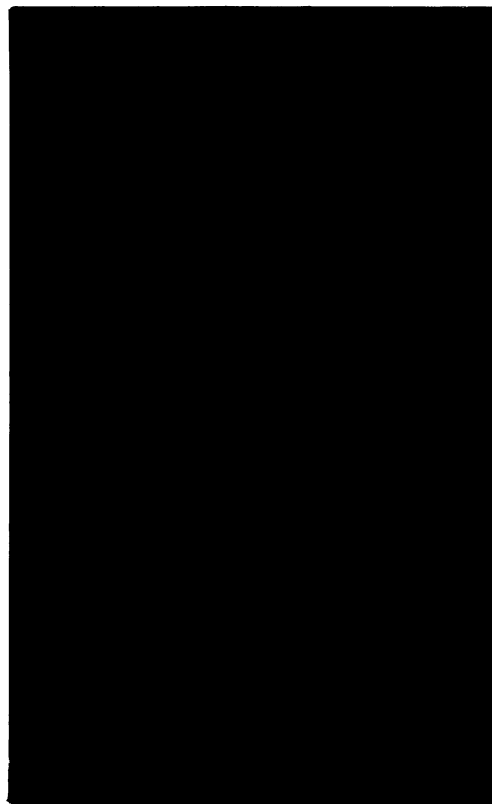# Center for Research on Economic and Social Theory
Research Seminar in Quantitative Economics

Discussion Paper

DEPARTMENT OF ECONOMICS
University of Michigan
Ann Arbor, Michigan 48109

On Capturing Oil Rents
With a National Excise Tax.

Theodore C. Bergstrom
Department of Economics
University of Michigan
January 19, 1980

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Everybody knows that in static competitive analysis the entire burden of an excise tax on a good in fixed supply falls on the supplier. Imposing a tax does not change the price paid by consumers and the price received by suppliers falls by the amount of the tax. One is tempted to conjecture that this result extends to the case of costlessly extracted depletable resources. Although the amount of such a resource that is supplied in any single period can change in response to variation in the intertemporal price structure, the total amount available for all time is fixed. Thus it is plausible that the effects of an excise tax imposed once and forever might be the same as in the static model.

This conjecture turns out to be true. In a Hotelling-type model with a costlessly extracted natural resource, if a uniform excise tax rate is collected from all consumers, the entire burden of the tax is borne by suppliers. This is the case whether the resource is supplied competitively or by a monopoly.

Where there are many consuming nations, there is unlikely to be perfect collusion among national governments in taxing away the rents of suppliers. It therefore is of interest to examine the implications of non-cooperative behavior among consuming nations. Thus we consider a "Nash equilibrium" in which each nation chooses a tax rate which it cannot "improve upon" by unilateral action. We show that this Nash equilibrium is characterized by a simple rule relating the equilibrium excise tax rates to demand elasticities and market shares.

Our strategy is first to analyze tax incidence and optimal taxation in a static model and then to extend the results to the intertemporal case by establishing an isomorphism between the multiperiod and the one period models.

Section I - Static competitive analysis

Following common practice in the analysis of depletable resources, we con-

fine ourselves to a partial equilibrium model. In this section there is only one time period, a natural resource, call it "oil", and a numeraire. There are n countries. Throughout the discussion it will be assumed that arbitrage possibilities establish a single "supply price" $\bar{p}$ that suppliers receive regardless of the country in which they sell. Each country, i imposes an excise tax on oil at the rate θ_i expressed as a fraction of $\bar{p}$. Then the price paid for oil by consumers in country i is:

$$(1) \qquad p_i = \bar{p}(1+\theta_i) .$$

The total revenue from the excise tax is rebated to the citizens of country i in such a way that a consumer's rebate is essentially independent of his purchases of oil.

