DETERMINANTS OF RATES OF OCTROI TAX IN PAKISTAN

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Octroi is a tax imposed by local governments in Pakistan on commodities imported into the municipal limits for local use, sale or consumption. It is levied generally by urban local councils on goods coming in by all modes - sea, land and air transport. The point of assessment is alongside roads at octroi posts situated at or before municipal boundaries, at railway stations, seaports or airports.

Octroi is currently the largest source of revenue to urban local councils in the country and contributes 86 percent to total tax revenues and over 59 percent to total local revenue receipts (see Table 1). Its revenue significance (in terms of share in total receipts) has increased over the years. In 1987-88. it accounted for about 57 percent of total local receipts. Also. revenue generation from octroi is higher than that by any provincial lax. In 1991-92, total national collection from octroi was Rs 5.5 billion compared to Rs 3.5 billion from stamp duties, the largest provincial tax source.

TABLE 1

REVENUE SIGNIFICANCE OF OCTROI [For all Urban Local Councils Combined]

Year	Octroi Revenue [Rs. in million]	Share in Total Revenue [%]
1987-88	2892	57.2
1988-89	3185	57.4
1989-90	3906	58.5
1990-91	4659	59.0
1991-92	5466	59.6

SOURCE: National Centre for Rural Development Data Base.

Despite its obvious revenue importance, octroi remains a controversial tax, and has been subjected to a series of criticisms. Important among these arc that it is regressive in its income distributive effects, inelastic and inefficient [Karachi Master Plan (1974)]. Some work has been done to show that the former two may. to some extent, be valid. Pasha et. al. (1988) and Iqbal (1986) suggest that the incidence of octroi collected from land posts tends towards regressivity. Similarly. Pasha ct. al. (1988) Iqhal (1986). Ghaus and Pasha (1989) show that this component of octroi has limited revenue claslicily. No formal analysis has, however, been undertaken to establish the efficiency of the tax. The objective of this paper is to see whether octroi is an efficient tax in Pakistan through its adherence to certain principles of

optimal commodity taxation. This involves an analysis of the determinant of octroi rates in Pakistan.

The paper is organised as follows: Section 1 briefly describes the tax as administered in Pakistan. Section 2 discusses the existing octroi rates. Section 3 presents the theoretical framework of the analysis while in Section 4 results of econometric analysis of determinants of octroi rates arc presented. Finally, a summary of conclusions is presented in Section 5.

1. DESCRIPTION OF OCTROI

Octroi is assessed on consignments entering by road and rail transport on the basis of weight in terms of 100 Kilogram units. Flat rates of octroi arc imposed and these rates vary between commodities. However, in the case of sea consignments destined for consumption within the city of Karachi, an ad-valorem system of assessment of octroi with respect to the value of consignment has been in operation since 1972-73.

The largest contribution to octroi revenues is by food items. It ranges from 62 percent of total octroi revenues in the case of town committees to 18 percent in Metropolitan Corporations. In general, octroi in the bigger cities appears to be more broad-based. The dependence of octroi revenues on basic commodities like foods, textiles, drugs, medicines, building material, etc., particularly in the smaller cities implies that the incidence of this component of octroi is likely to be regressive in character. Also, buoyancy of revenues may be low because of the relatively slow growth in demand of basic items like food, clothing, etc. Therefore, it seems that part of the problem of rcgcssivity and inelasticity in the tax arises due to the composition of its tax base.

Municipal Governments have. in general, handed over octroi collection to private contractors. Auctioning of octroi collection to private contractors was introduced in the 70's and had lead to substantial revenue gains to local councils due to stricter supervision of octroi collection.

2. EXISTING OCTROI RATES

The presence of a specific rate octroi structure implies, that in the absence of discretionary changes in tax rates, revenues respond only to changes in quantities and not to a rise in prices of goods imported into municipal limits. Local governments have, therefore, attempted to preserve the growth of revenues by periodically escalating rates to, at least partially, reestablish the link with prices. However, the strategy has been small, across-lhe-board rate

escalations. The consequence is that octroi rates are very low compared to the price of commodities and there appears to be a certain degree of ad-hocism in the structure.

