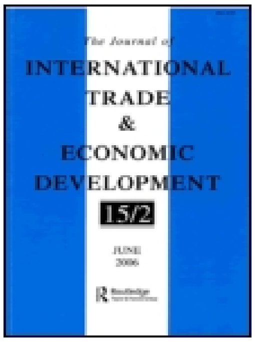

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Dual tariff: reforming controlled prices

Kaushik Basu
Delhi School of Economics, India

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Abstract

For a variety of goods and services, such as taxi rides, gas cylinders and hospital charges, government fixes the tariffs in advance. In developing countries the list of such items is often quite long. Even when these prices are 'correctly' set in the sense that average demand matches average supply, problems arise during fluctuations in demand and supply. In India, for instance, it often happens that one has to wait for days for the supply of gas cylinders. Similarly hospital services are often in short supply. In this paper a pricing scheme is suggested which partly solves this problem. While the scheme is not an *optimal* one, it has the advantage of simplicity and, in addition, it is welfare increasing for the consumers without causing losses to the existing firms, and hence stands a greater chance of being acceptable as a reform measure. The model also throws some general light on the special pricing problems that arise in models with stochastic demand.

1. INTRODUCTION

There are several goods and services for which it is felt that there should be pre-announced prices or what we shall call uniform tariffs. The price of such a good is set in advance for all transactions instead of the buyer and seller being left to bargain and set the price separately for each transaction. Thus in most cities taxi fares are pre-announced. Similarly, doctors usually have pre-announced fees. It does not normally happen that the doctor tells you: 'Today, I am busy, so let's negotiate a higher fee.' Instead, he would simply refuse to see you if he were extra busy. For certain goods pre-announced prices seem to be desirable, especially in developing countries where consumers may be ignorant or illiterate and therefore are likely to be charged unfair prices. And indeed in a country such as India these are widely used.

It should be clarified that a uniform tariff does not necessarily mean a government-controlled price. Doctors, barbers and indeed most sellers use some amount of pre-announced rigidity in prices. These prices respond to fluctuations in supply and demand not on a transaction-by-transaction basis but periodically. I shall here be concerned, however, with uniform tariffs which are fixed by the government, such as transportation charges, public hospital rates and the price of gas cylinders. If the uniform tariff is carefully set so as to equate average demand and average supply, it may work well 'on average'. It nevertheless runs into occasional difficulty. When demand rises suddenly, commodities under uniform tariff can come under strain. Hospital services may run into temporary shortage, and taxis may not be available when needed. The aim of this paper is to suggest a simple modification of the existing tariff scheme to partly mitigate this problem.

The dual tariff scheme is of special interest not because it is an optimum policy but because (a) its implementation is easy, (b) it will increase the quality of the service in question and (c) it should be politically more acceptable because it will leave the *existing* firms unhurt and the consumers better off. In contrast, *optimum* policies often entail stepping on powerful toes and therefore get abandoned by governments on the grounds of political infeasibility. In addition, (d) dual tariffs can work in situations where it is not known in advance when demand will be high so that usual peak-load pricing rules, such as those used for telephone pricing, do not work well.

Instead of working in the abstract, I shall here develop my model with an example and work throughout with it. In many cities the usual way to call a taxi is to dial one of the numbers of taxi companies listed in the yellow pages of the telephone directory. *On average* this works well, but every now and then, when demand peaks, finding a taxi can be a harrowing experience.

The scheme suggested in this paper is this. The government should choose a fare or tariff (i.e. the price of taxi rides which the commuter has to pay to the driver) higher than the existing one and allow companies to choose between the two rates – the existing low one or the new higher one. Once the company chooses which tariff it wants to use, it will have to state this in the yellow pages of the telephone directory and it will not be allowed to vary the rate. This means that the caller when calling a taxi will be fully cognizant as to which one (expensive or cheap) he is calling.[1]

While other schemes can be formulated in theory, what is interesting about the tariff reform suggested in this paper is that for its implementation the government does not have to make any complicated calculations. No demand functions need to be estimated. The new high tariff that the government fixes can be anything, for instance 20 per cent above the existing tariff. It is entirely possible that it will have no takers. That is, no taxi company may want to ply cabs at the high rate because it feels the rate is so high that not enough people will use it. If no company takes up the new offer, the existing situation will remain unaffected. If, however, there are takers, then this reform will improve efficiency because the conditions under which companies find it profitable to take up the new offer are also the conditions under which the dual tariff scheme benefits everybody. It is in this sense that I assert that the new scheme is easy to implement and it cannot hurt.

