

## **The new Keynesian Phillips Curve. Implications. Strengths and weaknesses**

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**Abstract.** *The present paper explores the first Dynamic Stochastic General Equilibrium New Keynesian Model and it seeks to emphasize the main advantages and disadvantages involved by the NKPC. Firstly, we start the analysis by discussing briefly about the history of the Phillips Curve and then we try to stress the most important aspects regarding the standard and the hybrid New Keynesian Phillips Curves. Secondly, our goal is to provide an insight about this topic which can represent the starting point for further analysis. Moreover, a special section is included which emphasizes the evidence referred to the NKPC and the hybrid NKPC.*

**Keywords:** the new Keynesian Phillips curve, the hybrid new Keynesian Phillips curve, dynamic stochastic general equilibrium models, forward-looking inflation, backward-looking inflation.

**JEL Classification:** H10, O23.

## 1. The traditional Phillips Curve and the transition to the NKPC

In most industrialized countries, inflation seems to be pro-cyclical. Therefore, inflation rate is high when economic activity is high. Moreover, when economic activity is quantified through the rate of unemployment, this yields to the statistical relationship called “the Phillips curve”. This can also be considered as a menu for policymakers, as they can choose either low inflation-high unemployment or high inflation-low unemployment. Hence, there exists a trade-off.

Also, the interpretation of the Phillips curve underlines that the relationship unemployment-inflation is structural and it cannot break down if a monetary decision-maker seeks to exploit the trade-off. But after the high inflation periods that many economies faced during the 1970s, the Phillips curve’s structural interpretation was not accepted anymore. Nevertheless, after periods with low inflation rates during the 1980s and early 1990s, more economists have started their work in finding a new structural interpretation of the naive Phillips curve and that was the time when the NKPC appeared.

## 2. DSGE new Keynesian Model

### 2.1. The new Keynesian Phillips Curve

In this section, we present the main elements of the standard model. That is, the NKPC assumes the existence of nominal price rigidities. Imperfect competition in the market of goods is included by supposing that each firm can produce differentiated goods for which it has the power to set the price (an important assumption is that firms are price setters and not price takers). Furthermore, there are some constraints imposed on the mechanism of price adjustment, by supposing that there are firms that decide to change their prices every period, while there are other firms that keep the prices fixed. At every point in time a fraction  $\theta$  of firms keep prices fixed and the rest,  $(1 - \theta)$  adjust prices optimally. Therefore, the following analysis is based on the model proposed by Calvo (1983, pp. 383-398). In this model, every firm can keep fixed prices until it observes a random signal which stresses that the price can be changed. Hence, these changes of the price are considered as “staggered” and when fixing prices, firms take into consideration the prices the other firms will ask for until they can set prices again.

Following Gali (2005, pp. 1-10) notation, we obtain the following formulas for the basic NKPC:

a. in terms of the marginal cost:

$$\Pi_t = \beta E_t \{\Pi_t + 1\} + \lambda m \hat{c}_t \quad (1)$$

$$\text{where } \lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta} \theta$$

b. in terms of the output gap:

$$\pi_t = \beta E_t \{\pi_{t+1}\} + k \tilde{y}_t \quad (2)$$

$$\text{where } k = \lambda \left( \sigma + \frac{\varphi + \alpha}{\varphi - \alpha} \right)$$

Next, we are going to underline the first set of weaknesses and strengths based on what the assumptions of the model implied and what the evidence showed. We consider as strengths the characteristics that match both the assumptions in the model and in practice and weaknesses the ones that are not true after being tested.

**Table 1.** Strengths and weaknesses of the standard NKPC

In the model...	vs. the evidence:	Strengths	Weaknesses
Inflation conducts measures of $\tilde{y}_t$ (output gap)	The output gap seems to lead measures of inflation (for instance, Fuhrer and Moore in 1995)	✓	
There is no trade-off between the output gap and inflation	Inflation stabilization requires large output fluctuations (for supply shocks)		✓
Disinflation can be obtained in a costless way	Periods of disinflation involved over time massive output losses		✓
Inflation is mainly forward-looking and lagged inflation is not relevant	Inflation seems to exhibit a lot of inertia (for example, Ball in 1994)		✓
NKPC is able to reproduce inflation persistence	Hump-shaped response of $\pi_t$ to shocks		✓

**Source:** Table made by the author based on the analysis of Gali, Jordi (2002) on the 15<sup>th</sup> of March 2019.

Another important strength to mention is that the NKPC is micro-founded. Sandeep Mazumder affirmed that: “Fischer (1977), Taylor (1980) or Calvo (1983) are the pioneers of analyzing the inflation in a modern econometric way by observing the nominal wage and the process of price-setting by firms and individuals that look forward. If we aggregate such individual behavior, this yields to the relation between real marginal cost and short-term inflation. So, this is the NKPC, which stands out because it represents a macroeconomic relation that was borne out of explicit micro-foundations” (Mazumder, 2008, pp. 1-25).

