EVALUATION OF POLICIES FOR THE OPERATION OF THE MARKET OF URBAN TAXI SERVICES: THE CASE OF SANTIAGO DE CHILE

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ABSTRACT

In this paper we use a microeconomic model to evaluate, for the case of Santiago De Chile, the most commonly used regulatory policies applied to the production of cruising taxi services. The analysis considers the influence of both, supply demand synchronization problems and consumption externalities on the passengers waiting times. We assume that taxi services are produced by both taxi operators and passengers. The later provide production factors as the waiting and travel times, which makes them both producers and consumers of the services. Consistent with this, we define short run and long run production cost functions, considering factors provided by operators and passengers. We use a generalized price function formulation in order to define the demand function for taxi runs. This function considers that the demand for taxi services does not only depend on the fare value, but also on the level of service experienced by passengers.

The analysis allows obtaining interesting conclusions with respect to the social benefits and costs associated with the different regulatory policies evaluated. These conclusions should be valid for any system of urban taxis that operates similarly to that of Santiago De Chile.

1. INTRODUCTION

In most developing countries, cruising rather than dispatch taxi service is the norm[1]. Several authors have analyzed operating and economic characteristics of this market, which normally is considered subject to different imperfections: supply depends on demand, through waiting times (Beesley and Glaister, (1983); Manski and Wright (1976)), non-existance of equilibrium (Cairns and Liston-Heyes (1996)), production externalities (Paul (1982) and Yang and Wong (1998)) and supply-demand synchronization problems (Shreiber (1975,1977,1981)). Therefore, most of the studies recommend regulation policies to obtain second best solutions that maximize social welfare, subject to financial constraints: fare regulation (Douglas (1972), De Vany (1975) and Paul (1982)), entry regulation (De Vany (1975)), and both fare and entry regulation (Shreiber (1975,1977), Paul (1982) y Cairns and Liston-Heyes (1996)).
In this paper we analyze the Santiago de Chile cruising taxi market. For this purpose we use as basic theoretical framework the microeconomic model developed in Fernández De Cea and Briones (2000). The real values for the main variables and parameters needed for the application of the model are taken from prior studies and the direct observation of the current operation of the Santiago de Chile cruising taxi system. The current market operation is analyzed and evaluated and then compared with the social optimum operation. Then several regulation policies are considered and their effects are evaluated. Finally the main conclusions and recommendations are synthesized.

2. THE SANTIAGO THE CHILE TAXI MARKET

Tables 1 and 2 contain the main data describing the cruising taxi system operating in Santiago the Chile. This data was taken from a study performed by the Chilean Transportation Secretary (MTT, 1993) and the direct observation of the current system operation. Table 1 contains basic operational data and some important prices and parameters necessary for the estimation of taxis operational costs. Table 2, contains data describing the current market operation and some basic passengers values.

Table 1: Basic operational data and prices [$ year 2000]

Data	Value	Information Source
Distance per year	52,800 Km	MTT (1993)
Distance per day	202 Km	MTT (1993)
Working hours per day	13.3 hrs.	MTT (1993)
Gasoline consumption rate	10 Km/lt	Estimate[2]
Gasoline price	$ 290/lt	Estimate
Taxi driver wage per day	$ 15,500	Estimate
Vehicle Monthly Quota	$ 90,996	Estimate[3]
Monthly Expenditure in Various factors	$ 4,250	Estimate
Monthly Expenditure in vehicle maintenance	$ 49,430	Estimate

Note: 1US$ = 565 Chilean $

1 In Santiago, the chilean capital, a total of 45,716 taxis were operating in 1999; 35,978 of them providing cruising service.

2 Los valores de estos parámetros fueron estimados por el Consultor, basándose en consultas realizadas a taxistas.

3 Estimación basada en un estudio de la antigüedad promedio del parque de taxis de la ciudad de Santiago (6 years) y el precio de un vehículo representativo de los taxis (NISSAN V16).

