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DISCUSSION OF HYBRID NEW KEYNESIAN PHILLIPS CURVE METHODOLOGY ON INFLATION DYNAMICS

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Abstract

The new Keynesian Phillips curve accepts forward pricing and real marginal costs as the dynamics of inflation. While some firms change prices in every period, the rest of the firms keep prices constant. When fixed prices are evaluated as the lagged value of inflation, price inertia emerges. To prevent this, the hybrid model has been developed by adding backward pricing to the New Keynesian Phillips curve. In this study, while the methodological development of the hybrid model was examined technically, the statistical significance of these parameters was questioned. Thus, the limits of the hybrid model were discussed in explaining inflation dynamics.

Keywords: New Keynesian Phillips curve, price inertia, hybrid model

JEL Codes: B22, B 41, E12

ENFLASYON DİNAMİKLERİNE İLİŞKİN HİBRİD YENİ KEYNESYEN PHILLIPS EĞRİSİ METODOLOJİSİNİN TARTIŞILMASI

Öz

Yeni Keynesyen Phillips eğrisi, enflasyonun dinamikleri olarak, ileriye dönük fiyatlandırma ve reel marjinal maliyetleri ölçüt kabul etmektedir. Her dönemde firmaların bir kısmı fiyatları değiştirirken, geri kalan firmalar fiyatları sabit tutmaktadır. Sabit tutulan fiyatlar, enflasyonun gecikmeli değeri olarak değerlendirildiğinde, fiyat ataleti ortaya çıkmaktadır. Bunun önüne geçmek için, geriye dönük fiyatlandırma Yeni Keynesyen Phillips eğrisine dahil edilerek hibrid model geliştirilmiştir. Bu çalışmada, hibrid modelin metodolojik gelişimi teknik açıdan incelenirken, söz konusu parametrelerin istatistiksel olarak anlamlılığı sorgulanmıştır. Böylece, enflasyon dinamiklerinin açıklanmasında hibrid modelin sınırları tartışılmıştır.

Anahtar Kelimeler: Yeni Keynesyen Phillips eğrisi, fiyat ataleti, hibrid model

JEL Kodları: B22, B41, E12

INTRODUCTION

Phillips curves are at the center of the debate on the relationship between inflation dynamics and monetary policy. Because shocks, in which total demand and disinflation strategies are effective, play an important role in determining the monetary policy. This discussion has been explored especially within the framework of the New Keynesian Phillips curve.

Although the new Keynesian Phillips curve is the basic element of modern macro models, it derives its power from micro bases (Arnato and Laubach, 2003; Smets and Wouters, 2003; Christiano et al., 2005; Gali et al., 2011). Accordingly, forward looking expectations about inflation play a role when the New Keynesian Phillips curve is driven by real marginal cost or current output gap.

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Therefore, there is a clear structural interpretation of these parameters. The final model created in the new Keynesian Phillips curve focuses on how monetary policy should react to the real sector.

In the model of Calvo (1983), the pioneer of the New Keynesian Phillips curve, the increase in product prices will increase the future inflation expectations due to the increase in the real marginal costs of the firms. As a result, a different monetary policy towards high inflation will be followed.

On the other hand, Ma (2002), Bardsen et al. (2004), Mavroeidis (2005), Nason and Smith (2008), Martins and Gabriel (2009) agree that the New Keynesian Phillips curve will not be effective in guiding monetary policy , because it is a problem of parameter definition. Rudd and Whelan (2007) stated that under the assumption of rational expectations, unit labor costs shaped by forward inflation expectations do not adequately explain inflation dynamics.

In addition, the New Keynesian Phillips curve has become controversial around price inertia, considering that price rigidity or inertia is a key mechanism affecting monetary policy (Dennis, 2007: 1-3). Empirically approaching the issue, Andrews (1999), Donald and Newey (2001), Kapetanios (2006), Nason and Smith (2008), Hwang and Kim (2012) state that the parameters in the New Keynesian Phillips curve should be predictable. Rudd and Whelan (2005 a, 2007) think that backward looking expectations are more effective in explaining inflation.

Gali and Gertler (1999) included the lagged value of inflation related to inflation expectations and aggregate demand within the framework of Calvo (1983) model. The model, which has been transferred to the literature as the Hybrid New Keynesian Phillips curve, explains why monetary policy responds gradually to shocks. Firms adjust their prices according to the average of lagged total inflation and current inflation and determine the future inflation.

The aim of this study is to guide the parameters to be considered in the selection of monetary policy strategies and instruments to be applied for inflation targeting. In this context, based on the work of Gali and Gertler (1999) on determining inflation dynamics, which play a key role, the hybrid model are discussed objectively and methodologically. It is thought that the study will contribute to the literature both in terms of evaluating different economic thoughts about macroeconomic problems and questioning theory and statistics together.