Table 2 presents the average effective octroi rates [EOR] for a sample of twenty three cities in Pakistan for 89 commodities which account for bulk of octroi revenues. EOR is defmeds as the specific rate as percentage of the price. The table shows that EORs are very low, at about 0.3 percent, of the wholesale consumer prices. A large proportion of items, about 37 percent, in the octroi schedule have EORs of less than 0.3 percent. 38 percent of commodities have rates in between 0.31 to 0.5 percent while only about one-fourth of the commodities have rate equivalent to more than 0.5 percent of the price.

TABLE 2

EFFECTIVE OCTROI RATE* IN PAKISTAN"

Effective Rate (EOR)	% of Commodities*** in the Octroi Schedule
0-0.10%	2.3
0.11 -0.20%	15.1
0.21 -0.30%	19.8
0.31 - 0.40%	25.6
0.41 - 0.50%	12.8
0.51% and above	24.4
TOTAL	100.0
AVERAGE RATE	0.31%

$$\text{* Effective Octroi Rate} = \frac{\text{Specific Octroi Rate}}{\text{Consumer/Wholesale Price}} \times 100$$

**For a sample of 23 cities
*** for 86 Commodities in the Schedule

Also. octroi rates vary significantly by type of commodity as shown in table 3. Commodity groups with the lowest octroi rates arc consumer durables with the average EOR of 0.26 percent. As opposed to this food and drinks arc among the highest octroi rate category with an average EOR of about 0.35 percent. EOR on sugar is 0.91 percent, on salt 0.71 percent while on consumer durables like refrigerators, air conditioners, cars it ranges from 0.1 percent to 0.45 percent. Therefore, there are initial indications of existence of fiscal anomalies in the octroi structure which may exacerbate the regressivety of the tax incidence, reduce its buoyancy and may have an impact on the efficiency of the tax. We next turn to a

formal analysis of determinants of octroi rates.

TABLE 3

**AVERAGE EFFECTIVE OCTROI RATES
BY TYPE OF COMMODITY**

Type of Commodity	Average Effective Octroi Rate (%)
Consumer Goods	0.30
Food and Drinks	0.35
Consumer Durables	0.26
Others	0.25
Raw Materials/Intermediate Goods	0.36
Capital Goods Overall Average	0.36 0.31

3. THEORETICAL ANALYSIS OF DETERMINANTS OF OCTROI

Analysis of optimal octroi rates can potentially be undertaken by application ofRamsey [1927] type of principles of optimal indirect taxation. The technical analysis is presented in the Appendix to the paper. It appears that the basic choice for municipal governments between octroi taxation of imported consumer goods or intermediate goods depends upon their relative concern for the impact on residents' welfare via taxation of consumer goods versus the impact on profits (and employment) of taxation of intermediate goods. The theoretical framework developed by us enables a formal analysis of the dcierminar.ls of the relative effective rates of octroi on consumer and intermediate goods respectively. Some of the principal conclusions which emerge from the theoretical analysis of the determinants of optimal octroi rates are as follows:

(1)   If local councils arc relatively more concerned about the impact of octroi rates on profitability of industry and trade within the city than on utility levels of residents arising from their consumption of goods, they arc more likely to have lower octroi tax rates on intermediate goods than on consumer goods. This. of course, hinges on whether changes in the rates arc seen as local or global in character. In the latter case, impact on profitability of industry will be less.

(2)   Given a certain revenue target, the level of octroi rates depends on the size of tax base. Councils where imports of consumer or intermediate goods are high in relation to resident income will have lower tax rates, other things being equal.

(3)   If the price elasticity of demand for imports of consumer goods is higher then tax rates for such goods would tend to be lower, other things being equal. The same conclusion applies in the case of intermediate goods.

(4)   If the revenue target of octroi is higher then, other things being equal, tax rates on both consumer and intermediate goods will be higher.

Econometric analysis has been undertaken of octroi rates in a sample of councils to determine their degree of consistency with the theoretical principles enunciated above.

4.   EMPIRICAL RESULTS

Given the qualitative nature of some of the above factors and data limitations the impact of some of these factors on octroi rates have been captured through the use of dichotomous variables and proxies. Dummy variables for each type of good (basic consumer goods/luxury consumer good/intermediate goods/capital good) and different types of local councils (metropolitan corporation/municipal corporations/municipal committees/town committees) have been used. The latter is used to capture tlie impact of the si/.c of the tax base on rates alongwith per capita industrial value added since a major component of octroi tax base consists of industrial import.

