Ekonomik Yaklaşım, Cilt : 22, Sayı : 79, ss.1-20

THE NEW KEYNESIAN PHILLIPS CURVE: IN SEARCH OF IMPROVEMENTS FOR ADAPTATION TO THE TURKISH ECONOMY

Ayşegül ERUYGUR*

Abstract

This paper provides a survey of the vast literature on the New Keynesian Phillips Curve (NKPC) by attempting to give a complete picture of the many disagreements surrounding the NKPC from both a theoretical and an empirical perspective. A few NKPC studies that are applied to Turkish data provide mixed evidence on the validity of this curve for the Turkish economy. The NKPC models employed in the Turkish literature do not account for one or more key structural features of the Turkish economy and thereby give rise to the reported conflicting results. These studies employ different modeling approaches especially when open economy factors are introduced. The NKPC model for the Turkish economy should combine imported intermediate goods with incomplete exchange rate pass through in import prices. The incomplete pass through assumption allows one to model import pricing decisions and the inclusion of imported intermediate inputs to the production function reflects an empirical regularity for the Turkish economy. In Turkey most of goods imported by Turkey are at the intermediate level and constitute a large fraction of the costs of the industry.

***Anahtar sözcükler**: New Keynesian Phillips Curve (NKPC), Inflation, Open economy, Law of One Price, Exchange Rate Pass-Through.*

***JEL Sınıflaması:** E30, E31, F41.*

* Assist. Prof. Dr., Çankaya University, Department of Economics.

Yeni Keynesyen Phillips Eğrisi: Türkiye Ekonomisine Uyarlama için Bir Geliştirme Arayışı

Özet

Bu makalede oldukça geniş olan Yeni Keynesgil Phillips Eğrisi literatürü; hem teorik hem de ampirik açıdan bir çok tartışmayı gözler önüne serecek biçimde incelenmiştir. Yeni Keynesgil Phillips Eğrisi'nin Türkiye uygulamaları bu eğrinin Türkiye'ye uygulanabilirliği ve geçerliliğiyle ilgili oldukça çelişkili sonuçlar vermektedir. Bu çelişkili sonuçlar özellikle, bu çalışmalarda Türkiye'nin önemli yapısal özelliklerinin göz ardı edilmesine ve açık ekonomiyi tanımlayan etmenlerin Yeni Keynesgil Phillips Eğrisi'ne dahil ediliş şekline göre oluşan farklı model yapılarına atfedilmiştir. Türkiye'ye uygulanacak bir Yeni Keynesgil Phillips Eğrisi modelinde, ithal ara malları içeren bir üretim fonksiyonu, ithal mallarda tam-olmayan döviz kuru geçişkenliği ile birleştirilmelidir. Ampirik bulgular ithal malı fiyatlarına kur geçişkenliğinin tam olmadığını gösterdikleri halde; Türkiye için yapılmış çalışmaların hiçbirinde bu özelliğe yer verilmemiş ve dolayısıyla da ithal malı fiyatlama kararı modellenememiştir. Bunun yanı sıra, Türkiye'ye uygulanan Yeni Keynesgil Phillips Eğrisi modellerinde üretim sadece emeğin üretim faktörü olduğu doğrusal Cobb-Douglas fonksiyonu kullanılarak modellenmiştir. Halbuki Türkiye'ye ithal edilen malların çoğu ara malı düzeyindedir ve endüstrilerin üretim maliyetlerinin temelini de yine bu girdilere yapılan harcamalar oluşturmaktadır.

Key words: *Yeni Keynesgil Phillips Eğrisi, Enflasyon, Açık Ekonomi, Tek Fiyat Yasası, Döviz Kuru Geçişkenliği.*

JEL Classification: *E30, E31, F41.*

1. Introduction

Phillips curve has always been one of the most important and controversial relations in macroeconomics. It has undergone recurrent revisions as macroeconomics has evolved with the introduction of rational expectations, intertemporal optimization and various rigidities. Still over the last decade it has been challenged by the so-called New Keynesian Phillips Curve (NKPC).

The NKPC describes the inflation process within a *dynamic general equilibrium* framework where *imperfectly competitive* firms face *constraints on price changes*. This framework integrates the Keynesian features of *imperfect competition* and *nominal rigidities* into a microeconomic founded dynamic optimizing model called the *new neoclassical synthesis* model. Allowing for both

nominal rigidities and market imperfections in these models alters the transmission mechanism for shocks and also provides a more potent role for monetary and fiscal policy. In this way, one goal of this new strand of research is to provide an analytical framework that is relevant for policy analysis. These models are theoretically consistent, have explicit microeconomic foundations, are able to model risk and uncertainty, provide a rigorous analytical groundwork for credible welfare and policy analysis, and are exempt from the Lucas critique due to the direct linkage between its parameters and the behavior of agents. The NKPC is the crucial equation that describes the *supply block* of these models. It serves to estimate the model's structural parameters that capture price setting behaviour in an economy. With all the aforementioned theoretical underpinnings, it is not surprising that the NKPC is currently the most commonly used inflation dynamics model in modern macroeconomics.

A crucial issue, however, is whether the NKPC is empirically relevant. The studies that have found empirical support for the NKPC are accumulating rapidly from all over the world. In particular, among others, the studies of Galí and Gertler (1999), Galí, Gertler and Lopez-Salido (2001), Galí and Lopez-Salido (2001), Balakrishnan and Lopez-Salido (2002), Batini, Jackson and Nickell (2005), and Muto (2006) give empirical support for the NKPC using data from US, Euro area, Spain, UK, and Japan. However, Rudd and Whelan (2007), Lindè (2005), Bjørnstad and Nymoen (2008) and Dufour, Khalaf and Kichian (2006) argue that the NKPC fails to give a good description of the inflationary process in the U.S., OECD counties and Canada. Therefore, while the NKPC is argued to become the workhorse equation for describing short term inflation dynamics by some researchers, there is still an ongoing debate about its merits.

