An Empirical Note on the Impact of the Price of Imported Crude Oil on Inflation in the United Kingdom

Cebula, Richard and McGrath, Richard and Saadatmand, Yassamand and Toma, Michael

Jacksonville University, Armstrong Atlantic State University, Armstrong Atlantic State University, Armstrong Atlantic State University

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Richard J. Cebula, Richard D. McGrath, Yassaman Saadatmand, and Michael Toma

ABSTRACT

This study empirically investigates whether the assumption by the Bank of England that rising prices of imported crude oil lead to domestic inflation in the United Kingdom has had validity. In a model where real GDP growth and money stock growth are both all allowed for, empirical estimation reveals compelling evidence for the validity of this assumption. In particular, the greater the percentage increase in imported crude oil prices, the greater the domestic inflation rate. In addition, oil shocks involving imported crude oil price hikes of 40 percent or more in a given year further elevate the domestic inflation rate.

I.   INTRODUCTION

During the last three decades, it has been commonplace among public policymakers as well as consumers to assume that *rising* prices on imported crude-oil act to *increase* domestic inflation; clearly, this constitutes a form of the so-called "imported inflation hypothesis" (i-i hypothesis). This assumption may have been predicated to some extent on the experience of the 1970s, wherein sharply rising crude oil prices imposed by O.P.E.C. nations were believed in so many nations to have systematically exacerbated domestic inflation. For the case of the U.S. and the other G7 nations, at least one study [Cebula and Frewer (1980)] found strong empirical support for the i-i hypothesis. For the 1955-1979 period, Cebula Frewer (1980) find rising prices on imported crude oil to lead to increased domestic inflation in *all* of the G7 nations. More recently, Cebula (2000) provides similar findings for the U.S. for the more current period of 1965-1999. However, whereas there has been only a limited formal analysis of the i-i hypothesis as it involves crude oil prices for the U.S., even less such formal analysis has been performed for the other industrialized nations. Indeed, the Cebula and Frewer (1980) study is over two decades old. Given the resilience of the acceptance among policymakers in industrialized nations of the i-I hypothesis as it relates to the price of imported crude oil, it may be useful to provide a formal *updated* investigation of the hypothesis for industrialized nations other than the U.S. Such is the purpose of the present study. In particular, for the period 1975-1999, this study empirically investigates for a large industrialized nation, namely, the United Kingdom, the i-I hypothesis as it relates to the price of the imported crude oil. A simple model is given in section II of this study, whereas an empirical model and the data descriptions are found in section III. Empirical results are provided in section IV, whereas section V provided a summary of findings.

II.   A SIMPLE MODEL

Based on the models in Cebula and Frewer (1980), Cebula (2000), and the standard IS/LM/AD/AS model, the inflation rate (P) is assumed to depend on a variety of demand-side and supply-side type factors. In principle, the demand-side influences presumably would include the following:

- The percentage growth rate of real GDP (Y)
- The percentage growth rate of the M2 money stock (M2)
- The percentage rate of increase in imported crude oil prices (POIL)
- The experience of crude oil price shocks (POILSHOCK)

Presumably, the greater the growth rate of real GDP, the greater the growth rate of aggregate demand for goods and services and thus the greater the domestic inflation rate, *ceteris paribus*. Next, in the spirit of the monetarist tradition, the greater the growth rate of the money supply, the greater the growth in the aggregate demand for goods and services and hence the greater the inflation rate, *ceteris paribus*. This money-aggregate demand-inflation linkage could assume a variety of forms, including those of a simple wealth effect, lowered interest rates, and/or by higher bond portfolio values resulting from lower interest rates. Next, the greater the rate of increase in the price of imported crude oil, the greater may be the expected inflation rate; in turn, the latter presumably accelerates the growth rate of aggregate demand and leads to higher actual inflation as households endeavor to "beat" or at least insulate themselves from the *expected* inflation. Finally, as by-product of the effects of POIL, an oil-price shock (POILSHOCK), in which there is a sudden and dramatic increase in the price of imported crude oil, is likely to produce (as the market reacts) a sudden and dramatic increase in expected inflation and hence in actual inflation, ceteris paribus.

- Supply-side factors presumably might include the following: the percentage rate of increase in imported crude oil prices (POIL); and the experience of crude oil price shocks (POILSHOCK)

Presumably, the greater the rate of increase in the price of imported crude oil, the greater the rate of increase in both oil-product-related *production* costs and *transportation* costs for a broad spectrum of goods and services; therefore, to the extent that increased production and transportation costs are passed onto final consumers, the greater the actual inflation rate, *ceteris paribus*. Similarly, crude-oil price shocks presumably tend to exercise a sudden and dramatic increase in *production* costs for certain goods and services and *transportation* costs for a broad spectrum of goods and services and hence act to elevate final product and service inflation rates as well. Finally, to the extent that increases in POIL and oil price shocks are experienced and lead to *expected* inflation, the greater the upwards pressure on (1) nominal wage rates and (2) nominal interest rates, I.E., borrowing costs, and hence – to the extent that such costs are passed on to the final consumers – the greater the inflation rate of final commodity output, *ceteris paribus*.

