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This is what happened to the oil price–macroeconomy relationship

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Abstract

Many of the quarterly oil price increases observed since 1985 are corrections to even bigger oil price decreases the previous quarter. When one looks at the net increase in oil prices over the year, recent data are consistent with the historical correlation between oil shocks and recessions.

Key words: Macroeconomic fluctuations; Oil price shocks

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Mark Hooker has convincingly demonstrated that neither the linear relation between oil prices and output proposed by Hamilton (1983) nor the asymmetric relation based on oil price increases alone advocated by Mork (1989) is consistent with observed economic performance over the last decade. Hooker's evidence is overwhelming and his conclusion is unassailable. Oil price changes are clearly an unreliable instrument for macroeconomic analysis of data subsequent to 1986.

Fig. 1 displays the extension of Mork's series for changes in oil prices used by Hooker. Clearly oil prices have behaved radically differently after 1986 than before. The huge decreases in the price of oil are something that was not seen before, nor was the continuous quarter-to-quarter choppiness.

The view expressed in Hamilton (1988a, b) is that oil shocks affect the macroeconomy primarily by depressing demand for key consumption and

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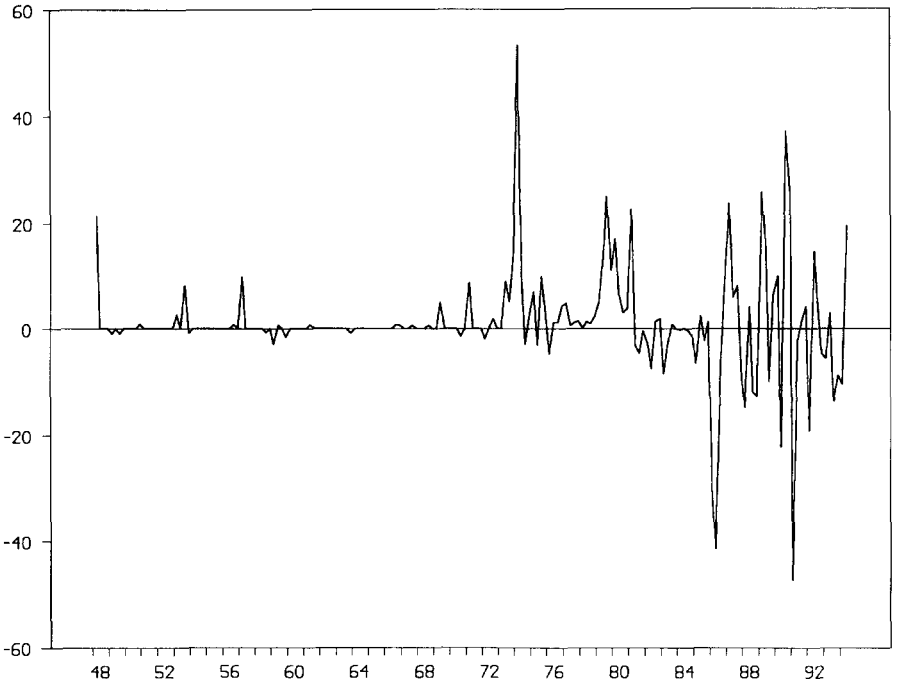

Fig. 1. Change in nominal oil prices. First-difference of logarithm of producer price index for crude petroleum or for domestic first purchase price, from Hooker (1996).

investment goods. Historical oil crises have been characterized by widespread concern about the price and availability of energy, concerns which could well cause certain irreversible investment decisions to be postponed. If that is indeed the mechanism by which oil shocks affect the economy, then a decrease in oil prices would not confer a positive effect on the economy that mirrors the negative consequences of an oil price increase. For this reason, Mork (1989) proposed an asymmetric relation in which the regressor is given by the magnitude of the oil price change when oil prices go up but equal to zero when oil prices decline.

A glance at Fig. 1 indicates why Mork's proposal has not provided a satisfactory way of handling the data that have been obtained subsequent to his study. Most of the increases in oil prices since 1986 have followed immediately on the heels of even larger decreases. If one wants a measure of how unsettling an increase in the price of oil is likely to be for the spending decisions of consumers and firms, it seems more appropriate to compare the current price of oil with where it has been over the previous year rather than during the previous quarter alone.

