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Notes and Communications

THE PRICING OF PETROLEUM PRODUCTS IN PAKISTAN

MIA A. M. de KUIJPER*

I. INTRODUCTION

In Pakistan the prices of petroleum products are set by the government, to raise revenues, stabilize prices, and achieve redistributional and social objectives. But in addition to these benefits, governmental taxes and subsidies for petroleum products result in losses in economic efficiency through the misallocation of resources. How do the benefits compare with these losses? Are revenues raised in a manner that minimizes economic waste? Do the subsidies achieve equity or other social benefits at minimum cost?

Each of these questions can be answered relatively easily in theory. But in practice the answers are difficult to obtain. In 1979, when this research was undertaken, even the magnitudes of taxes and subsidies were not known by the responsible policy-makers. This ignorance is understandable, for, as described in Part II, the structure of petroleum prices is quite complex. The identification of the funds flowing in and out of the petroleum sector required new research, which is reported in Part III.

Part IV applies elementary economic analysis to estimate the effects of these various pricing methods and overlapping grant and tax programmes on the prices of petroleum projects. I calculate the estimated effective taxes (subsidies), total tax revenues (subsidy costs), and losses in economic efficiency for six products for 1977-78 and 1978-79. These six products are: motor spirits (M.S.), high-octane blending compound (H.O.B.C.), kerosene (S.K.), high-speed diesel (H.S.D.), light diesel oil (L.D.O.) and fuel oil (F.O.).

* Miss Kuijper wrote this Note when as a Research Scholar at Harvard, she visited the Pakistan Institute of Development Economics from May to August 1979 on a Ford Foundation Scholarship.

In part V it is shown that the effective taxes (subsidies) are far removed from those that would minimize economic inefficiency given certain revenue or equity objectives of the government. The consequences of these deviations are illustrated with some practical examples of misallocation of resources.

This exercise in applied economic analysis should be of interest not only to policy-makers in Pakistan's petroleum sector, but also to others interested in the application of relatively simple techniques for the estimation of effective taxes and subsidies.

II. THE PRICING SYSTEM

It is practically impossible to tell whether petroleum products are taxed or subsidized by merely looking at their official price structures. Because there are so many stages at which (taxes) subsidies can creep in, their net effect is hard to gauge.

The Directorate of Oil Operations of the Ministry of Petroleum and Natural Resources does not just determine the final retail prices. Instead, this agency sets the level of ex-refinery prices, custom and excise taxes, an "inland freight margin", "distributor's margin", "dealer's commission", and a "development surcharge" for products refined from domestic or imported[1] crude, as well as for products imported in refined form. An illustration of the price structure is given in Table 1.

Table 1

The Price Structure of Petroleum Products on 1.1.1979

At: 1-1-79	Ex-Refinery Price	Excise, Customs	Inland Freight	Distrib. Margin	Dealers' Margin	Development Surcharge	Fixed Price
M.S.	1.607	.88	.09	.078	.055	.49	3.20
H.O.B.C.	1.899	.88	.11	.066	.055	.79	3.80
Kerosene	.765	–	–	.035	–	.08	.89
H.S.D.	1.049	.25	.08	.029	.022	.13	1.56
L.D.O.	.763	.04	.12	.027	–	.15	1.04
Fuel Oil	625.100	35.20	43.31	16.810	–	79.58	800.00

Source: The Directorate of Oil Operations.
Note: The prices are in Rupees per litre except for fuel oil whose price is expressed in Rupees per Metric Ton.

[1] About 10 percent of distillate consumption in 1977–79 came from domestic oil resources.

The *ex-refinery price* is the price at which refineries can sell their product to the marketing companies, and the price at which importers can sell the distillates in the Pakistani domestic market. The ex-refinery prices were below the average import prices, except for H.O.B.C. (Table 2).