Table 2: Current market operational data and passengers values

Data	Value	Information Source
Number of taxis in the Santiago Register	45,716 vehículos	National Register[4]
% of cruising taxis	78.7 %	MTT (1993)
% of operative fleet in the current situation	85.0 %	MTT (1993)
Occupancy rate in the current situation	30.0%	Estimate
Waiting time in the current situation	0.067 hr (4 min)	Estimate
Elasticity in the current situation	-1.20	Based in references
Average run distance	5.2 Km	MTT (1993)
Fix charge (for the first 800 mts.)	$ 150	From the current situation
Fare per unit of distance (per 200mts. or 60 sec.)	$ 67.5	Estimate
% fare increasing caused by stops	15 %	MTT (1993)
Passengers average travel time value	$ 1,600	Estimate
Passengers waiting time value	$ 3,200	Estimate

Note: 1US$ = 565 Chilean $

The determination of some parameter values deserve a special comment. The value of travel time was estimated based on the travel times and fares differences observed between buses and taxis in Santiago. Based on prior studies performed for the urban public transport system (SECTRA (1997)) the waiting time value was taken as twice the travel time value. The demand elasticity value used was estimated taking into account the results of several international studies (Report of the Committee on the Taxicabs Services, 1953. Appendix V to the Report, Brown and Fitzmaurice (1978) and Beesley and Glaister (1983). The final value adopted was –1,2. During the study sensibility analysis were performed with respect to this and other key values. Finally, the average taxi occupancy rate was calculated using all the other parameter values and considering that in the current situation taxi operators break even. This gave a 0,3 value, that was validated with experimental values provided by taxi operators.

3. TAXI MARKET MICROECONOMIC MODEL

We use the basic approach developed by Mohring (1976) and applied to cruising taxis by Fernández, De Cea and Briones (2000) to model the operation of cruising taxi market. In this approach consumers of taxi services are also considered producers jointly with taxi operators. Taxi passengers provide two fundamental production factors: waiting and travel times. Only with the provision of those factors a real taxi service can be produced (taxi runs). Therefore the production of taxi services requires the participation of the passenger that is at the same time consumer and participant in the production process[5].

The main assumptions used in the modeling process are the following: (i) Only cruising services are considered. Taxis permanently run the streets looking for passengers. When a passenger is found he is driven to his destination and after that the taxi resumes the search for a new passenger. The trip with a passenger is called a "run". (ii) Taxis operate in a given geographical area, during a given time period, for which homogeneous operating conditions are assumed. (iii) It is assumed that each taxi operates independently without possibility of

[4] Flota inscrita en el Registro Nacional hasta Septiembre de 1998, dos meses antes del congelamiento del parque de taxis. Esta flota incluye taxis básicos que operan en todas las modalidades, es decir, como radio taxis, como taxis de paradero y realizando barrido.

[5] This approach makes evident that in this market supply depends on demand (Beesley and Glaister, (1983); Manski and Wright (1976)). Given this it is impossible defining a supply function for the typical taxi operator (like in monopoly) and therefore a typical supply-demand equilibrium analysis is impossible.

collusion[6]. The driver-owner and the vehicle constitute the individual taxi firm. (iv) Runs have an average length, and their duration is equal to a constant time, t[7]. (v) All taxis make the same average number of runs per period, q. Therefore, if N is the number of taxis and Q is total number of runs produced by all taxis during the analysis period, $Q=N\cdot q$.

In addition we will use the following concepts: the individual capacity of a taxi is the maximum number of runs that it can produce per period, and is equal to the inverse average duration of a run, $1/t$. Therefore the industry capacity will be given by the sum of the individual capacities over the total number of taxi operators, N/t. The occupancy rate, is equal to ratio between the number of runs produced by a taxi during θ the analysis period and the individual capacity of the taxi, $\alpha(q) = q\cdot(1/t)^{-1} = q\cdot t$ with $q \leq 1/t$. Notice that also $\alpha(N,Q) = Q\cdot t/N$, with $Q < N/t$.

We assume in the present analysis that congestion exist in the urban road network operation. Therefore travel time is affected by the number of taxis operating and the average run duration increases as N increases, $t = t(n)$[8]. In Appendix A the effect of congestion on taxis operating costs is analyzed. It is concluded that this is not significant and can be neglected. Therefore, in the present study the only effect of road congestion considered is that the average run duration increases with N, making decrease the number of runs that can be produced during the period considered. Using the strategic planning model ESTRAUS[9], calibrated for Santiago (See De Cea, J.; Fernández, J.E. and Soto, A. (2000)), a travel time vs. taxi fleet size N was estimated for the city of Santiago. The resulting equation is presented in Figure 1. and can be analytically expressed as $t(N) = 0.000002 \cdot N + 0.2068$.

