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# AN ANALYSIS OF THE NEW KEYNESIAN MONOPOLISTIC COMPETITION MODEL

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## Abstract

This paper analyzes the fundamental characteristics of a representative model of monopolistic competition as those used by the new keynesian economists. From this analysis it is concluded that the representative model offers great potential for this school of thought. It is pointed out that some economic issues have not been analyzed in a very convincing way. As a consequence of these drawbacks, we question and evaluate the pros and cons of working under the representative-agent methodology. We also contrast the economic implications derived from this model with the typical results of the keynesian analysis. In particular, we focus on the involuntary unemployment and the effectiveness of the monetary and fiscal policies. Our findings in this respect are far from conclusive.

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## AN ANALYSIS OF THE NEW KEYNESIAN MONOPOLISTIC COMPETITION MODEL

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Nowadays, the New Keynesian Economics (NKE) has become one of the main macroeconomic developments of the keynesianism. Within this stream of research, the imperfect competition models have been well studied and this work has made important contributions to the microeconomic foundations of macroeconomics. Among those models, one that has been widely analyzed is the monopolistic competition model, not only in the context of price rigidities but also in studies of the labor market. Our analysis portand to determine the main advantages and limitations of this model. For that, a representative monopolistic competition model, as those studied by the NKE, is considered. The implications of the model about unemployment and effectiveness of the economic policy are deeply discussed and evaluated in the context of the keynesian framework.

### 1. ANALYSIS OF THE NKE MONOPOLISTIC COMPETITION MODEL

The NKE tries to find a theoretical explanation to the slow adjustment of wages and prices -which is the main feature that eventually characterized the orthodox keynesianism-. The analysis is based on the maximizing behavior of the economic agents, without imposing any exogenous restrictions on the prices or the wage flexibility. To proceed in this way, the NKE abandons the traditionally competitive paradigm and instead introduce price-determining agent models, where the agents face some nominal frictions and respond with no changes in their prices as the aggregate demand changes. In this paper we focus specially on two of the aspects of these models: menu-costs and the quasi-rational behavior of the economic agents<sup>1</sup>.

In the first phase, the macroeconomic effects of the menu-costs were studied in the framework of monopolistic market models<sup>2</sup>. The main original contributions were made by Barro(1972), followed among others by Mussa(1981),

Rotemberg(1982a,b and 1983), Mankiw(1985) and Rotemberg and Saloner(1987). This analysis was extended later on to models of monopolistic competition<sup>3</sup>. The main contributions were given by Akerlof and Yellen(1985a), Parkin(1986), and the seminal work of Blanchard and Kiyotaki(1987) -whose model would establish the basis for the NKE posterior research on nominal frictions-.

### 1.1. The product market

The first NKE monopolistic competition model was based on the original model developed by Chamberlin. As it is well known, this model stands on three main assumptions:

1. A large number of sellers whose individual decisions do not affect each other<sup>4</sup>.
2. Each firm produces a good which is an imperfect substitute of the other goods produced by the rest of the firms<sup>5</sup>, which implies that the demand faced by each firm is not perfectly elastic.
3. There are not entry or exit barriers in the product market.

In this model, each domestic economy acts as a consumption unit, and supply some type of labor that is an imperfect substitute of that offered by the other households. The total demand faced by a firm is just the sum of the individual households demands for its product.

A very important feature of this model is the assumption of households with strictly quasi-concave utility functions. These functions are assumed to be separable in leisure and in consumption and real balances<sup>6</sup>; they are assumed too to be homogeneous of degree one in consumption and real balances in order to eliminate the income effect over the labor supply; also, a constant elasticity of substitution is adopted to obtain a logarithmic linear demand function<sup>7</sup>.

The individual household utility function is defined as:

$$U_j = \left(\frac{C_j}{g}\right)^g \left(\frac{M_j}{P(1-g)}\right)^{1-g} - N_j^\beta \quad (1)$$

where "g" is a parameter that lies between zero and one<sup>8</sup>.