In the next part of the study, the theoretical framework for the development of the Hybrid New Keynesian Phillips curve is presented in three parts. In the conclusion part, hybrid model is interpreted in line with the findings obtained.

1. TRADITIONAL PHILLIPS CURVE

The Phillips curve, which expresses the inverse relationship between wage inflation and unemployment rate, is defined as follows (Phillips, 1958: 290)[2]:

$$\pi_t = \alpha + \beta u_t + e_t \qquad (1)$$

[2] The original version of the Phillips curve is as follows (Phillips, 1958: 290): $y + a = bx^e$ veya $\log(y + a) = \log b + c \log x$. Where, y; percentage change in wages, x; percentage change in unemployment.

In Equation (1), π_t; wage inflation, u_t; the current unemployment rate and $\beta < 0$. Accordingly, a high unemployment rate means excessive labor supply, while putting downward pressure on wages. Therefore, the balance between inflation and unemployment plays an important role in the implementation of economic policies. In this case, the Phillips curve represents the supply side of the economy, the IS-LM curves represent the demand side.

However, the relationship between inflation, which is a nominal variable, and unemployment, which is a real variable, was criticized in the second half of the 1960s. Phelps (1969) and Friedman (1977) suggested that the traditional Phillips curve contradicts the rational expectations hypothesis. Because workers will negotiate real wages based on inflation expectations instead of nominal wages. With high inflation, workers will perceive that inflation will be higher than expected and real wages will drop. Thus, the unemployment rate will return to the beginner level.

In fact, this idea expressed by Phelps and Friedman expressed in his work Muth (1961) as adaptive expectations or backward expectations (Muth, 1961: 321-327):

$$\pi_t = \gamma \pi_t^e + \beta(u_t - u_n) + e_t \quad (2)$$

In Equation (2), π_t^e; the expected inflation, calculated as the weighted average of past inflation rates, u_n; the natural unemployment rate. In this context, workers form their inflation expectations according to past forecast errors.

However, Sargent (1971) and Lucas (1972) stated that the workers' only predicting real wages with historical inflation data could turn into systematic estimation errors. Therefore, a dataset containing forward looking inflation information should be created up to the current period.

2. NEW KEYNESIAN PHILLIPS CURVE

Taylor (1980) and Calvo (1983) developed the Phillips curve, which includes forward-looking wages and price choices for workers and firms. The New Keynesian Phillips curve, which is considered as the relationship between inflation and the real marginal costs[3] of firms, is as follows (Calvo, 1983: 385-388):

$$p_t = \delta p_{t-1} + (1-\delta) p_t^* \quad (3)$$

In Equation (3), p_t; total price level, p_{t-1}; the previous period is the total price level.

$$p_t^* = (1 - \emptyset\delta) \sum_{i=0}^{\infty} (\emptyset\delta)^i \, E_t\{mc_{t+i}^n\} \quad (4)$$

In Equation (4), p_t^*; price level that provides profit maximization to companies, $\emptyset$; discount factor, mc_{t+i}^n; real marginal costs of firms. Kiley (1997), states in particular that the fact that inflation has great real marginal cost elasticity leads to monetary policy differences.

[3] Using the Cobb-Douglas production function known as $Y = A_t K_t^{\alpha} N_t^{\alpha-1}$, the real marginal cost is obtained as follows (Gali and Gertler, 1999: 9): $mc_t = \frac{W_t}{P_t} \frac{1}{\partial Y_t / \partial N_t} = \frac{\frac{W_t N_t}{P_t Y_t}}{\alpha - 1}$ where, real marginal cost is the ratio of unit cost of labor to marginal product. In the other words, unit labor costs are dominant (Lown and Rich, 1997).

When both equations are examined, it is seen that the New Keynesian Phillips curve is based on micro bases and its parameters have a clear structural interpretation. δ; it is the ratio of firms that cannot adjust their prices optimally in the current period, (1- δ); it is the ratio of firms that optimally adjust their prices in the current period. Therefore, firms that cannot adjust their prices are tied to past prices. However, firms need to make optimal price adjustments in order to maximize their profits. Otherwise, the price level that maximizes the profit of the firms will be written as follows:

$$p_t^* = mc_{t+i}^n \quad (5)$$

Where, firms will make normal profit instead of maximum profit. Given the situation in question, the New Keynesian Phillips curve[4] is expressed as follows:

$$\pi_t = \lambda mc_t + \gamma f E_t(\pi_{t+1}) \quad (6)^5$$

In Equation (6), $\pi_t = p_t - p_{t-1}$ the current period inflation, $E_t(\pi_{t+1})$; the future inflation forecast. Accordingly, current period inflation is a function of real marginal cost and expected inflation. Firms will act forward for the purpose of profit maximization.