The criterion related to economic efficiency implies that. other things being equal, lower octroi rates should be specified on those commodities import demand for which is relatively price elastic. Price elasticities for major food and on-food items in the urban areas of Pakistan have been estimated by Tariq (1994). As expected these price elasticities are, by and large, low for most food items.

Analysis of the recent data on national imports and the income elasticity of demand of different commodities has been undertaken to rank different commodities in terms of the buoyancy of demand. Income elasticity of major food and non-food items has been estimated by Tariq (1994) using a linear expenditure system. The study shows that broadly speaking income elasticity of major food items in urban areas ranges from 0.2 to 2.0. Some of the high income elasticity items include bakery products, poultry, fruits, butler and coffec/ovaltine etc. Dummy variables have also been used to see if there are inter-provincial differences in octroi rates.

Based on the above the following equation has been specified.

$$RATE_{ij} = \beta_0 + \beta_{1K}MTYPE_{Kj} + \beta_2 PE_i + \beta_3 IE_i + \beta_{4L}PROV_{Lj} + \beta_{5M} MSTAT_{Mj}$$
$$+ \beta_6 PRICE_{ij} + \beta_{7K}PTYPE_{Kj} + \beta_{8L}PROV_{Lj} + \beta_{9M} PMSTAT_{Mj} + \beta_{10} PCIND_j + \epsilon_{ij}$$

$$K = 1...3 \text{ for type of goods}$$
$$L = 1...3 \text{ for provinces}$$
$$M = 1...3 \text{ for type of municipal status}$$

where;

RATE,,	: The octroi rate on the ' ith' commodity in the 'jth' local council
TYPE,,	- Type of good (basic consumer/luxury consumer/intermediate)
PE,	: Price elasticity of the ' ith' commodity
IE,	-- Income elasticity of the 'ith' commodity
PROV^,	. Province (Balochistan/NWFP/Sindh)
MSTAT,, =	: Type of Local Council (Municipal Corporation/Municipal Committee/ Town Committee)
PRICE,,	: Price of the ith commodity in 'jth' local council
PCIND,	: Per Capita Industrial Value added in the 'jth' city
PTYPE,,, =	: Price of the 'ith' commodity in 'jth' city interacted with 'kth' type of Good.
PROV^,	: Price of the 'ilh' commodity in 'jth' city interacted with '1th' province
PMSTAT^, =	: Price of the 'ith' commodity in the 'jth' city interacted with 'mth' type of municipal status.

Price variable has been interacted to see if effective octroi rates vary by type of good. type of local council and provinces.

The above model has been applied to octroi rates of 86 commodities in 23 cities of varying population size and municipal status.' The results are presented in table 4. The model specified is only able to explain less than half the variation in octroi rates. This indicates that for a large number of items rates diverge significantly than what would be implied on the basis of application of above principles. Some of the key conclusions from the table are as follows:

i)   intermediate goods appear to liavc somewhat lower rates than non-food consumer goods, while the lowest rates arc observed for food items. This indicates that local councils do attach importance, first, to protecting local industry from decline in profitability levels and. second, to insulating lower income groups from the burden of octroi to the extent possible.

ii)   The industrial value added per capita variable has a negative coefficient, as expected. This implies that in municipal jurisdictions where the level of import of intermediate goods is relatively high (because of greater industrial presence) octroi tax rates are lower.

iii) Economic efficiency criteria appear to be implicit in the rate setting and some effort has been made. other things being equal, to specify lower rates for items which have relatively high price elasticity of demand.

iv)   A significant finding is that. other tilings being equal, rates arc lower in the larger

Sample cities include: l.ahorc, Karachi. I'cshawar. (^ucita. Hyderabad, l''aisalabad, Rawalpindi, Sialkot. Bahawalpur. (iiijranwala, Sarpodha, Nawahshah, Charsadda, Kasur, Vehari, Rahim Yar Khan, Shaikhupura, Shabqadar. Raiwind. Manshcra and Shikarpur. Larkana.