If all countries charged the same excise tax rate, θ, then consumers everywhere would pay the same price, p, for oil. Equilibrium in the oil market requires that:

$$(2) \qquad \sum_{i=1}^{n} D_i(p) = S$$

where S is the fixed world supply of oil. Since the functions, $D_i(\cdot)$, are decreasing in p, there is only one value of p that satisfies (2). This is true regardless of the level of θ. Therefore the price, p, of oil to consumers is independent of the tax rate, and the price $\bar{p} = \frac{p}{1+\theta}$ received by suppliers is less than p by the amount of the excise tax per unit. Thus if the consuming nations were disjoint from the producing nations, they could extract nearly the entire economic rent from the suppliers by setting θ sufficiently large. There would be no "dead-weight loss" since the consumer price is independent of θ.

Suppose, instead, that each country sets its own excise tax rate and there is no cooperation among consuming nations, but each country believes that all other countries' tax rates are chosen independently of its own. The condition for market equilibrium is:

$$(3) \qquad \sum_{i} D_i(\bar{p}(1+\theta_i)) = S$$

If we totally differentiate (4) with respect to Θ_j, we obtain:

$$(4) \quad \cdot \sum_i (1+\Theta_i) D_i'(p_i)\frac{d\bar{p}}{d\Theta_j} + \bar{p}D_j'(p_j) = 0$$

Manipulating expression (4) and recalling (1) we have:

$$(5) \quad \frac{1}{\bar{p}}\frac{d\bar{p}}{d\Theta_j} = -\frac{1}{1+\Theta_j}\frac{q_j\xi_j(p_j)}{\sum_i q_i\xi_i(p_i)}$$

where for each i, $\xi_i(p_i) \equiv \frac{p_i}{q_i} D_i'(p_i)$ is the price elasticity of demand for oil in country i.

We can also calculate the effect of a unilateral change in country j's excise tax rate on the price of oil to consumers in j and on oil consumption in j. Since $p_j = (1+\Theta_j)\bar{p}$, it follows that:

$$(6) \quad \frac{1}{p_j}\frac{dp_j}{d\Theta_j} = \frac{1}{\bar{p}}\frac{d\bar{p}}{d\Theta_j} + \frac{1}{1+\Theta_j}$$

Substituting (5) into (6) yields

$$(7) \quad \frac{1}{p_j}\frac{dp_j}{d\Theta_j} = \frac{1}{1+\Theta_j}\frac{\sum_{i\neq j} q_i\xi_i(p_i)}{\sum_i q_i\xi_i(p_i)}$$

Using (7) and the fact that $q_j = D_j(p_j)$, one can show that:

$$(8) \quad \frac{1}{q_j}\frac{dq_j}{d\Theta_j} = \frac{\xi_j(p_j)}{1+\Theta_j}\frac{\sum_{i\neq j} q_i\xi_i(p_i)}{\sum_i q_i\xi_i(p_i)}$$

Since the price elasticities are all negative, we see from (5), (7) and (8) that the effect of an increase in country j's excise tax rate is to lower the world supply price, raise the domestic price to the consumer and lower domestic consumption of oil. To solve for a non-cooperative equilibrium distribution of excise tax rates, we need to solve an "optimal tax problem" for each country. We define on excise tax and rebate policy to be optimal for country j if no unilateral change in that country's excise tax rate and in its distribution of rebates will benefit all citizens of country j.

For this analysis we assume a pure exchange economy in which consumer k in country j initially owns w_{j_k} units of the numeraire and s_{j_k} units of oil. Let $s_j = \sum_k s_{j_k}$ and let $w_j = \sum_k w_{j_k}$. A consumer allocation is described by the amounts c_{j_k} and q_{j_k} of numeraire and oil respectively, consumed by each k in j. For any such allocation, let $c_j = \sum_k c_{j_k}$ and $q_j = \sum_j q_{j_k}$.

Since the proceeds of the excise tax in country j can be returned to its citizens, the set of feasible consumption allocations for country j is the set of allocations for which total consumptions satisfy the trade balance equation:

$$(9) \qquad c_j + \bar{p}q_j = w_j + \bar{p}s_j.$$

From (9) it follows that for any feasible rearrangement of consumption in response to a change in the excise tax,

$$(10) \qquad \frac{dc_j}{d\Theta_j} = (s_j - q_j)\frac{d\bar{p}}{d\Theta_j} - \bar{p}\frac{dq_j}{d\Theta_j} \ .$$