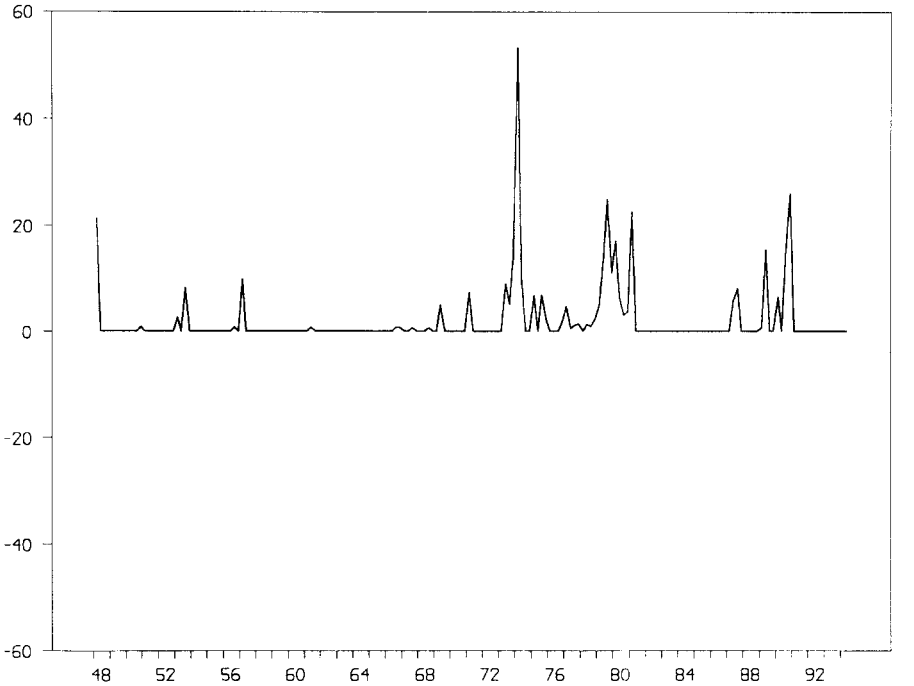

Fig. 2. Net oil price increase. Maximum of (a) zero, and (b) the difference between the level of the crude oil price for quarter t (measured as in Fig. 1) and the maximum value for the level achieved during the previous four quarters.

Fig. 2 plots what might be called the net oil price increase. It compares the price of oil each quarter with the maximum value observed during the preceding four quarters. If the value for the current quarter exceeds the previous year's maximum, the percentage change over the previous year's maximum is plotted. If the price of oil in quarter t is lower than it had been at some point during the previous four quarters, the series is defined to be zero for date t. This calculation makes clear that most of the individual price increases observed since 1986 were simply corrections to earlier declines. The one event since 1986 that produced the most significant increase in the price of oil relative to its value of the previous year was Iraq's invasion of Kuwait in 1990. This event, of course, was followed by the first recession in the United States since the recession that followed the previous major oil shock associated with the onset of the Iran–Iraq war in 1980.

Table 1 reproduces some of the key results from Hooker's Table 1 using the original oil price data plotted in Fig. 1, and compares them with the results obtained when the series in Fig. 2, the net oil price increase, is used instead. A regression for 1948:I to 1994:II of quarterly GDP growth on a constant and

Table 1
Chow stability and Granger causality tests

	Oil price measure	
	Nominal oil price change	Net oil price increase
A. Tests for structural break in 1973:IV		
i. Basic Chow test for change in all coefficients, $F(41,96)$	2.65 ($p < 0.001$)	1.97 ($p = 0.003$)
ii. Test for change in oil price coefficients only, $F(8, 129)$	2.47 ($p = 0.016$)	1.71 ($p = 0.102$)
B. Tests of null hypothesis that oil does not Granger cause GDP		
i. Early subsample 1948:I–1973:III, $F(8, 54)$	2.94 ($p = 0.008$)	3.15 ($p = 0.005$)
ii. Late subsample 1973:IV–1994:II, $F(6, 52)$	0.87 ($p = 0.525$)	1.26 ($p = 0.294$)
iii. Full sample 1948:I–1994:II, $F(12, 113)$	0.83 ($p = 0.615$)	2.14 ($p = 0.020$)

Tests and lags are identical to those in Table 1 of Hooker. Every test is based on a regression of quarterly GDP growth on a constant and lags of itself, an oil price measure, Treasury bill rates, inflation, and import price changes. The structural break tests use eight lags. Row B.i tests the null hypothesis that all 41 coefficients changed in 1973:IV, whereas row B.ii tests the null hypothesis that only the eight coefficients on the oil price measure changed in 1973:IV. The Granger causality tests use eight lags in the early subsample, six lags in the late subsample, and twelve in the full sample, and represent F-tests of the null hypothesis that coefficients relating GDP changes to lagged oil prices are all zero. All variables other than oil prices are as described by Hooker.

eight lags of itself, the net oil price increases, Treasury bill rates, inflation, and import price changes still produces a Chow statistic of 1.97, leading to rejection of the null hypothesis that there was no structural change in this relation beginning in 1973:IV. However, it appears that factors unrelated to oil prices, such as the slowdown in growth since 1973, are the principal cause of this rejection. This Chow statistic of 1.97 is in fact lower than the value of 2.19 reported by Hooker for a comparable regression that does not include oil prices at all. Furthermore, a test of the null hypothesis that none of the coefficients relating GDP to net oil price increases have changed since 1973 produces an F-statistic of 1.71, leading us to accept this null hypothesis – apparently it is the change in the nonoil coefficients that account for the statistical rejection of the stability of this relation.

