A Monetary Explanation of the Great Stagflation of the 1970s

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Abstract – This paper argues that the major oil price increases of 1973/74 and 1979/80 were not nearly as essential a part of the causal mechanism generating stagflation as is often thought. We show that monetary expansions and contractions can explain stagflation without reference to supply shocks. Monetary fluctuations help to explain movements in the prices of oil and other commodities, including the surge in the prices of non-oil industrial commodities that preceded the 1973/74 oil price increase. They also can account for the striking coincidence of major oil price increases and worsening stagflation. In contrast, there is no theoretical presumption that oil supply shocks are stagflationary. We show that oil supply shocks may quite plausibly lower the GDP deflator and that there is little independent evidence that oil supply shocks actually raised the deflator (as opposed to the CPI).

Key Words: Stagflation, commodity prices, oil market, monetary policy.

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I. Introduction

There continues to be considerable interest, both among policymakers and in the popular press, in the origins of stagflation and the possibility of its recurrence. The traditional explanation in intermediate textbooks of the Great Stagflation of the 1970s is an adverse shift in the "aggregate supply" curve that lowers output and raises prices on impact.[1] Indeed, it is hard to see in such a static framework how a shift in aggregate demand could have induced anything but a move of output and prices in the same direction. This fact has lent credence to the popular view that exogenous oil supply shocks in 1973/74 and 1978/79 are primarily responsible for the unique experience of the 1970s and early 1980s. For example, *The Economist* (November 27, 1999) writes:

> Could the bad old days of inflation be about to return? Since OPEC agreed to supply-cuts in March, the price of crude oil has jumped to almost $26 a barrel, up from less than $10 last December and its highest since the Gulf war in 1991. This near-tripling of oil prices evokes scary memories of the 1973 oil shock, when prices quadrupled, and 1979-80, when they also almost tripled. Both previous shocks resulted in double-digit inflation and global recession […] Even if the impact will be more modest this time than in the past, dear oil will still leave some mark. Inflation will be higher and output will be lower than they would be otherwise.

Academic economists, even those who may not fully agree with the prevailing view, have done little to qualify these accounts of stagflation. On the one hand, the recent scholarly literature has focused on the relationship between energy prices and economic activity without explicitly addressing stagflation (see e.g., Hamilton 1983, 1985, 1988, 1999; Rotemberg and Woodford 1996). On the other hand, some authors (e.g., Bohi 1989) have stressed not the direct effects of oil price increases on output and inflation, but the indirect effects arising from the response of the Fed to the inflation caused by oil price increases. In that view the Fed responds to higher inflation by monetary tightening, thereby creating a recession. Bernanke, Gertler and Watson (1997), however, show that there is no empirical support for that view at least for 1973/74; only for 1979/80, do they find some support for the notion that the Fed was responding to oil price increases.

In contrast, in this paper we question the conventional view that monetary considerations cannot account for the historical experience of the 1970s, and we make the case that the oil price increases were

[1] For example, Abel and Bernanke (1998, p. 433) write that - after a sharp increase in the price of oil - "in the short run the economy experiences stagflation, with both a drop in output *and* a burst in inflation".

not nearly as essential a part of the causal mechanism generating stagflation as is often thought.[2] We show how in a stylized dynamic model of the macroeconomy stagflation may arise endogenously in response to a sustained monetary expansion. Bruno and Sachs (1985) and, to a lesser extent, Blinder (1979, p. 77) discuss monetary expansion as one important source of stagflation, but their emphasis is on the inadequacy of money as an explanation of the bulk of stagflation and commodity price movements. Although we come to the same conclusion as Blinder (1979) that oil caused a spike in consumer price inflation during the two most stagflationary episodes, we show that oil prices do not provide a plausible explanation of the sustained inflation in both the CPI and the GDP deflator.

The purpose of this paper is to assess the plausibility of the monetary and of the oil-shock explanations of stagflation in light of empirical evidence and of theoretical considerations. Section II outlines a stylized macroeconomic model that explains how stagflation may arise as a purely monetary phenomenon without reference to supply shocks. The model is based on the idea that economic agents learn only gradually about shifts in the monetary policy regime. The model is broadly consistent, both qualitatively and quantitatively, with the dynamic properties of the actual output and inflation data for 1971-1975.

In section III, we provide empirical support for the view that monetary policy played a central role in creating (and ending) the Great Stagflation of the 1970s. We present four additional pieces of evidence in support of the monetary explanation of stagflation. First, we show that episodes of "stagflation" were associated with swings in world-wide liquidity which dwarf monetary fluctuations elsewhere in our sample. Second, we examine several indicators of monetary policy stance to show that monetary policy in the United States, in particular, exhibited a go-and-stop pattern in the 1970s. Third, we show that there were dramatic and across-the-board increases in the prices of industrial commodities in the early 1970s that preceded the OPEC oil price increases. These price increases do not appear to be related to commodity-specific supply shocks, but are consistent with an economic boom fueled by

[2] References that we identify with the traditional view include Samuelson (1974), Blinder (1979), and Bruno and Sachs (1985). Pre-cursors of our alternative explanation of stagflation include Friedman (1975), Cagan (1979), McKinnon (1982), Houthakker (1987), and De Long (1997).

monetary expansion. Fourth, we document that in early 1973 a broad range of business cycle indicators started to predict a recession, nine months before the first OPEC oil crisis, but immediately after the Fed began to tighten monetary policy.

Section IV links these changes in monetary policy to the breakdown of the Bretton Woods system and changes in policy objectives. Monetary policy moved from a regime of low and stable inflation at the beginning of the 1960s to a regime permitting substantial inflation by the end of the decade. The underlying cause of the shift towards higher inflation was the gradual reduction in the United States' commitment to the twin goals of low and stable inflation and the avoidance of "excessive" balance-of-payments deficits. We show that the collapse of Bretton Woods was both caused by this shift in policy goals and in turn contributed to the breakdown of monetary stability.

In section V, we discuss several reasons for being skeptical of the importance of commodity supply shocks in general, and the 1973/74 and 1979/80 oil price shocks in particular, as the primary explanation of the stagflation of the 1970s. We provide a simple model in which oil price increases have an inflationary effect on gross output price measures such as the CPI, but not on the price of value added, as proxied by the GDP deflator. This example mirrors what we observe in the data. In periods with large oil price increases, the CPI rises sharply relative to the deflator. There is no independent evidence that oil price increases raise the GDP deflator.

If oil price shocks are not the source of stagflation, what explains the striking coincidence of the major oil price increases in the 1970s and the worsening of stagflation? In sections VI and VII, we argue that in the 1970s oil prices - like other commodity prices - were in substantial part responding to macroeconomic forces, ultimately driven by monetary conditions. In Section VI we show that the view that oil prices contain an important endogenous component coheres well with existing microeconomic theories about the effect of real interest rate variation and output movements on resource prices.

In section VII we challenge the view that oil price movements are ultimately due to exogenous political events in the Middle East. Our view is not that political factors played no role at all in the decision-making process of OPEC, but that the two major OPEC oil price increases in the 1970s would

have been far less likely in the absence of favorable macroeconomic conditions resulting in excess demand in the oil market. Additional evidence from the most recent oil price increase is discussed in section VIII. Section IX contains the concluding remarks.

II. A Purely Monetary Explanation of the Great Stagflation of the 1970s

The 1970s and early 1980s were an unusual period by historical standards. Table 1 describes the pattern of inflation and of GDP growth for each of the NBER business cycle contractions and expansions. For each phase, we present data on nominal GDP growth and its breakdown into real and price components. Two critical observations arise immediately from Table 1. First, with one exception, the phase average of the rate of inflation rose steadily from 1960.II to 1981.II, and declined steadily thereafter. The exception is that inflation was two percentage points lower (9.48% compared with 7.07%) during the 1975.I-1980.I expansion than in the preceding contraction period from 1973.IV to 1975.I.

The second, and most important, observation is the appearance of stagflation in the data. Stagflation is defined as periods of low or negative output growth, and inflation that is high by historical standards. There were three episodes in which inflation, as measured by the growth in the GDP deflator, exceeded nine percent per annum. In two of these three episodes real output contracted sharply (i.e., in 1973.4-1975.1 and 1980.1-1980.2), and in the third it grew very slowly (i.e., in 1980.2 – 1981.2). Indeed, in all but one contraction (i.e., with the exception of the second Volcker recession in 1981.2-1982.4), average inflation during the contraction was higher than during the previous expansion.

Essential Features of a Monetary Model of Stagflation

In this section, we describe a stylized monetary model that illustrates how stagflation may arise even in the absence of supply shocks when (a) inflation is inherently "sluggish" or persistent, and (b) the monetary authority follows a rule that prescribes a sharp contractionary response to increases in inflation. In the model as well as in the data, inflation continues to rise after output has reached its maximum and peaks only with a long delay. Impulse response estimates from structural vector autoregressions indicate that a monetary expansion is followed by a prolonged rise not just in the price level, but in inflation, a phenomenon that Nelson (1998) calls "sluggish inflation". Likewise, it is widely accepted that output

exhibits a hump-shaped response to a monetary expansion. An important empirical regularity in VAR studies is that the response of output peaks after about 4-8 quarters, followed by a peak in inflation after about 9-13 quarters (e.g., Bernanke and Gertler 1995; Christiano, Eichenbaum and Evans 1996; Leeper 1997). Thus, the peak response of output occurs about one year before the inflation response reaches its maximum.[3] Related, though not equivalent, is the fact that output leads inflation, the cross-correlation function showing (HP-detrended) U.S. GDP peaking about three quarters before inflation (see Kiley 1996). Similarly, Fuhrer and Moore (1995) report a lead of six quarters using linearly detrended GDP.

What is the source of sluggish inflation? Sluggish inflation is not a property of the most commonly used monetary business cycle models (see Taylor 1979; Rotemberg 1982, 1996; Calvo 1983). In these models, both inflation and output jump immediately to their maximal levels, followed by a monotonic decline. Although recent research has demonstrated the inconsistency of the Taylor-Calvo-Rotemberg model with the stylized facts about inflation and output dynamics (see Nelson 1998), it has not provided a generally appealing alternative.

Some authors (e.g., Fuhrer and Moore, 1995; Fuhrer 1997) have treated inflation persistence as structural - a phenomenon that would hold in any monetary regime. In this paper, we instead take the position that sluggish inflation reflects the fact that agents are learning about changes in the monetary policy regime (also see Sargent 1998). Agents are always processing new information, but especially so in a period following regime changes as dramatic as the changes that occurred in the 1970s. Given the low and stable inflation rates of the 1960s, it is plausible that agents were slow to revise their inflationary expectations when confronted with an unprecedented monetary expansion under Arthur Burns in the early 1970s. This interpretation appears even more plausible considering the financial turmoil and uncertainty associated with the gradual disappearance of the Bretton Woods regime. Similarly, expectations of inflation were slow to adjust in the early 1980s, when Paul Volcker launched a new monetary policy regime resulting in much lower inflation.

We propose a stylized model that formalizes the notion that in times of major shifts in

[3] Nelson (1998) presents estimates that the response of inflation to a monetary innovation peaks after 13 quarters, but his VAR only includes money and the price level.

monetary policy (defined in the model as a permanent change in the money growth rate) inflation is likely to be particularly sluggish. Consider a population consisting of two types of firms. A fraction ω_t of "sleepy" firms is not convinced that a shift in monetary policy has taken place and sets its output price (p_t^s) at last period's level adjusted for last period's inflation rate. The remaining fraction $(1-\omega_t)$ of "awake" firms is aware of the regime change and sets its output price at $p_t^w = p_t + \beta(y_t - y_t^f)$, where β is a constant, y_t denotes the log of real GDP and y_t^f the log of potential real GDP. As time goes by, the fraction of agents that is unaware of the regime change evolves according to $\omega_t = e^{-\lambda t}$. These considerations imply an aggregate price-setting equation of the form:

(1a) $$p_t = \omega_t p_t^s + (1-\omega_t) p_t^w = e^{-\lambda t}\left(2p_{t-1} - p_{t-2}\right) + (1-e^{-\lambda t})\left(p_t + \beta(y_t - y_t^f)\right)$$

This price equation is the source of the inflation persistence in our model. Equation (1a) is very much in the spirit of Irving Fisher's (1906) reference to an earlier monetary expansion that "caught merchants napping". Its motivation is closer to that of the Lucas supply schedule (see Lucas 1972, 1973) than to that of sticky price models. Agents are always free to adjust prices without paying "menu costs". Moreover, by the choice of appropriate time-vaying weights ω_t, our inflation equation may account for the fact that agents learn more quickly about some shifts in policy than about others. For expository purposes, however, we postulate that these weights evolve deterministically.