Table 2

A Comparison of Ex-Refinery and Import Prices

	Ex-Refinery Prices 77-78		Import Prices 77-78	Ex-Refinery Prices 78-79		Import Prices 78-79
	July 1, 77	Jan. 15, 78	Average 77-78	June 26, 78	Jan 1, 79	Average 78-79
M.S.	1.207	1.407	1.501	1.407	1.467	2.015
H.O.B.C.	1.549	1.699	1.098	1.699	1.759	1.215
S.K.	.707	.705	1.076	.705	.765	1.225
H.S.D.	.996	.996	.986	.999	1.049	1.148
L.D.O.	.703	.703	.904	.703	.763	1.060
F.O.	500.0	500.0	724.3	592.1	625.10	892.0

Source: Interviews with officials from the Directorate of Oil Operations, and the Energy Resource Cell, Ministry of Petroleum and Natural Resources; and foreign trade account.
Note: The prices are in Rupees per litre except for fuel oil for which prices are given in Rupees per Metric ton.

The *inland freight margin* is the part of the freight costs incurred by the oil-marketing companies that they are allowed to pass on to the final consumers. This freight margin does not cover total transport costs as can be seen from Table 3.

Table 3

Inland Freight Margin Versus Actual Freight Costs

Product	Inland Freight Margin	Actual Average Transport Cost
M.S.	.90	.12
H.O.B.C.	.11	.19
Kerosene	.13	.18
H.S.D.	.08	.21
L.D.O.	.12	.20
Fuel Oil	43.31	223.69

Source: Ministry of Petroleum and Natural Resources. Directorate of Oil Operations.
Note: The prices are in Rupees per litre except for fuel oil for which prices are expressed in Rupees per Metric Ton.

The *distributors' margin* accrues to the marketing companies. The *dealers' commission* on H.O.B.C., M.S. and H.S.D. accrues to pump dealers.

The *development surcharge* is levied on the marketing companies. The government thinks of the development surcharge as an instrument to stabilize prices, by offsetting fluctuations in import prices or cost of transportation and distribution with variations in the development surcharge.

From this description it is apparent that taxes and subsidies enter a product's price at various stages. But it is not clear whether these add up to a net tax or subsidy.

III. SUSTENANCE OF THE PRICING SYSTEM

It is also not quite clear whether this pricing system results in a positive or negative tax cash flow for the government. The Directorate of Oil Operations interprets the positive balance on the development surcharge account as evidence that its pricing system is self sustaining and even contributes revenues to the national budget. But this interpretation does not take account of those grants that fall outside the responsibility of the Directorate but, nevertheless, are necessary to maintain the price structure.

The government does collect sizable taxes in the form of development surcharges. But these funds are used to reimburse the marketing companies for the difference between import costs and ex-refinery prices or, as they are called in the Budget, the "High Cost of Imports of Refined Petroleum Products" (Table 4).

Table 4

Development Surcharge Receipts and Disbursements

(Million Rupees)

Years	Gross Receipts	"High Cost of Imports" Refunds	"Inland Freight Deficit" Refunds	Other Refunds	Net Receipt
1976-77	733	175	152	70	336
1977-78	810	267	260	30	253
1978-79	1204	422	340	30	412
1979-80 (budget)	1428	567	340	205	316

Source: [4].

Transport costs over and above the "inland freight margin" are also paid to the marketing companies out of development surcharge receipts. These funds are allocated in the Budget under the heading "Inland Freight Deficit" (Table 4).

In recent years, refunds for import costs and transportation costs did not consume all the development surcharge fund. The refunds amounted to 65 percent of the fund. But besides the development surcharge allocations, the government had to give significant other grants to sustain the pricing system. For instance, the government guarantees the refineries a 15–20 percent profit, even though the ex-refinery prices do not at times cover the refineries' costs. This gap is closed with "Contributions to Refineries", general revenue funds transferred by a "Non Development Appropriation" to the Ministry of Natural Resources, which then allocates it to refineries (Table 5, column 5).

Table 5

Net Government Receipts from Petroleum Companies

(Million Rupees)

Fiscal Year	Gross Receipts	Refunds*	Net Receipts	Constribution to Refineries	Development Expenditure	Net Receipts from Petroleum Co.
1	2	3	4	5	6	7
1972-73			119.8	n.a.	n.a	n.a
1973-74	n.a	n.a.	22.9	174.7		= –151.8
1974-75			71.9	258.2		= –186.3
1975-76			352.4	248.1		= +104.3
1976-77	732.7	396.5	336.5	61.7		= +279.9
1977-78	810.0	557.0	253.0	305.4	489.0	–541.4
1978-79	1203.7	792.0	411.5	295.6	593.0	–477.1
1979-80 (budget)	1427.5	1111.5	316.0	481.0	n.a.	= –165.