The function depends positively on the consumption of goods, " $C_j$ ", and exhibits a constant elasticity of substitution which is given by " $C_{ij}$ ", where " $i$ " represents the commodity and " $j$ " the individual. The elasticity of substitution is supposed to be greater or equal to one to ensure the concavity of the function. In the same manner, the utility level depends positively on the real balances, " $M_j/P$ ", where " $M_j$ " is the nominal amount of money held by household " $j$ " and " $P$ " is a deflator calculated using a geometric price index<sup>9</sup>.

Correspondingly, the utility level is inversely related to the amount of work offered by individual " $j$ ", " $N_j$ ", with " $\beta-1$ " as the elasticity of the marginal disutility of work. It is important to mention that within the NKE there has been a more simplified generalization of the nominal frictions models. In that version each economic agent acts as a production agent as well as a consumption unit, that is, there is not an explicit labor market. That is why we commonly find that the utility function depends directly on the production level<sup>10</sup>; in which case " $\beta-1$ " would keep the same meaning, as long as the function exhibits constant returns to scale (a linear technology). This is the case, for instance, in Ball and Cecchetti(1988), Ball and Romer(1989a,b, 1990, 1991) and Rotemberg(1987) where a production function of the type ( $Y_j = L_j$ ) is specified. Blanchard and Fischer(1989), for instance, adopted this simplified version except that they did not imposed the restrictive assumption of constant returns to scale. In their model, " $\beta-1$ " is interpreted as the disutility-production elasticity which is related to the production function technology<sup>11</sup>.

In the model we focus on, each individual " $j$ " will maximize his utility subject to his budget constraint<sup>12</sup>:

$$\sum_{i=1}^m P_i C_{ij} + M_j = I_j = W_j N_j + M'_j + \sum_{i=1}^m V_{ij} \quad (2)$$

this expression establishes that the nominal expenditure on consumption plus the demand for nominal cash, (" $M_j$ "), constitutes the total wealth (" $I_j$ ") held by " $j$ ", and this is equal to the income that the individual obtains from work, plus his initial endowment of money, (" $M'_j$ "), plus his corresponding proportion of

dividends coming from firm "i".

Given the consumer's maximization problem<sup>13</sup>, the individual demands will look like:

$$C_{ij} = \left(\frac{P_i}{P}\right)^{-\theta} \left(\frac{gI_j}{mP}\right) \quad (3)$$

$$M_j = (1-g) I_j \quad (4)$$

The total demand faced by producer "i" is the sum of all the individual demands for its good. It has to be defined for "m" firms and "n" households which -after some suitable substitutions of terms- can be expressed as:

$$Y_i = \left(\frac{P_i}{P}\right)^{-\theta} \left(\frac{\bar{M}}{P}\right) \quad (5)$$

in order to simplify the notation we have defined the aggregate demand for nominal balances, "M", as:

$$\bar{M} = \frac{g}{(1-g)m} M \quad (6)$$

The last function to be defined is the real aggregate demand for the entire economy which is the sum of all the individual demands for each commodity produced divided by the general price index. That is:

$$Y = \frac{g}{1-g} \frac{M}{P} \quad (7)$$

In summary, the product market is characterized by the demand function "Y<sub>i</sub>" which is determined by: i) the relationship between the price set by firm "i", "P<sub>i</sub>", and the general price level, "P"; and ii) the aggregate demand for real balances, "M/P".

## 1.2. The labor market

Taking as given the technology and the structural market conditions of the productive factors, the firms production function is going to depend only on the

labor input. So this function is defined for firm "i" as<sup>14</sup>:

$$Y_i = \left( \sum_{j=1}^n N_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \frac{1}{\alpha} \quad (8)$$

where " $N_{ij}$ " is the amount of labor type "j" that is used in the production of good "i"; " $\sigma$ " is the elasticity of substitution between two different types of labor; and " $1/\alpha$ " measures the degree of the returns to scale. In order to ensure the existence of an equilibrium, it is necessary to assume either constant or decreasing returns to scale, and an elasticity of substitution strictly greater than one. The firms' profits are given by:

$$V_i = P_i Y_i - \sum_{j=1}^n W_j N_{ij} - C_0 \quad (9)$$

where " $C_0$ " stands for the fixed costs which are not made explicit in our model due to their irrelevance in the general analysis; " $P_i$ " is the nominal price of good "i"; and " $W_j$ " is the nominal wage paid to labor type "j".