TABLE 4

DETERMINANTS OF OCTROI RATES"

Variable	Coefficient	t-statistics
CONSTANT	-0.2186	-0.17
Type of Good [TYPEJ Food Items	2.2223	1.57**
Intermediate goods	4.5600	2.49'
Luxury Consumer Goods	7.3910	3.72*
INCOME ELASTICITY [IE_1]	1.0563	0.61
PRICE ELASTICITY [PE_1]	-2.6100	-1.63**
PER CAPITA INDUSTRIAL VALUE ADDED [PCIND]	-7.69×10^5	-1.11
MUNICIPAL STATUS [$MSTAT_m$]		
Municipal Corporation	0.0002	1.61**
Municipal Committee	0.0003	2.00*
Town Committee	0.0006	2.76*
PROVINCE [PROV,]		
Balochistan	5.9367	2.18*
NWFP	-1.3569	-0.81
Sindh	2.6308	1.87*
$PRICEij_2$	0.0039	10.25*
PRICE ij3	-1.62×10^7	-6.71*
PRICE $_{ij}$	1.68×10^{12}	4.04*
INTERACTIVE $TYPE_1$		
Food Items	-0.0009	-2.72*
Intermediate goods	-0.0013	-3.45*
Luxury Consumer goods	0.0002	1.50
INTERACTIVE $PRICE_{ij}/MSTAI_m$		
Municipal Corporation	0.0002	1.61*
Municipal Committee	0.0003	2.00*
Town Committee	0.0006	2.76*
INTERACTIVE $PROV_1$		
Balochistan	0.0040	15.55*
NWFP	-8.80×10^5	-0.55
Sindh	0.0005	3.84*
CITY-SPECIFIC DUMMIES		
Shikarpur	-9.0127	-4.01*
Rahim Yar Khan	5.3218	2.48*
Sialkot	5.2816	2.47*
No. of Observation	=	1901
R2	=	0.478
F-Stat	=	73.55

[a] Tested for homoskedasticity.
* Significant at 5 percent level
** Significant at 10 percent level

councils and that rates tend to rise with a fall in municipal status, with town committees on the average having the highest rates. This may be a reflection partly of the restricted tax base and partly of lack of access to revenues from property tax which compel local governments in small towns and cities to resort to higher octroi taxation. Similarly, rates arc higher on average in Balochistan, followed by Sindh, Punjab and NWFP. There is evidence that per capita expenditures in Sindh and Balochistan are relatively high fPasha (1986)1. Therefore, higher rates may be necessitated by more ambitious revenue targets.

v)   Local councils do not appear to have major concern for buoyancy of revenues in the fixation of octroi rates. The income elasticity variable does not emerge as significant, although it has the right sign.

vi)   effective rates appear to rise initially with respect to price, then fall and rise again. Also, there appear, be a to minimum flat rates imposed irrespective of the price. This diminishes the neutrality of (he effective tax rate with respect to price.

Altogether, we have the conclusion that while on the average there is broadly some adherence to the principles of optimal indirect taxation in the context of octroi rate setting, there are still large deviations from these principles in the case of a number of commodities. Therefore, rationalisation of the octroi structure will require changes in rates for such commodities which bring them closer to the level predicted by the regression line.   More fundamental restructuring would require changes in the regression equation to more effectively reflect considerations of economic efficiency, equity and buoyancy.

Table 5 indicates commodities where rates at current levels arc 'outliers' in relation to predicted levels. These commodities ought to be targeted first in any efforts at rationalisation of the octroi structure. The list includes consumer durables (like air conditioner, refrigerator, deep freezer, television, etc.), other consumer goods (like cigarettes, milk powder, ready made garments, tea etc.) and some intermediate goods (like bricks, acids, leather, tiles etc.).

5. CONCLUSION

This paper analyses determinants of octroi rates on major commodities for a sample of cities in Pakistan of varying population sizes and municipal status and formulates a judgement on the extent to which norms of optimal indirect taxation have been followed. The results indicates that while octroi rates arc broadly in line with the contours of optimal taxation and vary broadly with respect to prices, nature of good, si/.c of tax bases, municipal status, considerations of equity, buoyancy and minimisation of distortions have not been taken into account adequately. Criteria of fixation of octroi rates, based on norms of optimal taxation are specified and rationalisation of octroi rates accordingly suggested.

