (Blanchard; Summers, 1986, p. 8)".

Figure 3

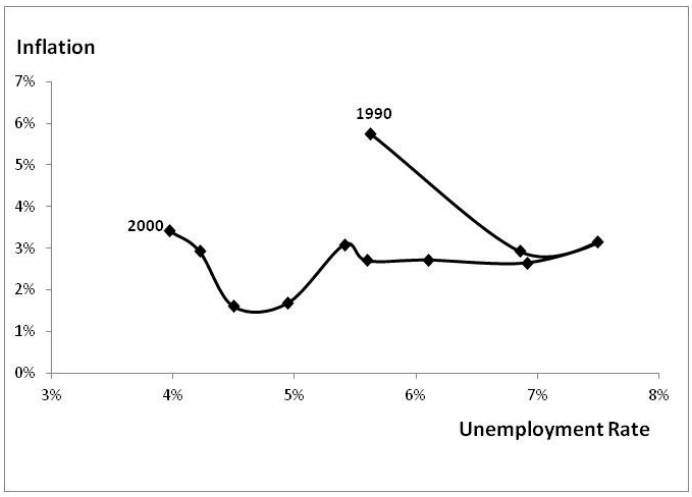


Source: IMF World Economic Outlook

Even the initial fall in prices, observed in the three countries, is strongly influenced by the fall in the terms of trade of OECD countries during the eighties (Stirati, 2001). Therefore, according to Figure 3, it seems that the PCs are moving and changing the terms of the tradeoff between unemployment and inflation, without describing a vertical long-run PC.

For the US, Figure 4 shows that during most part of the nineties, the north-American unemployment rate has decreased. Indeed, it fell below the 6% level, that is, the widely accepted NAIRU level for the US economy at that time (Gordon, 1997). Contrary to what would have been expected by the NAIRU model, the inflation did not accelerate in that period, which is also called "the Great Moderation" (Bernanke, 2004). Indeed, the inflation was stable during that period, including in 2000 when the unemployment rate was 4%.

Figure 4



Source: IMF World Economic Outlook

As previously mentioned, the empirical puzzles basically generated two different reactions in the New Keynesian literature. The first one is associated with the European case, and its main feature was the incorporation of hysteresis channels for the long-run unemployment rate (Lindbeck; Snower, 1985; Blanchard; Summers, 1986). The second case is the model presenting a modified NAIRU, i.e., the TVNAIRU (Ball, 1996; Gordon, 1997; Staiger; Stock; Watson, 1997; Ball; Moffitt, 2001; Ball; Mankiw, 2002). Stockhammer (2008) makes a distinction between these two classes of models saying that whereas the first is focused on an explanation for the unemployment growth in Europe, the second seeks to estimate a PC that fits the data.

The case for hysteresis is mainly represented by the Insider-Outsider model (Lindbeck; Snower, 1985; Blanchard; Summers, 1986). According to this model, only a fraction of the labor force is part of the wage negotiation, i.e., the Insiders. The market power of the Insiders, which can be the unions, allows them to ask for a real wage above the one that would balance the demand and supply of labor. Therefore, the higher the Insiders' market power is, the higher the unemployment and the real wage in the economy will be. Ultimately, the long-run wage curve would be vertical. Now, if the current unemployment affects the membership rules of the Insiders, it may influence the long-run unemployment rate. Hence, through imperfection in the labor market, there is a hysteresis channel in the model. More specifically, according to this model, the growth in the long-run European unemployment is explained by factors that increase the barriers to entry in the labor market and contribute to the augment of Insiders' market power, such as unemployment benefits, social security system, minimum wage policy, etc. (OECD, 1994; Nickell, 1997)

The TVNAIRU model is more about the best way for the estimated PC to fit the data, such as in Gordon (1997), Staiger et al. (1997) and Ball and Mankiw (2002). Nevertheless, Ball and Moffit (2001) propose an interpretation for the US TVNAIRU in the nineties. The labor productivity growth in that period, according to them, was not followed by a raise in the demand for real wages. Thus, if the real wage growth is below productivity, this is the same as a downward shift in the wage curve, provoking a decrease in the equilibrium unemployment rate (or NAIRU).

In short, both New Keynesians reactions recognize the failure of the PC based on a unique NAIRU. Consequently, the models discussed in this paper somehow tried to eliminate the more fixed NAIRU, advocated by early Monetarists, and opened the possibility for the non-neutrality of the aggregate demand in the long-run. Nevertheless, as it will be shown in the section 4, this effort faced other empirical and theoretical puzzles.