The parameter values that result from the estimation of the NKPC largely depend on the model specification used. Thus, the empirical success or failure of the NKPC depends very much on the way the microeconomic foundations are modeled. As the NKPC was originally conceptualized for a closed economy setting, it should be altered accordingly if it is to be estimated for an open economy like Turkey. External influences on inflation need to be taken into account to improve the validity of the results.

A few NKPC studies that are applied to Turkish data provide mixed evidence on the validity of this curve for the Turkish economy. When the Turkish literature is evaluated from a theoretical perspective, the mixed empirical results can be attributed to the diverse modeling approaches used in these studies. The NKPC models employed in the Turkish literature do not account for one or more key structural features of the Turkish economy (i.e. openness, high dependence of the

costs of industry to intermediate goods especially imported ones and incomplete exchange rate pass through to import prices) and thereby give rise to the reported conflicting results. In light of these, this paper discusses the approach that seems most promising for the successful adaptation of the NKPC to the Turkish economy.

The paper proceeds as follows. Section 2 reviews the basic theory underlying the NKPC and discusses the existing empirical literature. We distinguish between the closed and open economy NKPC literature and show that there is an ongoing debate on the appropriate specification of this curve for both the closed and open models. A few NKPC studies that are applied to Turkish data also provide mixed evidence on the validity of this curve for the Turkish economy and section 3 is reserved for the survey of these studies. Section 4 highlights the lessons derived from the literature and relates them to the key modeling features that a NKPC formulation should have if it is to be adapted to the Turkish economy. Finally, section 5 is reserved for the concluding remarks.

2. The NKPC: Background Theory and Evidence

As argued in Gordon (2008), the Phillips curve has mainly embraced an American perspective since the work of Samuelson and Solow (1960). Gordon (2008) attributes this to the dominance of the literature by Americans and to the empirical studies generally investigating its applicability to the American economy. For the same reasons the early literature on the NKPC has also adopted an American perspective. Since the U.S. is virtually considered as a closed economy, the most influential papers of the early NKPC literature has commonly used closed economy models. Still in the literature when one refers to the so called NKPC, a single basic formulation comes into mind and that is the standard *closed* economy NKPC specification that will be presented in subsection 2.1.

More recently, Batini et al. (2005), Balakrishnan and Lòpez-Salido (2002), and Galí and Lòpez-Salido (2001) have highlighted the importance of introducing *open* economy aspects to the basic closed economy specification of the NKPC. These authors agree that external influences on inflation need to be taken into account to improve the validity of the results. Thus, subsection 2.2 discusses the open economy NKPC models from both a theoretical and an empirical point of view.

2.1 Closed Economy NKPC Models

The *standard* formulation of the NKPC describes the inflation process within a dynamic general equilibrium framework where monopolistically competitive firms face constraints on price changes. In most of the literature a *rational expectations*

staggered price setting model of Calvo (1983) is assumed to simplify the aggregation problem where each firm has a probability *(1-θ)* of being able to reset its price in any given period. Then, optimization on behalf of firms subject to this Calvo pricing constraint leads to the following *pure forward looking* version of the NKPC

$$\pi_t = \lambda mc_t + \beta E_t\{\pi_{t+1}\} \tag{2.1}$$

where π_t denotes the inflation rate at time t, mc_t represents the firm's real marginal cost (measured as log deviation in period t from its steady state value) and $0<\beta<1$ is the subjective discount factor[1]. $E_t\{\pi_{t+1}\}$ is the *rational expectation* of π_{t+1} at t that is conditional on all the information available at time t implied by the model, Ω_t.

According to equation (2.1) current inflation is a function of expected *future inflation* and current real marginal costs, which is a measure of the real economic activity. In the *traditional Phillips curve*, inflation is also a function of the real economic activity, but the striking difference is the *forward looking* nature of inflation emphasized by equation (2.1). This difference stems from the expected future inflation term appearing in equation (2.1) so that when (2.1) is iterated forward, one can obtain,

$$\pi_t = \lambda \sum_{k=0}^{\infty} \beta^k E_t\{mc_{t+k}\} \tag{2.2}$$

In contrast to what the traditional Phillips curve literature argues, equation (2.2) clearly shows that *past inflation* is *not* a relevant factor in determining current inflation. Current inflation is just equal to a discounted stream of expected *future* marginal costs. Therefore, equation (2.1) is called the *pure forward looking* specification of the NKPC. The NKPC in this form implies *no intrinsic inflation inertia*[2]. This feature is a consequence of the fact that firms facing constraints on the

---

[1] A detailed derivation of this equation can be found in Woodford (2003, pp. 187-188).

[2] Intrinsic inflation inertia is defined by Rudd and Whelan (2007) as the structural dependence of inflation on its own lagged values.

frequency of price changes are aware that a price once set may remain for many periods so that they set current prices in anticipation of future demand and cost conditions. Since aggregate price level in any period is determined by current pricing decisions, inflation is forward looking. This *forward looking* nature of inflation dynamics is the most crucial feature of the NKPC literature.