TABLLE 5

CANDIDATE COMMODITIES FOR OCTROI RATE RATE RATIONALISATION

S.No.	Name of Commodities	Number of Local Council	Positive Outlier*	Negative Outlier*
1	Air conditioners.	7	7	-
2	Bricks	1	1	-
3	Cigarettes of all kinds	2	2	-
4	Combs, Brushes etc.	1	1	-
5	Commercial acid, sulphuric acid etc.	1	1	-
6	Cotton cloth.	2	2	-
7	Electric Bulbs &. Tubes	2	2	-
»	Hosiery of all kinds.	1	1	
9	Jute Bags etc.	1	1	-
10	Leather	1	1	-
11	Milk powder, glucose, etc.	1	1	-
12	Motorcycle, scooters, etc.	6	6	-
13	Pepper black, etc.	1	1	-
14	Pickles etc.	1	1	-
15	Poultry.	1	1	-
16	Perfumes etc.	6	6	-
17	Ready made garments, etc.	3	2	1
18	Refrigerators & deep freezers.	7	7	-
19	Sewing machine, knitting machine.	1	-	1
20	Shaving Creams & Blades	2	1	1
21	Silk Cloth	1	1	-
22	Tables, Chairs, Sofas etc.	1	1	-
23	Tablets of all kinds	3	3	-
24	Tea.coffee & cocoa etc.	1	1	-
25	Television	^	2	-
26	Tiles & Glazed Tiles	3	3	-
27	Washing machines	5	5	-
28	Woolen Cloth	3	3	-

* An outlier is an observation whose value exceeds the value of other observations 9in the sample by perhaps two standard deviation away from the mean value of all the observations

APPENDIX THEORETICAL FRAMEWORK OF OPTIMAL OCTROI RATES ANALYSIS

The optimal octroi rates problem is set up in the context of a city which is small in relation to the rest of the country/world and, therefore, faces cxogcnously given (metropolitan) border prices. These prices can be enhanced at the point of entry into the city by levy of octroi. The import supply curve is perfectly clastic. In other words, we do not allow for the existence of import quotas.

A. TYPES OF GOODS

Four types of goods are distinguished, as follows:

Imported Consumer Good: This is a composite good of consumer goods imported into the city either internationally or from the rest of the country. It is assumed that these goods are non-competitive in character with respect to production within the city. Such an assumption has been made at the national level hy Ahmcd and Stem 119'^i j. Il seems even more likely in the context of an individual city which is likely to show greater specialisation in its economic activities depending upon locational factors, etc.

Included in this category are food items like wheat (atta), rice. sugar, fruits, tea, vegetables, etc. It is unlikely that a significant quantum of food production takes place within the metropolitan boundaries. Other non-competitive goods could include various types of consumer durables. In additon, if we allow for product differentiation between imports and domestic production then the assumption of the non-competitive nature of imports is likely to be more valid. This category of goods is referred to as good 1.

Imported Intermediate Good: II is also assumed that this a composite good of non-competitive intermediate good imports. Imports of edible oil. POL products, chemicals, building materials, etc., fall into this category. This composite good is defined as good 2

Domestic Consumer Good: This is a composite good of consumer goods produced within the city and partially exported either to the rest of the country or abroad. Textile products, for example, fall into this category. This composite good is referred to as good 3.

Domestic Intermediate Good: This is a composite good of intermediate goods produced within the city and partially exported to the rest of country or abroad. Production of cotton yam may fall into this category in the context of Karachi. This composite good is referred to as good 4,

B. INPUT-OUTPUT RELATIONSHIPS

As a simplifying assumption regarding input-output relationships within the city we assume that only intermediate goods are used in the production of other goods. That is, consumer goods enter final consumption by households only. Therefore, we specify the input-matrix as follows:

	OUTPUT OF	
INPUT OF	Good 2	Good 4
Good 2	$M3_2$	M_{42}
Good 4	M34	M_{44}

The m's arc input-output coefficients.

C. NATURE OF MARKET EQUILIBRIUM For the imported consumer

good the market equilibrium is depicted below:

In the absence of octroi, it may be noticed that initially the import price is normalised to unity. E represents the equilibrium following the imposition of octroi at the rate of $t_,$. M, is the quantity imported and the shaded area is me octroi revenue.