Assuming that all consumers consume some of each good, and observing that then the price p_j is the marginal rate of substitution of all consumers in j between oil and numeraire, we can conclude that a small increase in the excise tax together with a rebate that enables consumer k to move along a path where

$$(11) \qquad \frac{dc_{j_k}}{d\Theta_j} > - p_j \frac{dq_{j_k}}{d\Theta_j}$$

will benefit consumer k. If a tax increase and rebate is found that satisfies (11) for all consumers k in j then everyone is benefited by the change. In this case, summing the expressions (11) over all k yields:

$$(12) \qquad \frac{dc_j}{d\Theta_j} > - p_j \frac{dq_j}{d\Theta_j}$$

Substituting for $\frac{dc_j}{d\Theta_j}$ from the feasibility constraint in (10) and rearranging

terms produces:

$$(13) \qquad (p_j - \bar{p})\frac{dq_j}{d\Theta_j} > (q_j - s_j)\frac{d\bar{p}}{d\Theta_j}$$

Since $p_j - \bar{p} = \Theta_j \bar{p}$ and $\frac{dq_j}{d\Theta_j} < 0$, (   ) is equivalent to:

$$(14) \qquad \Theta_j < \left(\frac{q_j - s_j}{q_j}\right)\frac{\frac{1}{\bar{p}}\frac{d\bar{p}}{d\Theta_j}}{\frac{1}{q_j}\frac{dq_j}{d\Theta_j}} \qquad .$$

Therefore if the inequality in (14) holds, there is a feasible way to increase

the excise tax and redistribute the proceeds so as to benefit everyone in

country j. A similar argument shows that if the strict inequality in (14)

were reversed, there would be a feasible way to benefit everyone in country j by

lowering the excise tax rate and reallocating the proceeds. It follows that

a necessary condition for Θ_j^* to be an optimal excise tax rate for country j is

$$(15) \qquad \Theta_j^* = \left(\frac{q_j - s_j}{q_j}\right)\frac{\frac{1}{\bar{p}}\frac{d\bar{p}}{d\Theta_j}}{\frac{1}{q_j}\frac{dq_j}{d\Theta_j}}$$

Recalling equations (5) and (8), we see that (15) is equivalent to:

$$(16) \qquad \Theta_j^* = \frac{-1}{\xi_j(p_j)} \left(\frac{q_j - s_j}{q_j}\right) \frac{q_j \xi_j(p_j)}{\sum_{i \neq j} q_i \xi_i(p_i)} \qquad .$$

Thus the optimal tax rate for any country can be found by a simple computation

from magnitudes for which empirical estimates exist. In case the price

elasticities are nearly constant and identical across countries, (16) reduces

to the even simpler expression:

$$(17) \qquad \Theta_j^* \simeq \frac{-1}{\xi} \frac{q_j - s_j}{\sum_{j \neq i} q_i} \qquad .$$

Section II Intertemporal competitive analysis

   Suppose that there are a countable, possibly infinite, number of time

periods and that there is a constant interest rate, r. Let $\bar{p}(t)$ be the price received by suppliers for oil supplied in period t. If there is a fixed total amount, S, of oil in the ground which can be costlessly extracted at any time, then, as is well-known, competitive equilibrium can occur only where

$$(18) \qquad \bar{p}(t) = \bar{p}(o) \, (1+r)^t \; .$$

Let $\theta_i(t)$ be the excise tax rate on oil in country i at time t. Let

$$(19) \qquad p_i(t) \equiv \bar{p}(t) \, (1+\theta_i(t))$$

be the price paid by consumers in i at time t and let

$$(20) \qquad \vec{p}_i \equiv (p_i(0),..,p_i(t),...) \; .$$

Assume that demand for oil in country i at time t is a function:

$$(21) \qquad q_i^t = D_i^t(\vec{p}_i) \; .$$

If country i imposes a constant excise tax rate, θ_i, in all periods, then from (18) and (19) we see that:

$$(22) \qquad p_i(t) = \bar{p}(o)(1+r)^t(1+\theta_i) \; .$$

Therefore the entire time path of prices, $\vec{p}_i$ and hence total consumption over all time in country i is determined by $\bar{p}(o)(1 + \theta_i)$ and the exogenous interest rate, r. Thus we can define:

$$(23) \qquad D_i^*(\bar{p}(o)(1 + \theta_i)) = \sum_t D_i^t(\vec{p}_i)$$

where $\vec{p}_i = (\bar{p}(o)(1+\theta_i), \; \bar{p}(o)(1+\theta_i)(1+r), \; ...,\bar{p}(o)(1+\theta_i)(1+r)^t,...)$