The second building block of the model is the quantity equation

(1b) $$\Delta y_t = \Delta m_t - \Delta p_t,$$

where Δp_t is the inflation rate (which we will associate with the rate of change of the GDP deflator) and Δm_t is the rate of nominal money growth.

We complete the model by adding a policy reaction function. We posit that the Fed cannot observe the current level of the GDP deflator. We postulate a reaction function under which the Fed targets the steady state rate of inflation under the new policy regime. The Fed responds to periods of excessively high inflation by decelerating monetary growth by some small fraction γ of last period's inflation rate.

(1c) $$\Delta^2 m_t = -\gamma \Delta p_{t-1} I(\Delta p_{t-1} > \pi^{new}) + \Delta\varepsilon_t ,$$

where $I(\cdot)$ denotes the indicator function and π^{new} is the steady state rate of inflation under the new policy regime. ε_t represents exogenous changes in the money growth rate. In addition, by way of comparison, we will explore a much simpler model in which money supply growth follows a sequence of exogenous policy shocks ε_t and in which there is no policy feedback.

(1c') $$\Delta^2 m_t = \Delta\varepsilon_t .$$

The model is parameterized as follows. We postulate that in steady state output grows at 3% per annum. Moreover, prices grow at a steady rate of 3% per annum prior to the monetary expansion. We follow Kimball (1995) in setting $\beta = 0.06$. The single most important parameter in the model is λ, which determines the fraction of agents "awake". We choose λ to give our model the best possible chance to match the timing of business cycle peaks and troughs in the U.S. inflation and output gap data for 1971-1975. The resulting value of $\lambda = 0.08$ implies that after two years slighly less than half of economic agents will have adopted the new pricing rule. This rate of transition may appear slow, but - as we will discuss below - is consistent with evidence from other sources as well. Finally, for the model with policy feedback, we choose $\gamma = 0.05$ for illustrative purposes. This value means that, if, for example, the inflation rate last quarter is 2 %, the Fed will decelerate monetary growth by 0.1 percentage points (one tenth of the initial monetary expansion). Our choice of γ ensures that the inflation rate returns to the initial steady-state rate in the long run.

Given this choice of parameters, consider a permanent increase in the growth rate of money by four percentage points per annum in period 5, starting in steady state. Figure 1a shows that a monetary expansion produces the essential features discussed above. The model economy displays stagflation, sluggish inflation and a hump-shaped response of output to a monetary expansion. Most importantly, the output gap rises with the inflation rate initially, with output peaking about two years after the shock, whereas inflation peaks only after three years (close to the 13 quarters reported by Nelson 1988). Between these two peaks output and inflation move in oppposite directions, resulting in stagflation.

Although Figure 1a shows impulse responses to a one-time change in monetary regime, rather than a time path of the underlying process in response to a sequence of shocks, it is of some interest to consider the implications of this model for the correlation properties of the data in the absence of other shocks. The cross-correlation function for the data in Figure 1a shows a lead of 4 quarters of output over inflation (close to the lead of 3 quarters reported by Kiley (1996) for the U.S.). It is interesting to note that although the permanent increase in the money growth rate initially produces a Phillips curve correlation, the *overall* (contemporaneous) correlation between inflation and the output gap is small (0.26) and close to the value of 0.20 reported by Kiley (1996). Moreover, the correlation between money growth and inflation is only 0.40, despite the fact that, as a theory of money demand, the quantity theory holds by construction. This correlation is only slightly higher than the correlation of 0.29 reported by Nelson (1998) for the monetary base. Finally, the correlation between money growth and the gap is 0.79. This last feature is not robust across alternative policy rules, however.

We now address the extent to which a monetary regime change (defined in the model as a permanent change in the money growth rate) can explain the business cycle peaks and troughs over the 1971-1975 period. Consider the following thought experiment: Since we know that a strong monetary expansion took place starting in the early 1970s, we – somewhat arbitrarily - propose to date the monetary expansion in the model such that period 5 in Figure 1a corresponds to 1971.I. This thought experiment allows us tentatively to compare the behavior of output and inflation in the model in response to a monetary expansion with the actual U.S. data. Given this interpretation, the monetary model predicts a peak in GDP in 1972.IV-1973.I, followed by a peak in deflator inflation in 1974.II (shortly after the OPEC oil price increase) and a trough in GDP in 1975.II. Note that, although the NBER dates the end of the expansion in late 1973, Hodrick-Prescott detrended GDP peaks in 1973.I, at the same time as the gap peaks in our model. Thus, the timing of the cycle that would have been induced by the monetary expansion in 1971.I (after accounting for the Fed's reaction to the changes in inflation set in motion by this initial expansion) is remarkably close to the timing of the actual business cycle. Note that this

coincidence of the timing of the business cycle peaks and troughs does not occur by construction, but arises endogenously given our choice of parameters.

Continuing with the same analogy, we now focus on the magnitude of the output and price movements induced by the monetary expansion. Of particular interest is the ability of the model to match the phase averages for the 1971.I-1973.III NBER expansion and the 1973.IV-1975.I NBER contraction. We find that the average per annum inflation rates for 1971.I-1973.III and 1973.IV-1975.I in the model are fairly close to the data. The model predicts average inflation rates of 5.1% and 10.4% per annum, respectively, compared with 5.2% and 9.5% in Table 1. Thus, both the model and the data show a substantial increase in inflation during the NBER recession. Similarly, for GDP growth the model fit is not far off. The model predicts 4.8% growth per annum for 1971.I-1973.III compared with 4.4% in the data, and –3.0% for 1973.IV-1975.I compared with –1.8% in Table 1. We conclude that the quantitative implications of this model are not far off from the data in Table 1, especially considering that we completely abstracted from other macroeconomic determinants. Also note that the Fed inflation target in our model economy becomes binding in early 1973, consistent with the empirical evidence of a monetary tightening in early 1973 in response to actual and incipient inflation (see section III). This example illustrates that go-stop monetary policy alone could have generated a large recession in 1974/75 even in the absence of supply shocks.

A question of particular interest is how essential the endogenous policy response of the Fed is for the generation of stagflation. Some authors have argued that the 1974 recession may be understood as a consequence of the Fed's policy response to inflationary expectations (e.g., Bohi 1989; Bernanke, Gertler and Watson 1997). Figure 1b shows the policy reaction is an important, but by no means essential element of the genesis of stagflation. In fact, a qualitatively similar stagflationary episode would have occurred under the alternative policy rule (1c') without any policy feedback. The main effect of adding policy feedback ($\gamma > 0$) is to increase the amplitude of output fluctuations and to dampen variations in inflation.

In the model without policy feedback, holding fixed the remaining parameters, the timing of the cycle induced by the monetary regime change is roughly similar to that in Figure 1a. Figure 1b shows a peak in GDP in 1972.IV-1973.I, followed by a peak in inflation in 1974.III and a trough in GDP in 1975.II. On average, output leads inflation by 5 quarters, somewhat farther from the lead of 3 reported by Kiley (1996). The correlation between inflation and the output gap is still small, but negative, in this alternative model (-0.08), and the correlation between money growth and the gap falls to 0.14. The low correlation between money growth and inflation, however, remains virtually unchanged (0.35). The model without policy feedback predicts an average annual inflation rate of 5.1% and 12.0% for 1971.I-1973.III and 1973.IV-1975.I, respectively, compared with 5.2% and 9.5% in Table 1. Average output growth per annum over these same subperiods is 4.9% and -2.0%, respectively, in the model compared with 4.4% and -1.8% in the data.

The policy shift associated with the monetary tightening under Paul Volcker in late 1980 provides a second example of the basic mechanism underlying our stylized model. Using the same parameterization as for Figure 1b, our model predicts a sharp recession in late 1982, followed by an output boom in 1985 and an output trough in early 1987. This pattern closely mirrors the movements of HP-filtered actual output. At the same time, inflation in the model falls sharply, reaching its trough in 1984, followed by a peak in 1986. Actual inflation in the GDP deflator follows a similar, if somewhat delayed pattern. It reaches its trough in 1986, followed by a peak in mid-1988. This sluggish response is consistent with the slow adjustment of agents' beliefs about the monetary regime in our model.[4]

III. Support for the Monetary Explanation of Stagflation

In this section, we will present four additional pieces of evidence in support of the monetary explanation of stagflation. First, we will show that episodes of "stagflation" were associated with swings in world-wide liquidity which dwarf monetary fluctuations elsewhere in our sample. Second, we will examine

[4] In our model it takes about two years for half of the agents to adopt the new pricing rule. This rate of adaptation may appear very slow, but it is not unlike those found in many other economic contexts. For example, data from the literature on the entry of lower-priced generics into the market for branded drugs show that after two years only about half of the consumers have switched to the lower-priced generic drug (see Griliches and Cockburn 1994; Berndt, Cockburn and Griliches 1996). If it takes so long for agents to adapt in such a simple problem, it does not appear implausible that it would take at least as long in our context.

several indicators of monetary policy stance to show that monetary policy in the United States, in particular, exhibited a go-and-stop pattern in the 1970s. Third, we will show that there were dramatic and across-the-board increases in the prices of industrial commodities in the early 1970s that preceded the OPEC oil price increases. These price increases do not appear to be related to commodity-specific supply shocks, but are consistent with an economic boom fueled by monetary expansion. Finally, we will document that in early 1973 a broad range of business cycle indicators started to predict a recession, nine months before the first OPEC oil crisis, but immediately after the Fed began to tighten monetary policy.

Worldwide Changes in Liquidity

The monetary model of stagflation sketched in the preceding section relies on some initial monetary expansion to induce stagflation. The two main episodes of global "stagflation" in 1973/74 and 1979/80 were indeed preceded by unusually large increases in world excess money supply. One indicator of liquidity is world money growth. We focus on world, rather than simply U.S. monetary growth, both because the prices of oil and non-oil commodities are substantially determined in world markets, and because - despite its origins in the U.S. - the monetary expansion in the early 1970s was amplified by the workings of the international monetary system, as foreign central banks attempted to stabilize exchange rates in the 1968-1973 period. The counterpart of the foreign exchange intervention in support of the dollar was the rapid creation of domestic credit in all of the large economies (see McKinnon 1982; Bruno and Sachs 1985; Genberg and Swoboda 1993).

Figures 2a and 2b show a suitably updated data set for GNP-weighted world money growth and inflation, as defined by McKinnon (1982). There is evidence of a sharp increase in money growth in 1971-72 and in 1977-78 preceding the two primary stagflationary episodes in Table 1. The increase in world money growth is followed by a substantial rise in world price inflation in 1973-74 and in 1979-80 (see Figure 2b). The data also show a third major increase in world money supply growth in 1985-86. This does not pose a problem for the monetary explanation of stagflation, because 1985-1986 is fundamentally different from 1973-74 and 1979-80. The coincidence of substantial money growth and low world inflation constitutes a partial rebuilding of real balances following the restoration of the

commitment to low inflation.[5]

We now turn to the United States where the monetary expansions of the 1970s originated. Figure 3 shows that U.S. liquidity followed a pattern similar to that of other industrial countries. Figure 3a shows two large spikes in money growth in 1971-1972 and in 1975-1977 that preceded two episodes of unusually high inflation in the GDP deflator in 1974 and in 1980 (see Figure 3b) and that coincided with two episodes of significantly negative growth in real money balances in 1973-74 and 1978-1980 (see Figure 3c). Figure 3c also shows evidence of a rebuilding of real balances (and possibly of the financial deregulation) after 1980.

Additional evidence of excess liquidity in the 1970s is provided by the U.S. real interest rate. Figure 3d shows that 1972-76 and 1976-80 were periods of abnormally low real interest rates, followed by unusually high real interest rates in 1981-86. This pattern is consistent with the view that the excess money growth in the early and mid-1970s depressed ex ante real interest rates via a liquidity effect and further depressed ex post interest rates by causing unanticipated inflation. The timing in Figure 3d contradicts the view that oil shocks were responsible for the low ex post real interest rates. Real interest rates were negative during 1973, after the evidence of excess money growth, but well before the two major oil price increases. In fact, the 1973/74 and 1979/80 oil price increases were followed by a rise in ex-post real interest rates.

Evidence of Go-and-Stop Monetary Policy in the United States

Our evidence is based on several measures of the "total stance of monetary policy" for this period - some based on the behavior of the Federal Funds rate, some based on narrative evidence (see Bernanke and Mihov 1998; Bernanke and Blinder 1992; Boschen and Mills 1995). The Bernanke-Mihov index of the overall monetary policy stance shows a strongly expansionary stance from mid-1970 to the end of 1972 (see Figure 5). Interestingly, the Boschen-Mills index on the basis of narrative evidence is mostly neutral during this period with the exception of 1970/71. The reason is that the Boschen-Mills index is based on

[5] This is precisely the standard interpretation of the patterns of inflation and money growth that have been documented for the period following the monetary reform that ended the German hyperinflation (see Barro (1987), p. 206, Table 8.1).

policy pronouncements as opposed to policy actions. Quite simply, the Fed's pronouncements in this period were uninformative at best and probably misleading.

