POLICY ANALYSIS WITH YOUR HANDS TIED: THE DISRUPTION TARIFF UNDER OIL PRICE CONTROLS

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ABSTRACT

While virtually everyone has expressed dissatisfaction over both this country's dependence on foreign oil sources and its vulnerability to an interruption in supply from those foreign sources, there has been no real agreement on the optimal policy response during an oil supply disruption. Most existing empirical policy analyses have based forecasts and policy recommendations on a future which carries no oil price controls; that is, they assume that market forces determine equilibrium oil prices. The existence of oil price controls (for example, for political reasons) could easily affect the optimality of particular policy responses. This paper focuses on the how the desirability of a short-run oil import tariff ("disruption tariff") might be enhanced by underlying rigidities in the oil market like oil price controls. To the extent that the prior existence of oil price controls can by shown to increase the demand for oil imports, a tariff could be used to dampen that demand. In order to complete the story, we must be able to measure the macroeconomic impacts of having both policies in place at the same time. The analysis centers around the effects on the domestic economy and the world oil market of a large oil supply disruption, and the results are quantified using an econometric model which empahsizes energy-economy interactions.

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INTRODUCTION

Since 1973, a host of domestic economic woes has been blamed on the "energy crisis," or more correctly, the "oil problem." While virtually everyone has expressed dissatisfaction over both this country's dependence on foreign oil sources, and its vulnerability to an interruption in supply from those foreign sources, there has been no real agreement on the optimal policy response during an oil supply interruption. Most existing empirical policy analyses have based forecasts and policy recommendations on a future which carries no oil price controls; that is, they assume that market forces determine equilibrium oil prices. Summaries of such efforts may be found in Plummer (9) and Hubbard and Fry (3). The existence of oil price controls could easily affect the optimality of particular policies in combatting the problems of oil supply interruptions. In particular policies in combatting the problems of oil supply interruptions. In particular, the economic benefits from a short-run ("disruption") tariff may be dramatically affected by underlying institutional rigidities in the oil market like oil price controls.

In order to amend policy recommendations in the presence of oil price controls, we must first understand how the oil market functions during an oil supply shock and how domestic policy responses can influence outcomes. After reviewing the macroeconomic costs of oil supply disruptions, we review the linkages between the oil market and the world economy and how policy-induced changes in domestic oil prices can affect prices in the world oil market. Specifically, we examine the effects of imposing crude oil price controls (with an entitlements program) and of placing a disruption tariff on imported oil. For political (as opposed to economic efficiency) reasons, price controls may be put in place at the onset of an oil supply disruption; the discussion addresses how the tariff might mitigate some of the macroeconomic costs of the price controls. Simulations of an economic model of the U.S. economy and the world oil market are then used to evaluate the costs and benefits of the separate policy responses and of the disruption tariff in the presence of price controls.

Problems of Oil Supply Disruptions

Crude oil and petroleum products are important to the U.S. economy both as inputs to the production of other goods and services (like electricity, chemicals, and transportation) and as final goods (like gasoline or heating oil). Because there is no abundantly available perfect substitute for oil in either production or consumption, an oil supply disruption will diminish the levels of production and consumption the economy can achieve. Moreover, the shortfall in oil supply increases the price of oil, which directly and immediately affects the general price level.

There are two primary channels through which the effects of oil supply disruptions operate. First, the increase oil price diverts spending from home-produced goods to imports, increasing the wealth transfer to oil producing countries and reducing aggregate demand for U.S. output. Second, the rise in the relative price of oil, an important input, reduces the profit-maximizing level of output for firms which use oil, necessitating a fall in real GNP. This reduction in output reduces the demand for other inputs, such as labor, and consequently, reduces the real wage at which the supply of and demand for labor are equalized.

These direct agregate demand and supply effects are magnified because our economic system is not perfectly flexible. Because of rigidities in the economy, particularly rigid nominal wages, unemployment of resources will result, and the economy will fail to attain its (already diminished) consumption and production possibilities. The failure of wages and prices to adjust downward aggravates and renders permanent the rise in the price level caused by an oil price increase. The ultimate quantitative consequences for inflation and GNP will depend on the size and timing of the disruption (and oil price increases) on the effect of the consequent price level increases on wage settlements, and on the fiscal, monetary, and regulatory responses of the government.

Economic stabilization policy can influence these outcomes by affecting oil demand either through changes in income or changes in the price of oil as seen by the consumer. Such channels of influence must be considered in the context of overall economic goals, however. Engineering a recession will mitigate some of the effects of an oil supply disruption (by lowering the demand for oil and thereby lessening pressure on the price), but is inconsistent with overall economic goals. In this paper, we will concentrate on options which affect oil demand by changing the price of oil as seen by consumers.

DYNAMICS OF AN OIL SUPPLY DISRUPTION

In order to analyze the economic impacts and effects on oil prices of such policy responses as price controls or the disruption tariff, we need a simple conceptualization of the behavior of oil markets both during "normal" times and "disrupted" tiems, using a framework which emphasizes energy-economy interactions.

It is easiest to start with OPEC. Although the OPEC producers now supply only about half of the oil consumed in the free world, their role as residual suppliers - the suppliers of the marginal barrel of oil - makes them very sensitive to market pressures, which determine the price of oil and dictates that their pricing decisions will play the vital role in determining the structure of oil prices throughout the world.