For the domestic consumer good the equilibrium is shown below:
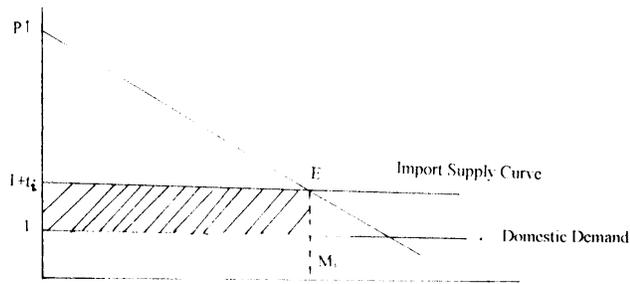
In this case the export price is unaffected by the imposition of octroi at the import stage. There is no octroi revenue directly from such goods as the level of import is zero. The level of export (to the rest of country or abroad) is represented by X,.

Market equilibrium for the domcstically produced intermediate good can essentially be characterised in the same manner as that for the domestic consumer good. In the case of imported intermediate good there is derived demand from production within the city of consumer and intermediate goods.

D. PRICES

As indicated above, in the absence of octroi all consumer/user prices are initially normalised to unity. Octroi is collected only from imported consumer and intermediate goods. We designate the octroi rates as follows:

t_1= octroi rate on the composite imported consumer good

t_2 = octroi rate on the composite imported intermediate good

It may be noted that at this stage we do not allow for any difference in octroi rates between

sea, air and land dues on the same commodity.'

The basic problem is one of determining the optimal magnitudes of t, and t^. In this analysis, we are concerned with the determination of octroi rates only in the case of commodities which are actually imported. The octroi schedules, of course, cover all goods but there is some redundancy in the rate fixation as not all these goods arc imported in any significant quantity.

Given the imposition of octroi, the prices in the city as follows:

	For the Imported Consumer Good	For the Imported Intermediate Good	For the Domestic Consumer Good	For the Domestic Intermediate Good
Type of Price				
Consumer/User Price	$p_1 = 1 + t_1$	$p_2 = 1 + t_2$	1	1
Local Producer Price	..	..	p_3	p_4

where $p_3 = 1 - m_{32} (1 + t_2) - m_{34}$ and $p_4 = 1 - m_{42} (1 + t_2) - m_{44}$.

Therefore, it may be noticed from above that the levy of octroi on imported intermediate good does not affect Local consumers directly. It. however, reduces the profitability of local industry by reducing p, and p4

E. CONSUMER EQUILIBRIUM The process of utility maximisation for the

typical consumer is given by

$$Max \ U \quad U \left(q_1, q_3 \right)$$

subject to $p_1 q_1 + q_3 = y$, where y is essentially treated as an income endowment.

This yields:

$$q_1 = q_1 \left(p_1, y \right)$$

$$q_3 = q_3 \left(p_1, y \right)$$

and $V = V (p_1, y)$ is the indirect utility function.

Applying the envelope theorem to the Lagrangian function we have

$$\frac{\partial V}{\partial t_1} = -\lambda q_1, \quad \text{where } \lambda \text{ is the Lagrangian multiplier and} \quad \lambda = \frac{\partial V}{\partial y}.$$

There are limits to the extent of difference between rates for the same commodity at different posts, otherwise arbitrage will lake place.

It is obvious that $\dfrac{\partial V}{\partial t_2} = 0$.

A levy on imported intermediate good does not affect consumer directly.

F.   INDUSTRY EQUILIBRIUM

The process of profit maximisation in a typical industry is given by:

$$\pi_i = P_i Q_i (K_i, L_i) - wL_i - \tau K_i \qquad i = 3, 4$$

Maximisation of π_i with respect to L_i and K_i with exogenously given w and τ and application of the envelope theorem leads to

$$\frac{\partial \pi_i}{\partial P_i} = Q_i \qquad \text{where } Q_i = S_i(P_i)$$

and S_i is supply by industry i.