Both the Boschen-Mills index and the Bernanke-Mihov index show a sharp tightening of monetary policy in early 1973. The Boschen-Mills measure, measured on a scale from +2 (very expansionary) to –2 (very tight), moves from neutral at the end of 1972 to –1 for the first three months of 1973, and then spends the next 6 months at –2, followed by two months at –1, ending the year in neutral. Further, the Bernanke-Mihov index shows a sharp and prolonged contraction in monetary policy by early 1973 (see Figure 5). As noted by Boschen and Mills (1995), this contraction was an explicit response to rising inflation. It occurred long before the disturbances in the oil market in late 1973 and provides an alternative explanation of the recession in early 1974.[6] The contractionary response of the Fed in 1973 to the inflationary pressures set in motion by earlier Fed policy is a key element of our monetary explanation of stagflation.[7] Note that the observed increase in inflation in 1973 is understated as a result of price controls and the observed increase in 1974 is overstated due to the lifting of the price controls (see Blinder 1979).

As the U.S. economy slid into recession in 1974, the Fed again reversed course to ward off an even deeper recession. Indicators show a renewed monetary expansion that lasted into the late 1970s. The Bernanke-Mihov index from late 1974 into 1977 indicates that monetary policy was strongly expansionary (see Figure 5). This expansion was not reflected in high inflation initially, as suggested by our earlier discussion of sluggish inflation. Boschen and Mills record a similar, if somewhat briefer, expansion. Around 1978, the monetary stance turned slightly contractionary, becoming strongly contractionary in late 1979 and early 1980 under Paul Volcker, as inflation continues to worsen. Once again, the monetary policy stance provides an alternative explanation for the genesis of stagflation.

Movements in Other Industrial Commodity Prices

[6] This interpretation is consistent with Bernanke, Gertler and Watson's (1997) conclusion that the Fed in 1973 was responding to the inflationary signal in non-oil commodity prices, not to the oil price increase, as is commonly believed.

[7] There is no Romer date for 1973, despite the clear evidence of a shift in policy toward a contractionary stance.

An important piece of evidence that has received insufficient attention in recent research is the sharp and across-the-board increase in industrial commodity prices that preceded the increase in oil prices in 1973/74 (see Figure 4). These increases occurred as early as 1972, well before the October War, and are too broad-based to reflect supply shocks in individual markets (see Figure 4). They are, however, consistent with a picture of increased demand driven by the sharp increase in global liquidity documented earlier in Figure 2.

There is significant evidence that poor harvests caused food prices to soar in the early 1970s (see Blinder 1979). Our data set deliberately excludes food-related commodities. Instead, we focus on industrial raw materials. Commodities such as lumber, scrap metal, pulp and paper, for which there is no evidence of supply shocks, recorded rapid price increases in the early 1970s (see National Commission on Supplies and Shortages 1976). For example, the price of scrap metal nearly doubled between October 1972 and October 1973, and continued to rise until early 1974, to nearly four times its initial level. The price of lumber almost doubled between 1971 and 1974, as did the price of wood pulp. These commodity price data paint a picture of rapidly rising demand for all commodities in the early 1970s.

It is interesting to note that a similar increase did not occur in oil prices until late 1973. Similarly, the 1979 increase in oil prices was preceded by a boom in other commodity prices, consistent with the evidence of monetary expansion, although the commodity price increase is of lesser magnitude. In fact, a striking empirical regularity of the data in Figure 4 is that increases in other industrial commodity prices tended to precede increases in oil prices over the 1972-1985 OPEC period (and similarly for decreases). This fact is evident for example in 1972, 1978, 1980, 1983 and 1984. A natural question is how the monetary explanation of stagflation proposed here can be reconciled with the delayed response of oil prices relative to other industrial commodities. The explanation appears to be that, unlike other commodity transactions, most crude oil purchases until the early 1980s did not take place in spot markets, but at long-term contractual prices. The sluggish adjustment of these contractual prices in response to demand conditions in commodity markets tended to delay the response of the oil price relative to the price of more freely traded commodities, until the spot market largely replaced traditional oil contracts in the

early 1980s.

Business Cycle Indicators

Both the expected conditions component of the index of consumer confidence and the index of leading indicators peaked in January 1973, when monetary policy switched to a contractionary stance in response to rising inflation. Consumer durables started falling relative to trend in early 1973, as would be expected in response to a monetary tightening. Similar declines can be observed in the number of housing starts and motor vehicle purchases. Figure 6 suggests that both consumers and economic forecasters were expecting a recession many months before the October 1973 war and the subsequent oil embargo, and that this expectation was not driven by concerns over OPEC. The decline in the index of leading indicators continues throughout 1974. Although we cannot tell to what extent the fall in the index of leading economic indicators after September 1973 can be attributed to oil as opposed to money, a full two thirds of the fall in consumer confidence in 1973-74 was completed prior to the oil date.

IV. What Explains the Initial Monetary Expansion of the 1970s?

Monetary policy moved from a regime of low and stable inflation at the beginning of the 1960s to a regime permitting substantial inflation by the end of the decade. The underlying cause of the shift towards higher inflation was the gradual reduction in the United States' commitment to the twin goals of low and stable inflation and the avoidance of "excessive" balance-of-payments deficits. In the late 1960s, the central bank's commitment to these traditional goals was increasingly diluted by the additional goal of maintaining high employment.[8] The dilution of the commitment to controlling inflation and balance of payments deficits was behind both the weakening (and ultimately the destruction) of the Bretton Woods system and the initiation of expectations of high and persistent inflation in the late 1960s. The rise in inflationary expectations in turn triggered an "inflation trap" by raising the cost of subsequent

[8] This change in focus can be traced ultimately to the Great Depression and the perception that tight monetary policy had been responsible for excessively high unemployment during the Great Depression. The rise in social and political commitment to full employment was furthered by an intellectual belief in the more or less permanent exploitability of the Phillips-curve (see Samuelson and Solow 1960). The refusal to reign in social spending or to allow a sharp rise in interest rates, as the Vietnam war expanded in the late 1960s, reflected the change in priorities.

disinflations (also see Christiano and Gust 2000).[9] These inflationary pressures were reinforced by two serious errors of economic analysis on the part of the Federal Reserve: First, a miscalculation of full employment in the wake of the productivity slowdown and of structural changes in the labor market (see Orphanides (2000); Orphanides et al. 1999);[10] and, second, an increased tendency to attribute inflation to "special factors" rather than the underlying monetary environment.[11] A third element was the exploitation of the newly unconstrained policy environment in the service of electoral politics.[12]

A number of authors (see McKinnon 1982; DeLong 1997; Mundell 2000) have suggested that the collapse of the gold exchange standard associated with Bretton Woods played a key causal role in the creation of the inflationary monetary environment of the 1970s.[13] Although it is widely accepted that the eventual collapse of the Bretton Woods system was inevitable due to fundamental structural flaws (see the papers in Bordo and Eichengreen 1993), the timing of its demise was influenced by the same factors that also launched the initial wave of inflation in the mid-1960s to 1970. The collapse was triggered by

[9] What makes the expectations trap hypothesis plausible is evidence that by 1971 the Fed indeed perceived a shift in the public's expectations of inflation. As Christiano and Gust (2000) note, Arthur Burns was concerned about expectations of inflation as early as December 1970. By 1971, he perceived a shift in inflationary expectation due to the steady rise of consumer price inflation since 1965, well before the commodity supply shocks, the oil shocks, and the monetary expansion of the early 1970s (see Burns 1978, p. 118 and p. 126).

[10] Orphanides (2000) documents that the measurements of real output available to the Fed following both the 1970 and 1974 recessions were substantially lower than the output data now available. At the same time, official estimates of potential real output were in retrospect far too optimistic, resulting in excessively high estimates of the output gap, defined as the shortfall of actual output relative to potential. Drawing on evidence from simulated real-time Taylor rules and on the Fed minutes and the recollections of the policymakers involved, Orphanides concludes that the increase in the natural rate of unemployment and the productivity slowdown in the late 1960s and 1970s were two major factors in explaining the inflationary outcomes of the period.

[11] For example, Hetzel (1998) makes the case that then chairman Arthur Burns adhered to a special-factors theory of inflation which attributed increases in inflation to a variety of special circumstances ranging from unions and large corporations to government deficits and finally food and oil price increases. Hetzel argues that Burns systematically discounted any direct effects from increases in the money supply on inflation and did not appear to be overly concerned about the extent of the monetary expansion in the early 1970s. For a similar view see Christiano and Gust (2000).

[12] For example, DeLong (1997) stresses that the inflation of the early 1970s was fueled in addition by Arthur Burns' efforts to facilitate Nixon's reelection through expansionary monetary policy. Christiano and Gust's (2000) narrative evidence that Burns was not intimidated by Nixon does not contradict this interpretation because Burns' conservative economic views were closer to Nixon's than to those of his democratic opponent.

[13] The temporal coincidence is indeed an impressive one. The breakdown of the Bretton Woods system was foreshadowed by the introduction in 1968 of a two-tiered system of convertibility with significantly higher prices for private than for official transactions, in response to the declining private sector confidence in the dollar peg. It became official when President Nixon announced the "closing of the gold window" – ending the convertibility of dollars into gold in August 1971. The relaxation of the convertibility constraint coincided with a dramatic increase in U.S. monetary growth (see Figure 3a), and a period of expansionary monetary policy between mid-1970 and late 1972, as indicated by the Bernanke-Mihov index.

an excess supply of U.S. dollars resulting both from the expansion of the U.S. monetary base and a reduction of the demand for dollars abroad driven by the expectation of an incipient depreciation of the dollar (see McKinnon 1982; Bruno and Sachs 1985; Genberg and Swoboda 1993). In this sense, the breakdown of the Bretton Woods system was endogenous.

At the same time, awareness of the loss of prestige that would accompany suspension of convertibility continued until the end to serve as a partial commitment device that contributed significant restraint against higher inflation (see Bordo and Kydland 1996). By completely removing this constraint, the 1971 closing of the gold window permitted a second round of monetary expansion starting from an already high base. In this sense, the breakdown of the Bretton Woods system may also be considered one of the causes of the monetary expansion. As stressed by Kydland and Prescott (1977) and Barro and Gordon (1983), the incentive of the central bank to stimulate employment in the short run, tends to produce an excessively high rate of inflation in the absence of a suitable commitment mechanism. Not until the development of new commitment devices in the form of a lexicographic intellectual commitment to price stability and the cult of the conservative central banker at the beginning of the 1980s was the prevailing level of inflation reduced to the levels of the early 1960s (see Rogoff 1985). The reason that the 1970s are different from the preceding and the following decade thus is the absence of effective constraints on monetary policy behavior.

As the global monetary system underwent dramatic changes in the early 1970s, both central bankers and private agents slowly had to adapt to the new rules of the game. The monetary expansion was not immediately understood by market participants and required a process of learning that is reflected in the sluggish adjustment of inflation in the model of section II. Furthermore, the Fed itself was operating in a new monetary environment without the traditional constraints and needed to learn about the consequences of its own actions. There was a widespread sense that the "the rules of economics are not working in quite the way they used to" (see Burns (1978), p. 118). This element of trial and error is important in understanding the go-and-stop nature of monetary policy in this period and helps to explain why the generally inflationary stance of monetary policy was punctuated by occasional sharp

contractions. It also helps to answer the question of why the Fed did not learn from its mistakes after the first episode of go-and-stop monetary policy ended in 1974. The data for U.S. monetary growth in Figure 3a show a renewed expansion that coincided with a period from late 1974 until 1977 in which policy indicators signal a second "go"-phase for monetary policy. Part of the explanation may be that at the time the Fed attributed at least part of the observed stagflation to oil supply shocks and other special factors. More importantly, the Fed lacked a political mandate for serious reform. The lack of commitment to maintaining low inflation could only be overcome by the experience of double-digit inflation in the late 1970s.[14]

V. How Convincing is the Aggregate Supply Shock Explanation of Stagflation?

The view that the historical pattern of stagflation can be accounted for by the effects of money does not preclude the possibility that supply-side shocks played a major role in generating the stagflation either directly or indirectly by inducing a policy response. In this section, we will demonstrate that the supply-shock explanation of stagflation is less convincing than commonly thought.

