No. 9215

ENERGY SECURITY: A COMPARISON OF PROTECTIONIST POLICIES

by

Mine K. Yücel

and

Carol Dahl

Research Paper

Federal Reserve Bank of Dallas

No. 9215

ENERGY SECURITY: A COMPARISON OF PROTECTIONIST POLICIES

by

Mine K. Yücel

and

Carol Dahl

September 1992

Energy Security: A Comparison of Protectionist Policies

by

Mine K. Yücel
Senior Economist
Federal Reserve Bank of Dallas
Dallas, TX 75201

and

Carol Dahl
Professor of Economics
Department of Mineral Economics
Colorado School of Mines
Golden, CO 80401

July 1992

ABSTRACT: Rising oil imports have spawned a variety of policies for increasing energy security. We provide policy makers with a qualitative comparison of these policies using a dynamic optimal control model. By explicitly modeling long-term adjustment we capture the differences between immediate and long-term implications of the policies. Thirty year price and output paths for OPEC and the United States are simulated assuming that U.S. producers are competitive and OPEC is a dominant firm. We find that the policies have quite different effects on imports and welfare. The tariff reduces imports most, followed by the gasoline tax. The subsidy barely makes a dent in imports. However, U.S. monopsony power in the world oil market renders the subsidy welfare enhancing, whereas a per-unit tariff and gasoline tax are costly for the United States. An ad-valorem tariff on the other hand, both lowers imports and enhances U.S. welfare.

The crisis in the Middle East has renewed concern over dependence on foreign oil supplies and the United States' vulnerability to oil supply disruptions. Although low oil prices before the crisis benefitted consumers and the downstream refining industry, they wrought havoc with high cost domestic producers and their support industries. The resulting fall in domestic production[1] and increase in imports are projected to continue, causing concern over dependence on foreign oil supplies. These trends have renewed suggestions to protect the domestic oil market or reduce domestic consumption.[2] Environmental concerns also reinforce the calls to reduce domestic consumption. In this paper we will compare three of these suggestions - an oil import fee, increased gasoline taxes, and subsidies to domestic oil and gas producers.

Protectionist policies are appealing on a number of grounds. A buyer of oil as large as the United States can exercise monopsony power through taxation and shift the tax onto foreign oil suppliers. Tariffs and taxes would reduce the federal deficit while policies which increase domestic production would lower

---

[1]US oil production (8971 thousand b/d in 1985 and 7385 thousand b/d in 1991) is projected to fall further to 7150 mb/d in 1992. Crude oil imports (3201 thousand b/d in 1985 and 5780 thousand b/d in 1991) are projected to increase further to 6130 in 1992. Sources: American Petroleum Institute, Basic Petroleum Data Book, 1986 & Oil and Gas Journal, 1-27-92:52,58.

[2]For example, President Bush in his first campaign suggested subsidies to domestic producers. Representative Dan Rostenkowski recommended a 10-15 cent per gallon increase in the current 9 cent excise tax on gasoline. Oil and Gas Journal 12/12/88:3. Alan Greenspan argued that "... a gasoline tax would do 'less harm' than other levies." Wall Street Journal, 2/3/89:2. Salomon Brothers saw three energy tax options: a gasoline tax, an oil import fee, or a BTU tax. Oil and Gas Journal, 7/30/90:38. There were several tax incentives for domestic exploration and production in the 1990 Revenue Reconciliation Act. Oil and Gas Journal 2/24/92:69.

imports and soften the macroeconomic effects of a disruption in foreign oil supply.

A number of earlier studies have considered various protectionists policies.[3] Since production today may mean less production in the future, we analyze protectionist policies using long term dynamic analysis. Examples of dynamic analyses of these issues has included both analytical work and simulations. Bergstrom (1982) considered the revenue aspects of an oil tariff by analytically working out the static and dynamic optimal oil tariff in an n-country pure trade Nash equilibrium model with total oil supplies fixed and costlessly extracted or extracted at constant marginal cost. He concluded that the optimal tariff might be on the order of $10.50 to $21 per barrel.