Therefore,

$$\frac{\partial \pi_i}{\partial t_i} = Q_i \frac{\partial p_i}{\partial t_i}$$

This leads to

$$\frac{\partial \pi_3}{\partial t_1} = -m_{32} S_3$$

$$\frac{\partial \pi_4}{\partial t_2} = -m_{42} S_4$$

G.   OCTROI REVENUE FUNCTION

The octroi revenue T is given by
$$T = t_1 M_1 + t_2 M_2$$
where $\qquad M_1 = D_1 \qquad$ and $\qquad M_2 = m_{32} S_3 + m_{42} S_4$

H.   SOCIAL WELFARE FUNCTION We assume that elected representatives/officials of ilic

«.'ii.y government arc concerned both

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about the utility level of households (the electorate) living in their jurisdiction and also about the profit level of trade and industry in the city. The relative importance of these two factors depends upon the degree of representation in the house of the local council of different interests.

The utility level of all residents is give by

$$W = \sum_{i=1}^{N} U_i$$

where there are N households in the city. Utilities are assumed to additive in this specification.
The profit level of economic activities in the city is given by

$$\pi = \pi_3 + \pi_4$$

The Social Welfare Function, F, then is given by

$$F = F(W, \pi)$$

F has the properties of a conventional utility function.

From the previous sections we have that

$$\frac{\partial W}{\partial t_1} = \sum_{i=1}^{n} (-\lambda q_1)$$

On the assumption that all households are indentical,

$$\frac{\partial W}{\partial t_1} = -\lambda M_1$$

(Since domestic production is zero)

Of course, $\dfrac{\partial W}{\partial t_2} = 0$

Similarly $\dfrac{\partial \pi}{\partial t_2} = -m_{32} S_3 - m_{42} S_4 = -M_2$
In summary,

$$\frac{\partial W}{\partial t_1} = -\lambda M_1 \quad and \quad \frac{\partial \pi}{\partial t_2} = -M_2$$

I.   THE OPTIMISATION PROBLEM

We are finally in a position to set up the optimisation problem as follows:

$$\mathcal{L}_2(t_1, t_2, \mu) = F(W, \pi) + \mu\left[\bar{R} - t_1 M_1 - t_2 M_2 \right]$$

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where R is the exogenously given revenue target for octroi. The

first order conditions arc.

$$\frac{\partial \mathcal{L}_2}{\partial t_1} = \frac{\partial F}{\partial W} \cdot \frac{\partial W}{\partial t_1} + \mu \left[-t_1 \frac{\partial M_1}{\partial t_1} - M_1 \right] = 0$$

$$\frac{\partial \mathcal{L}_2}{\partial t_2} = \frac{\partial F}{\partial \pi} \cdot \frac{\partial \pi}{\partial t_2} + \mu \left[-t_2 \frac{\partial M_2}{\partial t_2} - M_2 \right] = 0$$

$$\frac{\partial \mathcal{L}_2}{\partial t} = \bar{R} - t_1 M_1 - t_2 M_2 = 0$$

Substituting the earlier results we have,

$$\frac{\partial F}{\partial W} \cdot \left(-\lambda M_1 \right) + \mu \left[-t_1 \frac{\partial M_1}{\partial t_1} - M_1 \right] = 0$$

This can be transformed to

$$+ \lambda \frac{\partial F}{\partial W} + \mu \left[+ \left(\frac{t_1}{P_1} \right) \epsilon_1 + 1 \right] = 0 \qquad \epsilon_1 = \text{price elasticity of demand for import of consumer good} \qquad \text{(A)}$$

Similarly,

$$\frac{\partial F}{\partial \pi} (M_2) + \mu \left[t_2 \frac{\partial M_2}{\partial t_2} + M_2 \right] = 0$$

This can be transformed into

$$\frac{\partial F}{\partial \pi} + \mu \left[\left(\frac{t_2}{P_2} \right) \epsilon_2 + 1 \right], \qquad \epsilon_2 = \text{price elasticity of demand for import of intermediate good} \qquad \text{(B)}$$

Also, we can write the revenue constraint as

$$\left(\frac{t_1}{P_1} \right) \left(P_1 M_1 \right) + \left(\frac{t_2}{P_2} \right) \left(P_2 M_2 \right) = \bar{R} \qquad \text{(C)}$$

Then we have a three equation system (A). (B) and (C) - which can be solved to yield y. and the optimal values of t, and t;,.

