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## Journal of Macroeconomics

journal homepage: [www.elsevier.com/locate/jmacro](http://www.elsevier.com/locate/jmacro)

## Cost-based Phillips Curve forecasts of inflation

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### ARTICLE INFO

#### Article history:

Received 28 April 2010

Accepted 8 April 2011

Available online 19 May 2011

#### JEL classification:

C53

E31

E37

#### Keywords:

Inflation forecasting

Phillips Curve

Marginal cost

### ABSTRACT

It is a well-established idea that prices are a function of marginal cost, yet estimating a reliable measure of marginal cost is difficult to do. Stock and Watson (1999) use the Phillips Curve to forecast inflation for a variety of existing activity variables that researchers commonly use to proxy for marginal cost. This paper uses a similar type of approach to examine the performance of a new candidate for the activity variable, which is marginal cost measured following the theoretical methodology of Bils (1987), which we find to be simple yet powerful when implemented empirically. We then use the Phillips Curve to conduct pseudo out-of-sample inflation forecasts for the US using: output, unemployment, hours, the labor share, the capacity utilization rate, and the new measure of marginal cost. For almost all cases, forecast errors are lowest in the regressions with the new marginal cost variable, indicating that this new measure is an improvement over previous attempts to proxy for marginal cost.

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### 1. Introduction

The ability to forecast inflation is of central importance for macroeconomists, who argue that there are several potential variables that determine the future path of prices. From microeconomic theory, we know that ultimately it is marginal cost that ought to drive the price level that is set by firms. This relationship between prices and marginal cost is one of the most fundamental results established in economics, which means that it is important to take the role of marginal cost seriously when it comes to understanding the behavior of prices.

That being said, this paper explicitly argues that marginal cost is an excellent predictor of inflation when it comes to forecasting future price activity. Currently the workhorse of the profession when it comes to investigating inflation dynamics is the New Keynesian Phillips Curve (NKPC), a model which states that there is a structural relationship between current inflation, current marginal cost and future expected inflation. This is an important model in the inflation literature, since it is one that is derived using optimizing models with price rigidities and monopolistic competition. Empirically this model has also been shown to fit inflation data well if marginal cost is proxied by the labor income share, as shown in Gali and Gertler (1999). Since this finding, estimating labor share-NKPCs has become standard practice in the literature.

However, a growing number of researchers are coming to realize that there are serious empirical flaws that exist when estimating the NKPC. For instance authors such as Rudd and Whelan (2005) have strongly argued that the labor share version of the new-Keynesian Phillips Curve is a very poor model of price inflation. Moreover, Mazumder (2010) emphasizes that the labor share really only proxies for real marginal cost under very specific and rare conditions, while Gwin and VanHoose (2008) argue that the NKPC is not very robust to alternative measures of inflation. These papers are examples of an increasing literature that casts serious doubts on the empirical validity of the NKPC.

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Fortunately when it comes to forecasting inflation, recent research has instead suggested that the traditional backward-looking Phillips Curve produces promising results. For instance, [Stock and Watson \(1999, 2008\)](#) compute year-ahead forecasts of inflation by using the conventional unemployment Phillips Curve. This model is estimated recursively in order to compute ‘pseudo’ out-of-sample forecasts for inflation using data that is available to the forecaster. The performance of the unemployment Phillips Curve is then compared to a variety of different specifications, where many alternatives measures of the ‘activity variable’ are tested.

There are several measures of economic activity that are used to proxy for marginal cost, since under certain assumptions we can expect these variables to move in the same way. For instance, the output gap and unemployment rate are widely-used activity variables that in essence are being used as proxies since we have no direct way in which to observe firms’ marginal cost. However, [Gali and Gertler \(1999\)](#) make a convincing argument that the labor income share ought to be used as the proxy for marginal cost when it comes to models of inflation. Indeed, this proxy of marginal cost has become the leading variable that is used in many recent papers (such as [Sbordone \(2002\)](#) and [Gali et al. \(2005\)](#)).