Although the vast majority of OPEC oil is sold by long-term contract (perhaps with appropriate discounts or premia), crude oil spot markets exist on the margin. The spot price serves as an important source of information for the producing countries, signalling an increase in the value of their oil on the international market. Since OPEC meets only quarterly to decide on contract prices, we would expect a lag between changes in the spot price and changes in the control price. On its face, this adjustment process is not very interesting. What we need is the underlying linkage between supply and demand factors which determines action in the spot market (and, indirectly, the contract market). One way of quantifying this linkage is a price reaction function, through which spot prices depend upon some measure of demand pressure in the market.

A logical candidate for such a function is one in which the change in spot prices depends on the extent to which actual oil production approaches maximum sustainable production (capacity production). Hence we have (1) $\Delta PSPOT = f\ (OUTPUT/CAPACITY),\ f'>0$, where PSPOT represents the spot price, OUTPUT represents actual oil production, and CAPACITY represents capacity production. In "normal" times, then, spot prices rise when production is increased toward capaicity (where such an increase is effected to meet the residual demand for OPEC oil).

But what about a <u>disrupted</u> market? For the sake of simplicity, we could divide total OPEC production into that which is produced by nondisrupted members (OUTPUT, as before) and that which is produced by disrupted members (DISRUP). From (1), it is easy to see why spot prices rise during a disruption. The capacity production (CAPACITY) falls, since it is decremented by the capacity of the disrupted producer(s). The output of the remaining procedures, OUTPUT, should increase to take advantage of the higher oil prices. The resulting increase in the capacity utilization ratio raises the spot price.[2]

The spot price function might look something like Figure 1.

Figure 1

SHORT-RUN SPOT PRICE REACTION FUNCTION

The goal of the analysis is, through, to be able to examine the general equilibrium effects of U.S. policy changes; we must work <u>demand</u> factors into our simple model. Given the assumption that OPEC is a <u>residual</u> supplier of oil, we can use the fact that at any time, the total quantity of oil <u>supplied</u> must equal the quantity <u>demanded</u> to solve for OUTPUT in terms of, among other things, demand factors. Suppose we make the following simple decomposition of the (free) world oil market:

FREE WORLD OIL DEMAND AND SUPPLY

<u>DEMAND =</u>

USCON (U.S. oil consumption demand)
+ NETCON (Oil consumption demand in the rest of the free world)
+ USSPR (U.S. oil demand for the strategic Petroleum Reserve)
+ USPSTCH (U.S. private oil inventory demand)
+ FSTCH (Inventory demand in the rest of the free world)

<u>SUPPLY =</u>

OUTPUT (production by non-disrupted OPEC members)
+ DISRUP (Production by disrupted OPEC members)
+ USOIL (U.S. oil production)
+ NONUSOPEC (Oil production in the free world outside of OPEC and the U.S.)

Thus,

$$(2)\quad USCON + NETCON + USSPR + USPSTCH + FSTCH$$

$$= OUTPUT + DISRUP + USOIL + NONUSOPEC.$$

If, for the moment, we take USSPR, UPSTCH, FSTCH, DISRUP, USOIL, and NONUSOPEC as exogenous, we can rearrange (2) (where a bar over a variable denotes that it is exogenous) to get:

$$(3)\quad OUTPUT = (USCON + NETCON) + (\overline{USSPR} + \overline{USPSTCH} + \overline{FSTCH})$$

$$- (DISRUPT + USOIL + NONUSOPEC).$$

So, the production of nondisrupted OPEC producers (residual suppliers) is just world consumption demand plus world inventory demand less production from other producers. Substituting (3) back into (1) yields:

$$(4)\quad \Delta PSPOT = f\left(\frac{(USCON+NETCON) + (\overline{USSPR}+\overline{USPSTCH}+\overline{FSTCH}) - (\overline{DISRUP}+\overline{USOIL}+\overline{NONUSOPEC})}{CAPACITY}\right)$$

To complete the analysis, we need to specify the demand relationships. Let:

$$(5)\quad USCON = g\ (Pus, Yus\ (pus), \overline{SDUM})\ \text{and}$$

$$(6)\quad NETCON = h\ (Pnus, Ynus, (Pnus), \overline{SDUM}),$$

where:

Pus = Price of a marginal barrel of oil in the U.S.,
Yus = U.S. real income,
Pnus = Price of a marginal barrel of oil outside the U.S., and
Ynus = Real income in the rest of the free world.[3]

Since policies like tariffs and price controls in the United States work through pus, the marginal price of a barrel of oil to U.S. refiners, we need to know

$$\frac{d(PSPOT)}{d\ Pus},$$

that is, the extent to which a change in the U.S. price affects the world oil price.[4]

Differentiating (4) and considering only the United States (i.e., holding other demand fixed) yields:

$$(7)\quad dPSPOT = f'\ \frac{1}{CAPACITY}\ \left(\frac{\partial USCON}{\partial Pus}\cdot dpus + \frac{\partial USCON}{\partial Yus}\ dyus\right),\ \text{so that:}$$

$$(8)\quad \frac{dPSPOT}{dpus} = \frac{f'}{CAPACITY}\ \left(\frac{\partial USCON}{\partial Pus} + \frac{\partial USCON}{\partial Yus}\ \frac{dyus}{dpus}\right).$$