3) The New Neoclassical Synthesis and the Phillips Curve

Gordon (2009) claims that after the mid seventies, the (mainstream) history of the PC has a bifurcation between an inertial PC with supply shocks (which the author calls the "triangular model") and a forward-looking PC, which emphasizes that expectations can anticipate policy changes. Whereas the former is predominant in the first generation of New

Keynesian models – especially in the NCM –, the latter is the basis for the New Keynesian Phillips Curve (NKPC) presented in the New Neoclassical Synthesis (NNS) models[15].

The NNS model is actually very similar to the NCM. Both of them are basically defined by the "3-equation model" (Carlin; Soskice, 2006, ch. 3), namely: an IS equation, a PC and a monetary rule. However, their main differences are the theory behind these equations and the specification of the PC. The NSN models combine the RBC modelling, i.e., the Dynamic Stochastic General Equilibrium (DSGE) model, with New Keynesian frictions, such as price or wage rigidity. For this reason, the PC derived from this model has a different specification that stresses the forward-looking expectations and a dynamic rule for price setting.

The adoption of the RBC modelling implies a different approach to the business cycle. In particular, the NNS basic models abandoned the New Keynesian idea of non-market clearing. The seminal works from by RBC School are Kydland and Prescott (1982) and Nelson and Plosser (1982). The latter estimated 14 economic series for the US to test the existence of a unit root in each series. In particular, they confirmed the existence of a unit root in the GDP and employment series, which implies that such series have a stochastic trend and are not mean reversing. In other words, it is not possible to isolate the determinants of the GDP cycle from the ones of the GDP trends. This is a problematic result for the New Keynesianism since its models postulate the division between the cycle components (the aggregate demand) and the trend components (aggregate supply). Therefore, the RBC answer is to claim that both cycle and trend are determined by supply factors. The traditional RBC model (Kydland; Prescott, 1982) presents a market clearing interpretation of the business cycle. There is no room in this model for market disequilibrium, such as involuntary unemployment, even in the short-run.

The cycles in the RBC tradition are then seen as optimal responses of representative agents (with rational expectations) to random supply shocks. The inexistence of real rigidities, such as in the New Keynesianism, allows an automatic market clearing. There is no involuntary unemployment in NNS models, for the representative agent is always on his labor supply curve[16]. On the other hand, the "Keynesian" side of this kind of model appears on the existence of price rigidities that allow the non-neutrality of money in the short-run and are combined with nominal wage flexibility. Hence, the cyclical changes in real wages that come

[15] See, for example, Goodfriend and King (1997) and Clarida et al. (1999).
[16] For an example of a NNS model with real rigidities and involuntary unemployment, see Blanchard et al. (2007)

with the pro-cyclical oscillations of aggregate demand and output, due to price rigidities, are assumed to allow the labor supply to adjust the cyclical labor demand, preventing the changes in aggregate demand and output from generating any involuntary unemployment. Goodfriend and King (1997) introduce nominal rigidity through imperfect competition and the price adjustment dynamics presented by Calvo (1983). His model provides a theoretical foundation for price rigidity without using real rigidities, such as in the Menu Cost model, which, conversely, failed to provide the PC inertial component with microfoundations.

It is also worth saying that DSGE models became prevailing in the macroeconomic mainstream from the mid-nineties on. Woodford (2009) even points out that DSGE modelling is the starting point to any academic debate in the field of macroeconomics. Consequently, the DSGE framework and the NNS model are seen as a greater process of convergence in macroeconomics. According to this view, any divergence in macroeconomics could be disputed in terms of a DSGE model. Finally, one of the main precursors of the NNS prescribes a general rule to write articles:

> "A macroeconomic article today often follows strict, haiku-like rules. It starts from a general equilibrium structure, in which individual maximize the expected present value of utility, firms maximize their value, and markets clear. Then, it introduces a twist, be it an imperfection or the closing of a particular set of markets, and works out the general equilibrium implications. It then performs a numerical simulation based on calibration, showing that the model performs well. It ends with a welfare assessment (Blanchard, 2009, p. 225)".