Additionally, Walsh (2003, pp. 195-225) believes that the NKPC is different from traditional Phillips curves, as the former was derived from the model of optimizing the behavior on the side of price setters, conditioned by the supposed economic environment (that is, monopolistic competition, constant elasticity in terms of demand curves, randomly arriving chances to set prices). He underlines one advantage of expressing the basic NKPC

depending on real marginal cost. Through  $\lambda$  (see equation 1) it can be seen what is the impact that real marginal cost exhibits on inflation (depending on  $\beta$  and  $\theta$ , which are structural parameters). On the first hand, if beta increases this implies that for the firm is more important the expected profits from future and as a result  $\lambda$  goes down, while on the other hand, if theta goes up,  $\lambda$  is being reduced (under the circumstances that firms can adjust prices less frequently this implies that firms focus less on present marginal cost -but more on marginal costs expected in the future- when it is possible to fix the prices).

Also, as it can be observed from the above formulas, that the NKPC can be measured either by overall detrended GDP or in terms of the marginal cost. However, the coefficients on the output gap seems to be negative and insignificant from the statistic point of view. Gali and Gertler (1999, pp. 195-222) stressed that the output gap resulted from the detrended real GDP is not a suitable proxy and the level of output includes important fluctuations.

Nonetheless, even though Gali, Gertler and Salido proved in some papers (via GMM estimation) that for both the USA and Euro-area, the labor income share's coefficient is statistically significant, considering labor income share the proxy for marginal cost cast a lot of controversy. The first reason is that labor income share is countercyclical, in contrast with the theory which suggests that marginal cost has to be procyclical.

We can conclude that the real marginal cost has a countercyclical proxy, as it violates what theory predicts, that is, marginal cost is procyclical. Secondly, labor share proxy of marginal cost is based on a very restrictive assumption, in other words, Gali and Gertler consider that the input (labor) is adjusted automatically at a fixed rate of the real wage and it is considered to be too simplistic. Mazumder (2010, pp. 747-765) tries to find a solution to this problem by constructing a 'disaggregated NKPC' (for the manufacturing sector) and seeks to improve the measurement of the marginal cost, but the test of this 'disaggregated NKPC' stresses an insignificant (negative) coefficient on marginal cost.

However, Bratsiotis and Robinson (2016, pp. 1826-1849) offer an alternative to the previous studies and construct unit total costs as a real marginal cost proxy by adding something new in the literature in two dimensions:

- transition from non-farm Gross Domestic Product, to all-sectors GDP;
- consider labor and non-labor costs proxy to marginal cost.

The results of using the Unit total costs emphasized:

- a more important role of forward-looking behavior than the one implied by the unit labor costs;
- the better fit of noticed inflation, that is, the current evidence for real marginal costs seen as the main variable in the NKPC;
- the duration of fixed nominal contracts which is closer to those proposed by firm-level surveys or than that involved by unit labor costs.

Nevertheless, Nason and Smith (2008, pp. 361-395) also debates the problem of finding a small and less significant coefficient on real marginal cost, result that is very bad for the NKPC as being a model of inflation and for monetary policy as well. Another weakness of the standard NKPC that is useful to point out is that there is a massive difference between the baseline NKPC and what individuals use to measure the inflation with real data.

## 2.2. The hybrid new Keynesian Phillips curve

However, the standard NKPC was attacked by the Keynesians as well who believed that it is too forward - looking and this does not capture reality at all. Moreover, for almost all measures of inflation and those considered optimal for marginal cost, inflation appears to be more persistent in comparison with the marginal cost. Furthermore, because marginal cost leads to inflation in the basic NKPC, this makes very difficult for the model and the data to match each other. Therefore, economists used the ‘rule of thumb’ (backward looking) in order to derive the Hybrid New Keynesian Phillips Curve (HNKPC).

$$\pi_t = \gamma_b \Pi_{t-1} + \gamma_f E_t \{\pi_{t+1}\} + \lambda m\hat{c}_t \quad (3)$$

$$\text{where } \lambda = \frac{(1-\omega)(1-\theta)(1-\beta\theta)}{\theta+w[1-\theta(1-\beta)]}$$

Fuhrer (1997, pp. 214-234) explains that the HNKPC is driven by inflation inertia. It is better than the standard NKPC, but if one looks at the coefficient obtained from the estimates, it is lagged inflation which drives the equation and not the forward-looking.

Jeffrey Fuhrer (1995, pp. 1-17) observes that for policy simulations or any other longer-run simulations, a mixture of forward-looking/backward-looking price specification can provide a better behavior without accepting a trade-off on empirical performance (strength).