Rearranging terms in (8) gives us:

$$(9)\quad \frac{dPSPOT}{dPus} = \left(\frac{f'}{CAPACITY}\right)\left(\frac{USCON}{Pus}\right)\left(\frac{Pus}{USCON}\ \frac{\partial USCON}{\partial Pus} + \left(\frac{Pus}{Yus}\ \frac{dyus}{dpus}\right)\left(\frac{Yus}{USCON}\ \frac{\partial USCON}{\partial Yus}\right)\right)$$

$$= \left(\frac{f'}{CAPACITY}\right)\left(\frac{USCON}{Pus}\right)\left(\varepsilon_{USCON,\ Pus} + (\varepsilon_{Yus,\ Pus})\ (\varepsilon_{USCON,\ Yus})\right),$$

Where:

$\varepsilon_{USCON,Pus}$ = Own price elasticity of U.S. oil demand (< 0),

$\varepsilon_{Yus,\ Pus}$ = elasticity of U.S. real income with respect to oil prices (< 0), and

$\varepsilon_{USCON,\ Ys}$ = income elasticity of oil demand (> 0).

Since f' is positive by assumption, dPSPOT/dPus is unambiguously negative. dPSPOT/dPus is more negative the larger (is absolute value) is the price elasticity of oil demand, the larger is the extent to which oil prices affect real income, or the more responsive is PSPOT to changes in the capacity utilization ratio. Reintroducing oil demand in the rest of the free world would not alter this qualitative result and would only magnify its quantitative implications provided that the policy-induced changes in the domestic prices were the same in both groups.[5] That is precisely the commonly made argument as to why the benefits to consuming countries are trebled if they cooperate in imposing an oil import tariff. Making private inventory demand endogenous would considerably complicate the argument, since speculative inventory optimizing behavior dictates a role for expected future prices as well.[6]

Crude Oil Price Controls

The imposition of crude oil price controls can be considered in this process. With large oil price increases yielding such a devastating effect on the economy, the political temptation to control domestic crude oil prices has been overwhelming. Though oil price controls have been rejected by the vast majority of economists, the concept is still popular among our political leaders. Indeed, the McClure bill (S.1054, 98th Congress), which would extend the President's authority to impose oil price and allocation controls, recently passed by a wide margin in the Congress.[7]

Proponents of crude oil price and allocation controls argue that controls help to insulate the economy from the effects of oil price shocks by lowering the average price of a barrel of oil and by preventing holders of domestic oil reserves from reaping a windfall from a foreign price increase. Inflation should be lower and real incomes higher under oil price controls than without them, they maintain.

Opponents of controls have often countered that the cap inhibits the economic viability of looking for new oil. If controls were lifted, the increased supply of oil would help to lower the oil price. It is likely, though, that even if supply is <u>completely unresponsive</u> to the price, oil price controls fail to accomplish their purpose. Indeed, the controls may have cost us dearly in the past.

An excellent survey of the economics of crude oil price regulation can be found in Kalt (4, pp. 69-102). Kalt concludes that the impact of price controls on the time path of <u>extraction</u> from existing oil reserves is <u>a priori</u> ambiguous, but that price controls unambiguously discourage <u>exploration and development</u> of new supply sources.

There is another, possibly more potent effect of U.S. oil price controls. The U.S. is a major consumer oil, consuming its own domestic production of 8.6 million barrels of oil per day and importing another 5.2 million barrels of oil per day. As long as the marginal barrel of oil is imported, changes in U.S. oil demand, whether from changes in the price of oil faced by U.S. consumers, can have a significant impact on world oil prices.

Under domestic price controls, the average price of oil is a weighted average of a lower controlled price and a higher "world" price. The lower average price faced by U.S. buyers of oil and oil products stimulates U.S. oil demand and U.S. oil imports, putting <u>upward</u> pressure on the world price of oil. The resulting increased oil import bill reduces GNP. Though the price controls may restrain inflation in the short run, in the long run they may <u>increase</u> inflation because of the higher world oil price. To the extent that there is a positive domestic supply response to decontrolling oil, the case against price controls becomes stronger.

Moreover, as firms optimally plan their level of inventories, we know that the higher is the expected price next period (relative to that today), the higher will be the inventory levels (since profits we made on increasingly valuable inventories). Price controls lower the path of expected future prices as seen by the firm. Hence, the existence of price and allocation controls may dampen the incentive for private companies to hold large speculative or strategic stockpiles, thereby reducing our supply cushion in the event of a disruption.

While the oil price controls try to minimize the inflationary shock to the economy from a sharp runup in oil prices, their medium-run effects reduce real income through their negative effect on the trade balance and through multiplier effects on consumption and investment. These macroeconomic effects extend beyond the microeconomic inefficiency caused by controls, inefficiency that often takes the form of reduced leisure or added inconvenience, rather than of GNP losses and unemployment.