Equation (2.1) makes it clear that the theory underlying the NKPC relates inflation to *real marginal costs*. The closed economy applications of the NKPC have commonly used an *output gap* variable (i.e. detrended gross domestic product) to measure the real marginal cost. With certain restrictions on technology and labor market structure, real marginal costs can be proved to move *proportionately* with the *output gap* and therefore equation (2.1) can be reformulated as follows[3]:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa y_t \tag{2.3}$$

where y_t denotes the output gap (again expressed as percentage deviations from its steady state value). When this equation is iterated forward the following equation is obtained:

$$\pi_t = \kappa \sum_{k=0}^{\infty} \beta^k E_t\{y_{t+k}\} \tag{2.4}$$

Despite the strengths that the NKPC enjoys on the theoretical side, the pure forward looking version given in (2.3) has been criticized for producing implausible results regarding inflation dynamics. First, in contrast to what equation (2.2) predicts inflation displays a considerable degree of inertia (Christiano, Eichenbaum and Evans, 2005; Fuhrer and Moore, 1995). Second, equation (2.4) implies a positive correlation between current inflation and future output and therefore leads to the conclusion that inflation *leads* output. However, the opposite is found when business cycle data is analyzed (Fuhrer and Moore, 1995; Galí and Gertler, 1999). Third, it follows from (2.4) that inflation can be reduced immediately *without* any output loss if a central bank can credibly commit itself to a zero path of future output gaps. However, as discussed in Galí and Gertler (1999), Fuhrer and Moore (1995), and

[3] See Galí and Gerter (1999) and Galí et al. (2001) and the references therein.

Ball (1994) disinflations induce large output losses. Fourth, equation (2.3) implies that the response of inflation to contractionary or expansionary monetary policy involves jumps, but the data shows that inflation responds to monetary policy shocks in a hump shaped fashion. (Ball, 1994; Christiano et al., 2005).

These empirical shortcomings have led the literature to develop a NKPC model that nests the pure forward looking NKPC and the backward looking traditional Phillips curve into a *hybrid* form where current inflation is also a function of *past inflation*. Galí and Gertler (1999) and Galí et al. (2001) introduce past inflation to the NKPC model by assuming that, within the group of Calvo price setter firms some follow a *backward looking rule of thumb* updating their prices with past inflation while the rest sets it optimally. The existence of *backward looking firms* introduces *intrinsic inflation inertia* to the model. This formulation leads to the following hybrid NKPC:

$$\pi_t = \gamma mc_t + \gamma_f E_t\{\pi_{t+1}\} + \gamma_b \pi_{t-1} \tag{2.5}$$

In this hybrid formulation of the NKPC, current inflation is again a function of the current real marginal cost, but this time it has not only a *forward* looking component measured by γ_f, but also a *backward* looking component represented by γ_b.

Interestingly enough, the empirical applications of the hybrid NKPC have also met with failure until the *seminal* works of Galí and Gertler (1999) and Galí et al. (2001). The results of Galí and Gertler (1999) applied to U.S. data and Galí et al. (2001) to U.S. and Euro area data using the *Generalized Method of Moments (GMM)* estimation technique provide empirical support for the hybrid NKPC. These studies reveal that real marginal costs are indeed a significant determinant of inflation in these countries. As argued in Galí and Gertler (1999), when output gap is used as a proxy for marginal cost and the hybrid NKPC given in equation (2.5) is estimated using quarterly data, the coefficient of output gap is found insignificant[4]. Galí and Gertler (1999) and Galí (2002) attribute this failure to two basic things. First is the observed poor relationship between the output gap and real marginal cost. Second is the inability of the existing literature to correctly measure the output gap variable and the incorrect usage of the detrended GDP as a proxy for the output gap.

---

[4] See Galí and Gertler (1999) and the references therein for critiques of these early studies.

2.2 Open Economy NKPC Models

When one enters into the world of an open economy, compared to the closed economy case, the studies are much more limited. This branch of the NKPC literature has gained importance after the so called *New Open Economy Macroeconomics (NOEM)*. The NOEM has been pioneered by the work of Obstfeld and Rogoff (1995). These models have been used to explore many issues not addressed in the closed-economy New Keynesian framework, such as the exchange rate regime choice (Devereux, 2004; Senay and Sutherland, 2004), and exchange rate pass-through (Devereux and Engel, 2002; Smets and Wouters, 2002).

From a *theoretical* point of view, there is an ongoing debate on the appropriate microfoundation of the open economy NKPC. All the controversies surrounding the closed economy Phillips curve discussed above are still central in the open-economy setting. However, the introduction of openness complicates the modeling of the NKPC due to the introduction of imported intermediate and final goods, exchange rate dynamics and terms of trade shocks. Thus in an open economy setting, unlike the closed economy case, there is still no standard baseline model that one can refer to.

The open economy NKPC models in the literature can be decomposed into *two* broad groups. The first group introduces open economy factors into the basic closed economy model by introducing imported intermediate inputs into the production function. The *first* contributions to this group have assumed that trade took place only at one level of production: the level of intermediate goods. These studies include, among others, Bjørnstad and Nymoen (2008), Batini et al. (2005), Balakrishnan and Lòpez-Salido (2002), and Galí and Lòpez-Salido (2001). On the other hand, the second wave, assumes that trade takes place at two levels of production: final and intermediate goods. These include the models by Leith and Malley (2007) and Rumler (2007).

The *second* group, ignoring the role of intermediate inputs used in production, concentrates on the interaction between exchange rate dynamics, price setting and inflation. The models in this group either assume that *law of one price* (LOOP) holds and that there is *complete exchange rate pass through* or that there are *deviations* from LOOP and exchange rate pass through is *incomplete*. While, the models specified by Galí and Monacelli (2005), Khan and Zhu (2006) assume that LOOP holds, Monacelli (2005) is the first to combine a Calvo type staggered price setting structure with incomplete exchange rate pass through. In Monacelli (2005), while pass through is assumed to be incomplete for local currency import prices, the export prices are determined by the LOOP.