3.1) Calvo's model and The New Keynesian Phillips Curve

The Calvo's model is the starting point to derive the NKPC, which allows for the existence of the tradeoff between wages and unemployment in the short-run (or the non-neutrality of money). In this model, as well as in the Menu Cost model, there is an assumption of monopolistic competition in the markets. Consequently, the optimum price set by the firm is the same as equation (2) shows. Additionally, although firms have rational expectations about the future, there are exogenous random effects that may prevent them from adjusting price, and this is crucial to the model. As a result, firms do not have control over when they will be able to adjust price and only a random fraction of the firms can adjust price in each period. Thus the NNS model provides an explanation for price rigidity in the context of a

general equilibrium analysis without reference to real rigidities, which would prevent the markets clearing.

A simplified version of this model is presented here in order to derive the NKPC, based on Woodford (2003), Goodfriend (2004), Carlin and Soskice (2006, ch. 15) and Wickens (2008). Considering, then, that labor is the only factor of production, its marginal productivity is constant and the demand curves have constant elasticity, it follows, consequently, equation (8) – which presents the optimum price set by the firms:

$$P_i^* = \left(\frac{\bar{\epsilon}}{\bar{\epsilon}-1}\right)\frac{W}{MPL} \qquad (8)$$

The only difference between equations (2) and (8) is the fact that in the latter the firm's mark-up is constant precisely because the price-elasticity of demand is constant (Goodfriend, 2004). Therefore, there is an optimum mark-up desired by each firm. Furthermore, this mark-up will be the one obtained by the firms when there is no price rigidity. Rewriting equation (8) in order to stress the optimum (and exogenous) mark-up μ^*:

$$P_i^* = (1+\mu^*)\frac{W}{MPL} \qquad (9)$$

Nevertheless, in the Calvo's model, only a random portion of the firms can adjust their price in each period in order to attain the optimum mark-up. In addition, because firms have forward-looking expectations, they adjust their prices aiming to minimize the distance between their actual and optimum mark-up. If it is further considered that the general price level is an average of the sector's prices, it follows that:

$$lnP_t = \delta lnP^* + (1-\delta)lnP_{t-1} \qquad (10)$$

$$lnP_t - lnP_{t-1} = \delta lnP^* - \delta lnP_{t-1} \qquad (11)$$

$$\pi_t = \delta\pi^* \qquad (12)$$

In equations (10) to (12) δ is the random fraction of firms that could adjust its prices at the moment t, P^* is the optimum price when firms obtain their optimal mark-up and π^* is the optimal price inflation. If every firm could adjust price in each period, π^* would be the economy's inflation rate. Since only a fraction δ adjusts its price, the inflation is given by

$\delta\pi^*$. π^*, in turn, is a function of inflation expectations and the deviations from the optimum mark-up. Therefore, this function is given by equation (13)

$$\pi^* = a_{t+1}E_t\pi_{t+1} + b(\mu_t - \mu^*) \qquad (13)$$

In equation (31), $E_t\pi_{t+1}$ stands for the expectations about future inflation, μ^* and μ_t are, respectively, the optimum and the actual mark-up; and a_{t+1} and b are positive parameters. Under the Calvo's model, the current mark-up may deviate from its optimum in case firms are unable to adjust prices. Additionally, the NNS literature (Rotemberg; Woodford, 1999) says that the actual mark-up is anti-cyclical, for in RBC models the real wages are pro-cyclical – since this model presents a positive slope labor supply curve. Accordingly, if in Calvo's model prices are rigid, the aggregate demand affects the real output and the level of employment in the short-run. For a given labor supply curve, firms have to pay higher real wages in order to increase their production, which, in the case of constant labor marginal productivity, results in an anti-cyclical mark-up. Therefore, whenever the aggregate demand expands the economy above the equilibrium given by a flex price RBC model, the actual mark-up falls below its optimum level. This gap makes the firms increase their prices whenever possible. That is why the mark-up gap has a positive impact on π^*.