Is the Textbook Analysis of "Aggregate Supply Shocks" Convincing?

Gross vs. Value-Added Concepts of Output and Price

The textbook view is that oil price shocks are of necessity inflationary. The only question of debate is the magnitude of the inflationary effect (see The Economist 1999). As we will show, however, this claim is unambiguously true only for the price of gross output, not for the price of value added. The following counterexample demonstrates that oil price shocks may in fact have a deflationary effect on the price of value added, even as they raise the price of gross output.

Suppose gross output Q is given by the production function $Y = Q[V(K, L, x), O]$, where x denotes a technology disturbance, O denotes the quantity of a foreign commodity import ("oil"), and $V(K, L, x)$ is domestic value-added. As is standard, we assume separability between O and the other factors in order to ensure the existence of a value-added production function. As is immediately clear, a decline in O, under separability, is *not* a shock to the production function for value-added - the ability to produce domestic

[14] Sargent (1998) provides a detailed account of competing explanations of the transition back to a low inflation regime.

output is unchanged. It follows that oil shocks cannot play the role of a technology shock in a standard real business cycle model (i.e., they do not alter value added holding constant capital and labor input), although they do lower the quantity of gross output.

Following Rotemberg and Woodford (1996), we consider an economy in which symmetric firms produce final output using the gross output production function

(2) $$Y_t = Q\left(V_t(L_t), O_t\right),$$

where O_t is the quantity of foreign oil used in production, Q is homogenous of degree one in its arguments, and V_t is a function of labor hours and capital. The capital stock is assumed to be fixed, ensuring concavity of V_t. Let gross output be the numeraire. V_t, the value added associated with capital and labor, should be thought of as real GDP. Nominal GDP is given by $P_t Y_t - P_t^O O_t$, where P_t^O is the price of imported oil.

Further postulate that the demand for money balances is proportional to nominal gross output:

(3) $$M_t = k\, P_t Y_t$$

where P_t is the price of gross output. Thus, nominal gross output is determined by the money stock alone.

Now suppose that labor is supplied inelastically. Further suppose that all markets are perfectly competitive. Logarithmically differentiating (2) and (3) with respect to P_t^O we obtain

(4) $$\Delta Y_t = -\frac{s_O}{1-s_O}\varepsilon_{O,V}\,\Delta P_t^O$$

(5) $$\Delta P_t = \frac{s_O}{1-s_O}\varepsilon_{O,V}\,\Delta P_t^O$$

where Δ denotes percent changes, s_O is the cost share of oil in gross output and $\varepsilon_{O,V}$ is the elasticity of substitution between value added and oil. This means that an increase in the price of imported oil will tend to lower the quantity of gross output and raise the price of gross output.

Next consider the deflator for value added, defined as the ratio of nominal over real value added:

(6) $$P_t^V = \frac{P_t Y_t - P_t^O O_t}{V_t(L_t)} = \frac{P_t Y_t (1 - s_O)}{V_t(L_t)}.$$

Again consider an increase in the price of imported oil. Clearly, under our assumptions the denominator of (6) does not vary with the price of oil. The numerator, however, will fall, since by (3) nominal gross output is determined solely by the money stock and the cost share of imported oil in gross output is expected to rise in response to an oil price increase (see Gordon 1984; Rotemberg and Woodford 1996). Thus, the oil price shock *lowers* the price of value added, even as it raises the price of gross output.

This stylized example illustrates that the "aggregate supply shock" view of oil price changes is questionable. Whereas "aggregate supply shocks" in the textbook model are stagflationary for value added, oil price increases may actually be *deflationary*. In this sense, in our example they are closer in spirit to "aggregate demand shocks" than to "aggregate supply shocks".[15] How realistic is this counterexample? Clearly, to overturn our benchmark result would require a sufficiently sharp fall in real value added in response to an oil price shock, without a commensurate drop in the money stock. We now discuss several mechanisms by which oil price shocks may in principle generate a fall in the quantity of value added.

Since oil shocks are not productivity shocks, the key to establishing that oil price shocks affect value added then must be showing that labor and capital inputs change in response to an oil price shock.[16] One model that establishes such a link is the sectoral shifts model of Hamilton (1988). A related channel has been discussed by Bernanke (1983) who shows that in a partial equilibrium model oil price shocks will tend to lower value added, because firms will postpone investments as they attempt to find out whether the increase in the price of oil is transitory or permanent.

[15] An additional factor that reinforces the "aggregate demand shock" interpretation is the transfer of purchasing power from the United States to OPEC (see Bruno and Sachs 1985).

[16] Under imperfect competition, as noted Rotemberg and Woodford (1996), an oil price shock does result in a rise in the supply price for all levels of value added. This increase occurs because firms apply the markup to all cost components, including imported oil, not just to capital and labor. The magnitude of this effect, however, is likely to be small for reasonable markup ratios, unless we allow in addition for substantial changes in the markup over time. The latter possibility is discussed by Rotemberg and Woodford (1996) who show that a model involving implicit collusion between oligopolists in the goods market can yield output responses to an oil price shock that are quantitatively important.

Even if we accept the view that an oil price shock lowers the real value added, however, there is no presumption that this shock will be stagflationary. First, consider the case of a fixed money supply. It is not enough to show that value added falls in response to an oil price shock. For the price of value added actually to rise when the money supply is fixed, value added must fall by *more* than the numerator in (6). More generally, the money supply will not be fixed. In that case, the direction of the change in the price deflator also depends on the Fed's reaction to the fall in value added. The optimal Fed behavior would be to contract the money supply in response to the fall in value added (see King and Goodfriend 1997). We already showed that indeed the Fed was conducting contractionary monetary policy at the time of the oil price shocks. Whether this monetary contraction would have been enough to stabilize the price level, as value added falls, is an empirical question.

This discussion shows that the implications of an oil price shock are unambiguous only for the price of gross output measures such as the consumer price index (CPI). Although one could construct other examples, in which oil price shocks are inflationary for the price of value added (measured by the GDP deflator), there is no presumption that in general they are. The direction and strength of the effect of oil price shocks on the GDP deflator is an empirical question.

Do Oil Price Shocks Move the GDP Deflator?

The preceding discussion stressed the important distinction between inflation in prices of gross output (such as the CPI) and of value added (such the GDP deflator). In this section, we provide some empirical evidence about the timing and relative magnitude of the changes in the GDP deflator and the CPI inflation rates during major oil price changes, and we consider a natural experiment that sheds light on the relative contribution of oil and money to the observed deflator inflation in the 1970s. Figure 7 shows the annualized inflation rates for gross output prices (as measured by the CPI) and the price of value added (as measured by the GDP deflator) for the United States in the 1960.I-2000.II period.[17] We use the PRXHS index of consumer prices that excludes housing and shelter. Despite the obvious differences in

[17] Our theoretical counterexample maintained the implicit assumption that no oil is produced domestically. This is not an issue for most OECD countries in the 1970s with the exception of the United States. There are reasons to doubt the quantitative importance of this channel, however, even for the United States. Not only is the share of domestic oil in U.S. GNP small, but there was little change in the quantity of domestically produced oil in response

the content and construction of these two indices, there is strong comovement in the long run. For our purposes, it will be of interest to focus on five major episodes: the two major oil prices increases of 1973/74 and 1979/80, the major drop in oil prices in early 1986, the invasion of Kuwait in 1990/91, and the recent oil price volatility since 1997.

Figure 7 shows an unusual discrepancy between the deflator and CPI inflation rates during the five episodes of interest. CPI inflation rose sharply relative to deflator inflation between 1972 and 1974 and again in 1979 and early 1980. This result is not surprising, as these periods were characterized by major fluctuations in world commodity markets. To the extent that prices of imported oil and other imported commodities enter the CPI but not the deflator, our discussion suggests that we should expect to see a wedge between inflation in the CPI and in the deflator. Moreover, it is well known that especially price-sensitive items such as food (whether imported or not) have comparatively higher weights in the CPI than in the deflator, adding to the discrepancy. Similarly, the 1986 and 1990/91 episodes are characterized by a differential response of CPI and deflator inflation rates. The same differential response occurs after 1997, as oil prices first plummet and then experience a dramatic reversal in 1999 and 2000.

Although CPI inflation reached double-digit rates in early 1974, the bulk of the inflation in the deflator only occurred from mid-1974 to 1975. One possible explanation is that value added fell for the reasons described by Hamilton (1988), and monetary policy did not contract enough to prevent an increase in the price level. An alternative explanation is that the delayed inflation was caused by the earlier monetary expansion. Similarly, although CPI inflation rates rose sharply in 1979/80, the bulk of the inflation in the deflator occurred only in mid-1980-1981.[18] Again, the delayed increase in deflator inflation seems consistent with both a delayed response to monetary expansion in the late 1970s and a

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to OPEC's price increase. Thus, it is possible to construct GDP deflator data for the non-oil component of GDP. The resulting inflation rates will be lower than the total GDP deflator, but qualitatively similar under realistic assumptions.

[18] The unusually long delay in the response of inflation to money can be explained by the presence of wage and price controls throughout 1973 and in early 1974. These controls effectively suppressed inflation rates. The lifting of price controls in April 1974 coincided with a sharp increase in deflator (as well as CPI) inflation (see Blinder 1979). The fact that the increase in deflator inflation rates in 1980/81 was smaller (if more sustained) than in 1974/75 also is consistent with this interpretation.

delayed response to the 1970/80 oil price increases. Thus, it does not seem possible to disentangle the relative contribution of oil and of money based on evidence from the 1973/74 and 1979/80 periods alone.

The 1986 episode, however, provides a natural experiment because it coincides with a major change in oil prices, but no major change in other industrial commodity prices (see Figure 4). Thus, the excess drop of the CPI inflation rate relative to the deflator inflation rate in Figure 7 can be attributed to oil. Moreover, the absence of a sharp change in the deflator inflation rate is suggestive of the absence of a major change in monetary policy stance. The fact that the sharp deflation in the CPI in 1986 was accompanied by only a minor reduction in deflator inflation, casts doubt on the view that oil was responsible for deflator inflation in earlier periods. Further evidence against the oil supply shock view is provided by events of 1997-2000. During this period oil prices first fell sharply to an all-time low and then rose sharply to heights not seen since 1979/80. As expected, these oil prices swings are reflected in considerable swings in CPI inflation rates in Figure 7, but they have little, if any, effect on deflator inflation. Together with the observation that the sharp rise of many industrial commodity prices in the early 1970s (well before the oil price increases) cannot be explained by supply shocks, these natural experiments are suggestive of a monetary explanation of the stagflation of the 1970s.

VI. The Relationship of Oil Prices and the Macroeconomy: Theory

In section V, we showed that, although an oil supply shock may well cause a recession, its effect on the GDP deflator (as opposed to the CPI) is ambiguous in theory and appears to be small in practice. Nevertheless, casual observers continue to be impressed with the coincidence of sharp oil price increases in the 1970s and the worsening of stagflation. In fact, some observers seem puzzled by the absence of a close link between oil prices and stagflation at other times (for example, The Economist 1999).

In this section, we will argue that the almost simultaneous occurrence of sharp increases in oil prices and worsening stagflation in the 1970s was indeed no coincidence. Unlike conventional accounts based on exogenous oil supply shocks, however, we stress that oil prices were responding in substantial measure to conditions in the oil market which in turn were greatly affected by macroeconomic conditions (and ultimately by the monetary stance). Put differently, we reject the common notion of a simple one-

way causal link from oil prices to the macro-economy and allow for the possibility that oil prices (like other commodity prices traded in international markets) tend to respond to macroeconomic forces.

The view that oil prices contain an important endogenous component is not as radical as it may seem. In fact, the observed behavior of oil and non-oil commodity prices coheres well with economic theory about resource prices (see Heal and Chichilnisky 1991). Commodity prices rise in response to high output and low real interest rates. Our emphasis on the endogenous response of oil prices to global (and in particular U.S.) macroeconomic conditions does not rule out that political events played a role in the timing of the observed oil price increases, but it suggests that politically motivated increases in the oil price would have been far less likely in the absence of a conducive economic environment created by monetary policy.