The relation obtained is only valid for the range of N values considered. The linearity of the relation obtained can be explained by the following: (i) the flow of taxis is a small fraction of the total flow in the system during the analysis period (15%), (ii) the relevant road capacity implicitly considered in the relation is not fixed, because as routes become more congested, when N increases, new alternative routes are used[10] increasing the total road capacity available and reducing the effect of flows on travel times. The increase in travel times is produced by the increase of taxi flows (with and without passengers), which is an indirect consequence of the increase of N. However the rate between N and taxi flows decreases as N increases (MTT, 2.000).

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6 In most developing countries and especially in Chile, taxi operators are individuals who own one vehicle and operate independently.

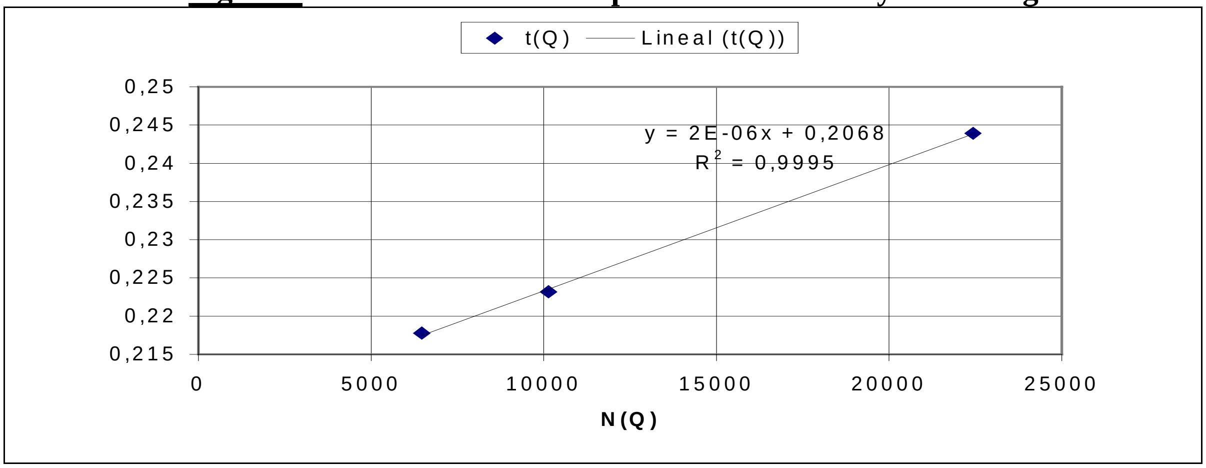
7 Duration time t is a consequence of operating conditions and general congestion levels experienced on the streets of the area considered. In this paper the influence of taxis on general congestion from is not considered. This analysis is made in a next paper.

8 The average duration of a taxi is a parameter representing the overall travel conditions in the system analyzed (the network considered and the analysis period). Therefore congestion produced by the other traffic is implicitly considered in the average run duration.

9 ESTRAUS is an strategic planning model developed and used by the Chilean government (See De Cea, J.; Fernández, J.E. and Soto, A. (2000)).