Substituting equation (13) with (12), it follows:

$$\pi_t = \delta a_{t+1}E_t\pi_{t+1} + \delta b(\mu_t - \mu^*) \qquad (14)$$

Equation (14) corresponds to the NKPC. Instead of an inertial component, this version presents a forward-looking component, which can make the PC shift, anticipating policy changes that affects the aggregate demand. Moreover, because the actual mark-up is anti-cyclical, an excess aggregate demand is translated into a positive mark-up gap. This positive gap causes an inflation pressure until the current mark-up reaches its optimum level. If equation (14) is recursively solved, it follows:

$$\pi_t = \delta b(\mu_t - \mu^*) + \delta b \sum_{i=t+1}^{\infty} E_{i-1}(\mu_i - \mu^*) \qquad (15)$$

Equation (15) stresses the fact that forward-looking expectations in this model means that firms care about future deviations of their mark-up relative to its optimum level. In other words, the actual inflation equals the sum of the current mark-up gap over the future expected

gaps. So, if the firms believe that in the future their mark-up will converge towards their optimum level, $E_t\pi_{t+1}$ in equation (14) declines, which reduces the inflation pressure of an expansionary policy. Gordon (2009) highlights that this approach to the PC is influenced by the tradition of the literature about policy's credibility in order to control inflation, such as the works by Kydland and Prescott (1977) and Sargent (1982). Indeed, Woodford (2003) and Goodfriend and King (1997) emphasize the importance of policy's credibility in order to ensure that expected future mark-ups will converge to their the optimum level.

Equation (15) can be modified aiming to allow for the existence of some inertial inflation. Clarida et al. (1999) propose the hybrid NKPC, which combines a forward-looking component with an inertial component. The model can accommodate this result if it assumes that the firms unable to adjust their prices optimally, in a given period, use a rule of a thumb to fix their prices. In this sense, firms could choose any rule of thumb to adjust their price. Clarida et al. (1999) assumes that firms choose to index their price to past inflation – however it is not explained why firms do not choose other rules of thumb. Therefore, equations (15) can be rewritten as follows:

$$\pi_t = \delta a_{\mathrm{t+1}} E_t \pi_{t+1} + a_{\mathrm{t-1}} \pi_{\mathrm{t-1}} + \delta b(\mu_t - \mu^*) \qquad (16)$$

The hybrid NKPC presented in (16) combines both the effects of forward-looking expectations and the inflation inertia. Furthermore, if the sum of $\delta a_{\mathrm{t+1}}$ over $a_{\mathrm{t-1}}$ equals unity, a persistent positive mark-up gap will cause not just a rise in inflation, but also its acceleration – which is very similar to the New Consensus PC with an inertial component (Serrano, 2007).

3.2) The Natural Rate of Unemployment in the NKPC

Besides its forward-looking term, the NKPC distinguishes itself from the New Consensus PC by the use of the mark-up, an "explicit microfoundation", as a source of inflation pressure. Wickens (2008) mentions the empirical troubles which the first New Keynesians had to face because they used the unemployment gap in the formal representation of the PC. The author says:

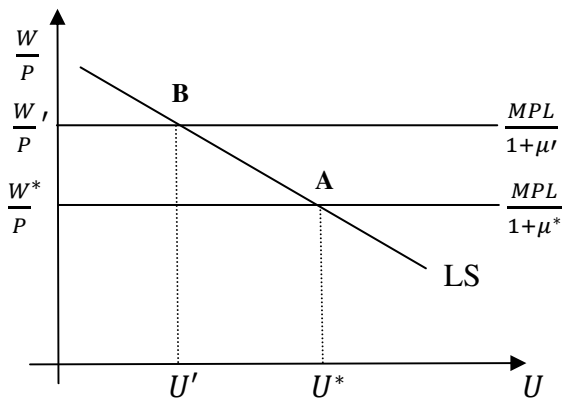
> "Later, in the 1990s, the evidence seemed to show that the natural rate of unemployment varied as much as the actual rate of unemployment, thereby largely destroying any link

between inflation and unemployment. This led to the development of the New Keynesian Phillips curve. This is closely related to the NAIRU model, but it has more explicit microfoundations and does not depend on unemployment to provide the driving variable linking the real economy to inflation (Wickens, 2008, p. 229)".

Nevertheless, it is possible to show the existence of a unique long-run equilibrium rate of unemployment (or a "natural rate of unemployment) behind the given optimum mark-up in the NKPC. Actually, it can be shown that again the long-run non-neutrality of money is based on a single equilibrium rate of unemployment.

Returning to the same labor market analysis made for the first New Keynesian model, Figure 5 represents the labor market according to the simplified NNS model explored here (Goodfriend, 2004). The price-setting curve is again horizontal. However this is so for a different reason. Whereas the New Keynesian model considered a decreasing mark-up, in the NNS, the optimum mark-up is fixed, since the price-elasticity of demand is constant. It is worth noting that, as in the previous model, the mark-up is exogenous to the real wage bargain in the labor market. The wage curve is here replaced by a traditional labor supply curve (LS) derived from the preferences between leisure and work of the representative agent.