Walls (1991) econometrically developed a U.S. supply model assuming U.S. dynamic optimization and used it to analyze regional effects of a tariff assuming oil prices are set in world markets and that the tariff will be totally passed on to U.S. consumers.

Dynamic analysis with endogenous oil prices and cost increasing as reserves are depleted can not be solved analytically. Thus, Nesbitt and Choi (1988) using the DFI World Oil Model dynamically simulated a U.S. tariff over a 60 year time

---

[3]Static analysis includes Broadman (1986), who argues for a domestic oil premium but finds a wide range of suggested values depending on the assumptions made about the market. Broadman and Hogan (1988), who include a security component and macroeconomic effects, find an optimal tariff around $10 per barrel. Bizer and Stewart (1987), using a small general equilibrium open economy model, conclude that a tax on labor income dominates both an oil consumption tax and a tariff in terms of the dollar cost of additional revenue. The tariff is particularly costly, especially if the rest of the world retaliates. Schmidt and Dunstan (1985) using the MIT-Penn-SSRC economic model find that a $5.00 tariff would be shifted to final consumers and would generate higher inflation and unemployment than an equal revenue income tax. Uri and Boyd (1989) examine a U.S. gasoline tax using a computable general equilibrium model. Dahl and Yücel (1992) contains a literature review of papers that consider the macroeconomic effects of protectionist policies.

horizon. In their model, with seven supply and five demand regions, OPEC is divided into the core cartel and the competitive fringe. Oil resources are a function of future additions to proved reserves and backstop fuels are $60 per barrel. They concluded that OPEC absorbs only a small share of a $10.50 per barrel tariff and found large losses in net economic welfare.

We extend the above dynamic work by focusing on not one but a comparison of three policies - an oil tariff, a gasoline tax, and a producer subsidy that have comparable revenue effects in a consistent dynamic framework with endogenous oil prices. The effects of our policies will depend on the costs of both OPEC and domestic producers, which are rather dissimilar and will change as reserves are depleted. Since explicit inclusion of these costs renders an analytical model solution unobtainable, we abandon the analytical attractiveness of Bergstrom (1982) in favor of the more computationally complex dynamic optimal control model.

We present this model in section II of our paper followed by base case model inputs in section III. The results of the base case simulations are presented in section IV of the paper followed by the sensitivity test results in section V. Conclusions are summed up in section VI.

II. Model

Given the concentration of reserves in OPEC countries and in the interest of keeping the model reproducible and relatively transparent, we focus our analysis on OPEC and U.S. domestic producers. Our choice of market structure is based on work by Griffin (1985) that favors a market sharing cartel model for OPEC but a competitive model for non-OPEC producers. We assume that OPEC is a dominant firm facing U.S. total demand for oil minus U.S. domestic production and non-OPEC U.S. imports. Domestic producers are profit maximizing price takers on the U.S. crude oil market while non-OPEC oil suppliers export a constant amount to the United States. Both the United States and OPEC own oil reserves and maximize their profits over a given time horizon T. We simulate the problem for a base case as well as a gasoline tax of δ, a per-unit oil tariff of τ, and a per-unit subsidy to U.S. producers of σ. The tariff and subsidy are chosen such that their revenues or costs are equal to the gasoline tax revenues. The general maximization problem for the United States is to choose the production path of Qu that maximizes:

$$\int_0^T [P - \beta\delta + \sigma - Cu(Ru)]Qu\ e^{-rt} \tag{1a}$$

subject to the constraint

$$\dot{R}u = -Qu \tag{1b}$$

while OPEC chooses the production path for Qo that maximizes

$$\int_0^T [f(Qu,Qo) - \tau - \beta\delta - Co(Ro)]Qo\ e^{-rt} \tag{2a}$$

subject to

$$\dot{R}o = -Qo. \tag{2b}$$

In the above expressions, P is the price of oil, β is the percent of the barrel going to gasoline, f is the inverted demand function for domestic and OPEC oil by U.S. consumers, Qo is OPEC production going to U.S. markets, Qu is U.S. domestic production, Ru and Ro are reserve levels, r is the real interest rate, and Cu and Co are costs of production. For both OPEC and the U.S., costs increase as reserves are depleted, i.e., $C_R < 0$.