Source: [4].
*See Table 4.

Refineries and oil exploration companies are also supported in their capital outlays with "Development Expenditure" grants which amounted to Rs. 489.0 million in 1977-78 and Rs. 593.0 million in 1978-79, (Table 5, column 6). When these grants are taken into account the cash tax flow to the government has been negative in a number of fiscal years (Table 5, column 7).

IV. EFFECTIVE TAXES AND DEADWEIGHT LOSSES

Effective Taxes

After this discussion of the price system and the funds that support it, it is not obvious what tax (or subsidy) results for any particular product. In this section we attack this question by comparing the actual price charged to consumers with a constructed price that we call "economic value". This price is an approximation of the efficient price or true opportunity cost of the distillates as they are sold to customers in Pakistan. To construct this price, we start with the import price (export price in the case of furnace oil) of the oil product. Each litre consumed in Pakistan represents either additional imports or foregone exports. For a small country like Pakistan, the elasticity of supply of crude oil and distillates will be infinite. Consequently, marginal costs equal average costs. Therefore, the marginal cost of a litre of distillate can be estimated by the average price paid which can be calculated from customs and balance-of-trade accounts. By adding to this price the costs of getting the distillate from the port to the point of distribution to consumers (the true average freight costs, distributor's and dealer's margins), we obtain the economic value (EV) (Table 6)[2]. The difference between this economic value and the fixed price charged to customers is the "economic subsidy" or "tax" per litre (Δp). Naturally, total tax revenue (R) is then Δp times the number of litres consumed. The tax rate (subsidy rate) is $\theta = \frac{\Delta p}{EV}$. Table 6 summarizes the calculations for six petroleum products: motor spirits, H.O.B.C., kerosene, high-speed diesel, light diesel oil, and furnace oil. Consider an example.

In fiscal year 1978-79, the average fixed price for kerosene was Rs. 0.885/litre. This is the price which must be compared with the economic value of a litre of kerosene. In 1978-79, the average import price for kerosene was Rs. 1.225/litre. To this amount we must add Rs. 0.0346/litre for the distributor's margin and Rs. 0.18/litre for the average cost of transporting kerosene from Karachi to distribution points throughout the country. There is no dealer's commission on kerosene. The economic value of a litre of kerosene at the distribution point, therefore, is Rs. 1.4396. The subsidy per litre, Δp, is Rs. 0.555. The subsidy rate, θ, is $\frac{.555}{1.4396} \times 100 = 38.55\%$. Consumption of kerosene in 1978-79 amounted to $.912 \times 10^9$ litre. Therefore, the economic subsidy was $(.555) \times (.912 \times 10^9) =$ Rs. 506.16 million.

Doing the same analysis for five other petroleum products, we found that in 1977-78 and 1978-79 M.S., H.O.B.C. and H.S.D. carried an economic tax and that S.K., L.D.O., and F.O. were subsidized (Table 6 and Figure 1). In 1977-78 the total economic tax on the six products was Rs. 382 million, but in 1978-79 this fell to a Rs. 73 million. The decrease in the kerosene subsidy and H.S.D. and M.S. taxes was largely due to the rise of the import prices of these products.

[2]These average transport and distribution costs probably are not equal to marginal costs as marginal, that is, new customers are probably more remote than current customers.