From an *empirical* point of view, the evidence on the empirical reliability of the open economy NKPC models is again rather mixed. Leith and Malley (2007) and Rumler (2007) have obtained supportive results in G7 and Euro area countries for the NKPC when open economy factors are taken into account. However, while Batini et al. (2005) argue that when open economy factors are included the NKPC specification fits the U.K. data quite well; Bardsen, Jansen and Nymoen (2004), using the same open economy NKPC model developed by Batini et al. (2005), refute this and show that the empirical relevance of this specification is very weak on U.K. data when encompassing tests are applied. Balakrishnan and Lòpez-Salido (2002) have also concluded that, although introducing open economy factors improves the fit of the NKPC, it still does not make the open economy NKPC a good representation of the data for the U.K. In addition, Bjørnstad and Nymoen (2008) have showed that the pooled estimator of the open economy NKPC in the panel of OECD countries fits the data well, but when it is evaluated against an Imperfect Competition Model (ICM) its reliability is seriously questioned[5].

3. Turkish NKPC Studies

For the Turkish economy, to our knowledge, the studies that have modeled and estimated the nature of inflation dynamics using the Phillips curve literature; except the ones by Agénor and Bayraktar (2010), Çatik, Martin and Önder (2008), Celasun (2006), Yazgan and Yilmazkuday (2005) and Celasun, Gelos and Prati (2004a, 2004b) have employed *traditional Phillips curves*[6].

Agénor and Bayraktar (2010) have estimated four different forward looking Phillips curve specifications for Turkey. Two of their specifications follow from Galí and Gertler (1999). They estimate Galí and Gertler's (1999) hybrid closed economy NKPC specification and a version that extends it to include two leads of inflation. The other two Phillips curve specifications follow from Taylor (1980) and Fuhrer and Moore (1995) staggered contracts model[7]. However, as argued in Galí and Gertler (1999), Fuhrer and Moore's (1995) and Taylor's (1980) Phillips curve specifications are not derived from an explicit optimizing microeconomic model. Moreover, although Phillips curve equations used in the study do *not* have an open economy context, variables like real exchange rate, relative oil price-nominal wage ratio and imported oil prices measured in domestic-currency terms are included in the specifications to account for openness without any *theoretical* justification. The estimation results are said to support a Taylor (1980) type of a price formation

---

[5] For details and the analytical foundation of the ICM model see Bjørnstad and Nymoen (2008).

[6] Examples of studies that estimate traditional Phillips curves for the Turkish economy include Domaç (2004), Önder (2004), Kuştepeli (2005), Sarıkaya, Öğünç, Ece, Kara and Ozlale (2005), Öğünç and Ece (2004) and Öğünç (2006).

[7] For details of the analytical specifications of these equations see Agénor and Bayraktar (2010).

equation for the Turkish economy, although the estimated coefficient of the output gap is found to be negative and insignificant. Furthermore, the variables included to account for openness were either found to be statistically insignificant or of the wrong sign.

Yazgan and Yilmazkuday (2005), although have stressed the importance of imported input costs and the *openness* for the Turkish economy, have employed the *same pure* and *hybrid* NKPC specifications derived in Galí and Gertler (1999) that does *not* take openness into account. Despite using the closed economy NKPC specification of Galí and Gertler (1999), the consumer price index (CPI) which includes the prices of imported goods is used to calculate the inflation series.

Çatik et al. (2008) have also used Galí and Gertler's (1999) hybrid *closed* economy specification, but they have further developed it into an empirical autoregressive distributed lag (ARDL) model in first differences, augmented by the lagged values of inflation and output gap, with the differenced rate of inflation used as the dependent variable. Thus, the empirical form of the hybrid Phillips curve relationship used in Çatik et al.'s (2008) estimation is very different from Galí and Gertler's (1999) original specification. As argued by the authors themselves the ARDL model developed has *no* formal microeconomic foundations. Moreover, although the underlying model used is a *closed* economy model, like Yazgan and Yilmazkuday (2005) the CPI is used to calculate the inflation series.

Celasun (2006) is the *only* study in the Turkish literature that actually derives and estimates a NKPC equation for Turkey from an explicit *open economy intertemporal optimizing* model. The NKPC equation of Celasun (2006) is derived and estimated for *nontradables* inflation obtained from the subcategories of the consumer price index (CPI). The specification derived is again equivalent to Galí and Gertler's (1999) hybrid NKPC specification but Galí and Gertler (1999) estimate it for U.S. GDP deflator. The real marginal cost of nontradables is replaced with a combination of the real wage rate and the demand for nontradables. The demand for nontradables is derived as proportional to the real exchange rate and the demand for tradables is proxied by the imports to GDP ratio. The *tradables* in Celasun (2006)'s model are *homogenous* and assumed to be supplied *exogenously* (i.e. there is a given endowment of tradables each period). Moreover the l*aw of one price (LOOP)* is assumed to *hold* for the tradables. On the other hand, for the *nontradables*, endogenous supply is allowed but only with *one factor of production which is labor*.

The NKPC equations that Celasun et al. (2004a, 2004b) employ do have an open economy setting, but rather than deriving the estimated NKPC equation from an explicit micro-founded open economy optimizing model, these studies have also

adopted the *same hybrid* equation derived in Galí and Gertler (1999)[8]. The *openness* in both of these studies stems from the different *proxies* used for *marginal cost* that are *not* theoretically justified from a microeconomic optimizing model. Celasun et al. (2004a, 2004b) extend Celasun's (2006) NKPC specification for the nontradables component of the CPI to the overall CPI.