The Hamiltonian for the United States is

$$H = [P - \beta\delta + \sigma - Cu]Qu\ e^{-rt} + \mu_u(-Qu) \tag{3}$$

The first order conditions are

$$H_{Qu} = [(P - \beta\delta + \sigma) - Cu]e^{-rt} - \mu_u = 0 \tag{4}$$

$$\dot{\mu}_u = -H_{Ru} = Cu_{Ru}Qu\ e^{-rt} \tag{5}$$

Similarly, for OPEC we have

$$H = [f(Qu,Qo) - \tau - \beta\delta - Co]Qo\ e^{-rt} + \mu_o(-Qo) \tag{6}$$

$$H_{Qo} = [(f_{Qo}Qo + f) - \tau - \beta\delta - Co]e^{-rt} - \mu_o = 0 \tag{7}$$

$$\dot{\mu}_o = -H_{Ro} = Co_{Ro}Qo\ e^{-rt} \tag{8}$$

The solutions to the maximization problem above will need to satisfy the constraints (1b), (2b) and the optimality conditions (4), (5), (7) and (8). Since an analytical solution is not possible,[4] we solve the first order conditions for price and output paths numerically using Miele's (1970,1974) highly efficient Modified Quasilinearization Algorithm. After solving the system for price, U.S. output, and OPEC production sent to the United States we calculate deadweight losses and/or gains in welfare given by the change in consumer plus producer surplus, net of tax revenues or subsidies. Inputs for these solutions are developed in the next section.

III. BASE CASE MODEL INPUTS

We develop U.S. demand for domestic and OPEC oil by starting with total U.S. demand for oil products:

$$Qt = Qu + Qo + Qn + Qp$$

---

[4] We can manipulate the first order conditions for the U.S. to see how the gasoline tax and the subsidy will affect prices. From the first order conditions we have

$$\dot{p} = rp - rc - r\beta\delta + r\sigma.$$

This equation implies that the gasoline tax causes the price to rise slower than the base case and the subsidy causes the price to rise faster than in the base case. Resource use is curtailed by the gasoline tax and so is the growth in prices. Similarly, the subsidy increases resource use, leading to higher costs of production and a faster rise in prices. Although the tariff does not enter the domestic producer's objective function explicitly, it increases domestic prices. As with the tax, we would expect a slower price increase with the tariff.

Where Qt = the total demand for oil products in the United States. Qu, Qo, Qn, and Qp are the demand for products satisfied by domestic oil, OPEC oil, non-OPEC/non-U.S. oil, and net product imports, respectively. For the constant elasticity of demand case Qt is the following function of demand price Pd and income Y:

$$Qt = \alpha \, Pd^{\beta} \, Y^{\pi}$$

Since consumer welfare depends on the demand for oil products, we must first relate this demand to the derived demand for domestic and OPEC oil which is an input into our simulation model. Product imports are assumed to be the same percent of total U.S. demand as in 1987[5] and product demand price, Pd, is assumed to be the same percent of product supply price, Ps. Under these assumptions, U.S. demand for crude oil as a function of supply price of oil is:

$$Qu + Qo + Qn = \alpha \, (Ps)^{\beta} \, Y^{\pi}$$

Inverting gives the supply price as a function of U.S. and OPEC production as:

$$Ps = [(1/\alpha)(Qu+Qo+Qn)]^{1/\beta} \, Y^{-\pi/\beta}$$

To simplify the analysis and focus on the United States and OPEC we assume in the base case that imports from non OPEC producers remain constant at 842.785 million barrels per year (imports from non-OPEC producers are referred to as non-OPEC supply hereafter).[6]

From a literature search, we choose base case price and income elasticities

---

[5]Product imports are needed to balance demands in various product markets and we assume this need for balance will continue. Current trends suggest that expectations of large OPEC product imports will not materialize as these products have tended to find other markets.