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What is the intuition behind the new tariff scheme being suggested? How can the same service command two prices in the market? Clearly, during slack periods no one will use the expensive cabs. In peak times people will first try the cheap cabs and only on failing to find one will they get the expensive ones. Hence with the introduction of the dual tariff scheme the existing (and cheaper) taxis will find that their profits remain unchanged. The new (and expensive) taxis will find that their utilization is low but, since they collect a higher tariff when they are utilized, they are viable overall.

It may be pointed out that in some cities we already have a multi-tariff system because there are different kinds of taxi service available: limousine service for long distance, day-long hire service, special air-conditioned taxis etc. It is true that this tends to mimic what is being recommended here but the difference should be clear. What is being recommended is a multi-tariff (though for simplicity we focus only on *dual* tariffs) structure for exactly the same kind of taxi service. That is, different companies should offer the same service at different fares.

Another objective of this paper is to model the market structure of the urban transport industry when demand is stochastic. This produces some unexpected results. Consider the taxi market just described. The fares are fixed and during slack periods commuters have no problems; but during sudden increases in demand severe shortages show up and many commuters get stranded. Could this peak hour problem not be lessened by raising the fare? It is shown that if the fare is raised (quite apart from the other disadvantages of raising a price), it is entirely possible for the shortage problem actually to get worse.

The formal model is constructed under the assumption of free entry. This simplifies the algebra. However, my main results remain unaltered by allowing governmental control over the number of taxis through the use of licensing. A final section discusses how the model has to be modified to allow for blocked entry.

2. A PRELIMINARY MODEL WITH NO UNCERTAINTY

The number D of taxi rides demanded is a function of the tariff p, which will also be referred to as the taxi fare or the price per ride.

$$D = D(p) \qquad D'(p) \leqslant 0.$$

In the next section we allow for variations in demand, i.e. for the possibility of peak and slack periods.

Let us assume that each firm or company owns one taxi. The cost of buying one taxi is c; and one taxi can provide a maximum of n rides. In other words, n is its capacity. Giving each ride costs nothing to the firm. That is, we are ignoring the cost of petrol, wear and tear, etc. This is a

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simplifying assumption. An alternative and more realistic interpretation of the above variable is to treat c as the rental for a full day that the taxi company has to pay to acquire a cab (and a day is the minimum period of time for which it can acquire a cab). During the day it can provide at most n rides to co ters. Each ride is costless to the firm.

If the supply of taxi rides is S (i.e. there are S/n taxis or taxi companies) and the tariff is p, then each taxi firm expects to sell $D(p)/S$ of its capacity rides. Of course, if $D(p) > S$, then it expects to sell n rides. We shall refer to this as the *(capacity) utilization ratio r*. That is,

$$r(p, S) = \min\left[\frac{D(p)}{S}, 1\right].$$

If there are S/n taxi companies (and therefore taxis) in the industry (i.e. the industry's *aggregate* supply of rides is S), and the price per ride is fixed at p, then each firm's profit $\bar{\pi}$ is given by

$$\bar{\pi}(p, S) = pnr(p, S) - c.$$

An interesting externality is already in the picture: each individual firm's profit depends on the aggregate number of firms in the industry[2] via the utilization ratio.

It is being assumed that the taxi tariff is controlled by the government, as is indeed the case in most countries. The firm's profit is positively related to the utilization ratio, but it cannot do anything, in its individual capacity, to influence the utilization ratio. In fact, a firm's decision is limited simply to deciding whether to enter the industry or not. Since we are considering a competitive industry with free entry, entry occurs as long as there is (super-normal) profit to be earned. Hence, in equilibrium, S is such that

$$\bar{\pi}(p, S) = pnr(p, S) - c = 0. \tag{1}$$

Solving this equation we get

$$S = S(p). \tag{2}$$

Equation (2) defines the equilibrium (aggregate) supply corresponding to each p. We shall refer to $S(\cdot)$ as the industry's *supply function* but its interpretation should be kept in mind. Of course, S also depends on n and c but since these are kept unchanging in the model I omit them from the $S(\cdot)$ function. The case where entry is not free will be discussed in a later section.