Imposing an oil price control program in conjunction with an entitlements program would lower the marginal price of oil by the amount of the "entitlement benefit." (See Arrow and Kalt (1) or Kalt (4)). Since dPSPOT/dpus is negative, this would suggest an increase in world oil prices. As the marginal price is lowered, oil demand increases, raising the demand for OPEC oil. This spillover effect into world oil prices makes it easy to see why this strategy on our part was never thought highly of by our allies. The increased oil import bill lowers real income, which somewhat mitigates the controls-induced fillup to import demand

Following footnote 4, we can think of the alteration of the marginal price under a price-controls-cum-entitlements program as

(10) $\hat{Pus}_t = \alpha(PSPOT_t - Pus_{t-1}) - ENTBEN_t$

where ENTBEN is the dollar value of the entitlement benefit. If we let PCAP be the ceiling price on crude oil under the controls and λ be the fraction of oil which is imported, then under the sort of entitlement program we have had in the past:

(10a) $ENTBEN_t = Pus_t - (\lambda\, Pus_t + (1-\lambda)\, PCAP_t).$

Hence, from (10) and (10a);

(10b) $\hat{Pus}_t = Pus_t - ENTBEN_t$

$= \lambda\, pus_t + (1-\lambda)\, PCAP_t$

$= \lambda\alpha\, (PSPOT_t - Pus_{t-1}) + (1-\lambda)\, PCAP_t$

Since lowering PCAP decreases the marginal price in the U.S., we know from (9) that the world price rises, so that the effective subsidy is reduced. Indeed, if this effect (of dPSPOT/dpus) is quite large, the controls may just yield an income loss and an increase in world oil prices without much of a reduction in effective domestic prices.

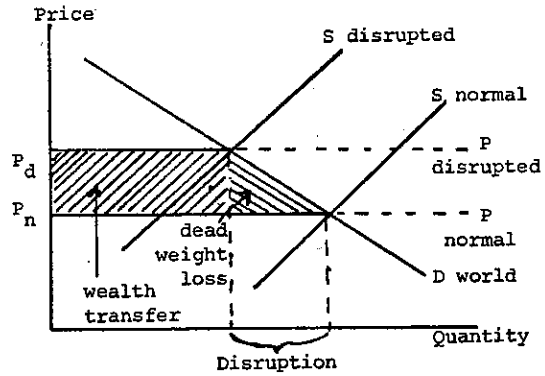
The Disruption Tariff

We are now prepared to analyze the effects of tariffs. The disruption tariff is a policy option frequently put forth to deal with an oil supply disruption. Its proponents argue that the disruption tariff can cut back the demand for oil imports during a disruption, limiting the amount of increase in world oil prices and the amount of domestic

wealth transferred to oil producers. Analyzing the tariff in that light. Plummer (10, p. 8) has estimated that if a specific disruption tariff of $X per barrel were applied, then domestic oil prices would rise by about seventy percent of X, and the other thirty percent of X would correspond to a reduction of OPEC's economic rents.

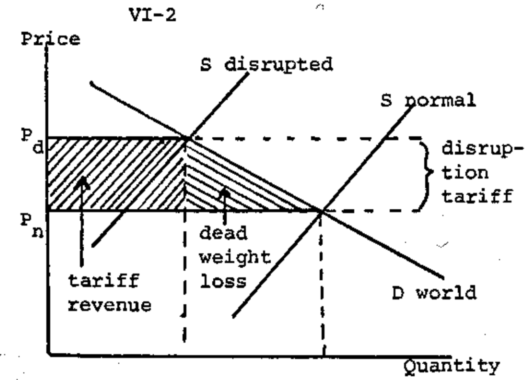
The DOE (7, p. VI-4) was more vehement in its support of a disruption tariff (to be applied at the very onset of a disruption before OPEC has raised prices). A disruption tariff imposed by all consuming countries would raise domestic market clearing prices of the consuming countries potentially by the same amount as the disruption. In that extreme case, such a tariff would reduce the demand for oil on the world market to a level that would clear the market at the price in normal periods. Consuming countries would still incure substantial deadweight losses and some resulting macroeconomic consequences; however, the wealth transfers would be captured by consuming countries as tariff revenues. Much of the macroeconomic costs of a disruption can be mitigated if the tariff revenues are promptly recycled to the economy. The reduction in losses from a disruption when a tariff if imposed by all consuming countries may be seen by comparing Figures VI-1 and VI-2.

VI-1



DISRUPTION LOSSES TO CONSUMING NATIONS

VI-2



DISRUPTION LOSSES TO CONSUMING NATIONS AFTER THE IMPOSITION OF A DISRUPTION TARIFF

This analytical framework is not without its problems, however. Complications may arise because of the possible violations of implicit assumptions regarding international cooperation during a disruption, because of the realities of the oil pricing process, and because of the macroeconomic costs associated with the tariff.

A collective tariff (imposed by major oil importing countries) as considered a desirable instrument because it could capture almost all of the wealth transfer during a disruption at very little cost. Unfortunately, there are strong incentives for individual consuming nations to cheat. Each could benefit greatly from the low world oil prices created by other countries without imposing on themselves the substantial deadweight losses and macroeconomic costs resulting from a tariff. (The DOE analysis acknowledged this point.) Even if the consuming countries were in perfect cooperation, the political realities of policy implementation within the bureaucracies of the democratic OECD countries versus that in the more autocratic OPEC-member governments cast serious doubt on the claim that the consuming nations could "beat OPEC to the draw" in raising the oil price (via the tariff) at the onset of a disruption. Moreover, the determination of precisely when a "disruption" commences is problematic, yet an immediate and exact determination would almost be required to obtain the rapid imposition of the disruption tariff necessary for its possible success.