If one uses only data from 1948:I to 1973:III for a regression of GDP growth on a constant and eight lags of itself, oil prices, Treasury bill rates, inflation, and

import price changes, the results are little affected by whether the quarterly oil price change or the net oil price increase is used as the measure of oil prices. Either measure displays a highly significant, negative relation to GDP over the earlier subsample, as seen in row B.i of Table 1. This is not surprising, since quarterly increases over this period almost always corresponded to an increase from an annual perspective as well. In contrast to Hooker's findings, however, the relation between GDP growth and net oil price increases remains statistically significant when the full sample from 1948:I to 1994:II is used, as seen in row B.iii. It is true that when estimated from 1973:IV to 1994:II, the parameters relating GDP growth to net oil price increases are not as a group statistically significant; see row B.ii. However, the individual coefficient that was found to be most significant in the 1948:I to 1973:III subsample is that relating GDP growth to the net oil price increase four quarters earlier. This produced a t-statistic of -3.0 in the earlier subsample and -2.2 in the later subsample, so this particular coefficient at least is still negative and statistically significant even in the shorter subsample. Moreover, the test for stability of the coefficients relating GDP to net oil price increases mentioned above suggests that the

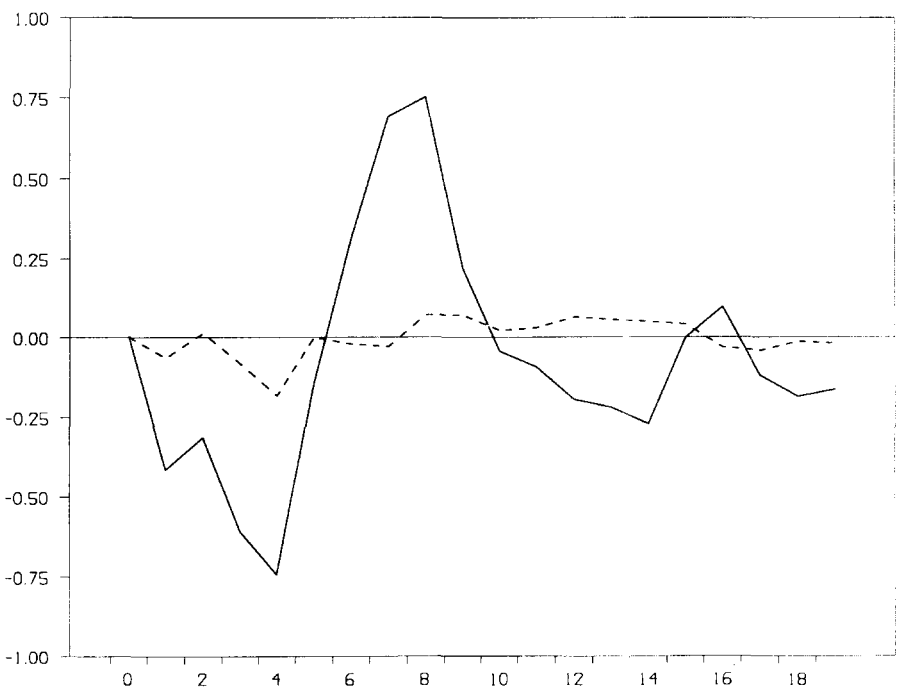

Fig. 3. Impulse-response functions relating GDP growth rate to net oil price increases. Solid line: relation as estimated from 1948:I to 1973:III. Dashed line: relation as estimated from 1973:IV to 1994:II.

statistical insignificance of the coefficients as a group for the smaller subsample might simply reflect lower power in the smaller sample rather than a meaningful change in the value of the coefficients.

Fig. 3 plots the impulse-response function that relates GDP growth to the net oil price increase. The solid line is the relation estimated over 1948:I to 1973:III and the dashed line is the relation estimated over 1973:IV to 1994:II. Even though the latter relation is statistically insignificant, both plots identify the primary effect as negative and spread over the first four quarters following the oil shock. Fig. 3 reproduces the conclusion of Fig. 2 in Hamilton (1983) that a given oil price increase seems to have had a smaller macroeconomic effect after 1973 than an increase of the same magnitude would have had before 1973.

To summarize, the evidence since 1983 has strengthened, not weakened, my earlier convictions. My 1985 article concluded with the statement: 'The political history of the Middle East makes it almost inevitable that sometime within the next decade economists will be granted some more data with which to assess the economic effects of oil supply disruptions.' This is exactly what happened in 1990 when Iraq invaded Kuwait, and surely this oil shock was a key factor in the recession that followed. But for those who have yet to be convinced, I hereby renew the forecast – sometime again within the next ten years, turmoil in the Middle East will produce another major disruption to world petroleum supplies. The crisis will produce a recession in the United States.

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