The few NKPC studies that are applied to Turkish data provide mixed evidence on the validity of this curve for the Turkish economy. On the one hand, Yazgan and Yılmazkuday (2005) and Celasun et al. (2004a) have found empirical support for Galí and Gertler's (1999) *pure* NPKC equation; on the other hand Celasun (2006) and Celasun et al. (2004b) have showed that the *hybrid* NPKC equation fits Turkish data quite well. Çatik et al. (2008) have showed that a *hybrid* Phillips curve á la Galí and Gertler (1999) exists for Turkey only if the variance and skewness of relative price changes are added to its specification. However, Agénor and Bayraktar (2010) also extending the hybrid closed economy NKPC specification of Galí and Gertler (1999) to include open economy elements (like real exchange rate, relative oil price-nominal wage ratio and imported oil prices) showed that this specification did not perform well for Turkey well when nested and non-nested tests were conducted. While Agénor and Bayraktar (2010) have found that the inflation process in Turkey is highly *backward* looking using a Taylor (1980) type of a price formation equation, Celasun et al. (2004b) have showed that the *forward* looking component of Turkish inflation is statistically more important than the backward looking component. The relative importance of the expected future inflation is further supported by Celasun (2006) using the nontradable component of the CPI index.

4. In Search of Improvements for the Turkish NKPC equation

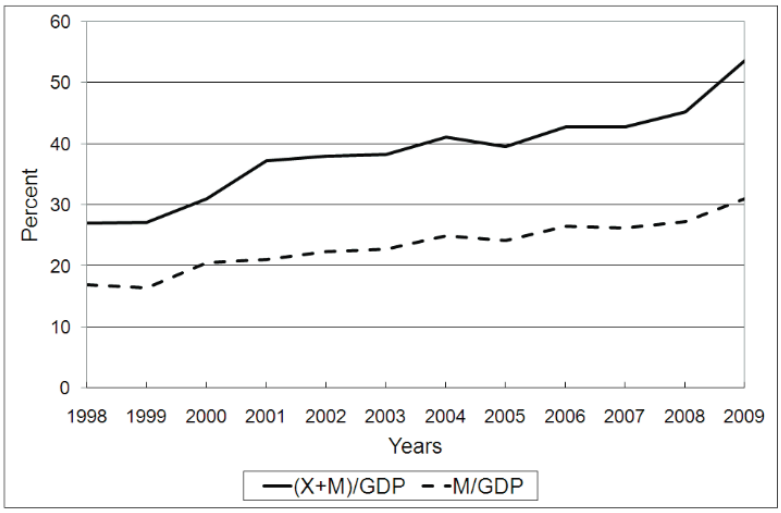
We attribute the aforementioned differences in the results reported to the diverse modeling assumptions used in these studies, especially with regards to the open economy factors introduced. On the one hand, Yazgan and Yılmazkuday (2005) have estimated Galí and Gertler's (1999) *closed* NKPC specification. On the other hand, Celasun et al. (2004a, 2004b) and Agénor and Bayraktar (2010) have estimated Galí and Gertler's (1999) reduced form hybrid NKPC specification by including variables like the real (effective) exchange rate, the relative oil price-nominal wage ratio, the imported oil prices or the imports to GDP ratio to account for openness *without* any theoretical justification. Celasun (2006) has derived and estimated a hybrid NKPC equation for Turkey from an explicit open economy intertemporal optimizing model. However, in this model, *LOOP* is assumed to *hold* for tradables and nontradables are assumed to be produced with labour *only*.

[8] The hybrid NKPC specifications of Celasun et al. (2004a, 2004b) differ from that of Galí and Gertler (1999) only in the sense that the discount factor parameter is restricted to unity.

We think that if a NKPC equation is to be used as a tool to analyze the short run inflation dynamics in Turkey, unlike the aforementioned studies except Celasun (2006), it should be derived *explicitly* from a theoretical optimizing NKPC model that takes into account the structural characteristics of the Turkish economy.

In this sense, first, the observed *inertia* in Turkish inflation makes it necessary to build a *hybrid* model rather than a pure forward looking model[9]. Second, as opposed to the closed economy specification used in Yazgan and Yılmazkuday (2006), introducing *openness* to the Turkish model is crucial because Turkish economy is an open economy when compared to a number of industrial countries and is even more open than some emerging countries (Ho and McCauley, 2003; Alper, 2003). As apparent in Figure 1, the openness of the Turkish economy when measured as the share of total exports and imports in GDP tends to increase since late 1990's and reaches 54 percent in late 2000's (Figure 1). Another openness criterion, imports ratio to GDP, follows a similar pattern and reaches 31 percent in late 2000's.

Figure 1: Openness of the Turkish Economy

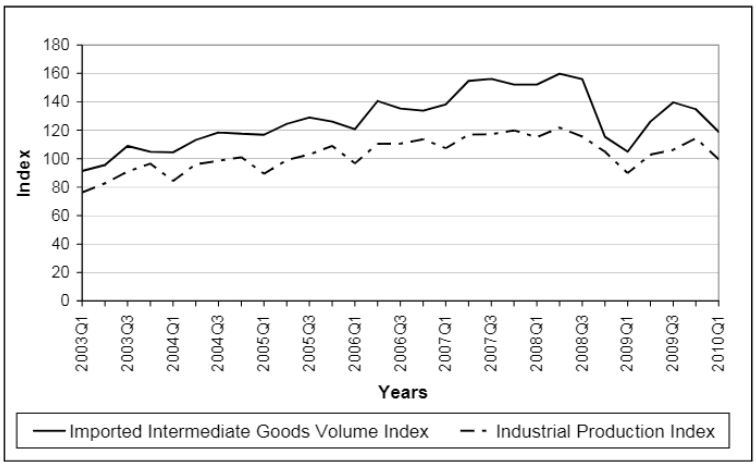


Source: Author's own calculations based on TurkStat (2009a, 2009b).

[9] The strong inertia in Turkish inflation is well documented, among others, in Kibritçioğlu (2002), Erlat (2002) and Baum, Barkoulas and Çağlayan (1999).