To the extent that the disruption tariff is added to an already increased OPEC price, it imposes extra sacrifices in terms of lost output and increased inflation at a time when the economy is least able to bear it. In conventional tax policy terms, such a disruption tariff is an automatic <u>de</u>stablizer, unlike an equilibrating Strategic Petroleum Reserve <u>re</u>lease. After all, it is the macroeconomic inability to adjust rapidly enough to the oil price shock which caused the large output losses and increase inflation, the disruption tariff deals a harsh second blow to the already hard-hit energy-intensive sectors within the economy.

There are a number of administrative problems associated with the disruption tariff. While the tariff brings in revenue (which pressumably will be spent by the government or rebated through tax cuts), it is inflationary, as it further pushes up the price of imported oil. The increased government spending (or cut in taxes) adds to nominal aggregate demand, but the increase in inflation has an opposing effect on <u>real</u> GNP. The net effect must be resolved empirically. <u>A priori</u>, the disruption tariff is not unambiguously a good idea and may well be a bad one. The speed with which the government spends or rebates the tariff proceeds could be crucial. To maximize the speed or disruption, a tariff-management authority should already be in place. Furthermore, a "prebate" (i.e., a distribution of money at the onset of the disruption, even before the tariff receipts begin to flow in) is more advisable than a straight rebate of the proceeds. (This still does not resolve the empirical ambiguity, since a temporary widening of the federal budget deficit also has macroeconomic consequences.) In light of the tariff's immediate contribution to price inflation, even relatively small losses in speed and efficiency of distribution of proceeds may nullify its effectiveness or magnify its cost.

Since the tariff raises the marginal oil price seen by U.S. refiners, (9) tells us that the world oil price is lowered, Again employing footnote 4, if we describe the (ad valorem) tariff alternation as:

(12) $\tilde{Pus}_t = \alpha\,(PSPOT_t - Pus_{t-1})(1+T)$, where T is the ad valorem tariff rate, then:

(13) $$\frac{d\tilde{pus}_t}{dT} = Pus_t + \alpha(1+T)\frac{dPSPOT_t}{dT}$$

Because the tariff exerts downward pressure on world oil prices (using (13) with (9)), the U.S. price does not rise by the full amount of the tariff. The tariff has macroeconomic impacts, though, so that the policymaker must worry about the inflationary impact and the optimal means of recycling tariff revenue.[7]

POLICYMAKING WITH PRE-EXISTING DISTORTIONS

The renewed interest in preparing some form of EPAA-styled price and allocation controls before the next disruption implies that a "base case" including price controls should be used in empirical policy analyses of oil price shocks. This is not to suggest that the imposition of oil price controls is an optimal strategy, either from an efficiency perspective or an equity perspective. Indeed, a properly designed revenue-recycling program (to recycle windfall tax revenue or perhaps revenue from some oil taxes) with market pricing and allocation of oil during a supply interruption would meet both the <u>efficiency</u> condition (of not artifically lowering the marginal price of oil seen by refiners) and the <u>equity</u> condition of seeing that large-scale shifts in the domestic income and wealth distribution by class and region do not occur. Given the present uncertainty in the minds of policymakers over the effectiveness, feasibility, and macroeconomic implication of a revenue-recycling system, some form of price controls may be imposed as the "only way" to address the equity concerns which policymakers must face.

Despite the ambiguity of the macroeconomic outcome of the imposition of the disruption tariff, it may be a good idea to impose the tariff at the onset of a supply disruption in the presence of a federally imposed price control and allocation program. Though the tariff cannot address the microeconomic inefficiency of the price and allocation controls or their distorting effects on oil production in the United States, it can address the <u>macroeconomic</u> problem-namely that the spillover into oil import demand lowers real income. A positive tariff on oil imports could offset the distortion of a lower marginal price as a result of the entitlement benefit. In the simplest case, a specific tariff t could change

(14) $Pus = Pus - ENTBEN$ to

(15) $Pus = Pus - ENTBEN + t$, where, following (10b), t could be set equal to $\lambda PCAP$.

Setting a tariff so as to raise the marginal price back to its market-clearing level helps to avoid the spillover to oil import demand (with its attendant effects on real income), and revenue from the tariff can be used in a recycling system (or to reduce the federal budget deficit).

To the extent that other nations also impose a tariff, we would get an even greater benefit, for as the world price falls toward our (controlled) domestic price, the microeconomic inefficiencies disappear as well.

Why would such a scheme occur? Why not do nothing or just impose a small disruption tariff? If, for whatever reason, politicians consider price and allocation controls to be the only effective means of dealing with the domestic problems of external oil shocks, the search for other policy responses must be conducted around that inflexibility. The disruption tariff mitigates the macroeconomic inefficiency of the price controls, while still leaving Congress with a plan to regulate domestic prices and income distribution.

To empirically test our propositions, we will use an economic model of the U.S. economy and the world oil market described in detail in Hubbard and Fry (3). We will begin by measuring the "costs" of a large oil supply disruption, then simulate the effects (and discuss the costs adn benefits) of imposing crude oil price controls or the disruption tariff individually. Finally, we will look at the optimality of the disruption tariff given that price controls are put in place at the onset of a disruption.