[6]We would expect this to be an upper bound on non-OPEC imports since industry expectations are that non-Opec oil in the coming decade will most likely continue the decline it began in the late 1980s. Oil and Gas Journal, 4/29/91:75.

of -.9 and .8, which are normalized around 1987 variable values giving an inverted demand function of:[7]

$$P = 136.83\ (Qu + Qo + Qn)^{-1.1} Y^{.89}$$

On the supply side of the market, we take cost and reserve estimates from Dahl (1991a) and (1991b).[8] U.S. total reserves are assumed to be 100.6 billion barrels and costs as a function of remaining reserves (R_u) and a time trend (T) are:

$$Cu = 33.13 - .2832\ R_u + .21\ T$$

OPEC reserves are assumed to be 769.290 billion barrels and OPEC landed costs in the United States as a function of remaining reserves R_o and a time trend are:

$$Co = 23.232 - .026\ R_o + .016\ T$$

Since we have abstracted from demand for the rest of the world, we assume

[7]For surveys of these elasticities see Bohi (1981), Bohi and Zimmerman (1984), and Dahl (1986). Many of the derived estimates for product price elasticity are between -.3 and -1.6, while many of those for income elasticity are between .6 and 1.4. In econometric work and simulations, our chosen long-run elasticities of -0.9 and 0.8 were found to fit U.S. data well for 1955-1973 and 1986-1990. In econometric equations on oil product demand per capita, the price of oil, the price of natural gas, the price of coal, income per capita, and these long-run elasticities, the equation explained 94% of the variation in oil product demand. They did not perform well for the years 1974-1985 which saw dramatic price increases and two rather severe recessions. For these years, a higher price and a lower income elasticity performed better. (Data was taken from various issues of the IMF's International Financial Statistics, Energy statistics, and Energy balances.) These elasticities are normalized around 1987 product demand minus net product imports of 5.624 billion barrels, GDP of $4.461 trillion, and an oil supply price of $16.35

[8]Because proven reserve estimates in the United States appear to be developed reserves, while those for OPEC appear to be much higher, US reserves are taken to be proven reserves plus reserve additions plus an estimate for unfound reserves. OPEC reserves are taken to be their reported proven reserves.

the United States gets the same share of OPEC reserves as in 1987 or 15%.[9] Finally, we assume income grows at 2.5% per year, the real interest rate is 8% and the time horizon is 30 years.

We first simulate optimal time paths for U.S. production, OPEC production, and oil prices for a base case with no tariff or subsidy, and the current gasoline tax (δ, σ, and $\tau = 0$). We then simulate the three policies: a \$.25/gallon gasoline tax (equal to \$10.50 per 42 gallon barrel of gasoline or roughly equal to \$5.25/barrel of crude oil with the current U.S. product mix); an equal revenue tariff of \$8.59 per barrel; and a subsidy of \$5.15/barrel that costs the same amount as the revenue the other two policies would generate.[10]

IV. RESULTS

__Base Case__ We find that initial simulated oil price is \$13.10 in 1987, rising an average of 6.1 percent per year to \$31.47 by 2017. Simulated U.S. production, which is somewhat higher than actual U.S. production, declines quite steeply for 20 years, and then rises very moderately until the end of the time horizon. Domestic production begins at 51 percent of total demand and falls to 40 percent of demand over the 30 year simulation period, while simulated OPEC production, which is somewhat lower than actual OPEC production in 1987, is more stable, with a flatter convex shape. Increases in demand lead to increased production in the

---

[9]Since 1960 the United States has received between 6 and 20% of OPEC production, with an average of 12%. As U.S. production falls it is expected that this share will rise.

[10]All revenues are measured in discounted present value with a discount rate of 8%. The tariff and subsidy rate that had equal revenues or costs with the gasoline tax were found by a grid search.

later years for both groups of producers.[11] By the end of the time horizon 28 percent of U.S. and 40 percent of OPEC's reserves remain.

The three policies produce rather different price and output paths, which are given in Figures 1 and 2. For improved resolution, they are expressed as a percent of the base case.

Gasoline Tax A 25 cent per gallon gasoline tax lowers producer prices and increases domestic consumer prices. The tax decreases oil imports by lowering oil consumption, but it is a costly way of achieving this end.