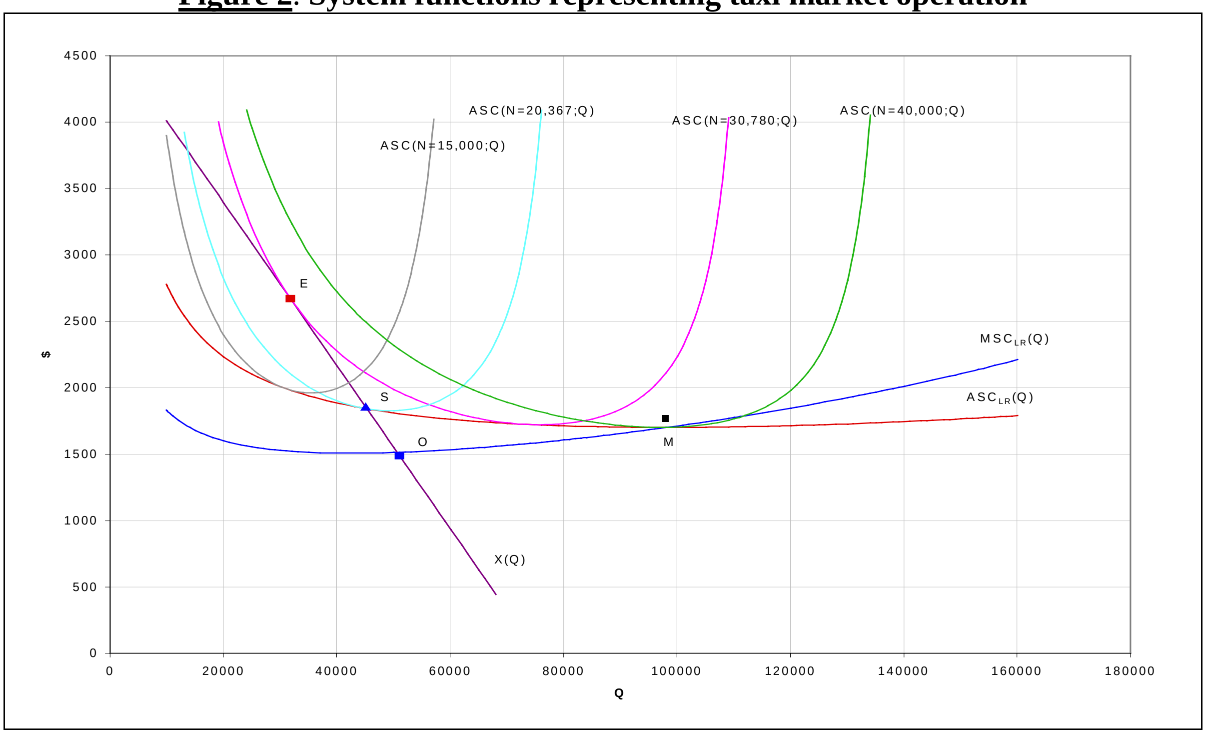
10 Given that the road system operation is governed by the user's equilibrium Wardrop principle. The number of alternative routes used to travel between two points increases as the O-D flows increase.

Figure 1. Time flow relationship for taxis in the city of Santiago



Using the data shown in Tables 1 and 2, the relevant functions describing the operation of the taxi market according top the microeconomic model developed in Fernández, De Cea and Briones (2000) were calculated. This are graphically shown in Figure 2. and correspond to: (i) the market demand function for taxi services *X(Q)*, (ii) the short run average system cost functions *ASC(N,Q)*, (iii) the average and marginal long run system costs, $ASC_{LR}(Q)$ and $MSC_{LR}(Q)$. Some intersections between these functions represent market conditions of interest for our analysis: free market equilibrium *T*, system social optimum *O*, and second best solution *S*.

Figure 2. System functions representing taxi market operation



Short run system average cost functions are represented in Figure 2 for different fleet size values: $N = 15{,}000$; *20,367*; *30,780* and *40,000*. These functions consider the unitary costs (average cost per run) incurred by both taxi operators and passengers to produce a taxi run when the fleet size is fixed. The functions have a general U form. This is because, for a small number of runs, the fix costs corresponding to production factors provided by taxi operators are the most relevant; therefore the average production cost decreases as these costs are distributed among an increasing number of runs. When the number of runs is large, the fix taxi operating costs become small per run produced; however as the runs production capacity of the system (maximum number of runs) is approached, $Q \Rightarrow N/t$, the average cost corresponding to factors provided by the passengers (specially waiting time) increases considerably, making the functions to increase. The increasing part reflects the negative externality in taxi services consumption, corresponding to the increase in waiting times generated on all other current passengers by the consumption of an additional run. It can be also observed that as fleet size increases the separation between the decreasing and increasing arms of the functions, increases[11].

Long run average and marginal system cost functions: $ASC_{LR}(Q)$ and $MSC_{LR}(Q)$, are also shown in Figure 2. The first one corresponds to the lower envelope of short run average system cost functions. The marginal cost function intersects with the marginal cost function at a production level of $Q^* = 98{,}000$ runs (point *M* in the figure). This corresponds to the minimum point of the average cost function. For $Q < Q^*$, the long run average cost function decreases with *Q*, and it turns increasing after that. The increasing part is produced by the effect of congestion on costs. As we can see this point corresponds to a significantly higher number of runs than that currently produced in the system ($Q = 34{,}238$, see table 3).