SIMULATIONS AND CONCLUSIONS

Simulations

Simulations of the economic model of the U.S. economy and the world oil market are used to test the propositions of the paper. While the modeling exercise concentrates on polar cases, it can at least help to quantify the intuition behind different policy responses to oil shocks.

To measure the cost of an oil supply interruption, we first set up a control scenario for the solution interval from the fourth quarter of 1981 (1981:4) to the fourth quarter of 1985 (1985:4). In the control scenario, there is no additional interruption in world oil supplies. Combined Iranian and Iraqi production recovers throughout the interval, and by 1983:4, Iraqi production becomes endogeous again.[9] U.S. oil production is projected to drop slowly throughout the interval, and production outside the U.S. and OPEC is expected to increase slowly and steadily. (specific assumptions are available from the author by request.)

The disruption to be examined is one in which Saudi Arabian output is interrupted in 1983. OPEC capacity production is decremented by ten million barrels per day from 1983:1 to 1983:4. One could think of such a shock as arising from a blockade or an embargo. By 1984:1, Saudi Arabia ceases to be disrupted, and its production becomes endogenous again. Since larger stock drawdowns are assumed during the disruption, some of the loss in supply is offset. That assumption, combined with increased production from nondisrupted OPEC members, the drop in consuming country demand (because of the higher prices), and the soft market at the onset of the disruption, explains why the resulting oil price increase is not as large as one might guess.

Table 1 compares some relevant macroeconomic and oil variables in the control scenario and the disrupted scenario. Despite offsetting effects, the disruption is constly to both the oil market and to the

TABLE 1

COMPARISON OF CONTROL SCENARIO WITH LARGE DISRUPTION SCENARIO

	REAL GNP ($ BILLION)		UNEMPLOYMENT		INFLATION (GNP DEFLATOR)	
	BASE	DISRUPTION	BASE	DISRUPTION	BASE	DISRUPTION
1981:4	1502.5	1502.5	7.8%	7.5%	7.5%	7.5%
1982:1	1509:8	1509.8	8.2	8.2	7.4	7.4
2	1513.1	1513.1	8.5	8.5	7.0	7.0
3	1522.0	1522.0	8.8	8.8	6.5	6.5
4	1529.5	1529.5	8.9	8.9	6.4	6.4
1983:1	1539.9	1538.0	9.0	9.0	6.1	6.5
2	1550.2	1549.5	9.1	9.1	6.0	6.8
3	1564.2	1559.4	9.1	9.2	5.8	7.2
4	1574.2	1565.7	9.2	9.3	5.7	7.2
1984:1	1588.2	1578.1	9.2	9.4	5.6	7.3
2	1608.1	1597.6	9.0	9.3	5.7	7.1
3	1626.4	1615.6	8.9	9.2	5.6	6.9
4	1642.0	1629.8	8.8	9.1	5.9	6.4
1985:1	1655.2	1637.5	8.7	9.1	6.0	6.2
2	1672.8	1663.0	8.6	9.0	6.4	5.9
3	1687.2	1679.2	8.6	8.8	6.3	5.7
4	1698.8	1694.0	8.6	8.8	6.6	5.5

	CRUDE OIL SPOT PRICE ($/BBL)		AVERAGE REFINER'S ACQUISITION COST OF CRUDE OIL ($/BBL)		U.S. OIL CONSUMPTION (1000 B/D)	
	BASE	DISRUPTION	BASE	DISRUPTION	BASE	DISRUPTION
1981:4	31.34	31.34	37.55	37.55	15230	15230
1982:1	28.40	28.40	36.78	36.78	15750	15750
2	26.11	26.11	35.42	35.42	14040	14040
3	24.16	24.16	33.77	33.77	14210	14210
4	23.26	23.26	32.09	32.09	15690	15690
1983:1	22.44	31.49	30.60	31.37	16580	16520
2	21.52	43.88	29.26	33.61	15100	14740
3	20.52	47.40	28.00	38.12	15530	14690
4	20.40	57.97	26.86	43.06	17330	15730
1984:1	20.97	50.68	26.86	43.06	17330	15730
2	22.02	43.86	25.66	49.94	16920	14260
3	23.61	37.87	25.74	49.26	17370	14320
4	25.94	33.69	26.32	47.17	19290	15710
1985:1	28.95	34.88	27.48	44.87	20250	16415
2	31.67	30.62	29.19	43.06	18250	14990
3	34.53	27.45	31.25	40.59	18370	15390
4	37.80	25.39	33.64	37.95	19960	17230

U. S. economy. Income growth is slowed in 1983 and thereafter; unemployment and inflation are higher under the disrupted scenario during 1983 and 1984. The price level remains higher throughout the interval for the disrupted scenario. The spot price rises considerably as a result of the interruption, and the average refiner's acquisition cost of imported crude oil rises by more than 50% during the disruption and remains high for the rest of the interval. The higher oil prices during the disruption greatly reduce U.S. oil demand, ultimately putting downward pressure on the spot price.