Producer "i"'s objective function will be to maximize profits subject to the technological constraints imposed by the production function, and taking as given the nominal prices of the rest of the goods produced in the economy. From this maximization process we derive the demand for labor type "j" by firm "i"; and hence the aggregate demand for labor type "j" which is the sum of all the firms' individual demands:

$$N_j = \sum_{i=1}^m N_{ij} = \left( \frac{W_j}{W} \right)^{-\sigma} n^{\frac{\sigma}{1-\sigma}} \sum_{i=1}^m Y_i^{\alpha} \quad (10)$$

The aggregate wage index is defined as:

$$W = \left( \frac{1}{n} \sum_{j=1}^n W_j^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (11)$$

### 1.3. The determination of prices and wages

Each firm will set the optimal price that maximizes its profits, given its cost function and the market demand function for its product:

$$\frac{P_i}{P} = \left[ \frac{\theta}{\theta-1} K_p \left( \frac{W}{P} \right) Y^{\alpha-1} \right]^{\frac{1}{1+\theta(\alpha-1)}} \quad (12)$$

where "Kp" is a positive constant term.

The relative price of good "i" will depend, therefore, on the level of the real wages and on the total amount demanded for the good. A variation in the real wage will make the relative price to move in the same direction, that is, as long as there are not barriers to the price adjustments. On the other hand, the effect of a change in the aggregate demand over the relative price is uncertain, it will depend on " $\theta$ " y " $\alpha$ ". If the production function exhibits constant returns to scale, i.e. ( $1/\alpha = 1$ ), then  $P_i/P = (\theta/(\theta-1)) K_p (W/P)$ , which implies that the price would be proportional to the real wage, that is, it will depend only on the costs and will be insensitive to the demand. When the firm is operating under decreasing returns to scale, ( $1/\alpha > 1$ ), an increase (decrease) in the aggregate demand will provoke an increment (reduction) in the relative price set by the firm<sup>15</sup>.

In the labor market, it has been assumed that the workers have some monopolistic power<sup>16</sup>. So, given the market labor demand curve, the workers will determine the wage at which they are willing to work by choosing the optimal level of consumption and real balances. So, the relevant real wage for worker "j" will be:

$$\frac{W_j}{P} = \left( \frac{W}{P} \right)^{\frac{\sigma(\beta-1)}{1+\sigma(\beta-1)}} \left[ \frac{\sigma}{\sigma-1} K_w \left( \sum_{i=1}^m Y_i^\alpha \right)^{\beta-1} \right]^{\frac{1}{1+\sigma(\beta-1)}} \quad (13)$$

where "Kw" is a positive constante term<sup>17</sup>.

The effects of an aggregate demand shock over the real wage will depend on the elasticity of the marginal disutility of work, " $\beta-1$ ". After a certain level of hours worked, it is possible to conclude that the elasticity is always



positive. Consequently, an increase in the aggregate demand will make workers demand a higher real wage, however, as it has been indicated previously, it will depend on the initial level of employment we start with.

#### 1.4. A digression about the representative-agent methodology

In the model just described it has been possible to accomplish the transition from the microeconomic to the macroeconomic level by replicating "n" times the behavior of the representative agent<sup>18</sup>. Stiglitz(1992) points out that this simplification introduces some inconveniences:

1. It is difficult to deal with issues like asymmetric information and coordination failures under this framework. The only way that asymmetric information can be reconciled with this model is if we assume that the representative agent suffers from some type of schizophrenia. On the other hand, there is no much room to analyze coordination failures using this methodology, since the model assumes individuals with similar characteristics that will therefore will have an identical behavior under the same set of circumstances.
2. The appropriate aggregation of consumers and firms is problematic in itself because it takes place under very restrictive conditions.