The starting point for our analysis is the classic resource extraction model of Hotelling (1931). Applying this model to oil, marginal revenue (MR) net of marginal cost of extraction (MCE) must rise at the rate of interest, so that well owners are on the margin indifferent between extracting oil today and extracting oil tomorrow. Further, the transversality condition says that, in the limit, no oil should be wasted. Combining these two conditions, for the special case of zero marginal extraction cost, we have:

(7) $$\sum_{t=0}^{\infty} D_t^{oil}(p_0^{oil} e^{rt}, y_t) = S^{oil}$$

where p_0^{oil} = initial relative price of oil, S^{oil} = fixed stock of oil, r = real interest rate, y_t = aggregate output in period t, and D_t^{oil} = demand for oil in period t. Under perfect competition, equation (7) implies that the price of oil rises at the rate of interest until the fixed stock of oil is exhausted. For the more general case of positive marginal extraction costs the first-order condition for profit maximization is that MR-MCE must rise at rate r:

(8) $$\left(\dot{MR} - \dot{MCE}\right) \Big/ \left(MR - MCE\right) = r$$

Note that the required rise over time in MR-MCE may be accomplished by a fall in MCE as new capacity is developed, even without a rise in the oil price (see Holland 1998). Indeed, this feature of the model allows for the oil price to fall over time.

This simple model has direct implications for how monetary policy affects oil prices. First, a one-time permanent drop in *r* raises the initial price, and implies slower price growth thereafter. Second, a rise in aggregate real income shifts out the flow demand for oil. Since the oil is consumed more rapidly, the price of oil must rise to clear the market. The magnitude of these effect depends on the *size* and *duration* of the effects of monetary policy on *r* and *y*. Money is not normally thought to permanently change *r* or *y*. Thus, the magnitude of price adjustment in response to monetary policy in this model may not be large. Much stronger effects on the price of oil may occur once capacity is modeled explicitly.

If marginal costs are increasing in the extraction rate (which – in the limit - may be interpreted as capacity constraints), a shift in demand for oil in this model may generate sharp increases in the price of oil as well as overshooting of the oil price.[19] In the limit, if installed capacity is instantaneously fixed, the price of oil at a moment in time is determined entirely by demand. A rise in real GDP, or a decrease in the real interest rate, shifts the demand curve for oil to the right, sharply raising the market price of the given stock of oil. However, this price increase carries the seeds of its own destruction. If we began in steady state, the shadow price of capacity will now exceed its replacement cost at current levels of capacity. If the price remains high for extended periods, investment in drilling and distribution capacity takes place, and in the long run the price of oil will fall.

In addition to the direct effect of real income and real interest rates on the demand for oil, there also is a second effect that links the stability of the oil cartel to macroeconomic forces. Standard theoretical models of cartels like Rotemberg and Saloner (1986) and Green and Porter (1984) predict that cartel stability will be strengthened by low real interest rates. Producers trade off the immediate gains from abandoning the cartel against the present value of the cartel rents foregone. This logic suggests that the unusually low real interest rates in the 1970s, all else equal, should have been conducive to the formation of cartels and the high real interest rates of the 1980s should have been detrimental. Moreover,

[19] Mabro (1998, p. 16) notes that "… exhaustibility as an ultimate outcome in a universal context is not very relevant [for the oil price] because the time horizon involved, even today, is far too long to have a noticeable impact. What matters is the relationship of current productive capacity to current demand and of planned investments in capacity to future demand. It is not the geo-physical scarcity of oil that poses problems … but the capacity issue at any given point in time."

Green and Porter show that if producers, rather than observing the cartel's output, only observe a noisy measure of the market clearing price, cartel activity will be pro-cyclical. The assumption of imperfectly observable output is particularly appealing for crude oil producers. The actual production level of crude oil can only be estimated in many cases, and reliable output statistics become available only with a long lag. Thus, we would expect strong economic expansions, all else equal, to strengthen cartel stability and major recessions to weaken cartels.

VII. The Relationship of Oil Prices and the Macroeconomy: Evidence

The view that oil prices are endogenous with respect to U.S. macroeconomic variables such as real interest rates and real GDP has considerable empirical support. The two most prominent increases in the price of oil in 1973/74 and 1979/80 were both preceded by periods of economic expansion (see Table 1) and unusually low real interest rates (see Figure 3d). In contrast, the fall in oil prices after 1982 coincided with a severe global recession and unusually high real interest rates. This section analyzes in detail the historical evidence for a link between oil prices and the macroeconomy.

Why Did the 1973/74 Oil Price Increase Occur When It Did?

An intriguing question is why the two major and sustained oil price increases of the 1970s occurred when they did. The dominant view in the literature appears to be that the timing was primarily determined by exogenous political events in the Middle East which are thought to have triggered supply cuts and thereby raised oil prices (see Hamilton 1999). However, as we will argue, sustained oil price increases are only possible under conditions of excess demand in the oil market. Such conditions are unlikely to occur in the absence of favorable macroeconomic conditions, notably economic expansion and low real interest rates. Thus the apparent success of OPEC oil producers in raising prices in the 1970s (and their failure to raise prices for sustained periods at other times) is no historical accident. The timing of the oil price increases in the 1970s coincided with periods of unusually strong demand for oil, driven in substantial part by global macroeconomic conditions.

Until the late 1960s, the excess capacity of the U.S. oil industry allowed the U.S. to play the special role of the supplier of last resort to Europe and Japan, in the event that oil supplies were

threatened. The fact that the U.S. assumed this role was an inadvertent consequence of the regulatory policies of the Texas Railroad Commission regime, under which rationing of production led to excess capacity (see Hamilton 1985). The ability of the U.S. to flood the market with surplus oil served as a deterrent against any attempt to raise international oil prices, and ultimately thwarted the effects of the 1956 and 1967 oil embargoes. What then were the changes in the world oil market that made the successful 1973 oil price hike possible? The main difference between the early 1970s and earlier periods was that, on top of the long-term trend toward increased energy consumption, there was a dramatic surge in world-wide demand for oil that was fueled by monetary expansion.

In March 1971, U.S. oil production for the first time in history reached 100 percent capacity (see Yergin (1992), p. 567).[20] The rising demand for oil was at first met with an increase in oil output in the Middle East that kept the price of oil low and falling in real terms (see Figure 8). Oil imports as a share of U.S. oil consumption rose from 19 percent in 1967 to 36 percent in 1973 (see Darmstadter and Landsberg (1976), p. 31). Mabro (1998, p. 11) notes that OPEC's average daily production increased from 23.4 mb/day in 1970 to 30.99 mb/day in 1973. All OPEC members but Kuwait, Libya and Venezuela increased production in this period. As a result, excess capacity was shrinking quickly in the Middle East.

Seymour (1980, pp. 100) documents that the oil market had been tightening since 1972 in spite of the rapid increases in oil output. In late 1972, all of the main market indicators – tanker freight rates, refined product prices, and spot crude prices – started rising and continued their climb throughout 1973. While the recoverable reserves in the Middle East were of course huge, available production capacity was lagging consumption. By September-October of 1973, immediately before the oil embargo, both Saudi Arabia and Iran had just about reached their maximum sustainable output. The capacity shortage was not limited to Saudi Arabia and Iran. Had oil prices not risen in late 1973, there would have been virtually no

[20] The normal market response to this shortage would have been rising oil prices. However, U.S. price controls on oil imposed in 1971 as part of an overall anti-inflation program were discouraging domestic oil production while stimulating consumption, and left little incentive for exploration or conservation. Moreover, growing environmental concerns held back U.S. oil production, even as new large oil reserves were being discovered in Alaska (see McKie (1976), p. 73).

spare productive capacity available anywhere in the world on the basis of the then projected forecasts of oil consumption for the winters of 1973-74 and 1974-75 (see Seymour (1980), p. 100).[21]

If the 1973 oil price increase was caused by demand shifts, why did oil output fall?

The normal market reaction to the increased demand for oil in the early 1970s should have been an increase in both price and quantity of oil. As we have noted, the data instead show a steady decline of the price of oil in real terms in the early 1970s, followed by a sharp rise in the price of oil in late 1973 and a drop in oil output. This puzzling result reflected the gradual resolution of a disequilibrium that arose from the peculiar institutional structure of the OPEC oil market at that time.

Throughout the 1960s, oil delivery contracts were long-term agreements between OPEC producers and oil companies. Oil producers agreed to supply oil at a price that was fixed in nominal terms for several years in advance. Contracts were periodically renegotiated to account for changes in economic conditions. As the macroeconomic environment became increasingly unstable in the early 1970s, the renegotiations failed to keep pace with the rapidly changing macroeconomic conditions. The stickiness of the nominal oil price contributed to the observed fall of the real price of oil, as inflation outpaced expectations. OPEC producers became increasingly reluctant to supply additional quantities of oil at prices well below the market clearing level.

By late 1973 this regime came to an abrupt end, when OPEC reneged on its contractual agreements with the oil companies and unilaterally decreed a much higher price of oil. As the price of oil rose sharply, the quantity of oil fell, lending credence to the view that a contemporaneous shift in the supply of oil had taken place. It is common to attribute the fall in oil output and the rise in the price of oil to the 1973 war and the subsequent oil embargo (see Hamilton 1999). As we will show, this interpretation is by no means obvious because excess demand in the oil market would have induced an

[21] Our reading of the evidence coincides with contemporary accounts. For example, in November 1968, only one year after the successful defeat of the 1967 oil embargo, State Department officials announced at an OECD meeting that soon the U.S. would not be able to provide extra supply to the world in the event of an embargo (see Yergin (1992), p. 568). In November 1970, a U.S. diplomat in the Middle East filed a report stating that "the extent of dependence by western industrial countries upon [foreign] oil as a source of energy has been exposed, and the practicality of controlling supply as a means of exerting pressure for raising the price of oil has been dramatically demonstrated." (Yergin (1992), p. 587).

unprecedented increase in oil prices at the end of 1973, even in perfectly competitive markets.

For expository purposes consider a two-period model of the oil market dynamics in the early 1970s (see Figure 9). In period 1, starting from the equilibrium point A, a shift in demand for oil as a result of expansionary monetary policy raises the shadow price for oil. The new market clearing price at point B, however, is never realized, because the price of oil is effectively held back by long-term contractual agreements (see Penrose 1976).[22] Instead, we move from A to C, corresponding to an increase in the quantity of oil supplied at the old price. In period 2, OPEC reneges on the contractual price, and raises the oil price to the market clearing level (D=B) while reducing the quantity supplied (which is no longer needed at the new price). The price and quantity movements in period 2 have the appearance of an oil supply shock, yet the supply curve never shifts; we are witnessing the correction of a disequilibrium resulting from the earlier demand shift.

Our stylized model of the 1973/74 oil market dynamics is consistent both with the absence of significant increases in the real price of oil and the observed increase in oil production in the early 1970s. It also is consistent with the fall in the quantity of oil produced and the sharp increase in the OPEC oil price in 1973/74. The 1973/74 episode illustrates the point that fundamental identification problems need to be addressed before we can assess the effect of exogenous political events in the Middle East on the price of oil. As we have shown, the observed price and quantity movements in 1973/74 are consistent both with supply interruptions and with the restoration of equilibrium after the removal of price ceilings. Our model also is consistent with the views of oil economists such as Mabro (1998, p. 10) that "a major political crisis will not cause a price shock when capacity cushions exist in other countries, while excess demand would cause prices to flare even in the absence of any political crisis".

There is no direct evidence on the question of how close the January 1974 oil price level was to the market clearing level, but the magnitude of the increases in other commodity prices suggests that the actual price was probably not far from the market clearing level and there is little evidence that OPEC

[22] The essential point here is that the price of oil in the early 1970s remained substantially below market clearing level in the presence of excess demand. The assumption of a fixed price is an oversimplification designed to allow us to abstract from the effects of inflation. The price of oil actually fell in real terms in the early 1970s, despite efforts by OPEC to offset these losses (see Figure 6).

used its market power to prop up the price of oil at this point. As we will argue later, OPEC market power played an important role in determining the price of oil only after January 1974, when OPEC attempted to stabilize the price of oil at its peak level, even as the U.S. economy slid into recession and other commodity prices fell sharply.

An alternative view of the oil price increase of 1973/74 has been proposed by Hamilton (1999). Hamilton stresses the role of oil supply interruptions that are exogenous to the state of the U.S. macroeconomy. He discusses several such supply interruptions that in his view were *caused* by "military conflicts" and "wars" (including (1) the October 1973 war, (2) the Iranian revolution of late 1978; (3) the outbreak of the Iran-Iraq war in September 1980, and (4) the Gulf war of 1990/1991). There is some doubt, however, about the extent to which these events were truly exogenous. Hamilton is not explicit about the nature of the causal link from military conflict to exogenous production cutbacks. In some cases, for example in discussing the Gulf war (p.28) or the Iraq-Iran war (in his Appendix B), he clearly has in mind the physical destruction of oil facilities and the war-induced disruption of oil shipping.[23] In contrast, the production cutbacks in late 1973 clearly were not caused directly by military conflict.[24] In fact, most of the production cutbacks occurred only after the war (which lasted from October 6 to October 23, 1973) as part of an oil embargo by Arab oil producers.