If it is the sharp oil price increase which causes the problems of increased inflation and lost real output, one possible policy response would be to control domestic oil prices through a system of price controls and entitlement benefits, thereby blunting the overall price increase. If policy makers are opposed to a "do-nothing" approach, price controls may very well be the first response considered. After all, the U.S. has had experience (through certainly not pleasant) with implementing a complex system of domestic price and allocation controls.

To implement a price controls program under the most favorable possible conditions, we simulated the imposition of crude oil price controls (at $30 per barrel) from 1983:1 through the solution interval. That is, the program began at the onset of the disruption and continued through 1985. An entitlements program (like the one formerly used in the United States) was placed in the model to average acquisition costs of crude oil. Table 2 presents the deviations from the large-disruption values (in Table 1) for real GNP, inflation, the crude oil spot price, the average refiner's acquisition cost of imported crude oil, and U.S. oil consuption.

As is evident from the comparison in Table 2, price controls fail the task for maintaining real income and reducing inflation. Since the controls artificially hold down the marginal cost of a barrel of oil to a refiner, oil import demand increases, raising world oil prices and the U.S. oil import bill. Table 2 indicates significant increases in both the spot price and the refiner's acquisition cost of imported oil. The decrease in real income brought about by the decline in net eports continues even after the disruption is over. Even though the overall inflation rate is slightly lower while the controls in 1983, the much higher world oil price ultimately leads to a higher inflation rate by 1985.

If we take as given that Congress has imposed the price controls as the only solution to the distributional problems of large oil shocks, we should search for a policy response which undoes the macroeconomic distortions of the crude oil price controls and entitlements program. Since the root of the problem is the artificially low marginal oil price, a disruption tariff might help to make up at least part of the difference between the world price and the weighted-average price under the entitlements program. Raising the marginal price would dampen the spillover to oil import demand occasioned by the price controls, thus removing part of the drop in real GNP through the trade balance effect. Moreover, the tariff could accomplish its oil demand reduction without a sharp increase in inflation, since the crude oil price controls are restraining domestic oil prices.

As a test of these propositions, we simulated an ad valorem disruption tariff of 30% imposed at the onset of the disruption in 1983:1

TABLE 2

REPORT CARD FOR POLICY INTERVENTION:
DEVIATIONS FROM LARGE DISRUPTION VALUES

	REAL GNP			INFLATION (IN PERCENTAGE POINTS)		
	DISRUPTION TARIFF	PRICE CONTROLS	BOTH	DISRUPTION TARIFF	PRICE CONTROLS	BOTH
1983:1	+1.3	-0.1	+1.6	+0.7	-0.2	+0.7
2	+2.3	-0.1	+2.2	+0.9	-0.2	+0.3
3	+3.9	-0.6	+3.5	+0.3	-0.5	0
4	+5.5	-1.7	+4.1	+0.5	-0.5	0
1984:1	+6.3	-3.2	+3.4	-0.4	-0.5	-0.8
2	+6.1	-3.7	+2.8	-0.5	-0.6	-1.0
3	+6.0	-4.7	+1.8	-0.6	-0.3	-0.6
4	+6.3	-6.2	+0.8	-0.3	-0.1	-0.5
1985:1	+6.8	-6.7	-0.1	-0.4	+0.2	-0.2
2	+5.9	-7.4	-0.7	-0.2	0	0
3	+5.6	-8.1	-1.9	-0.2	+0.4	-0.1
4	+5.1	-9.5	-3.6	0	0.3	-0.3

	SPOT PRICE ($/BBL)			AVERAGE REFINER'S ACQUISITION COST OF IMPORTED OIL ($/BBL)			U.S. OIL CONSUMPTION (1000 B/D)		
	DISRUPTION TARIFF	PRICE CONTROLS	BOTH	DISRUPTION TARIFF	PRICE CONTROLS	BOTH	DISRUPTION TARIFF	PRICE CONTROLS	BOTH
1983:1	-.75	-.84	-.65	-.06	+.01	-.05	-320	+20	-290
2	-2.25	+1.42	-1.42	-.04	+.10	-.30	-540	+140	-380
3	-3.26	+1.75	-1.54	-1.03	+.40	-.64	-760	+310	-420
4	-5.14	+4.26	-1.02	-1.88	+.71	-.88	-1030	+580	-390
1984:1	-4.85	+4.59	-.24	-2.85	+1.98	-.89	-810	+840	+40
2	-4.35	+5.00	+.39	-3.46	+2.86	-1.00	-520	+950	+390
3	-3.74	+5.52	+1.44	-3.76	+3.60	-1.78	-330	+1060	+640
4	-3.02	+6.44	+2.97	-3.79	+4.33	+.31	-180	+1170	+860
1985:1	-2.01	+8.23	+5.50	-3.58	+5.22	+1.69	-30	+1130	+960
2	-1.29	+8.52	+6.44	-3.14	+6.25	+2.65	+80	+1070	+900
3	-.55	+8.92	+8.19	+2.61	+7.09	+3.90	+160	+840	+850
4	+.26	+8.92	+8.19	-1.51	+7.77	5.07	+230	+710	+790

and removed at the end of the disruption in 1984:1. Revenue from the tariff is rebated through a combination of personal income tax cuts and increases in transfer payments. The tariff is imposed on top of the crude oil price controls and entitlements program.