It is useful to work out the nature of the supply function. Observe that, since r depends on the aggregate demand, the shape of the supply curve *depends on the shape of the demand curve.*

If $p < c/n$ (and since r can be at most 1), it follows from (1) that supply will be zero. If $p = c/n$, S is indeterminate as long as $r = 1$. As long as S is less than AB in Figure 1, $r = 1$; hence at $p = c/n$ supply can be anywhere

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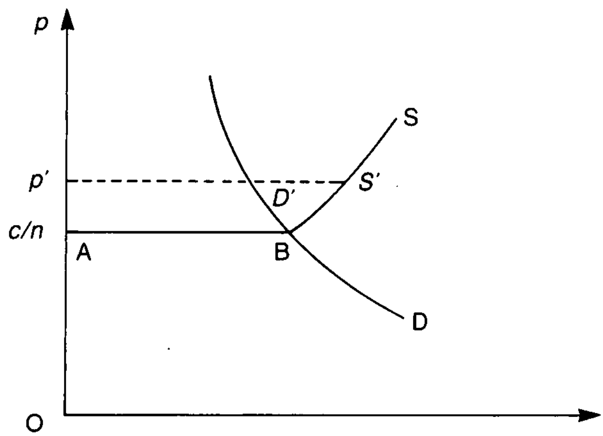

Figure 1

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between A and B. If $p > c/n$ and $S \leq D(p)$ (i.e. $r = 1$), then S cannot be an equilibrium. Hence for all $p > c/n$, supply exceeds demand. This explains the shape of the supply curve OABS in Figure 1.

In the traditional competitive model with identical firms and free entry, if price exceeds cost (i.e. c/n), aggregate supply will be indefinitely large. Here, as the aggregate supply increases, the utilization of each taxi's capacity falls, and it is this which drives down the profit earned by each firm even though price remains unchanged. In Figure 1, if the government fixes the taxi tariff at p', supply will be equal to S' and $r = D'/S'$; at this r each firm's profit will be zero.

It is interesting and for our later exercise important to note that the supply curve need not always be upward sloping. In fact, whether the supply curve will be upward sloping or not can be predicted perfectly from the elasticity of the demand curve at the relevant price. In particular, the following proposition is always true. *The supply curve will be backward bending if and only if the demand curve has elasticity greater than 1.*

Since supply is zero for prices below c/n, let us consider a $p > c/n$. Since here equilibrium supply exceeds demand,

$$r(p, S) = \frac{D(p)}{S}.$$

Hence, (1) implies

$$\frac{pnD(p)}{c} = S.$$

Therefore,

$$\frac{\partial S}{\partial p} = \frac{n}{c}\,[pD'(p) + D(p)].$$

This implies $\partial S/\partial p < 0$ if and only if

$$pD'(p) + D(p) < 0$$

or

$$\varepsilon \equiv -\frac{pD'(p)}{D(p)} > 1$$

which establishes what was claimed above.

Figure 2 displays a straight-line demand curve and a corresponding aggregate supply curve. Given the above discussion the shape is self-evident.

To see the limitations of the unique taxi-tariff rule which is used almost the world over, we need to introduce some element of uncertainty in the above model, which we proceed to do in the next section.

3. THE STOCHASTIC MODEL

There are times of the day when the demand for taxis is higher; also a sudden change in the weather, a strike by the metro and the inexplicable but frequent bunching of demand (over and above what can be explained by the time of day) could contribute to shortages. This is captured here by the simple assumption that there are two possible states of the world, 1 and 2, and all agents know their probabilities. This strong assumption is fairly common in stochastic models. The demand for taxi rides is state dependent and so

$$D_i = D_i(p) \qquad D_i'(p) \leqslant 0 \qquad i = 1, 2.$$

The functions, as before, are continuous. State 2 is where demand is high. So, $D_2(p) > D_1(p)$, for all p. The probability of state 2 occurring is given