Figure 5



Source: Own elaboration

As it has been noted, the existence of a labor supply curve, instead of a wage curve, means that in the NNS model there is no involuntary unemployment, that is, the workers are always on their supply curve. It is now possible to translate the discussion of the mark-up gap into the unemployment gap, since a fixed optimum mark-up implies a unique equilibrium rate of unemployment U_N. Increases in aggregate demand, given the price rigidity, will cause a

fall in actual mark-up, which decreases from μ^* to μ, because firms have to raise the real wage in order to employ more workers. The unemployment rate decreases from U^* to U'. This lower mark-up, associated to a lower unemployment rate, will generate an inflation pressure because firms want to increase their mark-ups. Therefore, the mark-up gap can be rewritten in terms of an unemployment gap. Rewriting the hybrid NKPC with the unemployment gap, follows equation (17), which is very similar to the New Consensus PC presented in (6).

$$\pi_t = \delta a_{t+1} E_t \pi_{t+1} + a_{t-1} \pi_{t-1} + \delta b (U^* - U_t) \qquad (17)$$

Despite the innovations brought forward by the NNS model the NKPC is very close to the New Consensus NAIRU model. If it is assumed that the sum of the parameters associated with the forward-looking over the inertial component equals unity, the equilibrium unemployment rate U^* will have the same effect on the PC that the NAIRU had. Hence, the single equilibrium unemployment rate is still present and implies the long-run neutrality of money.

In short, it was argued that one of the factors that contributed to the incorporation of the RBC modeling in the NNS was the empirical evidence of hysteresis in output and employment. Therefore, cycles are only driven by supply elements, which implies that workers are always on the supply labor curve. However, the NNS had also to be compatible with the New Keynesian feature of short-run non-neutrality of money. In this context, Calvo's model was convenient, for it theoretically justified the existence of nominal price rigidity without assuming real wage rigidity. Moreover, because the model assumes the full incorporation of expected and inertial inflation, and a single optimal mark-up, it presents a unique equilibrium rate of unemployment very similar to the NAIRU, implying the long-run neutrality of money.

4) A Critical Assessment of the NCM's PC and the NKPC: a summary

4.1) A Critical Assessment of the NAIRU

Section 2 showed some problematic aspects of the NAIRU model. It was emphasized that the Menu Cost model, combining real wage rigidity and price rigidity, failed to provide the required theoretical arguments to the inertial component of the PC. More specifically, the

model does not explain the price adjustment dynamics, i.e., the reason why and at what intensity firms adjust their prices in the long-run. Indeed, it is not clear why the adjustment costs in the course of time cease to be an impeditive to price adjustment. In this context, Calvo (1983) seems to provide a clearer argument to price adjustment mechanism – which may help to explain its broader acceptation in mainstream macroeconomics from the mid-nineties on.

The lack of proper microfoundations to the inertial component in the PC is especially problematic, since the full inertia assumption, presented in equation (6), is a central aspect of the NAIRU model. Under full inertia, the unemployment gap causes the acceleration of inflation and the long-run PC becomes vertical – resulting in the long-run neutrality of money. The equilibrium unemployment becomes, then, the NAIRU. Nevertheless, full inertia in the PC, as it has been stressed, is basically an assumption of the NCM, since the Menu Cost model does not explain why partial inertial (only a part of past inflation being incorporated in current inflation) is not a possible result of price rigidity in the short-run[17].

A second critique that can be raised against the NCM refers to the NAIRU. According to the discussion in section 2, empirical evidences demonstrated the failure of the PC based upon a unique NAIRU to explain the behavior of unemployment and inflation both in Europe and in the US. Indeed, it was not observed in both cases either a period of accelerated deflation, when the unemployment rate was persistently below its natural level, or of hyperinflation, when the unemployment rate in the US was below the historical limit of 4%.