If given these drawbacks of the representative-agent model, this approach results unsatisfying, the alternative approach of the classical school is also questionable. In the latter, the conventional general equilibrium analysis aggregates firms and individuals through the use of subscript and superscript indexes to generate the global demand and supply. In this respect, it is original the contribution of Dixon(1994). He specifies several combinations of market structures for the different sectors of the economy; and he concludes that there is not such a simple relationship between each one of the markets and the entire economy, as it is presumed in the representative-agent model<sup>19</sup>.

However, the methodology of the NKE representative-agent model may be justified on the basis of its partial equilibrium approach. Keeping this in mind, it is more acceptable to think of the economic agents that participate in some common market as behaving pretty much alike. But, the aggregation aspect also

represents some limitations to this approach. This is so because the price rigidities that might occur at the microeconomic level, as a consequence of the nominal frictions, tend to disappear under certain circumstances at the aggregate level<sup>20</sup>. This issue becomes more severe when we introduce in the analysis the "rules" that the different agents adopt when confronted to price adjustment costs.

In the NKE models, it is possible to distinguish between "state-dependent" rules and "time-dependent" rules. In the former set of rules, a firm changes its price when it is moved away from the optimal level; it is done according to the movements of some specific variables, and in some pre-established proportion. Most of the work done under this perspective, concentrate the attention on increases of the money supply ("one-sided rules"), since aggregation difficulties emerge if increases, as well as decreases ("two-sided rules"), are considered simultaneously<sup>21</sup>. The results obtained in this setting are not satisfactory for the NKE, since as Caplin y Spulber(1987) conclude, the monetary expansions do not generate real effects in the economy -a clearly, typical "new classical" result-. That is, the rigidities observed among in the firms that follow this price policy are offset at the aggregate level<sup>22</sup>.

Under the "time-dependent" rules, the price adjustment decisions are made with a regular periodicity that is predetermined by the firm far in advance. The combination of this rule with the "staggered price setting" one, leads to a more favorable results for the NKE approach. A slow price adjustment is observed as variations of the aggregate demand occur; in this way, the real effects of a variation might last longer in time.

## **2. THE NKE MONOPOLISTIC COMPETITION MODEL AS A MICROFOUNDATION OF KEYNESIAN MACROECONOMICS**

The keynesian school has originated a diversity of research streams that share the common assumption of slow price and wage adjustments in response to shifts in the aggregate demand. This gradual adjustment, on the one hand, generates a disequilibrium in the different markets, in particular involuntary

unemployment in the labor market; and on the other hand, it enables the fiscal and monetary policies to have real effects on the economy. So, the monopolistic competition model described above should be able to explain the existence of involuntary unemployment and the effectiveness of the fiscal and monetary policies, at the same time that links microeconomic foundations to the keynesian macroeconomics.

## 2.1. Involuntary unemployment

In the product market of a monopolistic competition model, each firm faces a downward sloping demand. This implies that profits maximization will lead to a lower production and a higher price level than those observed in a competitive world. As it has been indicated by Gerrard(1988, pp.140-141), this restrictive effect over production makes the imperfect competition a suitable departure point to obtain the microfoundations of the keynesian involuntary unemployment.

Following Hart(1982, p.337), it is relevant to emphasize that we should not confuse the restrictive effect over production caused by the imperfect competition with the corresponding effects provoked by the fixed price models developed by Benassy(1975) and Dreze(1975). Hart(1982) also points out that the unemployment provoked by the lower output level, tends to prevail in the long-run if the firms have no incentives to lower prices and increase output<sup>23</sup>.