It then follows that the equilibrium condition equalizing world oil demand over all time with world supply is just:

$$(24) \quad \sum_{i=1}^{n} D_i^*(\bar{p}(o)(1+\Theta_i)) = S.$$

But comparing (24) and (3), we see that the intertemporal method just posed is isomorphic to the single period model that we studied. The same formal results apply. All that is left for us to do is to supply the economic interpretations of these results for the intertemporal model.

Suppose that all consuming nations impose a uniform excise tax rate on oil consumed at any time. Then from (22) we see that the price paid by consumers in all countries at time t is $p(t) = \bar{p}(o)(1+r)^t(1+\Theta)$. From (24) we see that p(o) must satisfy

$$(25) \quad \sum_{i=1}^{n} D_i^*(p(o)) = S .$$

Thus the equilibrium price to consumers in period zero and hence in all future periods is independent of the excise tax rate. Therefore, just as in the static case, the entire burden of a uniformly imposed excise tax falls on the suppliers.

The comparative statics results in equations (5), (7) and (8) for single period analysis carry over to yield:

$$(26) \quad \frac{1}{\bar{p}(o)} \frac{d\bar{p}(o)}{d\Theta_j} = \frac{-1}{1+\Theta_j} \frac{q_j \xi_j^*}{\sum_i q_i \xi_i^*}$$

$$(27) \quad \frac{1}{p_j(o)} \frac{dp_j(o)}{d\Theta_j} = \frac{1}{1+\Theta_j} \frac{\sum_{i \neq j} q_i \xi_i^*}{\sum_i q_i \xi_i^*}$$

$$(28) \quad \frac{1}{q_j} \frac{dq_j}{d\Theta_j} = \frac{\xi_j^*}{1+\Theta_j} \quad \frac{\sum_j q_i^*}{\sum_i \cdots_i}$$

where $q_i \equiv \sum_t q_i^t$ and $\xi_i^* = \dfrac{q_i}{p_i(o)} D^{*\prime}(p_i)$.

The trade balance equation (9) for each country must now be expressed in present value terms. That is:

$$(29) \quad \sum_t \left[\left(\frac{1}{1+r} \right)^t \left(c_j(t) + \bar{p}(t) q_j^t \right) \right] = \sum_t \left[\left(\frac{1}{1+r} \right)^t w_j(t) + \bar{p}(t) s_j(t) \right]$$

where $c_j(t)$ and q_j^t are comsumptions of numeraire and oil in country j in period t and $w_j(t)$ and $s_j(t)$ are amounts of numeraire and oil supplied by country j in period t. Recalling that $\bar{p}(t) = \bar{p}(o)(1+r)^t$, we can express (29) as:

$$(30) \quad C_j + \bar{p}(o) q_j = W_j + \bar{p}(o) s_j$$

where C_j and W_j are the <u>present values</u> of total consumption and supplies of numeraire by country j and where q_j and s_j are <u>total</u> consumptions and supply oil by country j. Thus with appropriate interpretation, we ratain the exact formalism of (9).

In competitive equilibrium all consumers in country j have a marginal rate of substitution, $p_j(t)$ between consumption of oil and the numeraire in time t and a marginal rate of substitution of $\left(\dfrac{1}{1+r} \right)^t$ between consumption of numeraire at time t and numeraire at time 1. Therefore using the same kind of reasoning that developed (11) and (12), we can show that an increase in Θ_j with an appropriate distribution of the proceeds will benefit everyone in country j if:

$$(31) \quad \frac{dC_j}{d\Theta_j} > -p_j \frac{dq_j}{d\Theta_j}$$

From this point we reason exactly as in the static analysis to show that a necessary condition for Θ_j to be optimal for country j is:

$$(32) \quad \Theta_j = - \frac{1}{\xi_j^*} \frac{q_j - s_j}{q_j} \frac{q_j \xi_j^*}{\sum_{i \neq j} q_i \xi_i^*} .$$

This expression is formally the same as (16). Here, however, we must keep in mind that q_j and s_j should be total consumption and supplies over all future time and ξ_j^* should be the "long run" price elacticity. More specifically, ξ_j^* is the per cent change in total consumption over all time that results from a permanent 1% increase in the present and in all future prices.