J.   SIMULATIONS Suppose that the utility function for the typical Local household is given by

$$U = q_1^\alpha \, q_2^{1-\alpha}$$

Then it can be derived in this case that the indirect utility function is given by

$$V = \frac{Ay}{(1+t_1)^\alpha} \quad \textit{where } A = \alpha^\alpha (1-\alpha)^{1-\alpha}$$

$$\frac{\partial V}{\partial y} = \frac{A}{(1+t_1)^\alpha}$$

and a Cobb-Douglas social welfare function, F.
That is
$$F = W^\beta \, \pi^{1-\beta}$$

$$\frac{\partial F}{\partial W} = \frac{\beta F}{W}$$

$$\frac{\partial F}{\partial \pi} = \frac{(1-\beta)F}{\pi}$$

where $W = NV$. V is the utility level attained by each household.

Then, dividing equation (A) by equation (B) we have,

$$\frac{\beta F \frac{\partial V}{\partial y} \pi}{NV(1-\beta)F} = \frac{\tau_1 \epsilon_1 + 1}{\tau_2 \epsilon_2 + 1}$$

Substituting for $\frac{\partial V}{\partial y}$ and V from above we obtain

$$\frac{\beta \pi}{(Ny)(1-\beta)} = \frac{\tau_1 \epsilon_1 + 1}{\tau_2 \epsilon_2 + 1}$$

where $\tau_1 = \frac{t_1}{P_1}$ and $\tau_2 = \frac{t_2}{P_2}$ are the effective octroi rates on the consumer price.

Suppose that we designate as s the share of profits in income

i.e. $s = \dfrac{\pi}{N_Y}$

Then $\dfrac{\beta s}{(1-\beta)} = \dfrac{\tau_1 \epsilon_1 + 1}{\tau_2 \epsilon_2 + 1}$

This leads to

$$\frac{\beta s \epsilon_2}{(1 - \beta)} \tau_2 + \frac{\beta_3}{(1 - \beta)} - \tau_1 \epsilon_1 + 1$$

Therefore,

$$\epsilon_1 \tau_1 - \frac{\beta s \epsilon_2}{(1 - \beta)} \tau_2 = \frac{\beta s}{(1 - \beta)} - 1 \qquad [1]$$

We have from the revenue constraint that

$$\tau_1 \left(\frac{P_1 M_1}{Ny} \right) + \tau_2 \left(\frac{P_2 M_2}{Ny} \right) \quad \left(\frac{\bar{R}}{Ny} \right)$$

We designate the following,

$$m_1 = \frac{P_1 M_1}{Ny}, m_2 = \frac{P_2 M_2}{Ny}, r^* = \frac{\bar{R}}{Ny}$$

Then the equation is transformed to

$$m_1 \tau_1 + m_2 \tau_2 \quad r^* \qquad [2]$$

Therefore, equations (1) and (2) constitute a two equation system which can be solved to yield the values of τ_1 and τ_2, as follows:

$$\tau_1 = \frac{m_2 \{\beta s (1 - \beta)\} + \beta s \epsilon_2 \tau^*}{\epsilon m_2 (1 - \beta) + \beta s \epsilon_2 m_1} \qquad [3]$$

$$\tau_2 = \frac{\epsilon_1 \tau^* - m_1 \left\{ \frac{\beta s}{1 - \beta} - 1 \right\}}{\epsilon_1 m_2 + \frac{\beta s \epsilon_2 m_1}{(1 - \beta)}} \qquad [4]$$

which leads to

$$\tau_2 = \frac{\epsilon_1 \tau^* (1 - \beta) - m_1 \{ \beta s (1 - \beta) \}}{\epsilon_1 m_2 (1 - \beta) + \beta s \epsilon_2 m_1} \qquad [5]$$

T, in (4) and T.-^ in (5) are the optimal octroi rates, given the revenue target. T*. The results of comparative statics on equations (1) and (2) arc as follows:

Changes in

Due to Change in	τ_1 [Consumer Goods]	τ_2 [Intermediate Goods]
β	$-$	$+$
s		$+$
m_1		$-$
m_2		$-$
ϵ_1	$+$	$-$
ϵ_2		$+$
τ^*	$+$	$+$

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