In this context, it is also relevant the contribution of Weitzman(1992) who considers that involuntary unemployment can be explained by assuming a production function with increasing returns to scale, that is, the technological conditions justify the existence of few firms, and the involuntarily unemployees cannot hire themselves due to their relative disadvantage in terms of costs with respect to the larger firms. In this way, the increasing returns to scale technology leads to an imperfectly competitive microeconomic structure that may generate a macroeconomic equilibrium with unemployment.

In the corresponding specification of the labor market described above, the workers decide, given the labor demand schedule, how many hours to work, and hence the corresponding wage that they will receive in exchange. This situation

may originate an equilibrium with unemployment. Besides, the labor demand function that was obtained does not depend only on the wage but also, indirectly, on the aggregate demand which affects the individual demand faced by each firm. Therefore, a situation of unemployment generated by an "insufficient" labor demand may be due to a very high wage or to a very low aggregate demand level. Conclusion typically reached in the keynesian analysis<sup>24</sup>.

## 2.2. The effectiveness of the macroeconomic policy

In the monopolistic competition model and in general in all the models of imperfect competition, the economic policy intervention can be justified on the basis of the first welfare theorem. The theorem proofs that only the equilibrium reached under perfect competition constitutes a Pareto optimal; so under circumstances of imperfect competition, it would be advisable to articulate policies aimed to estimulate the aggregate production level.

### Monetary Policy

We will focus now on the effects that a monetary expansion would have over the production level in the framework of the model described above.

The equilibrium price level (equation 12) depends on the aggregate demand which is related, through equation (7), to the real balances; therefore, the price set by any firm will follow a pattern as the one indicated in the following expression:

$$\frac{P_i}{P} = \left[ \frac{\theta}{\theta-1} K_p \left( \frac{W}{P} \right) \left( \frac{g}{1-g} \frac{M}{P} \right)^{\alpha-1} \right]^{\frac{1}{1+\theta(\alpha-1)}} \quad (14)$$

Since we are interested in analyzing the behavior of "P<sub>i</sub>" with respect to variations in the money supply, the rest of the factors will be grouped in "R" and are supposed to be constant, so "P<sub>i</sub>" boils down to the following expression:

$$P_i = R P \left( \frac{M}{P} \right)^{\frac{\alpha-1}{1+\theta(\alpha-1)}} \quad (15)$$

by defining

$$a = \frac{[1 + (\alpha - 1)(\theta - 1)]}{[1 + \theta(\alpha - 1)]} \quad (16)$$

expression (15) becomes

$$P_i = RP^a M^{1-a} \quad (17)$$

By ignoring the constant term<sup>25</sup> and taking the logarithm of the variables, which will be denoted with lower cases, we get

$$p_i - p = (1 - a)(m - p) \quad y = m - p \quad (18)$$

Since in equilibrium all the prices are equal, we arrive to

$$p = m \quad y = 0 \quad (19)$$

which says that if there are not restrictions on the price determination, the production level is independent of the amount of money in the economy.

Given the equilibrium price level, an increase in the money supply will cause an increase in the real balances which bring an increase in the total individual demands faced by the firms. In this context, and with the additional assumption of decreasing returns to scale, each firm will try to raise the price of its product causing in this way a general increment of the price level. The pressure on prices will continue until the total aggregate demand had reached its original level and the relative prices had been equated to one; that is, until the general increase in prices equals the increase of the money supply. Concretely, in the monopolistic competition model, the movements of the money supply do not have real effects on the economy.

However, in the NKE, variations of the money supply in the presence of minor nominal frictions<sup>26</sup>, cause no response from the economic agents; that is, they follow a suboptimal policy of sticking to their original prices<sup>27</sup>. It is so because in monopolistic competition models, as supposed to the perfect competition ones, the losses that accrue to the firms that do not follow an

optimal price policy are relatively small, specially if there are high information costs<sup>28</sup>. In summary, the existence of nominal frictions impedes that the economy stay in a permanent state of equilibrium, fact that determines the effectiveness of the monetary policy<sup>29</sup>.