In his Appendix B, Hamilton postulates a causal link from the October war to this oil embargo. This link is questionable. Unlike the war itself, the oil embargo is not an exogenous political event. There is considerable evidence that oil producers carefully considered the economic feasibility of the oil embargo.[25] In fact, the oil embargo was contemplated as early as July 1973, independently of the October

[23] Hamilton (1999, p. 28) refers to "a number of historical episodes in which military conflicts produced dramatic and unambiguous effects on the petroleum production from particular fields" such as the Iraqi invasion of Kuwait in July 1990.

[24] During this war only Syrian and Iraqi oil facilities sustained battle damage. Neither country was a major oil producer and the loss of oil output was small. The bulk of the reduction in oil output that did occur in late 1973 can be attributed to countries that were not directly involved in the war, but chose to restrict output, notably Saudi Arabia and Kuwait (see U.S. Energy Information Administration 1994, p. 307).

[25] An early example is King Faisal of Saudi Arabia's rejection in 1972 of the use of the oil weapon on economic grounds (see Terzian (1985), p. 164). That decision was reversed in late 1973, when more than a third of U.S. oil consumption was accounted for by imports. Similarly, during the 1971 Teheran negotiations between the major oil companies, the Gulf states threatened to implement an oil embargo, but never implemented it. Again, during Israel's invasion of Lebanon in 1982 - that coincided with high oil prices, a global recession and high real interest rates - an

war (see Arad and Smernoff 1975, p. 124) and United States officials were aware of that threat.[26] Although some countries announced a first stage of production cuts as early as October 18 (in the last week of the war), the embargo was tightened only after hostilities had ended on October 23. Not surprisingly, the oil embargo was lifted without its original political goals being achieved, as soon as oil prices had reached a sufficiently high level. Concern for the Arab cause lasted only as long as it was economically expedient.

Why Did the 1979/80 Oil Price Increase Occur When It Did?

We now turn to the second major oil price increase of the 1970s which took place in 1979/80. As in the early 1970s, there is clear evidence of an output boom, unusually low real interest rates and rising inflation prior to 1980. The rapid growth was fueled by the renewed world-wide monetary expansion documented in section III. Although this expansion was reflected in a sustained increase in industrial commodity prices in 1976-79, the increase in other commodity prices was dwarfed by the increase in oil prices that started in late 1978 (see Figure 4). Since the surge in oil prices not only far exceeded inflation adjustments, but also was not supported by a corresponding tightening in other commodity markets, it must have reflected additional developments specific to the oil market. Judging by the increase in other industrial commodity prices in 1978/79, at best one third of the actual deflator inflation appears to be consistent with the monetary model. In that respect, the second oil crisis appears fundamentally different from the first oil crisis of 1973/74.[27]

The inability of the monetary model to explain more than one third of the oil price increase in 1979/80 does *not* imply that the other two thirds of the increase were due to oil production cutbacks caused by the Iranian revolution in late 1978 and the outbreak of the Iran-Iraq war in September 1980, as suggested by Hamilton (1999). First, accounting for offsetting production increases by other oil

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oil embargo was considered by the Organization of Arab Petroleum Exporting Countries, but rejected as inconsistent with the economic interests of the organization (see Yergin (1992), p. 582, 719, Skeet (1988), p. 187).

[26] Arad and Smernoff (1975, p. 190) note that in July 1973 the Committee on Emergency Preparedness of the National Petroleum Council issued a report that concluded that an interruption of petroleum imports into the U.S. was likely as early as January 1974, based on data on the dependence of the U.S. on oil imports.

[27] Also note that, unlike in 1973/74 when oil prices doubled in a single day, the oil price increase in 1979/80 was much more gradual. One reason is that – unlike in the early 1970s – oil prices had not been held back by what was

producers such as Saudi Arabia, the production shortfall in early 1979 was not nearly as dramatic as suggested by Hamilton (1999). Global production in October, November and December 1978 exceeded the September 1978 level. Only in January and February of 1979, at the height of turmoil in Iran, did global oil production fall significantly below its September 1978 level, by 4 percent and 3 percent, respectively (see U.S. Energy Information Administration 1994, p. 312).[28] Moreover, total annual OPEC oil production in 1979 was 4% higher than in 1978 (see Skeet (1988), p. 244).

Second, the timing of the oil price increase suggests that physical production shortfalls narrowly defined are not the cause of the oil price surge. The bulk of the oil price increases occurred well after the Iranian revolution was over and well before the outbreak of the Iran-Iraq war. Specifically, during the Iranian revolution, between October 1978 and April 1979, the average price of U.S. oil imports rose by only about $3/barrel (see DRI database). In February 1979, Iran announced the resumption of exports, and by April 1979, global oil production matched the September 1978 level. The main surge in oil prices began only in May 1979, at a time when global oil production exceeded its September 1978 level (see U.S. Energy Information Administration 1994, p. 312). Between May and October 1979 alone oil prices rose from $19 to $25 per barrel. Oil prices continued to climb to almost $34 by April 1980, when the armies of Iran and Iraq were first put on alert (see Terzian 1985, p. 279). The war broke out in September 1980. By December 1980, oil was still under $36. It finally rose to a peak of $39 in February 1981.

One explanation of the additional oil price rise that occurred between mid-1979 and mid-1980 that has been proposed in the literature is a temporary surge in precautionary demand in response to increased uncertainty about future oil supplies and expectations of strong future demand (see Adelman (1993), pp. 428). The uncertainty-based explanation of higher oil prices, however, does not seem plausible in the absence of taut demand conditions in the oil market which in turn were driven in no small measure by a booming world economy and low real interest rates. The fact, that a large number of

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effectively a price ceiling. Thus, the observed oil price dynamics cannot be explained by a disequilibrium adjustment of the kind described in Figure 7.

[28] Hamilton notes that Iranian cutbacks in January and February 1979 amounted to almost 9% of the average monthly global oil production for 1978. Using the same data source, after accounting for production increases elsewhere, global oil production in January and February 1979 actually matched or exceeded slightly the average 1978 level (see U.S. Energy Information Administration 1994, p. 312).

military conflicts and incidents in the Gulf region in subsequent years did not lead to sustained increases in oil prices, suggests that increased Middle-East uncertainty appears to have little or no effect on oil prices in the absence of favorable macroeconomic conditions.[29] It is no coincidence that oil prices (as well as non-oil commodity prices) peaked shortly after Paul Volcker launched a sharp monetary contraction resulting in a global recession and high real interest rates. The long slide in all commodity prices (including oil prices) that began in 1981, during the height of the Iran-Iraq war, and was completed by 1986, is qualitatively consistent with the predictions of the Hotelling model with capacity constraints.

Weakening demand played a crucial role in undermining Saudi Arabia's efforts to shore up the oil price between 1982 and 1985 by reducing oil supply. The fact that other OPEC members undercut the official OPEC price in the1982-85 period appears consistent with the view that, in the absence of effective monitoring and punishment, cash-starved oil producing countries (such as Iraq and Iran) had an incentive to undercut the cartel price in order to increase current revenue. At the same time, competition from other oil producers increased. By the early 1980s, a large number of new oil suppliers such as Egypt, Angola, Malaysia, China, Norway and the U.K. had entered the market in response to the unusually high oil prices of the 1970s, while existing producers including the U.S. (Alaska), Mexico, and the U.S.S.R. had invested in new capacity and expanded oil production. By 1982, less than 50 percent of world oil was supplied by OPEC, compared with two thirds in 1977 (see Skeet (1988), p. 201). The resulting downward pressure on oil prices is consistent with the predictions of the Hotelling model with capacity constraints. Thus, there is considerable prima facie evidence that oil prices respond to macroeconomic forces, as suggested by economic theory.

[29] Examples include the Israeli attack on an Iraqi nuclear reactor in June 1981; a state of near war between Israel and Syria from April to July 1981 (see Skeet 1988, p. 181); the invasion of Lebanon by Israel in June 1982; the Iranian Ramadan offensive against Iraq in July 1982 (see Yergin 1992, p. 764); Iran's threat in July 1983 to blockade the Straits of Hormuz (see Terzian 1985, p. 323); suicide attacks on the U.S. and French headquarters in Lebanon in October 1983 (see Skeet 1988, p. 197); the tanker war in the Gulf in February-April 1984, during which at least eleven tankers and the major Iranian oil terminal were hit (see Terzian 1985, p. 327; Yergin 1992, p. 743); the Iranian capture of the Fao Peninsula in the southeastern corner of Iraq in February 1986, followed by Iranian artillery and missile attacks on Kuwait's oil ports and Iranian naval attacks on Kuwaiti shipping; the Kuwaiti request for U.S. naval patrols in the Gulf in March 1987 to protect its oil tankers (see Yergin 1991, p. 765); the Iraqi missile attack on the U.S.S. Stark during the tanker war in May 1987 resulting in the deaths of 36 sailors; and the downing of an Iranian airliner by U.S. forces in the Gulf in July 1988 following skirmishes with Iranian patrols (see Yergin 1991, p. 766).

We do not attempt to address in this paper is what explains the long delay in the decline of oil prices - both in the mid-1970s and in the early 1980s – after the initial monetary expansion was reversed. Although the sharp oil price increases in the 1970s come on the heels of shifts in the demand for oil that – in our view - are directly or indirectly fueled by monetary expansion, OPEC seems to have been adept at restraining official price cutting even in the presence of significant excess capacity. Figure 8 shows that other industrial commodity prices dropped sharply in response to recessions and higher real interest rates, as theory would suggest. Oil prices, however, remained at a much higher level than other commodity prices during 1974-78 and again during 1981-1985. This differential response *after* the onset of the 1974/75 and 1981/82 recessions is suggestive of the use of OPEC market power to prop up oil prices. As Nordhaus (1980, pp. 367) notes, in periods of excess demand, there is little OPEC can do (or would want to do) to impede oil price increases. Once official OPEC prices have risen, however, they tend to be sticky, even when there is a glut in the oil market. Indeed, empirical and anecdotal evidence lends support to the view that OPEC was most influential not in 1973/74 or in 1979 during the time of the most rapid oil price increases - as popular opinion would suggest - but in preventing oil prices from falling as rapidly as they should have when oil demand subsided (also see Mabro (1998), p. 10-11).

VIII. Lessons from the Most Recent Oil Price Surge

The tripling of oil prices after 1998 provides us with yet another natural experiment that can be used to test the implications of our explanation of stagflation. Historically, as we have shown in section V, oil price increases by themselves have caused excess CPI inflation (relative to inflation in the GDP deflator) for short periods, rather than extended periods of inflation. The current episode is no exception. U.S. data after 1998 show a spike in CPI inflation relative to deflator inflation rates (see Figure 7). In contrast, there has been little movement in the inflation rate of the deflator. This finding is not surprising because there has not been a major monetary expansion of the kind that was characteristic of the 1970s. Thus, we would not expect a rebirth of inflation. Equally intriguing is the fact that, despite higher oil prices there is no evidence yet of a major contraction, which seems to belie the notion that oil price increases inevitably cause recessions.

Although real interest rates have not been unusually low, cumulative growth rates for the United States have been extraordinarily high – high enough to offset the less than stellar growth performance of Europe and Japan. That increase in output, however, appears to be different from the rapid output growth in the 1970s that was largely fueled by monetary expansion. The very strong real growth in the past several years, especially in the U.S., has been reflective of an increase of potential output rather than "demand" generated (see Basu, Fernald and Shapiro 2000). Our analysis suggests that this strong growth in output was instrumental in supporting the increase in oil prices in 1999-2000. If the U.S. had been in a recession during 1999-2000 and U.S. demand for oil had been low, it would be have been hard for OPEC to enforce high oil prices over extended periods. The ability of a cartel like OPEC to sustain prices above the competitive level depends on a conducive macroeconomic environment. If there is a significant contraction of the economy, historical experience suggests that OPEC will have an uphill battle maintaining the current level of oil prices.

Both oil and other commodity prices fell sharply after the Asian crisis, yet only oil prices have strongly rebounded. This discrepancy is suggestive of a larger role for OPEC after 1998 than in earlier episodes. One interpretation we can rule out for sure is that OPEC has been reacting to exogenous political events in the Middle East. Certainly, the latest major oil price increase was not preceded by physical production cutbacks "induced by war" along the lines of Hamilton (1999). In fact, oil prices rose during the period of peace-making between Israel and the Palestinians, but Arab leaders refused to use the "oil weapon" when the recent confrontations erupted (see *Washington Post* 2000). This is not surprising, given the already high level of oil prices, and certainly is consistent with our view that in previous episodes political factors were allowed to play a role in setting oil prices only to the extent that they did not conflict with economic objectives and constraints.