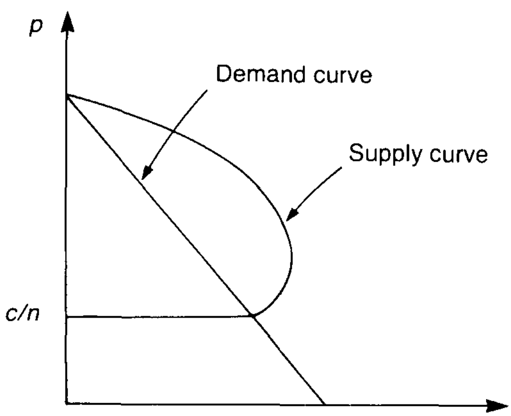

Figure 2

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by *f*. Let $\bar{D}(p)$ be the average demand function. That is,

$$\bar{D}(p) = (1 - f)D_1(p) + fD_2(p). \tag{3}$$

The supply of taxis cannot be state dependent. Once a firm enters the industry, if demand is slack it just has to wait idle. Hence the aggregate supply S of taxi rides has no state subscript.

The utilization ratio in state i is given by

$$r_i(p, S) = \min\left[\frac{D_i(p)}{S}, 1\right]. \tag{4}$$

Following the argument in Section 2, an individual firm's expected profit is given by

$$\pi(p, S) = pn[(1 - f)r_1 + fr_2] - c. \tag{5}$$

The equilibrium aggregate supply is derived in the same way as before (for competition with free entry) by setting $\pi(p, S) = 0$.

Using (4) and (5), it is easy to show that the aggregate supply curve will be as follows:

$$S = S(p) \equiv \begin{cases} 0 & \text{if } p < c/n \\ \dfrac{pn(1-f)D_1(p)}{c - npf} & \text{if } p \in [c/n, \tilde{p}] \\ \dfrac{n}{c} p\bar{D}(p) & \text{if } p > \tilde{p} \end{cases} \tag{6}$$

where $\tilde{p}$ is defined implicitly as the value of p which solves

$$(1 - f)p\,\frac{D_i(p)}{D_2(p)} + pf = \frac{c}{n}.$$

From now on all references to the supply function $S(\cdot)$ will be to (6) and *not* to (2). A typical picture of (6) appears in Figure 3.

Suppose price is somewhere between c/n and $\tilde{p}$, for instance at p' in Figure 3. Then there will be times (state 1) when it will be easy to get a taxi and other times (state 2) when some demand remains unfulfilled. This seems to be quite the situation in many countries.[3] Moreover, this will be true even if we do not assume free entry as will be shown later.

It is easy to see that this situation is inefficient. In fact, as the subsequent discussion will clarify, all unique tariff systems are inefficient.[4] The inefficiency of p' is clear from the fact that commuters who fail to get their taxi rides (namely the segment EF – see Figure 3 – in state 2) could be willing to pay a very high price for the marginal ride. It is also possible that commuters as a whole may be willing to switch to a higher tariff (at all times) just to cut out the risk of being without transport at some critical

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time. But here we encounter a curious problem. Suppose at the present price p' commuters too often get excluded from the market. One way, while remaining within the system of a unique regulated tariff, of trying to minimize the peak demand problem is to raise the tariff. From Figure 3 it does appear that as p' is raised the excess demand EF will diminish. This is not necessary, however. *It is possible that raising the taxi fare could accentuate the peak-period excess demand problem.*

To prove this, suppose $p \in [c/n, \tilde{p}]$ and differentiate (6) with respect to p:

$$\frac{\partial S(p)}{\partial p} = \frac{pn(1-f)D_1(p)nf + [n(1-f)D_1(p) + pn(1-f)D_1'(p)](c-npf)}{(c-npf)^2}. \tag{7}$$

Since the objective is to show that raising the taxi-tariff *can* exacerbate the excess demand problem, it is okay if we focus on a particular price. It is algebraically simplest if we consider $p = c/n$. It is easy to see that

$$\frac{\partial S(c/n)}{\partial p} = \frac{n[D_1(p) + (1-f)pD_1'(p)]}{c(1-f)}.$$

Clearly this can be negative if the state-1 demand curve is sufficiently flat (which makes $D'_1(p)$ a large negative number). Hence the supply of taxi