A criticism to this model is that, in the absence of nominal frictions, the flexibility of price movements restores the equilibrium through the real balances mechanism. In spite of the attention that this approach has attracted, it seems to have very limited empirical support<sup>30</sup>

### **Fiscal Policy**

Within the NKE, the monetary policy analysis has been quite extensive<sup>31</sup>, while the fiscal policy analysis has played a secondary role. However, we believe it is important to give it some attention here given that it is a typically keynesian field. Dixon and Rankin(1994, pp.188-194) show that the fiscal policy may generate real effects in an imperfect competition setting without having to resort to the existence of nominal frictions. It is so because: 1) in their model, the demand elasticity is such that the government policies might have a real impact on the aggregate demand and on the relative prices; 2) the fiscal policy might have a specific microeconomic effect on certain sectors and not necessarily on the entire economy, as it is the case in the use of the monetary policy; 3) the fiscal policy could have an impact over the income distribution, with additional effects on the aggregate demand and the labor supply<sup>32</sup>.

Mankiw(1988) introduces the government sector in the model of Blanchard and Kiyotaki(1987), and analyzes the value of the tax and public expenditure balanced-budget multipliers in perfect competition as well as in a monopolistic competition setting; likewise, he explores the impact of the fiscal policy on the individual welfare. Mankiw concludes that the fiscal policy multipliers approach the values established in the 45 degree keynesian diagram as the product market becomes less competitive.

## CONCLUDING REMARKS

The NKE monopolistic competition model, truly enriches the microeconomic foundations of the NKE research. It also opens the door for future research in several issues that some time ago did not seem very promising. However, as we have been pointing out throughout this analysis, there are also some aspects that do not have yet a satisfying answer; for instance, the issues that were discussed in the representative-agent model.

With respect to the consistency between the findings of the model revised in this paper and those of the keynesian macroeconomics, we can assert first of all, that this model is consistent with the microfoundations of the keynesian involuntary unemployment. About the effectiveness of the monetary policy, the conclusions seem less compatible; it is so because the results are derived from the existence of nominal frictions which could take us back, to some extent, to the undesirable "exogeneity". Finally, in spite of the fact that the conclusions seem to fit the keynesian tradition, the effectiveness of the fiscal policy has not been deeply analyzed and this would be necessary to have a more conclusive results.

## NOTES

1. In the NKE it is possible to distinguish two research streams. The first one -on which our analysis is based- focuses on the nominal frictions of the goods market -Gordon(1990) and Romer(1993) incorporate the fundamental characteristics of this stream-. The second one stresses the imperfections of the credit market -Greenwald and Stiglitz(1993) present a survey of the main features of this approach-.
2. The incorporation of the "quasi-rational" behavior would be made a decade later by Akerlof and Yellen(1985a,b and 1987).
3. In the short run, the monopolistic competition equilibrium is not too different from the monopoly equilibrium since the number of firms and products are taken as given in both markets. In the former, each firm determines a monopoly price for its product and the margin between this price and the marginal cost is just moderate due to the high price cross-elasticity. But however, we should point out that actually some differences exist; for instance, the demand faced by a firm under monopolistic competition does not coincide with the aggregate demand curve; and also, there are information asymmetries in this case, the firms ignore the reaction of the competitors to their price strategies. However, as a first approximation, the monopoly results can be translated to the the monopolistic market.

4. To begin, we accept the three assumptions but once the nominal frictions are introduced in the model, the first one can be abandoned, since in some cases the uncertainty about the other firms' reactions will be the one originating price rigidities. This would be the case, for instance, in the "staggered price setting" that deals with the fact that not all the firms determine their prices simultaneously. And this, combined with the uncertainty about the other firms' reaction, provokes a slow adjustment of the aggregate price level to variations in the aggregate demand.

5. This is a common assumption of the monopolistic competition models. However, Matsuyama(1992) incorporates the possibility that the goods act as complements within the same sector and as substitutes across sectors. This would be the case of the shopping centers where the entry of new firms increases the profits of the firms already in the market, fact that may explain the crowd of firms.