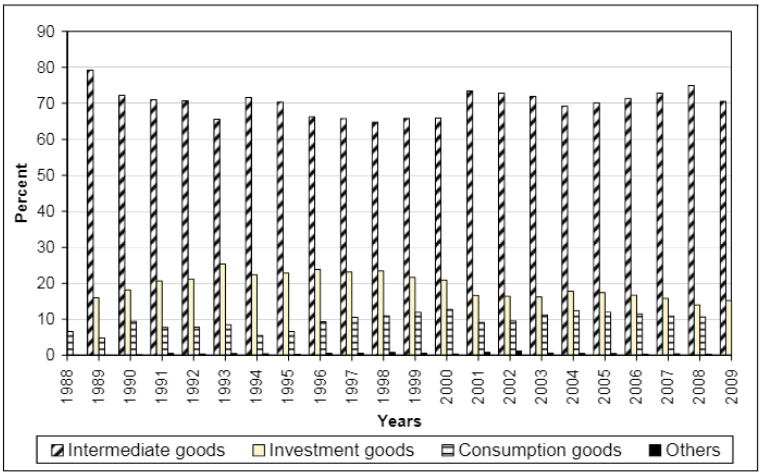
Besides, new channels that affect inflation dynamics arise with the opening of the economy to the rest of the world and these should be considered especially if one is to model inflation dynamics of a small open economy like Turkey. First and foremost, the effect of *exchange rate and terms of trade* shocks on the price setting process and therefore on inflation must be taken into account. Second, firms' marginal costs and price setting decisions are influenced by the *imported intermediate goods*. Indeed, in Turkey the amount spent on imported intermediate goods constitutes a considerable fraction of the costs of firms in the industry. The share of the value of imports in the value of total industry output is equal to 15 percent. Due to this high dependency and the lack of domestically produced substitutes of imported inputs, industrial production and imported intermediate goods follow a very close pattern (Alper, 2003) (Figure 2). This further makes the industry in Turkey very vulnerable to the terms of trade or exchange rate shocks since the prices of the imported intermediate goods are changing more unexpectedly (like the price of oil) and frequently than the prices of domestically produced inputs. In addition, the inclusion of the imported intermediate goods in the production function is again especially important for Turkey since relatively small part of the imported goods is final consumer goods with intermediate goods having the largest share (Figure 3). Thus, in contrast to Celasun (2006) and Celasun et al. (2004a, 2004b), any open economy NKPC model that is to be built for Turkey should incorporate imported intermediate inputs to the production function of firms.

Figure 2: Industrial Production Structure of the Turkish Economy



Source: CBRT (2010).

Figure 3: Import Structure of the Turkish Economy



Source: TurkStat (2009b).

However, the introduction of these open economy factors greatly complicates the theoretical foundations of the open economy NKPC models. First *marginal cost* should be correctly measured with the introduction of imported intermediate goods and second *exchange rate pass through* should be appropriately modeled.

As discussed in Goldberg and Knetter (1997), most of the theoretical and empirical literature on exchange rate pass through that analyze industrialized countries is concerned with exchange rate pass through to import prices. However, for emerging market economies the literature focuses more on the exchange rate pass through to *domestic prices*, although formally import prices are the first channel of the exchange rate pass-through to domestic inflation. This is motivated by the idea that in small open economies pricing to market behavior is less likely and even if exists it is expected to be small. This causes the studies conducted on small open economies like Turkey to assume complete pass through to import prices a prior and investigate the extent and implications of pass through to domestic prices (Kara and Öğünç, 2008; Kara et al. 2007; Kara and Öğünç, 2005; Leigh and Rossi, 2002). Recently, however, Tekin and Yazgan (2009) using VAR and cointegration analysis have showed that while there is complete pass through in export prices, for import prices the pass through is incomplete even in the long run. Also María-Dolores (2009) using a VAR approach, has showed that in Turkey exchange rate

pass through to import prices is high but incomplete both the short and the long run. Furthermore, María-Dolores (2010) using a different methodology has found that short and long run pass through to import price rates are *lowest* in Turkey when compared to the new member states of the European Union. In light of these empirical findings on incomplete exchange rate pass through for Turkey; the NKPC model for the Turkish economy, in contrast to all the NKPC studies conducted for Turkey, should allow *incomplete exchange rate pass through* in the local currency *import* prices. This *incomplete pass through* assumption will also allow one to model *import pricing* decisions and thereby will add richer dynamics to the model when compared to that of Celasun (2006).

5. Conclusion

In this paper, we surveyed the vast literature on the NKPC by attempting to give a complete picture of the many disagreements surrounding the NKPC from both a theoretical and an empirical perspective. The adaptation of the NKPC to an *open economy* framework has increased the controversies since now the curve must give a good representation of the price, inflation and exchange rate dynamics. In addition, the relationship between real marginal costs, labour share and output becomes more complicated when producers face a choice between imported and domestic intermediate goods. Modeling price setting also becomes more complex with import pricing and the need to decide on the degree of exchange rate pass through.

The few NKPC studies conducted on Turkish data give rise to conflicting policy implications of this curve for the Turkish economy. While according to the results reported in Celasun (2006) and Celasun et al. (2004b) nominal income growth targeting is stabilizing for the Turkish economy, the opposite holds for that in Agenor and Bayraktar (2010). Therefore, to choose among these conflicting results, we have searched for the possible improvements in the structure of the NKPC model that will ensure its successful adaption to an open economy like Turkey.

First and foremost, in contrast to all studies applied to Turkey except Celasun (2006), we think that if a NKPC equation is to be used as a tool to analyze the short run inflation dynamics in Turkey it should be derived explicitly from a theoretical optimizing NKPC model. Second, this model should take into account the key structural characteristics of the Turkish economy: the openness of the Turkish economy, the high dependence of the costs of industry to imported intermediate goods and the incomplete exchange rate pass through to import prices. Celasun

(2006) and the other studies applied to Turkey do not take one or more of these features into account and thereby lead to the reported conflicting results.