Table 6
Summary of Economic Values, Taxes and Subsidies, 1977-78 and 1978-79

	Average Import Price[1,2]	Distributor's Margin[1]	Dealer's Margin[1]	True Freight Cost[1,3]	Economic Value[1] EV	Actual Average Fixed Price[1], AP	Economic Tax[1,4] $\Delta P = EP - AP$	Economic Tax Rate, $\theta = \frac{\Delta P}{EV}$	Consumption, X[5] (litre$\times 10^6$)	Total Tax $R = \Delta P \times X$ (Rs.$\times 10^6$)
1977-78										
M.S.	1.50	.08	.06	.11	1.75	2.72	−.97	−.56	465	−453
H.O.B.C.	1.10	.07	.06	.18	1.40	3.29	−1.89	−1.36	137	−260
Kerosene	1.08	03	-	.17	1.28	.88	.40	.31	798	317
H.S.D.	.99	.03	.02	.20	1.23	1.40	− .17	− .14	1631	−274
L.D.O.	.90	.03	–	.19	1.12	.88	.24	.21	337	79
Fuel Oil	724.30	16.81	–	208.07	949.18	600.00	349.18	.37	.559	209
Total										−382
1978–79										
M.S.	2.02	.08	.06	.12	2.27	3.10	− .83	− .37	507	− 422
H.O.B.C.	1.25	.07	.06	.19	1.56	3.70	−2.14	−1.37	150	− 321
Kerosene	1.22	.03	–	.18	1.44	.86	.56	.39	912	506
H.S.D.	1.15	.03	0.2	.21	1.41	1.48	− .07	− .05	1830	− 130
L.D.O.	1.06	.03	–	.20	1.29	1.00	.32	.25	293	93
Fuel Oil	892.00	16.81	–	223.70	1132.50	750.00	382.50	.34	.525	201
Total										− 73

[1]Units are Rs. /litre, except for fuel oil, for which units are Rs./metric ton.
[2]For fuel oil: average export price.
[3]Average Cost. *Source:* Directorate of Oil Operations.
[4](−) indicates an economic tax, (+) an economic subsidy.
[5]Except for fuel oil, for which the units are: M.T. $\times 10^6$.
All numbers were rounded to two decimal places.