6. The real balances are introduced to avoid Say's law which establishes that under monopolistic competition, the supply of goods produced by each firm creates its own demand. With this purpose in mind, each economic agent is allowed to choose between consumption of some specific good and some other option -that, in this model happens to be cash-. Hart(1982, p.377), for instance, talks about some good that has not been produced yet that could be money or something else.

7. In the macroeconomic models of imperfect competition is common to use either some type of Cobb-Douglas utility function -as in Cooper and John(1988) and Dixon(1987,1988)- or a function with a constant elasticity of substitution -like the one used in this paper which follows the Dixit and Stiglitz(1977) version-.

8. The introduction of this parameter implies that the marginal utility of wealth is equal to one.

9. For convenient reasons, a geometric index price is of common use in the NKE adjustment cost and monopolistic competition models. Besides, the results are not modified substantially if the price index is defined as an arithmetic mean of all the individual prices -Naish(1988, pp.107-108)-.

10. This simplification does not modify neither the final demand faced by each firm nor the aggregate demand expression. However, it does affect the price that each firm sets because in the simplified model the price does not keep any link to wages.

11. In this sense, the interpretation by Borondo(1994, p.257) seems confusing since he interprets this parameter, in the context of Blanchard and Fisher(1989) model, as the elasticity of the disutility of work. In addition, he relates the parameter to constant and decreasing returns to scale, when it would be more appropriate to refer exclusively to constant returns to scale.

12. In the simplified version of the model, a small modification has to be made to the budget constraint. The third term of the right hand side of the equality is read as the initial endowment of money plus the income received for the sale of its product.

13. We assume that the individual only cares about the income level of the current period; however, the model by Rotemberg(1987) enhances the approach by considering the maximization of the discounted value of the utility subject to an intertemporal budget constraint.

14. We follow the formalization of Blanchard and Kiyotaki(1987) labor market. But even within the NKE, the assumptions about the markets vary; for instance, Akerlof and Yellen(1985a) model a product market with identical characteristics to the one we have specified. However, their labor market is featured by the efficiency-wage approach. There, the average productivity of workers is a function of the wage they are paid, which is denoted by "e" in the production



function that has been defined as:  $Y_i = (eN_i)^\alpha$ .

15. In the hypothetical case that the model allowed for increasing returns to scale ( $1/\alpha < 1$ ), it would be impossible to make any statements since depending on the elasticity of substitution, the relative price could even decrease when there is an expansion in the demand. In this case, it is important to remember that the marginal costs are decreasing and a price decrease does not mean a reduction in profits.

16. Ball and Romer(1990, p.199-200) determine the wage in a straightforward way in the simplified version of the model. They consider that each consumption-production unit is simultaneously employed by some other unit and receives a salary that adds additional income to the budget. The advantage of this method is that it does not have to define a labor market with monopoly power. In essence, Ball and Romer analyze a walrasian labor market under the hypothesis of efficiency wages.

17. In this model there is not monetary illusion. The NKE models attempt to explain the persistence of involuntary unemployment through the rigidities of wages which also contributes to the price rigidities generated by nominal frictions.

18. Naish(1993) follows the inverse procedure, that is, he determines the aggregate demand in an IS-LM macroeconomic setting.

19. In a very important result for the NKE, Dixon finds out that the presence of nominal rigidities in only one market might have effects over the whole economy. This means that nominal rigidities in all the sectors is not a necessary condition to observe price rigidities in the economy.

20. Caplin(1993) revises the most recent literature related to this issue.

21. In the study of the consequences, at the aggregate level, of the "two-sided" rules, the work of Caplin and Leahy(1989) is a great contribution.

22. Other "new keynesian" authors have questioned this result arguing that this is a static model with very restrictive assumptions: i) a continuous and monotonic growth of the money supply; ii) an index price that varies in the same proportion as the nominal prices; iii) a uniform distribution of the real prices.