However, [Mazumder \(2010\)](#) argues that the labor share of income only corresponds to the true concept of marginal cost under quite specific conditions, that are not likely to hold in reality. Specifically the labor share proxy assumes that labor can be costlessly adjusted at a fixed wage rate. However, closer examination of this idea reveals that labor – which is the product of employment and average hours – has adjustment costs to changing employment and varying wage rates that are paid to increasing hours. Therefore we cannot reasonably assume that labor input can flexibly varied at a fixed real wage rate. Fortunately we can improve upon prevailing techniques by estimating marginal cost using a methodology first proposed by [Bils \(1987\)](#). In particular, one can estimate real marginal cost by examining the cost of increasing output along any one input, while holding the other inputs fixed at their optimal levels. This paper takes the theoretical framework of [Bils \(1987\)](#) and innovates upon the empirical implementation of the theory, focusing on the manufacturing sector due to the overtime data that is required to estimate marginal cost in this setup.

Therefore we can obtain what we think may be a more reasonable measure of marginal cost for the manufacturing industry, which can now be compared to the other conventional proxies for marginal cost. The metric in which this paper compares the different marginal cost measures is by computing traditional backward-looking single predictor Phillips Curve forecasts of inflation. The term ‘Phillips Curve’ is used in a variety of different ways by the profession, and for the purpose of this paper, we use a definition of the Phillips Curve similar to that used in [Stock and Watson \(1999, 2007, 2008\)](#). That is, the Phillips Curve is an equation which states that inflation is determined by an activity variable which proxies for marginal cost, and past lagged values of inflation, which in effect are used to substitute for inflation expectations. We then use the Phillips Curve to compute pseudo out-of-sample forecasts of US inflation, with activity variables of output, the unemployment rate, hours, the labor share of income (which is equivalent to real unit labor costs), the capacity utilization rate (which [Stock and Watson \(1999\)](#) identify as the best individual measure available) and the new measure of marginal cost. In addition, to check how the inflation forecasts obtained from the Phillips Curve compare to other simple benchmark models, we also compute forecasts using a univariate autoregressive model, an ARMA(1,1) model, a random walk, and forecasts obtained under [Atkeson and Ohanian \(2001\)](#)’s “naive” projections.

From the results we obtain an important finding that can aid future macroeconomic research. That is, in almost all of the Phillips Curve regressions that we undertake, we obtain the lowest forecast errors in the specifications with the new measure of marginal cost as the regressor. This indicates that the simple yet powerful [Bils \(1987\)](#) methodology of constructing better measures of marginal cost actually helps us forecast inflation with greater accuracy. Future research can use this finding to further build upon and develop even more refined measures of marginal cost. In particular since the new variable of manufacturing’s marginal cost seems to be a better predictor of inflation than output, unemployment, hours, the labor share, or capacity utilization, this implies that an aggregate version of the new marginal cost measure could be extremely useful for forecasting economy-wide inflation, which is something that future work needs to address.

## 2. Phillips Curve forecasts of inflation

### 2.1. The new Keynesian Phillips Curve debunked

Prior to [Gali and Gertler \(1999\)](#), researchers who estimated the NKPC with rational expectations typically proxied for real marginal cost using the output gap. However, the use of this cost proxy produces counter-intuitive negative and significant coefficients in the model, which led [Gali and Gertler \(1999\)](#) to search for a more appropriate proxy for real marginal cost. They argue that the labor share of income fulfills this role, and show that the labor share-NKPC performs well when looking at the US inflation dynamics from the 1960s onwards. Indeed, this seminal paper has made the labor share-NKPC standard practice among NKPC advocates, as can be seen in subsequent work such as [Sbordone \(2005\)](#) and [Gali et al. \(2005\)](#).

The notion of including marginal cost in the Phillips Curve has sound microfoundations, and the intentions of searching for an adequate cost proxy should be commended. Unfortunately, many researchers strongly argue against the labor share as a measure of marginal cost. For instance, [Rudd and Whelan \(2005\)](#) find that the NKPC performs quite poorly when the labor share is used to proxy for marginal cost, and even go so far as to say that the labor share should not be considered in any type of monetary policy rule. Likewise [Rudd and Whelan \(2007\)](#) suggest that the labor share ought not to be a proxy for real marginal cost since it tends to be countercyclical, whereas from theory we would expect real marginal cost to be procyclical. In

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