In this respect, the NKPC model for the Turkish economy should combine imported intermediate goods with incomplete exchange rate pass through in import prices. The *incomplete pass through* assumption will allow one to model *import pricing* decisions and thus will add not only richer dynamics to the model, but also reflect an empirical regularity for the Turkish economy. To our knowledge there is no study that models import pricing decisions for the Turkish economy. Also, in the literature, the production side of the Turkish economy is modeled using a Cobb-Douglas production technology in which labor is used as the only factor of production. However, most of goods imported by Turkey are at the intermediate level and these constitute a large fraction of the costs of industry. Thus, a generalized CES-type of production function that will be employed to model this type of a domestic output structure will clearly distinguish this model from the ones employed in the other Turkish NKPC studies.

REFERENCES

AGENOR, P., and BAYRAKTAR, N. (2010), "Contracting Models of the Phillips Curve Empirical Estimates for Middle-Income Countries", *Journal of Macroeconomics*, 32, 555-570.

ALPER, K. (2003) Exchange rate pass-through to domestic prices in Turkish economy. Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

BALAKRISHNAN, R., and LOPEZ-SALIDO, J. D. (2002), "Understanding UK Inflation: The Role of Openness", *Bank of England Working Paper,* No.164, Available at SSRN: http://ssrn.com/abstract=340544 or doi:10.2139/ssrn.340544.

BALL, L. (1994), "What determines the sacrifice ratio?", *NBER Working Paper Series*, No. 4306.

BARDSEN, G., JANSEN, E.S., NYMOEN, R. (2004), "Econometric evaluation of the New Keynesian Phillips curve", *Oxford Bulletin of Economics and Statistics*, 66.

BATINI, N., JACKSON, B., NICKELL, S. (2005), "Inflation dynamics and the labour share in the UK", *Journal of Monetary Economics*, 52 (September), 1061–1071.

BAUM, R. T., BARKOULAS, J. T., and ÇAĞLAYAN, M. (1999), "Persistence in International Inflation Rates", *Southern Economic Journal*, 65, 900-913.

BJØRNSTAD, R., NYMOEN, R. (2008), The new Keynesian Phillips curve tested on OECD panel data, Economics, The Open-Access, Open-Assessment E-Journal 2 (23), 1–18.

CALVO, G.A. (1983), "Staggered contracts in a utility-maximizing framework", *Journal of Monetary Economics*, 12 (September), 383–398.

CBRT (Central Bank of Republic of Turkey) (2010), Electronic Data Delivery System: General Statistics, accessed at http://evds.tcmb.gov.tr/yeni/cbt-uk.html as of August 25, 2010.

CELASUN, O. (2006), "Sticky inflation and the real effects of exchange rate-based stabilization", *Journal of International Economics*, 70, 115-139.

CELASUN, O., GELOS, G., PRATI, A., (2004a) "Obstacles to disinflation: What is the role of fiscal expectations?", *Economic Policy*, 19 , 441-481.

CELASUN, O., GELOS, G., PRATI, A. (2004b), "Would cold turkey work in Turkey?", *IMF Staff Papers*, 51, No. 3.

CHRISTIANO, L. J., EICHENBAUM, M., EVANS, C. L. (2005), "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy", *Journal of Political Economy*, 113, 1-44.

ÇATIK, A.N, MARTIN, C., ÖNDER, A. Ö. (2008), *Relative Price Variability and the Philips Curve: Evidence from Turkey*, Paper presented at the International Conference on Emerging Economic Issues in a Globalizing World, İzmir, 2008.

DEVEREUX, M. B. (2004), Should the Exchange rate be a shock absorber?. Journal of International Economics 62, 359-378.

DEVEREUX, M. B., ENGEL, C. (2002), "Exchange Rate Pass-Through, Exchange Rate Volatility, and Exchange Rate Disconnect", *Journal of Monetary Economics*, 49, 913–940.

DOMAÇ, I. (2004), "Explaining and forecasting inflation in Turkey", *World Bank Policy Research working paper*, 3287, April, 1–41.

DUFOUR J.M., KHALAF, L., KICHIAN, M. (2006), "Inflation dynamics and the New Keynesian Phillips Curve: an identification-robust econometric analysis", *Journal of Economic Dynamics and Control*, 30, 1707–1727.

ERLAT, H. (2002), Long Memory in Turkish Inflation Rates. Forthcoming in: Inflation and Disinflation in Turkey, ed. by Kibritçioğlu, A., L. Rittenberg, and F. Selçuk, Aldershot: Ashgate, pp. 43-76.

FUHRER, J.C., MOORE, G. (1995),"Inflation Persistence", *Quarterly Journal of Economics*, 110, 127-159.

GALÍ, J., GERTLER, M. (1999), "Inflation dynamics: a structural econometric analysis", *Journal of Monetary Economics*, 44, 195–222.

GALÍ, J., LÒPEZ-SALIDO, J.D. (2001), *A New Phillips Curve for Spain*, BIS Papers No. 3.

GALÍ, J., MONACELLI, T. (2005), "Monetary Policy and Exchange Rate Volatility in a Small Open Economy", *Review of Economic Studies*, 72, 707-734.

GALÍ, J., GERTLER, M., LÒPEZ-SALIDO, J.D. (2005), "Robustness of the estimates of the hybrid New Keynesian Phillips curve", *Journal of Monetary Economics*, 52, 1107–1118.

GALÍ, J., GERTLER, M., LÒPEZ-SALIDO, J.D. (2001), "European inflation dynamics", *European Economic Review*, 45, 1237–1270.