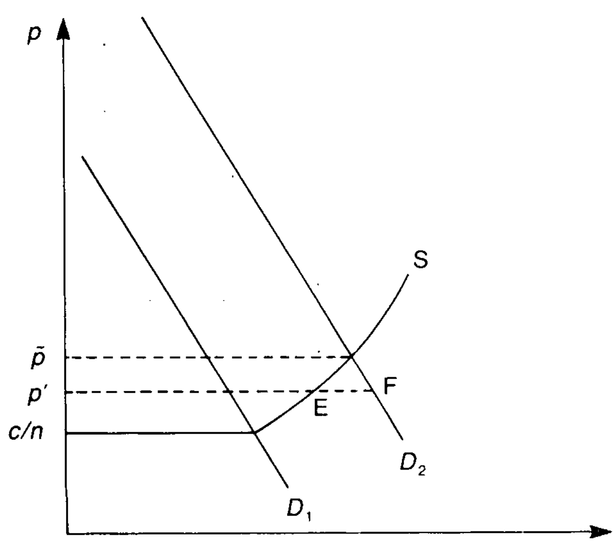

Figure 3

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rides could indeed fall as price rises. In addition, (7) shows that $\partial S(p)/\partial p$ is quite independent of the nature of the state-2 demand function $D_2(\cdot)$. Hence a negative $\partial S(p)/\partial p$ is compatible with any kind of $D_2(\cdot)$ function. Suppose $D_2(\cdot)$ is perfectly inelastic when $p = c/n$. Then as p rises supply falls and demand is unchanged. Hence the shortage of a taxi service is heightened by a rise in the fare. This establishes the italicized observation above.

The intuitive idea behind the above argument is as follows. As price is raised from p' in Figure 3, the state-1 demand D_1 falls. If this fall is sufficiently sharp it is possible that a taxi's overall expected profit will now be less because its utilization in state 1 is so much lower. This could cause enough firms to close down to exacerbate the excess demand problem in state 2.

What policy can the government follow to increase the quality of service in this industry? Consider the policy of lifting all controls on prices. Any commuter and taxi-driver are free to bargain and strike any fare agreement. I have seen too many examples of such free-for-alls in small Indian cities (and, at night, in larger ones) to require formal research to tell me that it does not work.[5] And in terms of formal argument one can easily see that, given the vast asymmetry in the information between drivers and passengers in terms of distances between places and congestion, the scope for 'cheating' could be large and also the wastage of effort spent on bargaining may be difficult to measure but large. This is because in the free-for-all system bilateral monopolies could often crop up (e.g. in a lonely road where there is only one passenger and one taxi).[6] Once this transaction cost is taken into account, it is possible that there will exist a regulated price which everyone would prefer *a priori* to a system of free-for-all.

Another possible policy response is peak-load pricing (see note 4), which specifies, for instance, that a higher rate be charged during office hours. The problem with this is that it may not be much use for unanticipated fluctuations in demand, which is what is being discussed in this paper. Moreover, by unanticipated fluctuations we need think not only of tram strikes and football matches but of the little shortages and bottlenecks that form every now and then, every day in different places. Second, peak-load pricing usually meets with problems of political dissension because many commuters, including thousands who use public transport only during peak hours (for instance, to travel to the office and back), may prefer lower fares with longer waiting to higher fares with no waiting involved. As I mentioned at the outset, the scheme being suggested here is not an *optimal* scheme but a *reform*, in the sense of being a Pareto improvement, with the advantage of hurting no group and therefore being politically acceptable.

Finally, the dual tariff scheme suggested below may be used in *conjunction*

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with traditional peak-load pricing. That is, some taxis could charge a price x per cent above the basic fare, where the basic fare could be different at different times of the day. The theory developed in this paper would be of use even if the ultimate aim was to have such a layered system.

4. DUAL TARIFF

Let the existing taxi fare be $p_L \in [c/n, \tilde{p}]$. What is being recommended in this paper is that the government ought to announce a higher fare p_H and allow taxi companies to ply under either of these two schemes. But once a company chooses to use a particular tariff (i.e. either p_H or p_L) it has to stick to it.[7] Let S_L and S_H be the supplies of, respectively, low fare taxis and high fare taxis.