The gasoline tax reduces domestic consumption and production of oil as well as imports by increasing consumer prices and decreasing producer prices. A higher proportion of the tax is borne by consumers with an initial consumer price increase of 20.8 percent, while producer prices decrease 4.8 percent. This policy produces the highest initial consumer prices, but they fall below tariff prices after the sixth year. Although domestic output is lowest with the gasoline tax, the fall in consumption is much greater, leading to a decrease in imports. Cumulative imports are reduced 10.5 percent over the 30-year time horizon.

The gasoline tax is a costly method of lowering imports and our dependence on foreign oil. The present value of U.S. profits are decreased 13.4 percent with the loss in consumer surplus almost twice the tax revenues collected. The total deadweight loss over the entire 30 year time horizon, after netting out tax revenues, is 89 cents per dollar of revenue generated. Although foreign suppliers of oil bear some of the burden of the tax, the gasoline tax is the most

---

[11]A convex shape does not result when income growth is zero.

welfare costly of the three policies, at a cost of $17.71 per barrel of reduction in imports. Figure 3 shows the level of imports to the United States under the three policies.

Tariff The tariff benefits domestic oil producers and hurts domestic consumers by increasing domestic oil prices by almost 15% over the base case in 1987. By increasing domestic oil prices, the tariff increases domestic oil production and lowers domestic oil consumption and thus lowers imports. At the same time, the United States is a large enough consumer of oil to have some monopsony power in the oil market and as a result world oil prices fall roughly 5 percent over the simulation period.

The tariff is the most successful policy in decreasing imports because it attacks the problem both from the production and consumption ends. By increasing domestic production and lowering consumption, the tariff decreases imports from 48 percent to 18 percent of consumption initially. Higher domestic production with the tariff levels off in the later years and, while still below base case levels, imports rise to 54 percent of total consumption. Over the entire time horizon, imports are decreased 27.8 percent with the tariff.

The per-unit tariff is costly for the United States. Although the discounted present value of domestic producer profits increase by 41 percent, these gains and the tax revenues are not enough to compensate for the total loss in consumers' surplus. The deadweight loss from the tariff is 175 percent of tariff revenues. The reduction of a barrel of imports with the tariff is much less than with the gasoline tax and costs the United States $2.82.

Subsidy The subsidy benefits both consumers and domestic producers of oil. Of the three policies, U.S. consumer prices are lowest and U.S. producer prices are highest with the subsidy. Although the subsidy turns out to be welfare enhancing for the United States, its affect on imports is minimal.

A per-unit subsidy of $5.15 increases U.S. production, backs out some imports and lowers world prices. Both the increase in domestic production and the United States' monopsony power in the oil market contribute to the decrease in U.S. consumer prices. Although imports initially decrease, in the longer run, increased consumption and production lead to a quicker depletion of the U.S. resource base, and imports rise towards base case levels in the long run. Overall, the subsidy decreases cumulative imports by only 1.2 percent.

The subsidy is welfare enhancing for the United States. The present value of producer profits over the 30-year time horizon increase 56 percent with the per-unit subsidy. The gain in consumer surplus is 150 percent over the base case. After netting out the cost, the subsidy still remains beneficial to the United States as a result of U.S. monopsony power in the world oil market.[12]

V. SENSITIVITY TESTING

Numerous sensitivity tests were conducted for each policy. In the interest of clarity and brevity, we only discuss interesting implications from the sensitivity analysis, done across various specifications and parameters.[13] The

---

[12]The subsidy is welfare improving following the Kaldor-Hicks rule: the subsidy has positive net benefits because the gainers could compensate the losers and still be better off.

[13]The following sensitivity tests were performed. Complete results of all simulations are available upon request from the authors.
1. A linear demand function; 2. Price elasticities ranging from -.7 to -1.1; 3. No GNP growth; 4. OPEC with a discount rate of 5%; 5. OPEC with a discount rate of 10%; 6. Non-OPEC production declining by 10 % per year; 7. Non-OPEC production a constant proportion of OPEC supply calibrated to the 1987 value of 17.589 percent; 8. An ad-valorem subsidy; 9. An ad-valorem tariff.

different demand specifications and different discount rates produce no qualitative differences in the welfare results and ordering of policies.