The optimal tax rate found in (32) has only been shown to be the optimal constant tax rate. More generally we could allow the possibility that a country could choose a schedule of changing tax rates over time. The analysis of a Nash equilibrium in varying strategies is, in general, much more difficult, both conceptually and as a matter of conputation. We shall defer further consideration of these matters except to remark that in the special case of stationary, time separable demand functions with a constant price elasticity of demand, there is a Nash equilibrium in which all countries find that a constant tax rate is the best response even if variable tax rates are possible.

Section III - The case of a monopolistic supplier

As in section II, we assume there are a countable number of time periods, a constant interest rate, and that oil can be extracted costlessly. We will suppose that resale possibilities are such that the monopolist is unable to charge different prices to different countries. Let $\bar{p}(t)$ be the price the monopolist charges in time t and let θ_i be the excise tax rate in country i. Thus, as in Section II, the price paid by consumers in country i is $p_i(t) = \bar{p}(t)(1 + \theta_i)$. The vector of intertemporal prices to consumers is then $\vec{p}_i$ as defined in (20) above. Assume that the monopolist chooses a pricing policy over time so as to maximize the present value of his profits, since extraction is costless, his profits are:

$$(33) \quad \sum_{t=0}^{\infty} \bar{p}(t) \left(\sum_{i=1}^{n} D_i^t(\vec{p}_i) \right) \left(\frac{1}{1+r} \right)^t$$

subject to

$$(34) \quad \sum_{i=1}^{n} \sum_{t=0}^{\infty} D_i^t(\vec{p}_i) = S ,$$

If all consuming countries set the same excise tax rate, θ, for all time, then in all periods, $\bar{p}(t) = \frac{p(t)}{1+\theta}$. Thus the monopolists profits in (33) can be rewritten.

$$(35) \quad \frac{1}{1+\theta} \left(\sum_{t=0}^{\infty} p(t) \left(\sum_{i=1}^{n} D_i^t(\vec{p}_i) \right) \left(\frac{1}{1+r} \right)^t \right)$$

Since $p(t)$ is a one-to-one function of $\bar{p}(t)$, we can view the monopolist as choosing $p(t)$ so as to maximize (35). But then it is apparent from the form of (35) that the profit maximizing level of $p(t)$ is independent of θ. Therefore we have the result that the level of a constant excise tax uniformly imposed in all countries has no effect on the price paid by consumers for oil. Since $\bar{p}(t) = \frac{p(t)}{1+\theta}$, we see that almost all of the monopolist's profits can be taxed away by the consuming countries if they choose θ sufficiently high.

In the interest of brevity, we omit the general analysis of noncooperative consuming nations and a nonopolistic supplier. It is worth noticing, however, that in the special case of constant demand elasticity, as remarked by Stiglitz (1976) a monopoly prices in the same way as do competitors. It is not hard to show in this case that the non-cooperative equilibrium in excise taxes is the same as in the competitive case.

Section IV - Comparing actual and "equilibrium" excise taxes.

It is of interest to attempt empirical estimates of the responsiveness of world price and domestic price to an excise tax imposed in various countries.

With these estimates we can check to see whether existing excise tax rates approximate the non-cooperative equilibrium rates. From equation (32) we see that the numbers needed in order to make such estimates are the shares of the world's total oil consumption consumed and produced in the country of interest, and the long run elasticity of demand for oil in each country. We make these estimates for the year 1977, the most recent year for which we have data.