The New Keynesian tradition addressed these empirical puzzles to the theory abandoning the idea of a unique NAIRU, defending either the hysteresis approach or the TVNAIRU model. The hysteresis argument is particularly problematic because in case the unemployment rate presents strong hysteresis, the NAIRU loses its relevance in the model (Gordon, 1989). Equations (18) and (19) illustrate this point:

$$U_t^N = \alpha U_{t-1} + C \qquad (18)$$

In the presence of hysteresis, the long-run unemployment rate U_t^N is explained by the past unemployment rate plus a white noise C. Strong hysteresis is defined if α equals unity. In this case, substituting (18) in (7), the NCM long-run PC, equation (19) is obtained:

[17] Gordon (1990) also mentions the Input-Output argument as an explanation for price rigidity and inflation inertia. However, this argument does not justify the adoption of full inertia instead of partial inertia.

$$\Delta\pi_t = -b(U_t - U_{t-1}) + bC \qquad (19)$$

It is not difficult to see that in this case the model, under the assumption of strong hysteresis, does not exhibit a NAIRU anymore. The acceleration of inflation in (19) is a function of the variation of the unemployment rate in time.

The only case where a NAIRU independent of time is maintained is when α is below unity, i.e., in case of weak hysteresis. The evidence of weak hysteresis in the unemployment rate is precisely the result found initially by Nelson and Plosser (1982) for the US economy, that is, the absence of an unit root in its series. In this case, according to the New Keynesian model, the actual unemployment converges to the equilibrium rate of unemployment that is constant over time. Therefore, although at first the hysteresis and TVNAIRU models seemed to allow for non-neutrality in the long-run, they are ultimately limited by a long-run constant unemployment rate.

It is also important to highlight that the fact that the solution of a Time Varying NAIRU, aiming to adapt the PC to the data, seems an average of the observed unemployment rate in time. Galbraith (1997) points out that the New Keynesians are in disaccord about the "true" value of the TVNAIRU. Consequently, if the NAIRU can be anything (in particular different estimated averages of the unemployment rate series), it may not provide an appropriate guide to macroeconomic policy.

Finally, the empirical literature initiated by Nelson and Plosser (1982), who tested for the existence of a unit root in GDP series, proved that the New Keynesian distinction between the non-neutrality of aggregate demand in the short-run and its neutrality in the long-run has not been confirmed by the historical data. Although the evidence of weak hysteresis in the unemployment rate allows for a stable level of the variable in the long-run – which is in accord with the supply side economics in a longer period –, the stochastic trend found for the GDP and employment level showed the impossibility of such a distinction (between demand and supply factor) in these series[18]. Therefore, trend and cycle, according to the data, should be explained in the same way, both by aggregate supply or both by aggregate demand components (Libânio, 2009). In any case, this finding poses a problem to the distinction between aggregate demand affecting output in the short-run and the supply side economics in the long-run.

[18] For a more recent discussion of this subject, as well as the New Keynesian reactions to Nelson and Plosser (1982), see Libânio (2009).

4.2) A Critical Assessment of the NKPC

The NNS seems to have solved two of the biggest problems of the first generations of New Keynesian models. Firstly by introducing a RBC model, it gave an answer to the fact that the economy has to be explained by the same factors both in the short and in the long-run. Secondly, presenting an equilibrium theory of business cycle (without any real rigidity) and introducing forward-looking expectations, the NNS tried to develop an alternative to the NAIRU model – which has shown many empirical and theoretical problems.

However the NKPC is also subject to criticism. First, some authors in the New Keynesian literature, who apparently are not included in the NNS, criticize the forward-looking component both in the traditional NKPC and in the hybrid version. Eller and Gordon (2003) and Fuhrer (1997) present empirical tests refuting the statistical significance of the forward-looking component. According to these estimations, the PC with an inertial component fits the data for the US economy better. Gordon (2009) also highlights the implausibility of the forward-looking component. As shown in equation (15), the current inflation could be totally explained by the sum of the actual over expected future deviations of the mark-up (or the unemployment rate) in relation to its optimum level. Inflation, in this case, is not correlated with supply shocks or with inflation inertia.

The second critique deals with the RBC modeling, more specifically, the RBC as an equilibrium theory of business cycle. According to this model, there is no involuntary unemployment in the economy, i.e., all the current unemployment is frictional or voluntary. In this case, recessions are characterized by periods when workers are reluctant to accept the current real wage and choose not to work. If this were true, the existent unemployment data would have to be discarded, given that the high unemployment rate currently observed both in Europe and in the US would be based on people looking for jobs at real wages higher than the current real wage rather than at the current real wage. The unemployed are, thus, either lying to the statistics office workers or misunderstand what it means to be "looking for work" in the recent period. In brief, in the traditional NNS model, the actual high unemployment rates in advanced countries have to be explained either by an increase in the equilibrium rate of unemployment (caused by a change in productivity or workers' preferences) or by the misleading labor statistics – which does not seems to be the case[19].