The relative effectiveness of such a strategy as compared with a strategy of just price controls can be found in Table 2. Real income is higher under the tariff/price controls scenario than under the "do nothing" alternative or the price controls alternative. The tariff not only reduces the effect of the price controls on oil imports, but the recycling of tariff revenues helps to maintain aggregate demand in the face of the oil shock. The combined program reduces U.S. oil consumption demand, lowering world oil prices. The policy mix, then, reduces both the income and inflationary effects of the oil shock.

Implications and Conclusions

The modeling exercises in the paper are not intended to suggest the optimality of a policy response of imposing both a price controls/entitlements program and a disruption tariff. First, the simulated responses were very exact - starting at the onset of a disruption and ending with it-sidestepping the question of how to trigger a response. The best activist policy response is likely to center around a federal tax recycling program-either rebating incremental revenue from the Windfall Profit Tax or from new oil excise taxes or oil import tariffs. Much more attention is being paid to such actions in light of the recent Bradley-Percy bill and the President's veto of the Standby Petroleum Allocation Act.

The fact that a good revenue-recycling program may be the best policy response to an oil supply shock should not preclude "second-best" policy analysis. Crude oil price controls may be put into place out of distributional concerns or out of uncertainty about the effects of other policies. A tariff could correct some of the distortions of the price control program. Moreover, a Congress which might be unwilling to use a tariff by itself may be willing to use it in conjunction with price controls (which are in place for "equity" reasons). The spector of crude oil price controls is, for the moment, dorment. We should, however, not restrict our empirical policy analyses to a world in which they are an unavailable tool.

FOOTNOTES

1

This partial adjustment process has been analyzed in Hubbard and Fry (3), Nordhaus (8), and Verleger (12).

2

One way to see this is to decompose OPEC producers into "banker" producers (with high reserves and low domestic requirements) and "borrower" producers (with high revenue needs relative to oil receipts. The first group consists of Saudi Arabia and possibly Kuwait and the United Arab Emirates; other producers fall into the second category. During a disruption, "borrower" countries will increase production (to the extent that they can) to garner needed revenue. "Banker" countries will likely also intervene for considerations relevant to their long-run optimization (to keep prices from too rapidly overshooting a long-run path) and to protect their substantial investments in the West. These and other economic and political motivations are discussed in more detail in Quandt (11).

3

Income depends on the price of oil in a complex way because of the effects of changing oil prices on the trade balance, because of the ways in which changes in inflation may alter the real economy, and because of the impact of changing oil prices on potential economic performance (aggregate supply). A more complete discussion of these roles and a macroeconomic model underlying them are given in Hubbard and Fry (3). A discussion of appropriate functional forms (i.e., in terms of specification and lag structure) for the demand equations is also presented in that paper.

4

The U.S. price differs from the world oil spot price for a number of reasons. We could think of the market-clearing U.S. price (in the absence of any government intervention) as being a partial adjustment to the spot price, i.e.,

$$Pus_t = a_o + a_1 \; pus_{t-1} \; a_2 \; (PSPOT_t - Pus_{t-1}),$$

so that Pus depends on PSPOT, but the two are not necessarily equal. Of course, and ad valorem tariff at rate T transforms Pus into $\tilde{P}us$ = Pus (1+T), and an entitlements program (to carry out crude oil controls) would transform Pus into $\hat{P}us$ = Pus - entitlement benefit.

5

This was certainly not the case in the past, when the U.S. controlled prices at the same time other OECD members were increasing energy taxes. Moreover, the exchange rate movements can complicate this analysis, since the price of oil traded on the international market is denominated in dollars.

6

The role of speculative private inventory behaviro in conjunction with actions in public stockpiling behavior is the subject of a forthcoming paper.

7
For a discussion of these issues, see Fry and Hubbard (2).

8
Several studies have documented the effectiveness of revenue-recycling programs. See Congressional Budget Office (5), Fry and Hubbard (2), and ICF, Inc. (6).

9
Recall that the output of disrupted OPEC producers (DISRUP) is set exogenously, while that of nondisrupted OPEC producers (OUTPUT) is endogenous to the model.

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UNMODELED EFFECTS OF OIL IMPORT DISRUPTIONS: WHAT IS THE SOUND OF A THIRD SHOE DROPPING?

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ABSTRACT

The art of modeling oil import disruptions has evolved to the point that a basic "story" regarding the effects of disruptions can be told. This story consists of reductions in the equilibrium level of national income in the real products market, radified by higher interest rates originating in the monetary sector.

This paper attempts to amplify that story by discussing effects of oil disruptions that may be different in the next disruption due to changing historic circumstances, or effects that are not incorporated in the basic story. These are fourfold:

- There is reason to believe that the oil market will be more responsive in the next disruption. This would be expected if the elasticity of demand has increased (owing to expectations and a broader array of alternatives to oil consumption), if the elasticity of supply has increased (owing to greater excess capacity in world markets), and if inventory-holders have learned not to be drive by panic after their experience in 1979-1981.

- The next disruption will see a greater share of revenues redirected toward the federal government, now that the windfall profits tax is in place. It is not clear that the government will promptly recycle these revenues; in fact, it may choose to retain them in an effort to shore up deficits and restrain inflation.

- A trend toward protectionism in the U.S. economy, and a general tendency to ignore the problems of sectoral adjustment when making economic policy, may add to the burden of