What then enabled OPEC to consolidate its power after its influence had declined ever since the late 1980s? There are two reasons. One is that other oil producers (such as Norway and Mexico) that are not part of OPEC have effectively joined forces with OPEC, raising the organization's effective market share that had declined dramatically in the 1980s (see *New York Times*, 2001). The consolidation of

OPEC is consistent with theoretical models of cartels such as Green and Porter (1984) that lead us to expect that cartels will flourish in periods of strong economic growth. Second, high demand for oil from the current economic expansion is one of the driving forces behind OPEC's apparent success. There is clear evidence that once again oil producers across the world, with the possible exception of Saudi Arabia, are operating close to capacity, and that few additional oil supplies are likely to be forthcoming in the short run. This scarcity is arguably driven in important part by strong demand for crude oil. The rise in oil prices coincided with a shortage of oil tankers and freight rates for crude oil shipments have increased sharply, suggesting a demand boom for oil. In fact, during 2000 it was hard to see how more oil could have been moved in the short-run, even if Saudi Arabia had increased production further. Thus, the problem appears to be one of insufficient inventories in the face of rapidly rising demand for oil, rather than a global supply shortage. This view is further supported by the sharp drop of crude oil prices in late December 2000 from a peak of more than 37 dollars per barrel back to under 27 dollars upon the news of an impending U.S. recession, despite low inventories, Middle East turmoil, one of the coldest winters in recent memory and the fact that much of Iraq's oil exports are likely to remain off global markets. Predictably, OPEC will attempt to stem the expected decline in oil prices by announcing production cutbacks, as they did after each of the major oil price increases in the 1970s when demand for oil began to slacken (see *New York Times,* 2001). How long OPEC will be able to sustain high real oil prices will depend on the depth of the economic downturn as well as the extent to which new non-OPEC oil supplies will be forthcoming in response to higher oil prices.

IX. Concluding Remarks

The origins of stagflation and the possibility of its recurrence continue to be an important concern among policymakers and in the popular press. Our analysis suggests that in substantial part the Great Stagflation of the 1970s could have been avoided, had the Fed not permitted major monetary expansions in the early 1970s. We stressed that the stagflation observed in the 1970s is unlikely to have been caused by supply disturbances such as oil shocks. This point is important, because to the extent that stagflation is due to exogenous supply shocks, any attempt to lower inflation would worsen the recession. In contrast, if we

are right that stagflation is first and foremost a monetary phenomenon, then stagflation does not present an inevitable "policy dilemma". We conclude that oil price increases by themselves are unlikely to reignite stagflation, as long as the Federal Reserve refrains from excessively expansionary monetary policies. Moreover, a sustained increase in the real price of oil is unlikely in the absence of a conducive macroeconomic environment in OECD countries.

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Table 1: Real Growth, Inflation, and Nominal Growth in the United States

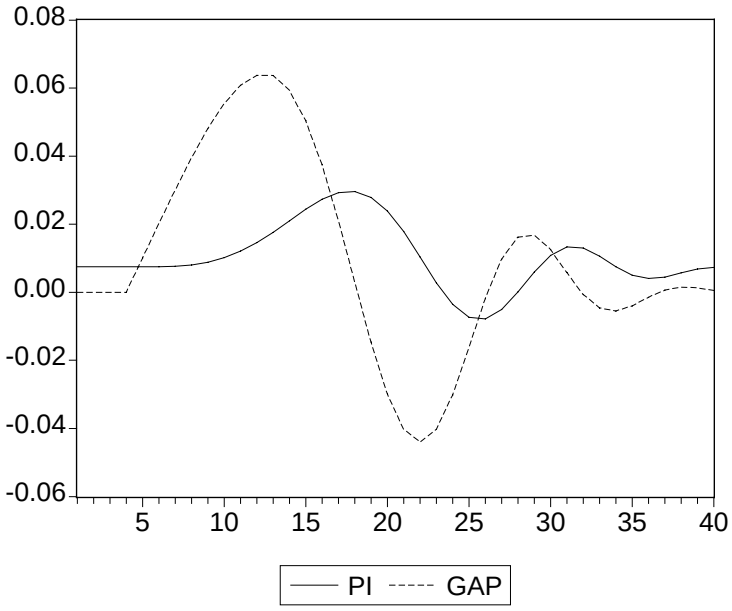
1960-1997

NBER Business Cycle Dates	State of the Economy	Percent Change Per Annum		
		Real Growth	Inflation	Nominal Growth
1960.2-1961.1	Contraction	- 1.22	+ 1.37	+ 0.15
1961.1-1969.4	Expansion	+ 4.62	+ 2.58	+ 7.20
1969.4-1970.4	Contraction	- 0.48	+ 5.00	+ 4.52
1970.4-1973.4	Expansion	+ 4.38	+ 5.24	+ 9.62
1973.4-1975.1	Contraction	- 1.84	+ 9.48	+ 7.64
1975.1-1980.1	Expansion	+ 3.69	+ 7.07	+ 10.76
1980.1-1980.2	Contraction	- 3.89	+ 9.03	+ 5.14
1980.2-1981.2	Expansion	+ 0.30	+ 9.32	+ 9.62
1981.2-1982.4	Contraction	- 1.48	+ 6.15	+ 4.67
1982.4-1990.2	Expansion	+ 3.76	+ 3.57	+ 7.33
1990.2-1991.1	Contraction	- 1.72	+ 4.54	+ 2.82
1991.1-1997.2	Expansion	+ 2.53	+ 2.53	+ 5.06

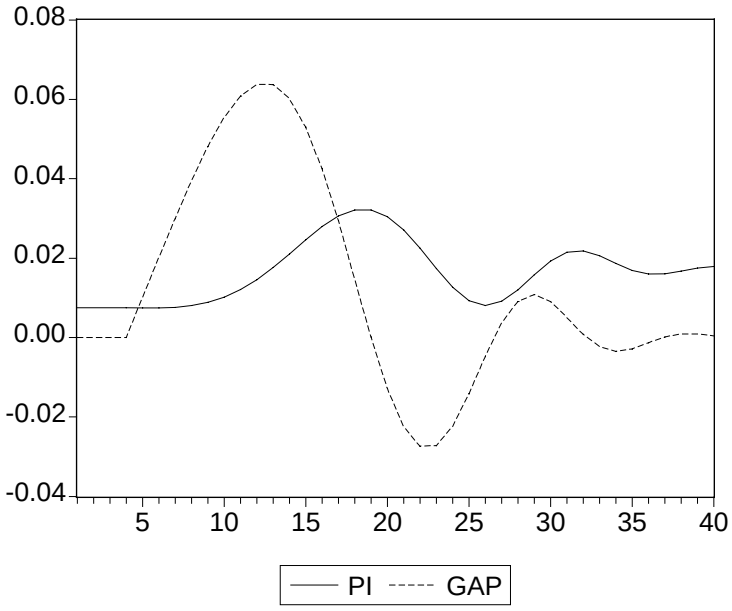
Source: Based on quarterly GDP (GDPQ) and GDP deflator (GDPD) data from DRI for 1960.1-1997.2. The business cycle dates are based on the NBER dating.

Figure 1: Implications of a Purely Monetary Model of Stagflation

(a) Model with Policy Feedback

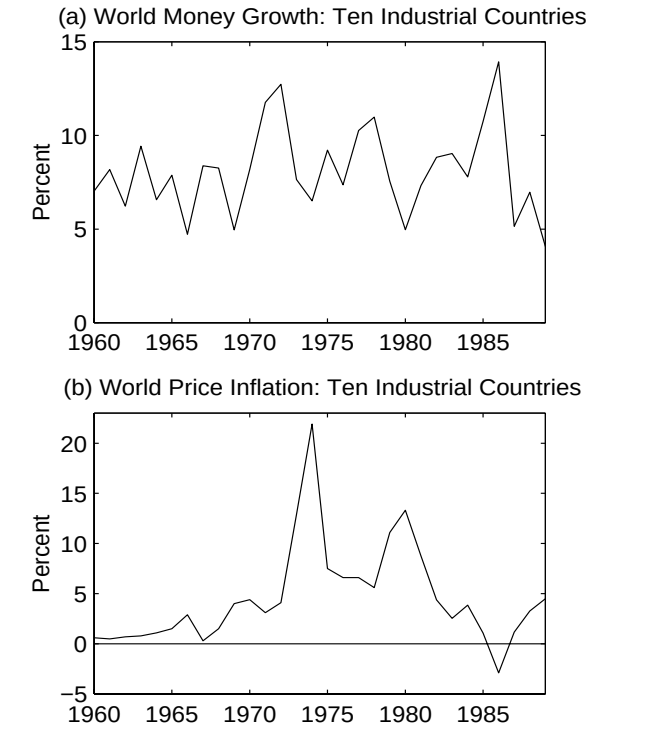


(b) Model without Policy Feedback



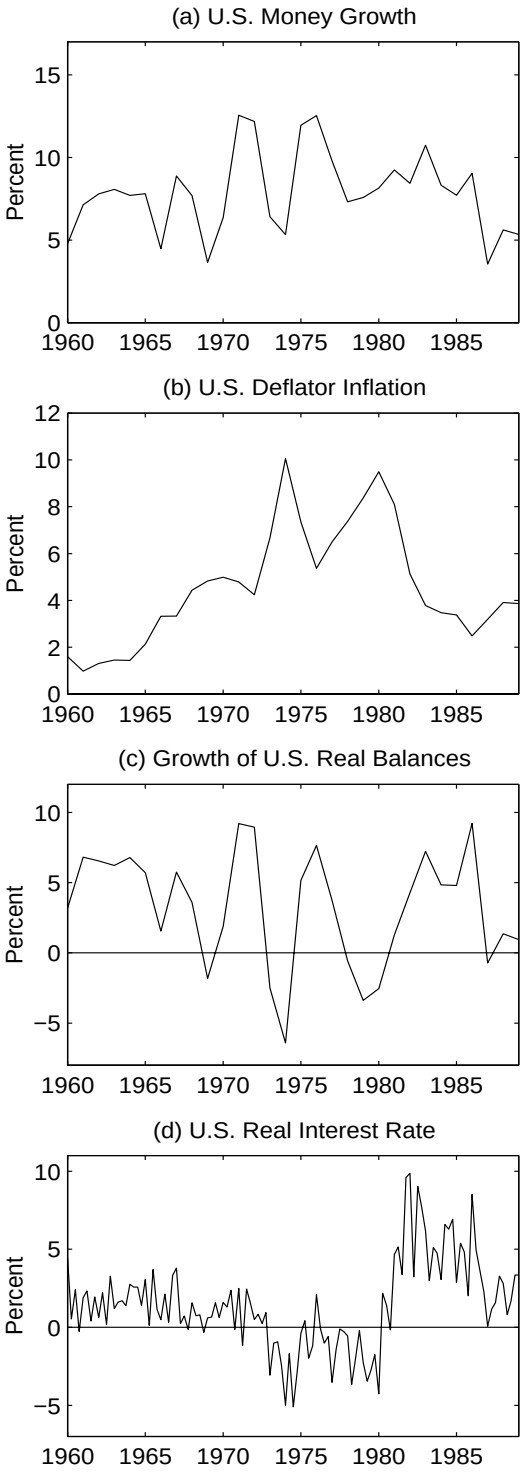
NOTES: PI = quarterly inflation rate. GAP = output gap. Models described in text.
Responses to a permanent 1 percentage point increase in money growth in period 5.

Figure 2: Measures of World Liquidity



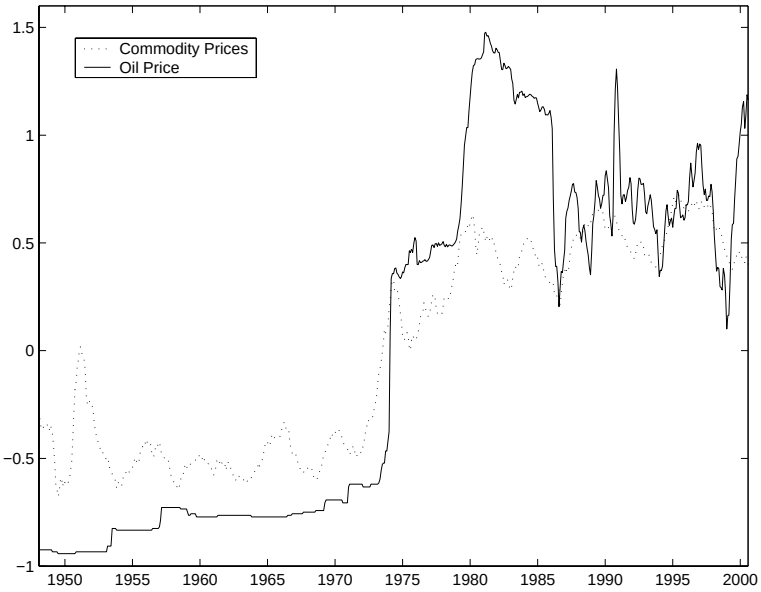
Source:
Inflation and money are GNP-weighted growth rates per annum as defined by McKinnon (1982, pp. 322), based on IFS data for 1960.1-1989.4.