Pindyck (1979) estimates the long run price elasticity of demand for petroleum products to be about -1 in all countries. Most other estimates place this number closer to -.5. If we use current shares of production and consumption as proxies for long run shares, we can make estimates both for the case $\xi_i^* = -1$ for all i and $\xi_i^* = -.5$ for all i. These results are summarized in Table 1. $\underline{1/}$

In Table 2 we report actual excise tax rates on gasoline and on distillate fuel oil. It is not appropriate, however, to treat the entire tax on gasoline as an excise tax since governments also indirectly subsidize gasoline consumption by financing roads. To account for this effect, we calculate a net tax on gasoline which is the difference between total road user taxes in the country (including fuel taxes, vehicle taxes, vehicle registration fees, etc.) and total road expenditure by local and central government in the country. We then divide net by total taxes and multiply by the gross tax rate reported in column (1) of Table 2 to obtain the net tax rate in column (2). While it is not hard to find reasons to quibble about this procedure, we suggest it as a reasonable first approximation.

Comparing columns (4) and (5) with either column (6) or column (7) suggests that there is at best little relation between actual excise tax rates and the non-cooperative equilibrium optimal taxes. For the United States, the non-cooperative equilibrium tax rate is estimated as approximately 25-50%. While

the tax rate on distillate and the gross tax rate on gasoline are about
27%, the net tax rate on gasoline when one allows for the subsidization of
roads was only about 2%. On the other hand, the non-cooperative equilibrium
tax rate, even for the larger countries in western Europe is less than 10%
while almost without exception they tax both gasoline and distillate at
much higher rates. If, however, one viewed the nine countries of the European
Economic Community as acting cooperatively among themselves and non-cooperatively
with respect to the rest of the world, then their optimal tax rate would be
between 20 and 40%. Examining columns (4) and (5), we see that excise tax
rates for the European countries listed are for the most part higher than 40%.
Japan spent about 40% more on roads than it collected in road user taxes in
1976 and did similarly in earlier years, 1973-1975, for which data is presented.
Thus it is reasonable to suppose that Japan on net subsidizes gasoline consumption
while the optimal tax rate for Japan is almost 10%. On the other hand, Japan
taxes distillate at almost 50%. It is interesting to observe that if the
United States, Japan, and the E.E.C. were to act cooperatively with each other
and noncooperatively with respect to the rest of the world, the optimal tax
rate in these places would be in the range 94-188%, somewhat higher than most
current European tax rates and much higher than U. S. and Japanese rates.

Section V. Some Final Comments

In this paper we have assumed that there is a fixed supply of oil all of which can be extracted at zero cost. An easy extension of our results is to the case where there is a fixed supply of oil all of which can be extracted at some constant positive cost. In this case the arbitrage condition requires that the difference between the price and the extraction cost grow at the rate of interest. Essentially all of the results discussed above extend to this case where the excise tax is held as a constant fraction of the difference between price and extraction case. A more realistic model, however, would have an array of oil deposits which can be extracted at differing costs. Analysis of tax incidence in such a model differs from the constant extraction cost model in much the same way that in a static model tax incidence is different when the supply schedule is not perfectly inelastic. Analysis where there is variable extraction cost raises a number of important issues which we intend to treat in another paper.

On the demand side of the market we have considered two alternative assumptions. One is that the consuming countries act cooperatively, like a monopsonist. The other is that they act non-cooperatively in a way analyogous to Cournot oligopsony. On the supply side we have considered two possible cases. One is where suppliers act competitively and the other is where they act monopolistically. Clearly there remains a good deal of interesting analysis to be done. For example one would like to consider the theory of oligopolists confronting oligopsonists and to consider bargaining theories more subtle than simple non-cooperative equilibrium.

In the construction of this model, we have assumed that the oil purchasing countries are indifferent to the levels and distribution of wealth outside their national borders. We have also ignored military and strategic considera-

tions. Much of the political discussion surrounding "energy independence" for the U.S. suggests that these considerations may in the view of many people dominate the considerations studied here. It has been argued by some that most of the "rents" received by major oil producing nations accrue to a small and extremely wealthy ruling class. Such concentrated wealth may be used in capricious and dangerous ways, such as in financing international terrorism. Furthermore, the concentration of enormous mineral wealth in a militarily and politically unstable portion of the world is extremely tempting to potential invaders and increases the likelihood of war. To the extent that an excise tax on oil consumption reduces the rents accruing to oil deposits, these pressures are reduced.