GOLDBERG P. K., KNETTER M., M. (1997), "Good Prices and Exchange Rates: What have we learned", *Journal of Economic Literature*, 35, 1243-72.

GORDON, R. J. (2008), *The History of the Phillips Curve: An American Perspective*, Paper presented at NU Macro Workshop Revised version of paper given at Australasian Meetings of Econometric Society Evanston, IL September 29th.

HO, C., MCCAULEY, R.N. (2003), "Living with flexible exchange rates: issues and recent experience in inflation targeting emerging market economies", *BIS Working Paper,* No 130, February.

KARA H., ÖĞÜNÇ, F. (2005), "Exchange Rate Pass-Through in Turkey: It is Slow, but is it Really Low?", *Central Bank of Turkey Research Department Working Paper*, No: 05/04.

KARA H., ÖĞÜNÇ, F. (2008), "Inflation Targeting and Exchange Rate Pass-Through: The Turkish Experience", *Emerging Markets Finance and Trade*, 44, 52-66.

KARA H., KÜÇÜK Tuğer H., ÖZLALE Ü., TUĞER B., YAVUZ D., YÜCEL E. M. (2007), "Exchange Rate Regimes and Pass-Through: Evidence from the Turkish Economy", *Contemporary Economic Policy*, 25, 206–225.

KHAN, H., ZHU Z. (2006), "Estimates of the Sticky-Information Phillips Curve for the United States", *Journal of Money, Credit and Banking*, 38, 195-207.

KİBRİTÇİOĞLU, A. (2002), Causes of Inflation in Turkey: A Literature Survey with Special Reference to Theories of Inflation. Forthcoming in: Inflation and Disinflation in Turkey, ed. by Kibritçioğlu, A., L. Rittenberg, and F. Selçuk, Aldershot: Ashgate, pp. 43-76 .

KUŞTEPELI, Y. (2005), "A comprehensive Short-run Analysis of A (Possible) Turkish Phillips Curve", *Applied Economics*, 37, 581-591.

LEIGH, D., and ROSSI, M., (2002), *Exchange Rate Pass-Through in Turkey*, IMF Working Paper, No 02/204.

LEITH, C., MALLEY, J. (2007), "Estimated Open Economy New Keynesian Phillips Curves for the G7", *Open Economies Review*, 18, 405-426.

LINDÈ, J. (2005), "Estimating New-Keynesian Phillips Curves: A Full Information Maximum Likelihood Approach", *Journal of Monetary Economics*, 52, 1135-1149.

MARÍA-DOLORES, R. (2009), "Exchange Rate Pass-Through in Central and East European Countries. Do Inflation and Openness Matter?", *Eastern European Economics*, 47, 42-61.

MARÍA-DOLORES, R. (2010), "Exchange rate pass-through in New Member States and candidate countries of the EU", *International Review of Economics and Finance,* 19, 23-35.

MONACELLI, T. (2005), "Monetary policy in a low pass through environment", *Journal of Money, Credit, and Banking*, 37, 1047-1066.

MUTO, I. (2006), "Can the New Keynesian Phillips Curve Explain Japanese Inflation Dynamics? A Labor Share Correction Approach", *Institute for Monetary and Economic Studies (IMES) Discussion Paper Series,* Bank of Japan, No. 2006-E-25.

OBSTFELD, M., ROGOFF, K. (1995), "Exchange Rate Dynamics Redux", *Journal of Political Economy*, 103, 624-60.

ÖNDER, A. Ö. (2004), "Forecasting Inflation in Emerging Markets by Using the Phillips Curve and Alternative Time Series Models", *Emerging Markets Finance and Trade*, 40, 71-82.

RUDD, J., WHELAN, K. (2007), "Modeling Inflation Dynamics: A Critical Review of Recent Research", *Journal of Money, Credit and Banking*, 39, 155-170.

RUMLER, F. (2007), "Estimates of the Open Economy New Keynesian Phillips Curve for Euro Area Countries", *Open Economies Review*, 18, 427-451.

SAMUELSON, P. A. and SOLOW, R. M. (1960), "Analytical Aspects of Anti-Inflation Policy", *American Economic Review*, 50, 177–194.

SARIKAYA, Ç., ÖĞÜNÇ, F., ECE, D., KARA, H., ÖZLALE, Ü. (2005), "Estimating Output Gap for the Turkish Economy", *Central Bank of Turkey Research Department Working Paper*, No. 05/03.

SENAY, O., Sutherland, A. (2004), "The Expenditure Switching Effect and the choice between Fixed and Floating Exchange Rates" *CEPR Discussion paper*, No. 4300.

SMETS F., WOUTERS, R. (2002), "Openness, Imperfect Exchange Rate Pass-Through and Monetary Policy", *Journal of Monetary Economics*, 49, 947–81.

TAYLOR, John B.(1980), "Aggregate Dynamics and Staggered Contracts", *Journal of Political Economy* February, 88:1, 1–23.

TEKIN, R. B., YAZGAN, E. M. (2009), "Exchange rate pass-through in Turkish export and import prices" *Applied Economics*, 41, 2221 – 2228.

TURKSTAT (2009a), TurkStat Databases web site: National Accounts Database, accessed at http://www.turkstat.gov.tr/jsp/duyuru/upload/vt_en/vt.htm as of May 27, 2009.

TURKSTAT (2009b), TurkStat Databases web site: Foreign Trade Database, accessed at http://www.turkstat.gov.tr/jsp/duyuru/upload/vt_en/vt.htm as of May 29, 2009.

WOODFORD, Michael (2003), *Interest and Prices*, Princeton: Princeton University Press.

YAZGAN, M. E., YILMAZKUDAY, H. (2005), "Inflation Dynamics of Turkey: A Structural Estimation", *Studies in Nonlinear Dynamics*, 9, 1-13.