Throughout this section it will be assumed that there is no income effect on the demand for taxi rides. Since commuters would never use a high fare service if the same service were available at a lower fare, using the notation of the previous section and defining the profits earned by low and high fare taxis as π_L and π_H, we can check that

$$\pi_L(p_H, p_L, S_H, S_L) = \pi(p_L, S_L), \tag{8}$$

where the $\pi(\cdot)$ function is the same as in equation (5). Also

$$\pi_H(p_H, p_L, S_H, S_L) = fp_H n \min\left[\frac{D_2(p_H) - S_L}{S_H}, 1\right] - c. \tag{9}$$

Equation (8) shows that the existing low price market is left completely unaffected by p_H and S_H, i.e. by what happens in the high price segment. Thus the new scheme should meet with no objection from existing commuters and taxi companies.

If, with $S_H = n$, $\pi_H > 0$, then at least one high price company will enter the industry. This will bring additional advantage to commuters by ensuring a greater supply of taxis during peak times.[8]

A more ambitious pricing reform would be to allow each company to choose its own tariff (but once fixed it may not vary the tariff). This reform could have more complicated implications than my simple scheme suggests, and also it may not be politically acceptable. But nevertheless it is analytically interesting to check what the equilibrium structure of tariffs would be under this system, which will be described as *semi-flexible price competition* (SFPC).

Without going into formalism, I shall describe an equilibrium in a market structure described by SFPC, as follows. There is an infinite number of potential identical taxi companies (this mimics the free entry assumption being used throughout this paper) and every potential taxi company announces a tariff. The tariff structure is an *equilibrium* if no company can do better by unilaterally changing its tariff.[9]

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It can be shown that in equilibrium there will be two kinds of taxis in the industry, those charging a fare of c/n and those charging c/nf. There will be $D_1(c/n)/n$ of the former type of taxis and $D_2(c/nf)/n - D_1(c/n)/n$ of the latter types.[10] This implies that in Figure 4 ABCE could be thought of as a kind of 'supply locus'.

It is clear that in equilibrium each firm's profit is zero. To see this note first that, since there are more firms than demand, some firms will have no custom (in other words they will be outside the industry) and they will earn zero profit. If there exists a firm k earning positive profit, one of the firms which are outside the industry could set a tariff slightly below firm k's tariff and ensure itself a positive profit, which contradicts the definition of equilibrium.

It is easy to see that in equilibrium there will be $D_1(c/n)/n$ taxis charging a fare of c/n and $D(c/nf)/n - D_1(c/n)/n$ taxis charging c/nf. If there are more than these numbers charging these fees then negative profits will be earned and if there are less then new firms can enter, charge a slightly higher price than c/n or c/nf and earn positive profits. Given the remarks in the above paragraph both these would constitute contradictions.

The only thing that remains to be proved is that there does not exist any company *in* the industry which charges a fare not equal to c/n or c/nf.

A company charging a fare above c/nf will not be *in* the industry since no customer will use it (given that there are $D_2(c/nf)/n$ taxis charging a fare of c/nf or less). A company charging less than c/n will make a loss. Hence the only serious case worth considering is a company charging a fare $\tilde{p}$ in between c/nf and c/n. Such a company will face no demand in state 1, and will be fully occupied in state 2. Hence its profit will be $\tilde{p}nf - c$. Since $\tilde{p} < c/nf$, therefore $\tilde{p}nf - c < 0$. Hence such a company is better off outside the industry (i.e. announcing a fare which is so high that no

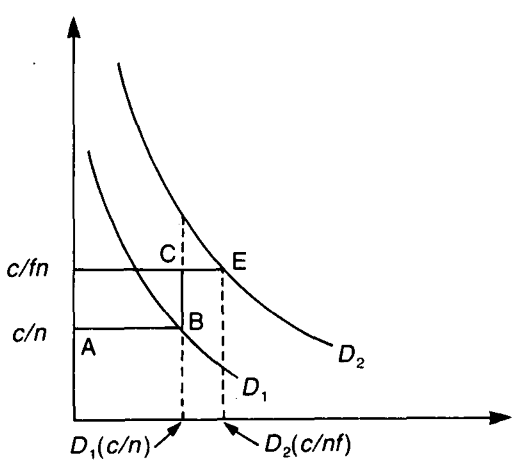

Figure 4

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customer would ever ask for it and so it need not possess a taxi). This completes the proof.