Thus, based on the above, we have the following: P = P(Y, M2, POIL, POILSHOCK)

III. EMPIRICAL MODEL AND DATA DESCRIPTION

Based on equation (1), the following reduced-form equation is to be estimated:

(1) $P(t) = a + bY(t-1) + cM2(t-1) + dPOIL(t-1) + ePOILSHOCK(t) + fTREND + u'$

Where:

$P(t)$ = percentage inflation rate of the consumer price index in the United Kingdom year t

a = constant term

Y(t-1) = percentage growth rate of the real GDP in the United Kingdom in year t-1

M2(t-1) = percentage growth rate of the M2 money supply in the United Kingdom in year t-1

POIL(t-1) = percentage rate of increase in the current pound sterling per barrel price of imported crude oil in the United Kingdom in year t-1

POILSHOCK(t) = a dummy (binary) variable to indicate the years in which the current YEN price per barrel of imported crude oil in the United Kingdom rose by 40% or more

TREND = a trend variable

u' = stochastic error term.

The Augmented Dickey-Fuller (ADF) test reveals that , for the 1975-1999 study period, two of the variables in the system (M2 and POIL) are stationary in levels but with a trend, whereas the remaining variables are all stationary in levels. Accordingly, in the estimate that follows, all of the variables are expressed in levels but a trend variable is also included.

The data sources for the variables were as follows: MS: http://bankofengland.co.uk *P, Y, XCHR: Council of Economic Advisors, *Economic Report of the President*, 2001, Tables B-108, B-110*POIL: http://www.eia.doe.gov

IV.   THE EMPIRICAL FINDINGS

The OLS estimate of equation (2), adopting the White (1980) procedure to correct for heteroskedasticity, is provide in equation (3):

(2) $P(t) = 3.82 - 0.144Y(t-1) + 0.638M2(t-1) + 2.603POIL(t-1) + 3.92POILSHOCK(t) - 0.01TREND$

$$(-1.04) \qquad (+3.49) \qquad (+3.37) \qquad (+2.32) \qquad (-6.91)$$

DW = 1.75, Rho = 0.05, F (5, 17) = 18.34, RSQ = 0.84, adjRSQ = 0.80

Where terms in parenthesis are t-values. In equation (3), three of the four estimated coefficients exhibit the expected positive signs, with two statistically significant at the one percent level and one statistically significant at the five percent level. Serial correlation is not a serious problem, given the DW and Rho values. Finally, the F-statistic is significant at the one percent level.

In equations (3), the coefficient on the Y variable is negative but not significant at the ten percent level, implying that the United Kingdom inflation rate was not significantly affected by the growth rate of real GDP over the study period. On the other hand, the coefficient on the M2 variable is positive and significant at the one percent level, implying – in the monetarist tradition - that a greater money supply growth rate acts to elevate the domestic inflation rate. The remaining estimated coefficients pertain to the price of imported crude oil. The coefficient on the POIL variable is positive and significant at the one percent level, implying that the greater the inflation rate of the price on imported crude oil, the greater the overall domestic inflation rate was in the United Kingdom. This finding for the United Kingdom is consistent with the recent study for the U.S. by Cebula (2000) and with the earlier period study that included the United Kingdom by Cebula and Frewer (1980). In addition, the

coefficient on the POILSHOCK variable I equation (50 is positive and significant at the five percent level, implying that imported crude oil price shocks involving an increase in the price of crude oil of 40 percent or more during any given year also acted to elevate the inflation rate, possibly adding to the effects of the variable POOIL because huge oil prices increases may exercise an especially acute awareness of a potential inflationary impact from imported oil prices changes. This finding for the United Kingdom is also compatible with the recent study for the U.S. by Cebula (2000).

## V.	SUMMARY

The *assumption* that rising prices on imported crude oil leads to greater inflation has for some years played a serious role in formulation of monetary policy for the Bank of England. This brief study has sought to find material evidence of the *validity* of this assumption. In a model where real GDP growth and money stock growth are both expressly allowed for, there is compelling evidence revealing that the price of imported crude oil significantly affected inflation in the United Kingdom over the study period. Thus, the greater the percentage increase in the price of imported crude oil, the greater the domestic inflation rate in the United Kingdom. Furthermore, the experience of oil price shocks exacerbates this effect: oil shocks involving imported crude oil price hikes of 40 percent or more in a given year *further* elevate the inflation rate of the United Kingdom. Thus, it appears that this critical assumption of the monetary authority (the Bank of England) has been valid and hence has constituted a sound foundation for monetary policy actions.

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