Discount rate changes make no qualitative differences in welfare or the ordering of the policies either. However, by changing cost functions as well as intertemporal opportunity costs, they change the timing of price and output. Conceivably, OPEC countries could have a lower social discount rate than private domestic firms. When we lower OPEC's discount rate to 5 percent, costs fall and OPEC's production is increased throughout the time horizon. However, there is an intertemporal effect as well, which shifts OPEC's production profile towards the future. With OPEC production shifted toward the future. U.S. production is initially higher than the base case but quickly resumes its decline. The United States produces less in this case over the entire time period.

On the other hand, Adelman (1986) argues that OPEC countries are very dependent on an unstable oil market and therefore should have a higher interest rate than oil companies. We model this contingency by increasing OPEC's discount rate to 10 percent.

With a higher discount rate, OPEC costs increase, reducing output in all periods. By shifting production to the present, the intertemporal effect counters the cost effect in the present and reinforces it in the future. The overall effect of an increase in the discount rate is to shift OPEC production to the present, increasing current production and reducing future production. Since OPEC is shifting production to the present, U.S. producers shift to the future. Although U.S. production is less than the base case for the first five years, it is greater than the base case for the rest of the time horizon. U.S. production is up 4.7 percent with respect to the base case at the end of the thirty year time horizon.

The base case assumed constant non-OPEC supply, which is by no means certain. Therefore, we have also experimented with non-OPEC supply as a fixed percentage of OPEC supply and non-OPEC supply declining through time. When non-OPEC supply is a constant percentage of OPEC supply, there are no qualitative differences from the base case, but OPEC's reactions to the policies are amplified.

A declining non-OPEC supply increases OPEC's market share, lowers the elasticity of demand facing OPEC, and raises prices. Interestingly, there is no tariff rate with equal revenues to a $0.25 per gallon gasoline tax when non-OPEC supply is declining. The imposition of a tariff reduces OPEC production drastically and maximum tariff revenues are lower than revenues from the gasoline tax.

Another interesting result is that an ad-valorem tariff, at low rates, is welfare enhancing for the United States. An ad-valorem tariff mimics a tax on OPEC rents. OPEC's extraction costs are very low and quite stable, hence the rate of increase in OPEC prices is relatively close to the interest rate. The ad-valorem tariff, based on OPEC prices, also rises at a rate close to the interest rate and consequently is similar to a tax on OPEC rents. OPEC's production is not altered significantly, and the United States reaps the rent. The ad-valorem tariff is welfare enhancing for the United States up to 30 percent of price. However, tariff revenues are not equal to the revenues from a $0.25 per gallon gasoline tax because maximum ad-valorem tariff revenues are only 81 percent of the gasoline-tax revenues.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

Dynamic simulations suggest that policies to reduce U.S. oil imports - a gasoline tax, an oil tariff and a producer subsidy -would have rather different effects on U.S. oil prices, imports, and production and consumption patterns. Therefore, support for these policies will vary across interest groups. Those most concerned about oil security as measured by total imports would favor a tariff. It has by far the most significant effect in reducing imports. The tariff is trailed by the gasoline tax, but with less than half the tariff's reduction in imports. The subsidy lowers imports the least, by a cumulative 1.2 percent.

U.S. producers would favor the subsidy with its high prices and high production profile. They would favor the tariff somewhat less, and would be opposed to a gasoline tax which lowers producers prices and profits. U.S. consumers, looking at the direct effects, shouldn't see too much difference in cost between a gasoline tax and a tariff. Both reduce welfare, although the tariff lowers consumers' surplus somewhat more. Consumers would clearly prefer the subsidy, which increases their welfare.

From an environmental perspective, the tariff would dominate since it curtails U.S. consumption the most over the simulation period. Consumption is reduced 27.8 percent with the tariff and 10.5 percent with the gasoline tax. The subsidy, on the other hand, increases consumption by 7.9 percent.