Figure 3: Measures of U.S. Liquidity



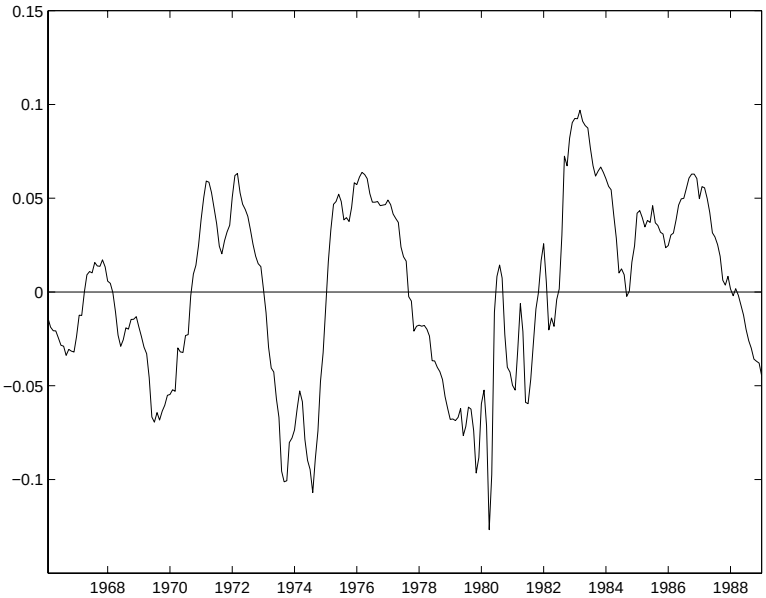
Source:
(a) Based on DRI series FM2.
(b) Based on DRI series GDPD.
(c) Based on DRI series FM2 and PRXHS
(d) Based on DRI series FYGM3 and PRXHS.

Figure 4: Nominal Price Indices for Crude Oil and for Industrial Commodities 1948.1-2000.7



Source: All data are logged and demeaned. We use the refiner's acquisition cost of imported crude oil (DRI code: EEPRPI) for 1974.1-2000.7. We use the U.S. producer price index for oil (DRI code: PW561) and the composite index for refiner's acquisition cost of imported and domestic crude oil (DRI code: EEPRPC) to extend the data back to 1948.1. The commodity price index excludes oil and food. The index shown is an index for industrial commodity prices (DRI code: PSCMAT). Virtually identical plots are obtained using an index for sensitive materials (DRI code: PSM99Q).

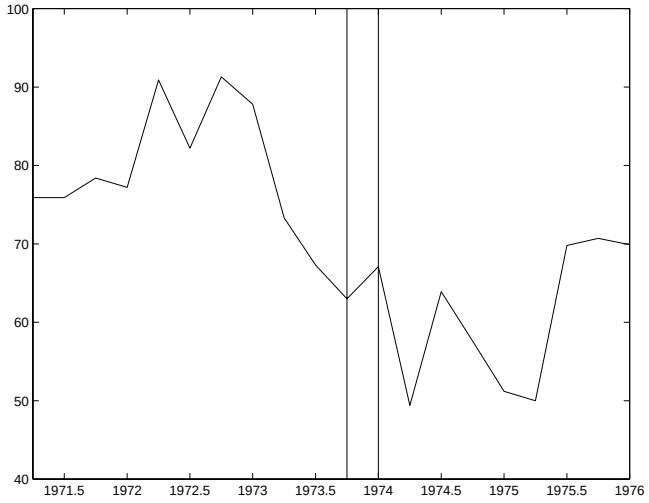
Figure 5: Indicator of Overall Monetary Policy Stance 1966.1-1988.12



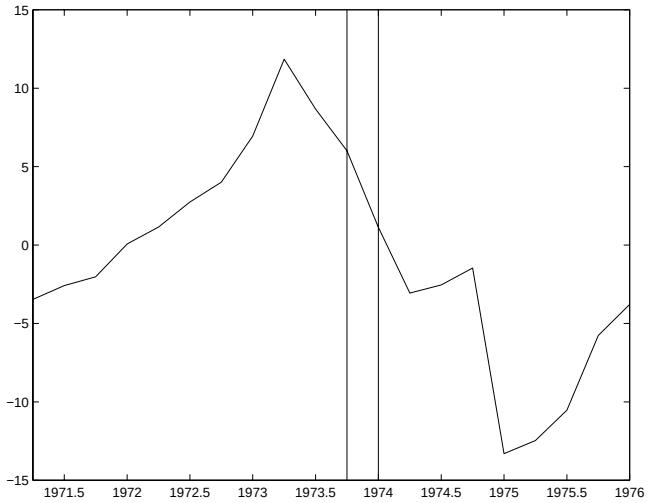
Source: Courtesy of B. Bernanke and I. Mihov.

Figure 6: Business Cycle Indicators with OPEC I Oil Dates

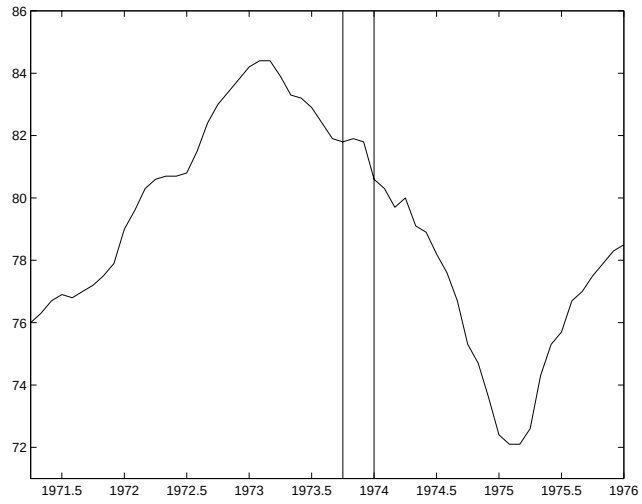
(a) Expected Conditions Component of Consumer Confidence



(b) Real Durables Consumption (Percent Deviation from HP-Trend)

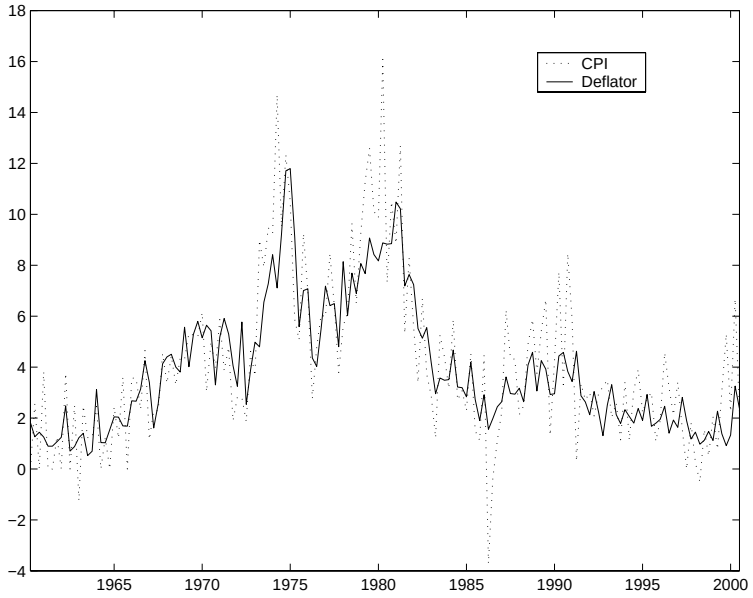


(c) Index of Leading Economic Indicators



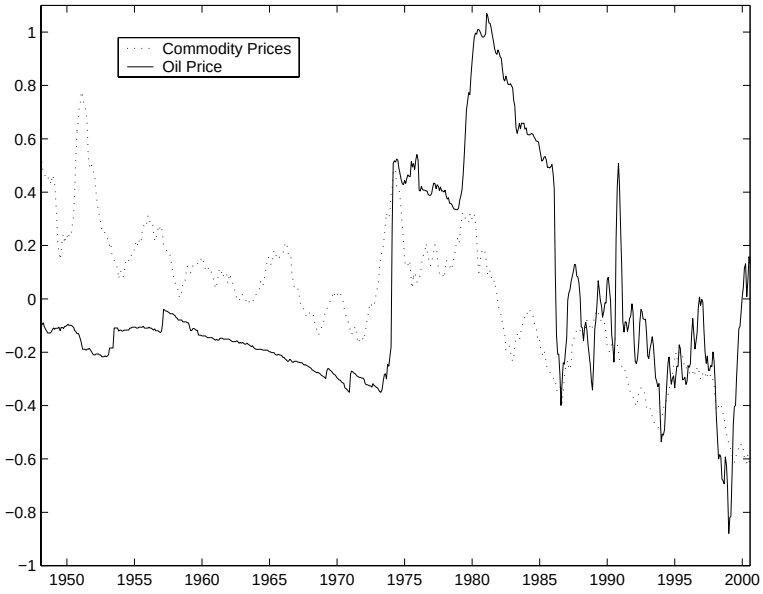
Sources: (a) Survey of Consumers, University of Michigan. (b)-(c) Based on DRI data.

Figure 7: Quarterly U.S. Inflation Rates for 1960.I-2000.II



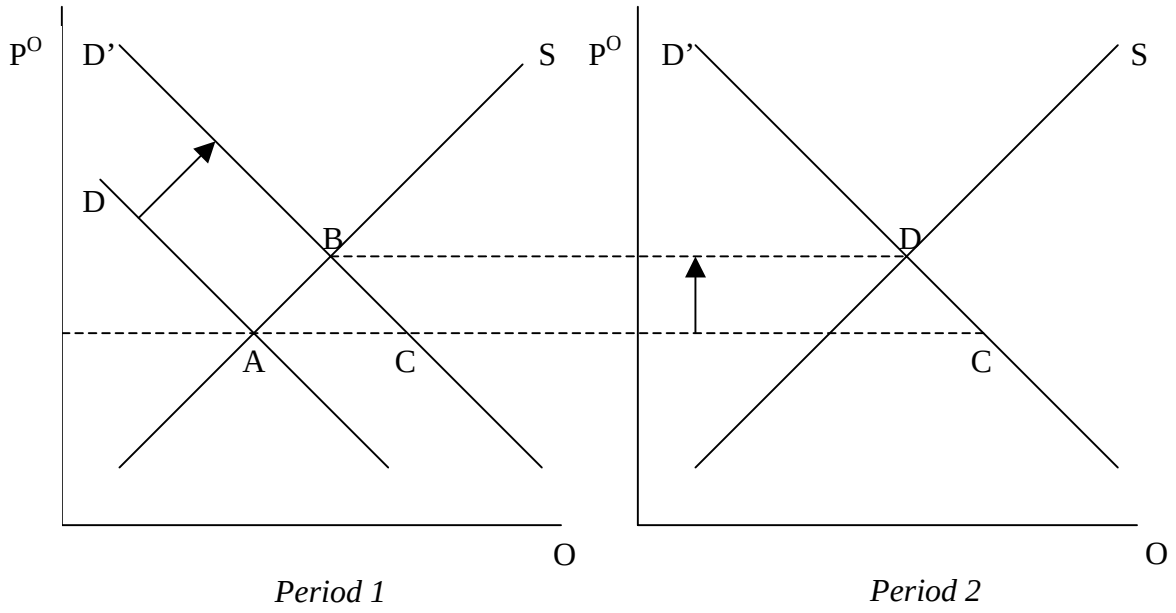
Source: All data are growth rates per annum. All data are taken form the DRI database. We use PRXHS (consumer prices excluding shelter) as the CPI measure, and GDPD as the implicit GDP deflator.

Figure 8: Real Price Indices for Crude Oil and for Industrial Commodities 1948.1-2000.7



Source: See Figure 4 for a description of the data. The price data have been deflated using the CPI index excluding shelter (PRXHS).

Figure 9: A Two-Period Disequilibrium Analysis of the Oil Market



NOTES: In period 1, starting from the equilibrium point A, a shift in demand for oil as a result of expansionary monetary policy raises the shadow price for oil. Given the fixed contractual price of oil, production increases and we move to C. In period 2, OPEC reneges on the contractual price, and raises the oil price to the market clearing level D while reducing the quantity supplied.