23. For Hart(1982), the crucial aspect is the assumption of monopolistic competition in the labor market, since in this case the equilibrium wage will depend positively on the workers monopoly power which simultaneously affects the price of the goods produced. A high price will mean a low demand which, at the end, will cause involuntary unemployment. This result is obtained even if the product market does not have a monopolistic competition structure. Hart arrives to this last conclusion because the specification of the utility functions do not depend on work.

24. It should be mentioned that the justification of the NKE involuntary unemployment is not restricted to the model studied here but it is extended to the "insider-outsider" approach -which incorporates the issue of workers with monopoly power-, an to the wage-efficiency models -where the entrepreneur plays a determinant role-.

25. Usually, the constant term is ignored but we believe this represents some inconveniences. In the simplified versions of the model the parameters have to take values that are not feasible in order for the constant term to be equal to one; it is so because the elasticity of substitution between goods is greater than one and  $\beta$  is less than one, or viceversa. In Blanchard and Kiyotaki(1987) model, it is actually possible to omit the constant term, and even when it is necessary to impose some restrictions on the parameters to do so, these are

compatible with the conditions that ensure the existence of an equilibrium. To avoid this problem, Ball and Romer(1989a,b, 1990, 1991) make the right modifications to the utility function such that, at the end, the constant term does not appear in the determination of the profit-maximizing prices.

26. In the simplified version of the model described here, the inclusion of adjustment costs is done by subtracting the factor "zD" from the utility function of each economic agent; "z" is the cost of adjusting the price and "D" is a fictitious variable that takes the value of one if the agent modifies his price and zero if he does not.

27. The introduction of nominal frictions in the model presents an additional advantage, since even under the assumption of agents with rational expectations, the monetary policy is still effective.

28. The demonstration of this proposition is simple. We start with a price "P" that maximizes profits. If a change in the money supply makes the firms to adjust their prices, the new price will be, let's say "P'". If they do not adjust the prices, the profits lost will be  $B(P') - B(P)$  where "B(.)" is the profit function. Focusing on "P" in this expression we can approximate the loss to:

$$B(P) = B(P') + B'(P') (P - P') + B''(P') \frac{1}{2} (P - P')^2$$

$$B(P') - B(P) = B'(P') (P' - P) - \frac{1}{2} B''(P') (P - P')^2$$

Since P' is the profit-maximizing price, then  $B'(P') = 0$ , and the loss will be proportional to  $(P - P')$ . Therefore, the closer these two prices are, the lower the loss due to rigidities. It is here where the menu-costs models find their justification because even if the loss is small, menu costs of small magnitude may explain price rigidities.

29. Silvestre(1993, p.123) points out that for the monetary policy to be ineffective it is required not only that the economy stay always in equilibrium but the equilibrium should be unique. In this case the first condition is not satisfied. In the coordination failure models, the real effects of money occur because there is a persistent equilibrium but it is not unique; so the monetary policy intervention can shift the economy from one equilibrium to another. The inclusion of this model in the NKE is not unanimous in the literature -for instance, Mankiw and Romer(1991) include them but Silvestre(1993) does not-. In these models, the monetary policy is effective, fact that brings them closer to the keynesian tradition; but on the other hand, the prices tend to adjust immediately to variations in the money supply, and this places them somewhat apart from the keynesian standpoint. But as Ball and Romer(1991) indicate, this approach is not incompatible with the menu-costs models.

30. Even Patinkin(1948) pointed out the irrelevant empirical evidence of his own proposition. Greenwald and Stiglitz(1993) ironically emphasize that two centuries would have to pass for the economy to recover from the crisis of 1929 if the expansionist effect of the real balances on the aggregate demand were used.

31. This might be due to the fact that the NKE emerges as a reaction to the New Classical Macroeconomics whose fundamental theoretical proposition is the ineffectiveness of the monetary policy.

32. The NKE monopolistic competition model does not admit this last possibility, since the assumption about the homogeneity of the utility function (degree one with respect to consumption and real balances) offsets the income effect over the

labor supply.

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