These simulated prices and output paths have interesting welfare implications. The social planner would find the gasoline tax the most costly followed by the per-unit tariff. Surprisingly, both a subsidy and an ad-valorem tariff are found to be welfare enhancing under the conditions in our model, with import reduction highest with the tariff. Hence, if the underlying parameter assumptions hold - OPEC a dynamically optimizing dominant firm, the United States a dynamically optimizing competitive firm, and the United States having some monopsony power in the world oil market - an ad-valorem tariff could be the best way of decreasing our dependence on foreign oil in the next three decades.

References

Adelman, M.A. (1986). "Oil Producing Countries' Discount Rates," Resources and Energy, 8:309-329.

Bergstrom, Theodore C. (1982) "On Capturing Oil Rents with a National Excise Tax," American Economic Review, 72(1), May: 194-201.

Bizer, David S. and Stuart, Charles (1987) "The Public Finance of a Protective Tariff: The Case of an Oil Import Fee" American Economic Review, December, 77(5):1019-1023

Bohi, Douglas R. (1981). Analyzing Demand Behavior: A Study of Energy Elasticities, Published for Resources for the Future by Johns Hopkins Press, Baltimore, MD.

Bohi, Douglas R. and Zimmerman, Mary Beth (1984). "An Update on Econometric Studies of Energy Demand Behavior," Annual Energy Review, 9: 105-154.

Broadman, Harry G. (1986) "The Social Cost of Imported Oil" Energy Policy, 14 (3): 242-252.

Broadman, Harry G. and Hogan, William W. (1988). "Is an Oil Tariff Justified? An American Debate: II. The Numbers Say Yes," Energy Journal, Vol. 9 (3): 7-29.

Crémer, Jacques and Salehi-Isfahani, Djavad (1991). Models of the World Oil Market, New York: Harwood Academic Publishers.

Dahl, Carol A. (1986). "Survey of Gasoline Demand." Energy Economics, 7(1), January, pp. 67-82.

Dahl, Carol A. (1991a) "U.S. Cost Function for Oil" (manuscript) Dept. of Mineral Economics, Colorado School of Mines, Golden, CO (September).

Dahl, Carol A. (1991b) "Cost Function for OPEC Oil Delivered to U.S. Ports," Dept. of Mineral Economics, Colorado School of Mines, Golden, CO, (September).

Dahl, Carol A. and Yücel, Mine K. (1992). "Modeling Macroeconomic Impacts of U.S. Oil Protectionist Policies," in International Issues in Energy Policy, Development, and Economics, Boulder, CO: Westview Press edited by James P. Dorian and Fereidun Fesharaki.

Griffin, James M. (1985). "OPEC Behavior: A Test of Alternative Hypothesis." American Economic Review 75 (5): 954-963.

Hausman, Jerry A. (1981). "Exact Consumer's Surplus and Deadweight Loss," American Economic Review, 71 (4) Sept.: 662-676.

Miele, Angelo; Iyer, R. R.; and Wells, K. H. (1970). "Modified Quasilinearization and Optimal Initial Choice of Multipliers, Part 2, Optimal Control Problems," Journal of Optimization Theory and Applications, 6.

Miele, Angelo; Mangiavacchi, A.; and Aggarwal,A. K. (1974). "Modified Quasilinearization Algorithm for Optimal Control Problems with Nondifferential Constraints," Journal of Optimization Theory and Applications, 14 (5).

Nesbitt, Dale M. and Choi, Thomas Y. (1988). "Is an Oil Tariff Justified? An American Debate: II. The Numbers Say No," Energy Journal. Vol. 9 (3): 31-59.

Schmidt and Dunstan (1985) "Effects of Reducing the Deficit with an Oil Import Tariff" Federal Reserve Bank of Dallas Economic Review, Sept.:15-24.

Uri, Noel D. and Boyd, Roy (1989) "The Potential Benefits and Costs of an Increase in U.S. Gasoline Tax," Energy Policy, 17(4):356-369.

Walls, Margaret (1991). "Dynamic Firm Behavior and Regional Deadweight Losses from a U.S. Oil Import Fee," Southern Economic Journal, 57(3):772-788.