Furthermore, most of the economists agree that the HNKPC performs better than the standard NKPC (strength), but it continues to fail to match the dynamics of inflation and also to explain the length of price contracts (weakness).

## 3. Empirical evidence

Abbas, Bhattacharya and Sgro (2016, pp. 378-403) together with supplementary studies such as Gali and Gertler (1999, pp. 195-222) and Gali et al. (2001, pp. 1237-1270) etc. have been tested mainly the standard NKPC and the HNKPC for the United States and for the countries from the Euro-area.

The practical performance of the baseline NKPC essentially relies on the proxy for the real economic activity. The output gap is generally used for estimation of the standard NKPC. But, the predicted coefficient on output gap seems to be negative and that is, statistically insignificant.

Gali and Gertler (1999, pp. 195-222) underline that the output gap resulted from the de-trended Gross Domestic Product (GDP) does not represent a good proxy and the potential output level might contain substantial variations. For this reason, marginal cost was proposed to be a better proxy of  $\tilde{y}_t$  (the output gap). They tested the baseline NKPC and the hybrid NKPC (HNKPC) for the US and they employed the GMM estimation method. Additionally, the authors used the share of labor income as a proxy for the  $m\hat{c}_t$  (marginal cost). Their finding is that for the baseline NKPC the coefficient on share of labor income is positive and significant from the statistical point of view. In contrast, if the output gap is

utilized as a proxy for the real economic activity, the coefficient seems to be negative and statistically insignificant. In terms of the HNKPC with the labor income share identical findings are reported. Specifically, the coefficient on predicted inflation which ranges from 0.59 to 0.87 is significant and dominates the parameter on lagged inflation that varies from 0.085 to 0.383. This implies that dynamics of inflation are forward looking in the US.

Gali, Gertler and Lopez-Salido (2001, pp. 1237-1270) showed that analogous to the results for the United States, the New Keynesian Phillips Curve (NKPC) with the labor income share explained dynamics of inflation for the Euro-area data. The parameter on labor income share stayed positive and statistically significant in the standard NKPC and HNKPC. The parameter on expected rate of inflation was again quantitatively bigger than the parameter on lagged inflation. This means that dynamics of inflation are forward looking as well, a finding compatible with the theoretical expectations of the NKPC.

However, employing the GMM estimation in Gali and Gertler (1999, pp. 195-222), Gali et al. (2001, pp. 1237-1270), together with the use of labor income share as a proxy for marginal cost have been examined and criticized. Particularly, Rudd and Whelan (2006, pp. 303-320) stressed that the parameter on lagged (forward) rate of inflation is biased downwards (upwards) as the domination of the lagged inflation has already been represented by the predicted inflation in the first-step of the regression. Rudd and Whelan (2006, pp. 303-320) also discovered that the NKPC exhibited a deficient empirical fit for the US data. The share of the labor income was not the right proxy for the economic activity whereas the data also did not tolerate the dominant role of future rate of inflation against lagged rate of inflation. These discoveries are in contradiction with those of Gali and Gertler (1999, pp. 195-222) and Gali et al. (2001, pp. 1237-1270).

In addition, Rudd and Whelan presented empirical evidence to demonstrate that the share of labor income displays counter-cyclical movements in periods of recessions whereas the output gap is pro-cyclical in economic recessions. Thus, the output gap appears to decline with recessions and this implies that it is a better proxy than the share of labor income for real economic activity.

As a response to the critics, Gali, Gertler and Lopez-Salido (2005, pp. 1107-1118) explained that the previous empirical discoveries of Gali and Gertler (1999, pp. 195-222) and Gali, Gertler and Lopez-Salido (2001, pp. 1237-1270) stayed valid under distinctive empirical specifications, methods of estimation as well as distinctive sets of instruments.

#### **4. Conclusion**

However, this literature developed by the New Keynesian School has been criticized a lot from the neoclassical because they not only used some elements from their theory, but also from Keynesian School (as they used imperfections from Keynesian models in order to match reality). Being so forward looking can also imply trouble (if one can run any regression of any variable, there will be observed a lot of correlation in terms of inflation; even if the variable is stationary, there can still be observed high correlation; this is where exactly the standard NKPC was “hit”). Nevertheless, Central Banks across the world use

Dynamic Stochastic General Equilibrium models, because they include imperfections observed in the real world.

There are lots of economists who criticized this model, but unfortunately nobody suggested a model that can fit better for the Central Banks to use. Last but not least New Keynesian School intended to capture the fact that it does not really matter what happens in the present or in the past in terms of surprises (in contradiction with the Keynesian School's way of thinking), but what matters the most are the expectations regarding leading inflation.

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