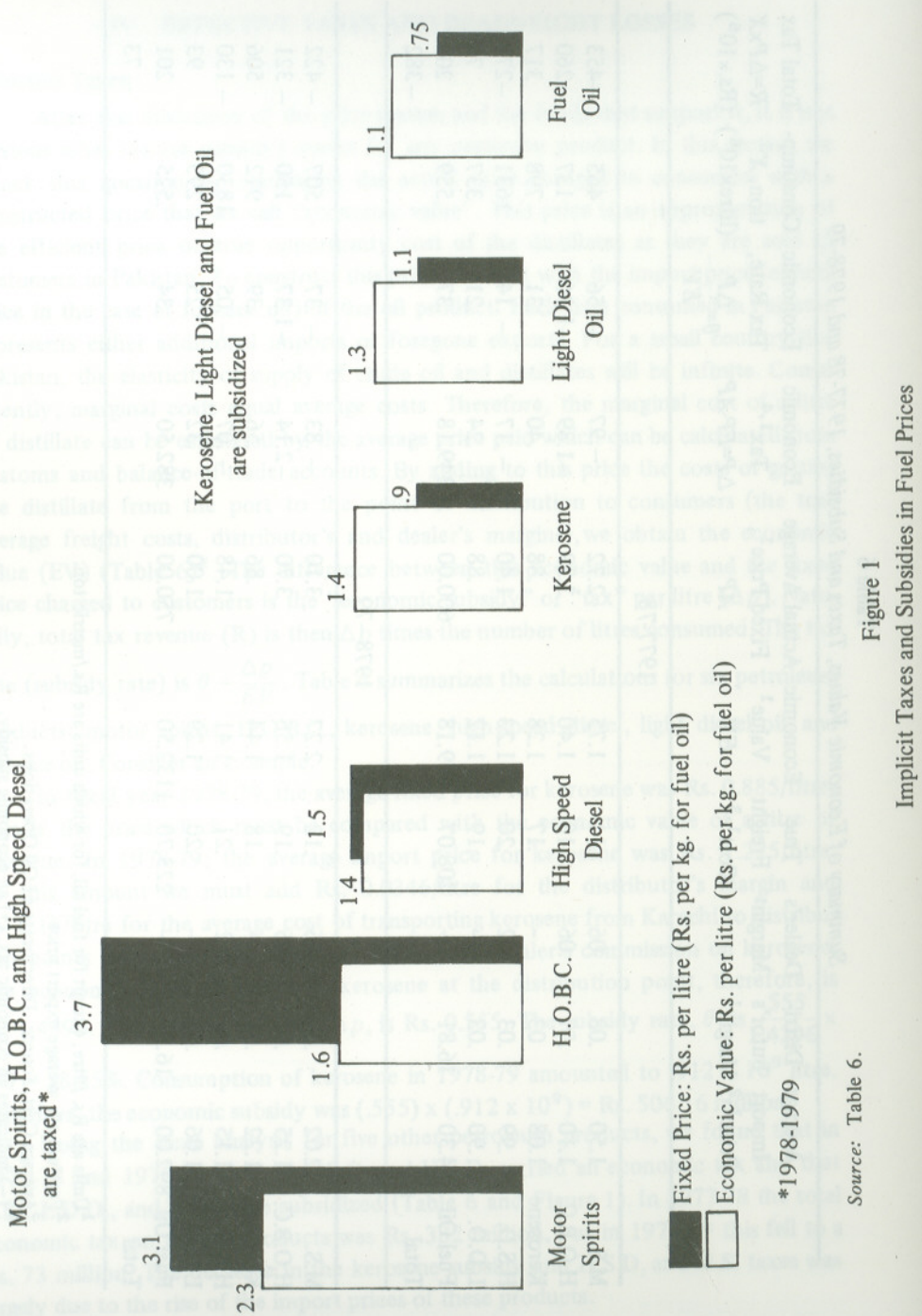

Figure 1
Implicit Taxes and Subsidies in Fuel Prices

Source: Table 6.

Deadweight Losses

The taxes and subsidies as were just measured do not capture all the economic costs, because any tax (subsidy) also causes a deadweight loss. This concept measures the difference between the total loss of welfare (or the economic cost) of a tax (subsidy) as it is actually imposed and the loss which would result if the same tax revenue had been collected without distorting economic decisions in the private sector.

In the case of a subsidy, the deadweight loss is the difference between the cost of providing the subsidy and the amount by which consumers become better off because they consume more of the good when it is subsidized. Similarly, in the case of a tax, the deadweight loss is the difference between the tax revenue raised and the amount by which consumers become worse off because they consume less of the good when it is taxed. This is illustrated in Figure 2.

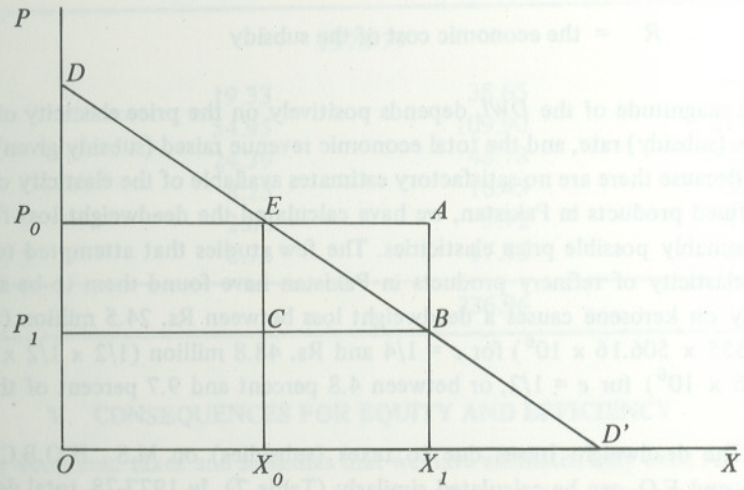

Figure 2

Changes in Prices and the Deadweight Loss

DD' is the demand curve for good X. Assume that P_0 is the constant economic value of the good but that P_1 is actually charged. The economic subsidy is therefore $\Delta P = P_0 - P_1$. At P_0, consumption is X_0. Consumer surplus is approximately $P_0\,ED$. At P_1 consumption is X_1. Consumer surplus then is approximately $P_1\,BD$. The cost of the subsidy is $R = \Delta P \cdot X_1 = P_0 P_1\,BA$. The increase in consumer surplus is $P_0 P_1 BE$. The

difference, $1/2\,\Delta P.\,\Delta X$, or the triangle EAB, is pure economic waste, a deadweight loss (DWL)[3]. Rewriting,

$$DWL = 1/2\,\Delta X \cdot \Delta P$$

$$= 1/2\left[\frac{\Delta X}{X} \cdot \frac{P}{\Delta P}\right]\cdot\left[\frac{\Delta P}{P}\right]\cdot\left[\Delta P \cdot X\right]$$

$$= 1/2\; e \cdot \theta \cdot R$$

where: $e = \dfrac{\dfrac{\Delta X}{X}}{\dfrac{\Delta P}{P}}$ = own price elasticity of demand

θ = the rate of subsidy $\dfrac{\Delta P}{P}$

R = the economic cost of the subsidy

So the magnitude of the DWL depends positively on the price elasticity of demand, the tax (subsidy) rate, and the total economic revenue raised (subsidy given).