RESEARCH PAPERS OF THE RESEARCH DEPARTMENT
FEDERAL RESERVE BANK OF DALLAS

Available, at no charge, from the Research Department
Federal Reserve Bank of Dallas, Station K
Dallas, Texas 75222

9101 Large Shocks, Small Shocks, and Economic Fluctuations: Outliers in Macroeconomic Time Series (Nathan S. Balke and Thomas B. Fomby)

9102 Immigrant Links to the Home Country: Empirical Implications for U.S. and Canadian Bilateral Trade Flows (David M. Gould)

9103 Government Purchases and Real Wages (Mark Wynne)

9104 Evaluating Monetary Base Targeting Rules (R.W. Hafer, Joseph H. Haslag and Scott E. Hein)

9105 Variations in Texas School Quality (Lori L. Taylor and Beverly J. Fox)

9106 What Motivates Oil Producers?: Testing Alternative Hypotheses (Carol Dahl and Mine Yucel)

9107 Hyperinflation, and Internal Debt Repudiation in Argentina and Brazil: From Expectations Management to the "Bonex" and "Collor" Plans (John H. Welch)

9108 Learning From One Another: The U.S. and European Banking Experience (Robert T. Clair and Gerald P. O'Driscoll)

9109 Detecting Level Shifts in Time Series: Misspecification and a Proposed Solution (Nathan S. Balke)

9110 Underdevelopment and the Enforcement of Laws and Contracts (Scott Freeman)

9111 An Econometric Analysis of Borrowing Constraints and Household Debt (John V. Duca and Stuart S. Rosenthal)

9112 Credit Cards and Money Demand: A Cross-Sectional Study (John V. Duca and William C. Whitesell)

9113 Rational Inflation and Real Internal Debt Bubbles in Argentina and Brazil? (John H. Welch)

9114 The Optimality of Nominal Contracts (Scott Freeman and Guido Tabellini)

9115 North American Free Trade and the Peso: The Case for a North American Currency Area (Darryl McLeod and John H. Welch)

9116 Public Debts and Deficits in Mexico: A Comment (John H. Welch)

9117 The Algebra of Price Stability (Nathan S. Balke and Kenneth M. Emery)

9118 Allocative Inefficiency in Education (Shawna Grosskopf, Kathy Hayes, Lori Taylor, William Weber)

9119 Student Emigration and the Willingness to Pay for Public Schools: A Test of the Publicness of Public High Schools in the U.S. (Lori L. Taylor)

9201 Are Deep Recessions Followed by Strong Recoveries? (Mark A. Wynne and Nathan S. Balke)

9202 The Case of the "Missing M2" (John V. Duca)

9203 Immigrant Links to the Home Country: Implications for Trade, Welfare and Factor Rewards (David M. Gould)

9204 Does Aggregate Output Have a Unit Root? (Mark A. Wynne)

9205 Inflation and Its Variability: A Note (Kenneth M. Emery)

9206 Budget Constrained Frontier Measures of Fiscal Equality and Efficiency in Schooling (Shawna Grosskopf, Kathy Hayes, Lori Taylor, William Weber)

9207 The Effects of Credit Availability, Nonbank Competition, and Tax Reform on Bank Consumer Lending (John V. Duca and Bonnie Garrett)

9208 On the Future Erosion of the North American Free Trade Agreement (William C. Gruben)

9209 Threshold Cointegration (Nathan S. Balke and Thomas B. Fomby)

9210 Cointegration and Tests of a Classical Model of Inflation in Argentina, Bolivia, Brazil, Mexico, and Peru (Raúl Anibal Feliz and John H. Welch)

9211 Nominal Feedback Rules for Monetary Policy: Some Comments (Evan F. Koenig)

9212 The Analysis of Fiscal Policy in Neoclassical Models[1] (Mark Wynne)

9213 Measuring the Value of School Quality (Lori Taylor)

9214 Forecasting Turning Points: Is a Two-State Characterization of the Business Cycle Appropriate? (Kenneth M. Emery & Evan F. Koenig)

9215 Energy Security: A Comparison of Protectionist Policies (Mine K. Yücel and Carol Dahl)