There has been a good deal of recent discussion about a proposal to impose a federal excise tax of $.50 per gallon on gasoline consumption in the U.S., with the revenue thus generated used to lower other taxes. Having warned the reader of many reasons to view our estimates of optimal tax rates are extremely crude, it is still hard to resist evaluating this proposal according to our estimates. According to our estimates the optimal tax rate for the United States if it acts noncooperatively with other consuming countries in somewhere between 25% and 50% of the pre-tax price. As of this writing gasoline prices in the U.S. exceed $1 per gallon. When one allows for the government subsidy of highways, gasoline currently is essentially untaxed. Therefore our estimates would suggest that currently an optimal tax rate for the U.S., acting non-cooperatively, might be on the order of $.25 to $.50 per gallon.

Table 1

Computing Equilibrium Tax Rates

Country i	(1) Domestic Consumption in 1977 (millions of barrels)	(2) Domestic Production in 1977 (millions of barrels)	(3) Domestic Consumption as a share of world consumption	(4) $\frac{1+\Theta_j}{P_j}\frac{dp_j}{d\Theta_j}$	(5) "Equilibrium" tax rate Θ_j^* if $\xi^* = -1$	(6) "Equilibrium" tax rate Θ_j^* if $\xi^* = -.5$
U.S.	6,727	3,009	.30	.70	.24	.48
Japan	1,874	4	.08	.92	.09	.18
Germany	1,035	39	.05	.95	.05	.10
France	815	8	.04	.96	.04	.08
U.K.	686	271	.02	.98	.02	.04
Italy	720	7	.03	.97	.03	.06
European Economic Community	3,899	338	.175	.825	.21	.42
US + Japan + EEC	12,490	3,351	.56	.44	.94	1.88

Source: Columns (1), (2) and (3) are taken from Table 6 of the
International Petroleum Annual 1977 published by the
United States Dept. of Energy, Energy Information Administrator
Column (4) is computed using equation (27) of text. Columns (5) and (6) are computed from equation
(32) of text.

Table 2

Actual and "Equilibrium" Tax Rates (1977)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country	tax on regular gasoline in $ per gallon		tax on distillate #2 fuel oil in $ per gallon	Θ_j = actual net tax divided by pretax retail price		Θ_j^* $\xi = -1$	Θ_j^* $\xi = -.5$
	gross	net		gasoline	distillate		
*U.S.	.13	.01	.13	.02	.27	.24	.48
*Japan	.61	negative	.29	negative	.47	.09	.18
Germany	.73	.13	.35	.21	.53	.05	.10
France	1.02	.48	.55	.73	.50	.04	.08
U.K.	.64	.40	.04	.78	.07⁻	.02	.04
Italy	1.48	.93	.19	1.63	.43	.03	.06

*Figures are for 1976

Source: Columns (1), (3), (4) and (5) are taken from Table 15 of the International Petroleum Annual, 1977, published by the U.S. Dept. of Energy - Energy Information Administration.
Column (2) is computed from column (1) and data on government road expenditure and road user taxation found in World Road Statistics, 1978, International Road Federation, Washington D.C. Tables X and Xl.
Columns (6) and (7) are taken from columns (5) and (6) of Table 1.

Footnotes

1/ Our estimates of the long run shares of world oil consumption consumed in

a country and produced in a country are actual 1977 shares. This of course is

not entirely appropriate. The condition in equation (32) states equilibrium

tax rates as a function of consumption and production shares when equilibrium

excise tax rates are charged. Since current excise tax rates in the U.S. are

lower and in western Europe are higher than equilibrium rates, we would expect

that in equilibrium, the U.S. share of world consumption would be lower and

European shares would be higher than is currently the case. Also, currently

the U.S. produces about 15% of the world's oil but the U.S. has only about 4%

of the world's proven reserves. (These figures come from the Oil and Gas Journal,

Dec. 1978). Therefore we might reasonably expect that in the long run the

relative U.S. contribution to world supply would be lower than it currently is.

These two considerations operate in opposite directions. While it is possible

to make reasonable adjustments on both accounts, we resist the temptation to

do so here.

References

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