

How Inflationary are Oil Price Shocks? A Regional Analysis

Jon Christensson*

Department of Economics, W. Frank Barton School of Business

Abstract. The impact of oil shocks is analyzed by estimating an augmented Phillips curve on a national, regional and city level in the United States. A significant pass-through to inflation (including all items) is recorded for all regions, while core inflation remains largely muted. The West region has experienced a much lower pass-through than other regions and a few reasons for this are; greater oil efficiency, lower inflation variability and a lower exchange rate pass-through in the West. Also noted is an increasing trend for pass-through to inflation since the late 1980's, and the contrary was found for core inflation.

1. Introduction

Intuitively, when the oil price increases due to a negative supply shock, the input cost of firms increases. If workers are rational, they will adjust their inflationary expectation and demand higher wages leading to higher labor costs. This causes the aggregate supply curve to shift to the left and prices to increase. Hence, the oil price has implicitly passed on its price hike to the average price level in the economy.

There have been surprisingly few papers specifically investigating the oil price pass-through to inflation. The existing studies have largely noted a decline in the pass-through in recent times. A few reasons identified for this decline include globalization, more flexible labor markets, reduction in oil intensity, and a declining exchange rate pass-through. [1] [2] [3]

The main contribution of this paper is to investigate the pass-through on regional and disaggregated levels, and how it changes over time. More precisely, this paper measures the oil price pass-through to various consumer price categories on a national, regional and city level in the United States.

2. Experiment, Results, Discussion, and Significance

This paper follows the framework of Fuhrer [4], Hooker [5] and De Gregorio, Landerretche and Neilson [3], though with some differences which are discussed shortly. An estimation of an augmented Phillips curve is estimated and the general form is shown in equation

(1).

$$\pi_t = \alpha + \beta(L)\pi_t + \gamma(L)(U_t - U_t^N) + \varphi(L)P_t^{oil} + \varepsilon_t \quad (1)$$

π_t is the seasonally adjusted inflation rate, $(U_t - U_t^N)$ is the unemployment gap created by subtracting the NAIRU (Non-Accelerating Inflation Rate of Unemployment) from the actual seasonally adjusted unemployment rate, P_t^{oil} is the UK Brent oil price in U.S. dollars. The inflation rate and the unemployment data was collected from BLS while the oil price comes from IFS. The (L) implies a polynomial in the lag operator.

The paper will use four models. Model 1 will have a fixed lag structure and polynomial degree of 6 and 2, respectively. Model 2 will have a fixed lag structure and polynomial degree of 12 and 2, respectively. Model 3 will have a varying lag structure and polynomial degree. Model 4 computes a time-varying pass-through coefficient allowing for the varying lag structure and polynomial degree of model 3.

The reason for inclusion of the first two models is to be able to compare the pass-through across regions as well as across price categories. Two different lag structures are imposed as to not over/under fit the model which is a serious issue. This is the primary reason of the third model; by determining the optimal lag and polynomial structure, the issue of over/under fitting the model is side-stepped. The fourth model is put forth to analyze how the pass-through has changed over time since the late 1980's.

Incorporating the various models above separates this paper from the rest. Hooker [5] uses the same lag structures as Fuhrer [4] which allows for different lags, though they do not specify to what degree of polynomial. De Gregorio, Landerretche and Neilson [3] claim to follow Fuhrer [4] and Hooker [5] but they do not mention the use of a polynomial in the lag operator.

It seems as if they impose a regular lag structure and fix this lag to four quarters due to comparability issues.

For most series the time period stretches from January 1987 to September 2008. Lastly, De Gregorio, Landerretche and Neilson [3] use the output gap, while Fuhrer [4] and Hooker [5] use the plain unemployment rate as a measure of economic activity. Due to the regional analysis in this paper the unemployment gap must be used as a proxy for economic activity.

From equation (1) the pass-through coefficient is derived and shown below in equation (2).

$$\theta = \frac{\sum_{i=0}^L \varphi_i}{1 - \sum_{i=1}^L \beta_i} \quad (2)$$

where the summation goes from i to L (in this case will be either 6 in model (1), 12 in model (2) and varying in model (3) and (4)).

On a national level, previous studies found that after the 1980, the pass-through to the general price inflation was around three percent, which understates the findings of this paper where the estimated pass-through in model 1 and 2 is 2.6% and 5.7% respectively [3]. In other words, if the oil price increases by 1%, the inflation is expected to increase by 0.03% (0.026-0.057% according to the current findings). Hooker [5] claims that a doubling of the oil price leads to approximately a 1% direct increase in inflation. Interestingly, the core consumer prices seems to have been unaffected by changes in the oil price in both lag specifications. Not surprisingly, one sees the largest pass-through rates in energy, transportation, commodity and nondurables prices that in one way or another include either gasoline or some form of oil directly.

At a regional level, the Northeast has the highest pass-through to consumer prices including all items and also, on average, the most price categories with higher pass-through. The most striking result is the Western region which experiences the smallest pass-through in almost every price category. Hence, an oil price shock would, on average, influence the inflation in the West less than it would have in other parts of the US.

At a city level there is no clear consensus as of where the highest pass-through is. However, yet again the West region has, on average, the lowest pass-through and least significant categories.

Model 3 gives comparable results and the main important observation is the lower pass-through in the West.

Model 4 reveals an increasing trend of pass-through to inflation (including all items) on a national and regional level, while a negative trend is recorded for the core inflation.

The most striking finding is the lower pass-through in the West. One possible explanation to the lower pass-through is a decline in oil intensity. The West uses less oil to produce the same amount of GDP as other regions. A second explanation is the fact that the West has a smaller exchange rate pass-through and thirdly, that the standard deviations of many price series are lower in the West compared to other regions.

For future research it may be beneficial to investigate how the various regions' economic structure impacts the oil price pass-through.

3. Conclusions

This paper differentiates itself from recent literature by focusing on the oil price pass-through on a regional level, as well as on a disaggregated level. A general Phillips curve is estimated on a national, regional, and city level. A significant pass-through is recorded in regular inflation and other price categories that directly incorporate oil, while the core inflation remains muted. The most striking result can be seen in the West where almost all significant price categories have a lower pass-through compared to the other regions. A few explanations to this are higher oil use efficiency, lower inflation variation and a lower exchange rate pass-through in the West. A rolling pass-through coefficient was also computed where the oil price pass-through to inflation has had an increasing trend since the late 1980's, contradicting previous research. However, the core inflation has seen a negative trend which is in line with other research.

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