A question of policy arises at this point. Instead of going for a dual tariff system by announcing a new tariff above the existing one as recommended above, why does the government not (a) announce a dual tariff with the tariffs fixed at c/nf and c/n or (b) tell taxi companies to choose their own tariffs but stick to them once chosen. Both these, (a) and (b), will result in the equilibrium in an SFPC market structure just described.

It is true that (a) and (b) would attain a greater efficiency than the minor reform being suggested in this paper but (a) and (b) require a considerable amount of information and may be politically difficult to implement because they will hurt some existing interest groups (or at least *appear* to hurt – which is, politically, as problematical). In short, though (a) and (b) are more attractive than the free-for-all system discussed above, trying to implement (a) or (b) may be futile. In the face of this, instead of letting things be, it seems sensible to adopt the pragmatic path of recommending a scheme which, while less than optimum, is better than the existing policy and is likely to be acceptable to politicians.

Before ending this section, it is worth noting that, quite apart from the policy issues which were the focus of this paper, the model of equilibrium in a market characterized by SFPC explains some positive features of an economy. First, it shows how in a competitive market the same service could command more than one price. One may be tempted to label this a case of product differentiation. If so, it certainly does not fall into any standard kind of product differentiation (see Waterson, 1984: ch. 6). Both types of companies in the above model provide the same service, and the only difference is that one may not always be available while the other can be bought at all times.

Second, the above market structure explains the existence of excess capacity in an equilibrium, because the expensive taxis will be under-utilized. While in most existing models this happens in monopoly or in oligopoly, especially where entry deterrence is a part of a firm's strategy, in the present model excess capacity is a feature of competition.

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5. SOME CONSEQUENCES OF REGULATED ENTRY

For ease of analysis the formal model thus far has been developed under the assumption of free entry. It is indeed arguable that in most urban centres the cab industry is subject to government control which limits the number of taxis that may operate; this is certainly the case in Australian cities. Once we allow for this, the model needs some modifications. The purpose of this section is to outline these. The main propositions and recommendations made in the previous sections fortunately turn out to be resilient to such modifications.

Return to the model of Section 2. Let us now add the assumption that the government has decided not to give permits to more than T taxis to ply in the city. This means that (1) need no longer be valid. If the S we get by solving (1) (i.e. from (2)) exceeds nT, then the equilibrium supply will be nT instead of $S(p)$. In other words, in the presence of controls on entry the equilibrium supply S will be given by

$$S = \min[S(p), nT]$$

where $S(p)$ is given by (2).

In terms of Figure 5, if with free entry the supply curve is ABECD, then with control on entry the supply curve will be ABCD. If the fare is allowed to adjust by itself, it will settle at F and firms will earn supernormal profits. If the fare is fixed by the government there may be excess demand or excess supply in equilibrium depending on whether the fare is set below or above F.

The modification in the stochastic model of Section 3 can be worked out in much the same way; I shall not go into that here. It is also easy to see that the proposition that raising the fare may result in a decline in the supply of taxis which exacerbates the peak-time shortage problem continues to be valid in the presence of government regulation since regulation is used to limit entry and not to block exit.

Finally, let us turn to an analysis of dual tariff in a regulated industry. Consider the framework of Section 4. Suppose there is an existing tariff p_L and a certain supply S_L of taxi services. Since entry is regulated S_L may indeed be less than the supply where profit per firm goes to zero. Let us

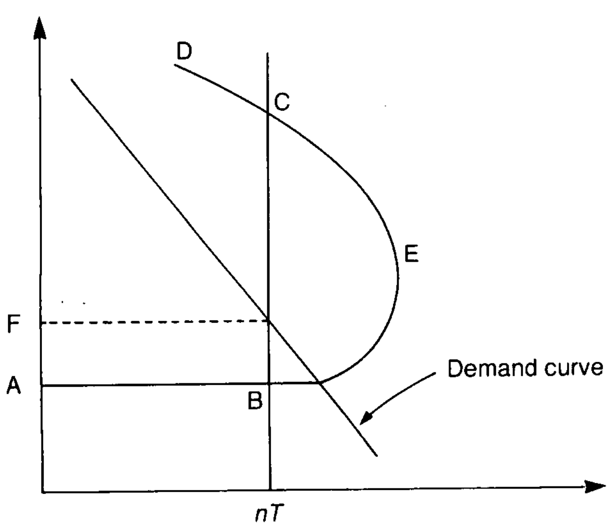

Figure 5

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suppose as before that, during times of high demand, commuters face shortages.