[19] It could be mentioned a third critique made by Pivetti (2008), who criticizes the relationship between mark-up and nominal interest rate derived from the NNS model. According to the NNS model, if the monetary authority

5) Final Remarks

Through a simplified model, this article explored the recent evolution of the neoclassical interpretation of the PC. It tried to show how this interpretation evolved from the traditional Neoclassical Synthesis approach, in which there is a permanent tradeoff between inflation and unemployment, into a vertical long-run PC centered on a unique equilibrium rate of unemployment. More specifically, both the NCM and the NNS models helped to shift the Neoclassical Synthesis approach, in which excess demand causes "demand-pull" inflation, to a different approach, in which excess demand causes an acceleration of inflation (Serrano, 2007).

It was argued that the evolution of the New Keynesian microfoundations of the PC consisted of an effort to react to the theoretical and empirical puzzles faced by the aggregate models in order to generate both the short-run non-neutrality and long-run neutrality of money. In particular, the article addressed the evolution from the first NAIRU model to the NNS model through the analysis of the labor market and of price and wage rigidities in each of the two models. Whereas the NAIRU model is based on the combination of the Menu Cost model with real wage rigidity to justify the short-run non-neutrality, the NNS model uses the Calvo's model without real wage rigidity.

Regarding the long-run neutrality of money, the paper tried to demonstrate, in section 2, that the unique NAIRU is derived from two assumptions: the full incorporation of past inflation and an decreasing exogenous mark-up combined with a decreasing marginal productivity of labor. Additionally, section 3 showed that a unique equilibrium rate of unemployment that does not accelerate inflation, very similar to the NAIRU, is also found in the model. Basically, its existence depends on the assumption of a given unique optimum mark-up and full incorporation of expected future inflation (and past inflation in the case of the hybrid NKPC).

Table 2 below summarizes the basic elements from both the first New Keynesian models and the NNS that characterizes an economy with a short-run tradeoff between inflation and unemployment, but with a neutrality of money in the long-run.

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increases the nominal interest rate, the aggregate demand and, thus, the output (and employment) will be reduced in the short-run. Consequently, real wages will also fall down and, given the price rigidity, the actual mark-ups will increase. Hence, there is a positive correlation, in the short-run, between nominal interest rate and mark-ups. However, as the economy has an optimum mark-up, Pivetti (Ibid) stresses that when firms become able to adjust price, they will reduce their prices (and their actual mark-up) in order to obtain the optimum mark-up, which is not influenced by the increase in the nominal interest rate. In brief, Pivetti (Ibid) criticizes the distributional neutrality of monetary policy in the NNS model.

Table 2

	Non-neutrality of money through:	Rigidity	Mark-up	Long-run unemployment rate determination
New Keynesians (80's and 90's)	Price rigidity	Nominal price rigidity (Menu Costs) + Real wage rigidity	**When prices are rigid:** Anti-cyclical for a given labor productivity. **When prices are flexible:** Anti-cyclical combined with decreasing labor marginal productivity	Labor market imperfections model (real wage rigidity)
New Neoclassical Synthesis	Price rigidity	Nominal price rigidity (Calvo model)	Actual mark-up is anti-cyclical, but there is a (fixed) optimum mark-up associated to the long-run equilibrium	Labor's supply curve + optimum mark-up

However, the empirical evidences for inflation and unemployment in both the US and the European economies proved that the vertical PC based on a unique long-run equilibrium rate of unemployment failed to explain the "Great Moderation" period. Additionally, as it was defended in section 4, the New Keynesian microfoundations are subject to serious theoretical problems. Therefore, in spite of the fact that most of the mainstream developments of the PC, including the DSGE models introduced by the RBC School, the mainstream interpretations of the PC did not provide sufficient theoretical and empirical basis to the non-neutrality of money in the long-run.

In conclusion, this paper contests the recent evolutions of the mainstream interpretation of the PC. In this sense, perhaps, macroeconomics should return (in line with Palumbo (2008)) to the old non-neoclassical interpretation of the PC with its institutional determination of nominal wages and permanent tradeoff between inflation and unemployment (see also Serrano (2007) and Stiratti (2001)).

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