However, ignoring the price rigidity or inertia caused by firms choosing the same price except for differentiated products and the prices that could not be adjusted in the current period were equal to the past price level, was effective in developing the Hybrid New Keynesian Phillips curve (Gali and Gertler, 1999: 4; Dennis, 2006: 1-4).

There are two different views on the assumption of price rigidity. First of all, according to Mankiw and Reis (2001: 7-9), there is information rigidity for firms. Because firms are pricing taking into account the costs of collecting information, so the outdated information leads to different inflation forecasts. The second is Dupor et al. (2006: 1-4) advocates for price and information rigidity. According to them, there are two different firm behaviors that prefer pricing rigidity or information rigidity.

3. HYBRID NEW KEYNESIAN PHILLIPS CURVE

The New Keynesian Phillips curve, which includes the past inflation component, is defined as follows (Gali and Gertler, 1999: 13-14):

$$p_t^* = (1-w)p_t^f + wp_t^b \quad (7)$$

[4] Considering the Cobb-Douglas production function and the Taylor monetary policy rule, the real marginal cost and output gap ($x_t = y_t - y_t^*$) will equal each other under the assumption that companies do not have variable capital (Rotemberg and Woodford, 1997: 298-300). Thus, based on the relationship between output gap and real marginal cost, the New Keynesian Phillips curve is defined as follows (Gali and Gertler, 1999: 6): φ; the elasticity of the real marginal cost to the output gap is $mc_t = \varphi x_t$. Then, $\pi_t = \lambda\varphi x_t + \gamma f E_t(\pi_{t+1})$. When the relationship between inflation and output gap is addressed, a faster total demand increase to be experienced compared to the increase in production leads to an economic boom (Ball, 1991: 1-25).

[5] $E_t\{(\pi_t - \lambda mc_t - \delta\pi_{t+1})z_t\} = 0$ When expressed z_t; is the vector of variables from the current period and before (Gali and Gertler, 1999: 15). This is the basis for using the Generalized Moments method (GMM). In this way, direct estimates of structural parameters are made.

In Equation (7), w; firms with historical expectations regarding inflation, $(1-w)$; firms with forward looking expectations regarding inflation. Because of, p_t^f; price set by firms with forward looking expectations, p_t^b; price set by firms with backward looking expectations.

The price set by firms using forward looking inflation expectations is written as in Calvo (1983) model:

$$p_t^f = (1-\emptyset\delta)\sum_{i=0}^{\infty}(\emptyset\delta)^i\, E_t\{mc_{t+i}^n\} \tag{8}$$

The price set by firms whose inflation expectations are based on the past is expressed as follows:

$$p_t^b = p_{t-1}^* + \pi_{t-1} \tag{9}$$

In Equation (9), the price is adjusted according to past inflation due to the latest price correction.

The hybrid version of the New Keynesian Phillips curve as a combination of equations (3), (7), (8) and (9) is:

$$\pi_t = \lambda mc_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b\, \pi_{t-1} \tag{10}$$

Where,

$$\lambda = (1-w)(1-\delta)(1-\emptyset\delta)\theta^{-1} \tag{11}$$

$$\gamma_f = \emptyset\delta\theta^{-1} \tag{12}$$

$$\gamma_b = w\theta^{-1} \tag{13}$$

$$\theta = \delta + w[1-\delta(1-\emptyset)] \tag{14}$$

The parameters in the Hybrid New Keynesian Phillips curve provide useful criteria for two specific situations: The first of these, when $w = 0$, all firms create forward looking expectations regarding inflation and are in line with the New Keynesian Phillips curve outlined in the previous section. The second is, when $\delta = 1$, under the effect of real marginal cost, $\gamma_f + \gamma_b = 1$ becomes and hybrid model is reached.

CONCLUSION

The new Keynesian Phillips curve links inflation with production costs and forward looking inflation expectations. Accordingly, inflation is flexible against firm behavior and inflation expectations. However, price inertia, which cannot be explained by forward looking inflation expectations, remains out of analysis. For this reason, a hybrid model that includes backward looking inflation expectations representing price inertia has been developed.

On the other hand, the hybrid model, which offers variation in determining inflation dynamics within the framework of its methodological development, has two main problems statistically. The first of these, although real marginal costs are an important quantitative variable, they only consist of unit labor costs. Therefore, as capital costs are excluded from the hybrid model, a small part of

economic activities is reflected. The second is, in case the rational expectations are not valid, the hybrid model turns into the traditional Phillips curve since the forward looking inflation expectations coefficient will be $\gamma_f = 0$.

As a result, while the hybrid model defines the detailed formulation of inflation dynamics, it remains statistically weak.

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