Now, consider the government introducing another tariff, p_H, which is higher than p_L. Since this is a regulated industry we shall assume that the government fixes the maximum number of low fare taxis and the maximum number of high fare taxis that will be given permits to operate.

These controls imply that the taxis, both type H and type L, may earn supernormal profits in equilibrium. But that does not alter the advantages of the *dual* tariff system discussed in Section 4. With the announcement of the new fare p_H, some currently low fare taxis may switch over to being the high fare kind but, since profits were positive for even the low fare taxis, there will be new applicants to take up the places left vacant by any existing low fare taxi switching over to being high fare. Hence with the announcement of the dual tariff system the low fare market will remain unchanged. So consumers will have no reason to complain. And as before, if taxis take up the high fare option this will be a Pareto improvement on the existing situation, and if taxis do not take up the new high fare option then everything remains as before. Hence, by switching to a dual tariff system, there can only be gains.

There is an interesting question about cartels, however. If it so happens that the high fare cabs are also more profitable (this need not necessarily be so), then the existing taxi companies would have an interest in forming a cartel and charging the higher fare. This in itself will not affect my analysis because it is easy to see that new companies will be formed to fill the low fare vacancies that would arise in the process. Hence the cartel would have to try and block entry over and above the limits which already exist by virtue of the government's regulation. Presumably, however, such action would be so blatant a violation of anti-trust norms that they would not survive in the long run. Nevertheless, the subject of cartel formation and anti-trust laws would be an interesting area of further research in the context of a model of the kind discussed here.

Another closely related subject is that of endogenous entry-deterrent behaviour and excess capacity. There is already a literature addressing this problem (see, for example, Spence, 1977; Dixit, 1979; Basu and Singh, 1990). There may be scope for applying those models more effectively in the framework developed in this paper since excess capacity is a natural feature of the transport industry. In fact, a certain amount of it is inherent and also desirable in the kind of market discussed in the present paper. But this remains an open area.

NOTES

1. To a certain extent this can be achieved by painting expensive taxis in a different colour even in countries where taxis are hailed from the roads, so that

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people know the tariff before they board a taxi. However, the trouble with this is that in a system where taxis have to be hailed from the streets there can be a lot of *frictional* under-utilization. That is, excess demand in one location could coexist with excess supply in another location. It is not clear how one should define an equilibrium for such a market.

2. I have elsewhere (in Basu, 1987a) considered a similar externality on the demand side. Even there the market equilibrium looks different from the standard textbook one.
3. Though I cannot cite published empirical evidence, I can refer to something more reliable and immediate, to wit, my experience.
4. In most countries taxi-tariffs are not *strictly* unique because charges are at times dependent on the time of day. This still does not take account of unanticipated variations in demand, and so the inefficiency criticism continues to hold.
5. I must record, however, that it has been pointed out to me by peripatetic economists that it does work in Bangkok. My familiarity with the Bangkok taxi market is inadequate and I cannot comment on this.
6. Clearly I am arguing that in transport pricing some form of intervention is desirable. But it is easy to misunderstand this prescription if one thinks of intervention as an antithesis of the market. Here intervention *enables* the market to function smoothly (see Jacquemin (1987: ch. 6) for a discussion of different kinds of intervention in industry) and is therefore complementary.
7. The dual tariff discussed here is distinct from the two-part tariff in Oi (1971) or Basu (1987b), though both schemes enhance efficiency. Also the present scheme does amount to a two-part tariff in the context of the aggregate supply curve of the industry.
8. While for simplicity I have restricted attention to two states of the world and dual tariffs, one could do the whole exercise in the more general 'multiple' framework.
9. It is convenient if we append to this the requirement that, if a firm is indifferent between being in the industry and being out of it, it chooses to be in.
10. I am ignoring the technical integer problem here by assuming that $D_1(c/n)/n$ and $D_2(c/nf)/n$ are integers.

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