Because there are no satisfactory estimates available of the elasticity of demand for refined products in Pakistan, we have calculated the deadweight loss for a range of reasonably possible price elasticities. The few studies that attempted to measure price elasticity of refinery products in Pakistan have found them to be small. The subsidy on kerosene causes a deadweight loss between Rs. 24.5 million ($1/2 \times 1/4 \times 0.3855 \times 506.16 \times 10^6$) for $e = 1/4$ and Rs. 48.8 million ($1/2 \times 1/2 \times 0.3855 \times 506.16 \times 10^6$) for $e = 1/2$, or between 4.8 percent and 9.7 percent of the subsidy itself.

The deadweight losses due to taxes (subsidies) on M.S., H.O.B.C., H.S.D., L.D.O. and F.O. can be calculated similarly (Table 7). In 1977-78, total deadweight loss for these six products, assuming a price elasticity of one-half, was Rs. 209 million for a total economic tax revenue of Rs. 382 million. In 1978-79, to collect economic tax revenue of Rs. 73 million, Rs. 237 million were wasted.

The loss of economic efficiency has been considerable relative to the size of the economic subsidies and taxes. This raises the question of how "optimally" these taxes (subsidies) have been set, which is considered in Part V.

[3]For a discussion of the appropriateness of computing consumer surplus and deadweight loss in this fashion, see [6].

Table 7

Deadweight loss for a Range of Price Elasticities

(Million Rupees)

	$e = \frac{1}{4}$	$e = \frac{1}{2}$	$e = 1$
	1977-78		
M.S.	31.57	63.15	126.29
H.O.B.C	44.03	88.06	176.11
S.K.	12.34	24.67	49.34
H.S.D.	4.68	9.37	18.73
L.D.O.	2.11	4.23	8.45
F.O. (M.T.)	9.63	19.25	38.50
Total		208.73	
	1978-79		
M.S.	19.33	38.65	77.30
H.O.B.C.	54.95	109.90	219.80
S.K.	24.39	48.78	97.56
H.S.D.	8.23	16.45	32.90
L.D.O.	2.86	5.72	11.44
F.O. (M.T.)	8.73	17.46	33.92
Total		236.96	

V. CONSEQUENCES FOR EQUITY AND EFFICIENCY

The economic taxes and subsidies that we have estimated may exist for various reasons. They may have developed unintentionally over time. Because of the opaqueness of the price and grant system one could lose track of economic taxes. For example, officials of the Ministry of Petroleum and Natural Resources were surprised to find that the H.S.D. was effectively taxed rather than subsidized. In general, however, taxes and subsidies were intended to provide tax revenue, to help the poor (the subsidy on kerosene), to encourage the use of tubewells for irrigation (subsidy on L.D.O.), or to stimulate industry (subsidy on furnace oil).

We will examine how "optimal" [1; 5] the actual economic taxes (and subsidies) have been: that is, how similar they have been to taxes (subsidies) that minimize economic waste for a particular level of revenue to be collected or social objective to be achieved.

If the objective is to simply raise revenue, optimal taxes on any number of goods should be inversely proportional to their own price elasticity. The closer substitutes two products are (i.e. the more positive their cross price elasticity of demand) the less the tax rates on those two products should differ.

During 1977–79, taxes on the six products had not been set optimally for the objective of raising revenue, because they are all substitutes to a certain degree. Especially, kerosene is a close substitute for H.S.D., L.D.O. and motor spirits, particularly if it is mixed with any of these products. So, if the only objective of the pricing system had been to raise revenue, the taxes on these close substitutes should not have been too different. Instead, in 1977-78 and 1978-79, there were economic *taxes* on M.S. (55.88% and 36.7%), H.O.B.C. (135.7% and 136.7%) and H.S.D. (13.6% and 5.1%) and *subsidies* on S.K. (31.1% and 38.5%), L.D.O. (21.2% and 24.6%) and F.O. (36.8% and 33.8%) (Table 6). Table 8 shows that over the last ten years the effect of the pricing policy has been to drive the prices of substitutes apart.

Table 8

The Development of the Fixed Prices of Kerosene, Motor Spirits, H.S.D. and L.D.O., 1969–79 (Indices of Current Prices; 1969 = 100)

Date	Kerosene	Motor Spirits	H.S.D.	L.D.O.
January 1969	100	100	100	100
1970	100	100	100	100
1971	100	100	100	100
1972	124	138	128	124
1973	124	164	128	124
1974	186	237	213	266
1975	248	276	234	283
1976	248	315	255	283
1977	249	334	271	319
1978	282	382	319	335
1979	353	431	372	451

The clearest example of the resulting misallocation of resources is the widespread incidence of adulteration. Although the true extent of adulteration is unknown, estimates within the Petroleum and Natural Resource Ministry range as high as 200,000 litre of kerosene or 22% of total kerosene consumption in 1978-79.

The incentives to adulterate can be illustrated with the simple example shown in Table 9. In the case of adulteration of H.S.D. with kerosene, for the owner of a car the losses in terms of fuel efficiency and the costs of keeping a vehicle in good operating condition far outweigh the benefits of lower fuel costs per litre. So a driver will not adulterate unless he is not aware of the increased maintenance costs, or unless he does not own the car and can in some way cheat the owner by adulterating the fuel. Pump-dealers are the ones who unambiguously gain from adulteration.

Table 9

*Costs and Benefits of Adulterating H.S.D. with Kerosene**

Fuel	Fuel Cost (Rs/km)	Maintenance Cost over 15000 km (Rs/litre)**	Total Operating Cost (Rs/km)
H.S.D.	0.195	0.072	0.267
Mix (50/50) of kerosene and HSD	0.278	0.192	0.470

Source: Crude estimates of adulteration ratios, fuel efficiencies, and engine damages were kindly provided by Awami Autos Limited of Rawalpindi.

*Based on a kerosene price of Rs. 1.0 per litre. and an HSD price of Rs. 1.56 per litre and an HSD fuel efficiency of 8 kms per litre and an 50/50 mixture fuel efficiency of 4.6 km per litre.

**This category does not include all maintenance costs – only those that depend significantly on the fuel grade.

A desire to support a particular group through subsidies on goods leads to a modification of the optimal tax rule. When distributional preferences are to be taken into account, the goods that are heavily consumed by the group which the society wants to benefit are to be taxed relatively less or even subsidized. But if the favoured group only spends a small amount of its income on those goods, or if only a small part of the total supply of those products is consumed by the favoured group, the case for subsidizing (or taxing less heavily) on equity grounds disappears [2]. The Household Income and Expenditure Survey of 1971-72 [3] suggests that this is the case for kerosene. In 1971, the lowest income groups (earning Rs. 50–200 per month) spent only 0.7 percent of their income on kerosene. The subsidies on kerosene which were calculated to cost Rs. 555 million including deadweight loss in 1978-79, most likely did not benefit the poorest for which they were intended. Subsidizing kerosene probably is not the most efficient way to achieve the desired wealth redistribution effect.

VI. SUMMARY

To make trade-offs between economic efficiency and other objectives, policy-makers would presumably benefit from knowing the size of the taxes (subsidies) and excess burdens involved. This information is not always readily available owing to overlapping tax and grant systems and the many agencies involved in determining and administering these.

This paper shows how economic taxes and deadweight losses can be determined relatively easily for petroleum products in Pakistan. The excess burdens were found to be quite large relative to the economic taxes and subsidies. Some net taxes existed without policy-makers being aware of them. Other taxes and subsidies were intended to collect revenue or to achieve some social objectives. But prices have generally not been set optimally to achieve either of these goals. Large differences between prices of substitutes have led to large-scale adulteration. Subsidies on products, at least on the ones that were selected, have not been very cost-effective ways to achieve objectives of income redistribution on mechanization of agriculture.

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