Finally, the demand function, $X(Q)$, is represented in Figure 2. This function gives the total passengers willingness to pay for taxi runs, expressed in terms of "generalized prices", *GP*. This prices are expressed considering the sum of fare plus travel and waiting times values experienced by taxi passengers. In this study we consider a linear for the demand function.

The following points shown in Figure 2 are of special interest:

1. The **Social Optimum** corresponds to the system operation that maximizes total social benefits and corresponds to point (*O* of Figure 2) where the demand function intersects to the long run system marginal cost function. For the Santiago de Chile taxi system, represented in the figure it corresponds to an operation where *50,670* runs are consumed ($Q^* = 50{,}670$). In this case and given that for such consumption level, the long run system marginal cost is lower than the long run system average cost: $ASC_{LR}(Q^*) > MSC_{LR}(Q^*)$, the operation produces loses for the taxi operators that must charge a fare that is lower than the corresponding unitary production cost. Therefore, this operational conditions would need a subsidy for the taxi operators. As we can see from the figure, such deficitary result will occur for any social optimum with $Q^* < 98{,}000$ runs.
2. The **long run free market equilibrium** is obtained at the point *T*, where the demand function is tangent to a short run system average cost function. In our case this condition is obtained for a taxi fleet size of *30,770* taxis ($N_T = 30{,}780$) and a level of consumption equal to *31,848* runs ($Q_T = 31{,}848$). In such free market equilibrium the fare charged is equal to the unitary production cost of a run and profits are zero.

[11] For an explanation of this and other technical characteristics of the model used, readers are referred to Fernández De Cea and Briones (2000).

Therefore, there is not incentive for a change in the number of taxis operating in the market. For the level of demand existing in the case analyzed any other fleet size would not correspond to an equilibrium.

3. Finally we call **second best solution** to the operating condition corresponding to the point where the demand function intersects with the long run system average cost function (point *S* in Figure 2). This corresponds to a system operation at which total social benefits are maximized subject to a financial constraint (operational income equal operational cost). Obviously social benefits are lower than for the social optimum *O*; however, subsidies are not necessary in this case.

Table 3. Comparison of four conditions for the Santiago taxi system

Characteristics	Equilibrium (T)	Current Situation	Social Óptimum (O)	Second Best (S)
Fleet size [Nº vehicles]	30,780	30,582	22,317	20,367
Run consumption [runs/hr.]	31,848	34,238	50,670	45,330
Average Travel time [hrs.]	0.268	0.268	0.251	0.248
Velocity [Km/hr]	19.4	19.4	20.7	21.0
Average occupancy rate[%]	28	30	57	55
Taxi operating cost[$/hr]	2,035	1,880	927	945
Waiting time cost [$/hr]	205	213	476	499
Fare ($ of 1999)	2,034	1,880	634	946
Elasticity	-1.37	-1.20	-0.49	-0.66
Consumer surplus [$/hr]	31,133,955	35,983,000	78,810,482	63,074,470
Taxi drivers surplus [$/hr]	0	0	-14,835,418	0
Social Welfare [$/hr]	31,133,955	35,983,000	63,975,063	63,074,470

Table 3 presents a numerical comparison of the characteristics corresponding to the three system states identified above with the current situation. Based on this data we can make the following comments:

i) Current situation vs. free market equilibrium. The main observation is that both states have very close results for all the items considered. Given this we can say that the current situation of the Santiago taxi system corresponds to what would have been expected from a free market equilibrium. This is not surprising, given that the policy applied to this market during the period was of free market: free entry and exit with some minimal technical requirements for the vehicles used and free fares.

ii) Social optimum vs. second best. Again we can say that both system states are similar. The main difference is that in the social optimum loses are experienced by taxi operators. This are eliminated in the second best case by an important increase in the fares charged (from $ 634 to $ 946). This produces a reduction in the number of runs consumed from 50,670 to 45,330, which generates a reduction in the social benefit, from $ 63,975,063 to $ 63,074,470. All the other values shown are not significantly different. The similarity of the two states will lead to recommend the second best instead of the social optimum conditions eliminating the need to use subsidies.

iii) Second best vs. current situation. Both states differ considerably . The fleet size is 50% higher in the current situation than the corresponding to the second best, but the number of runs consumed is 25% lower, which implies a considerable lower occupancy rate (30% vs. 55%) and therefore a considerable higher fare value (100% higher). As a consequence, the Social benefit obtained is 40% lower in the current situation.

Given the above comparisons we can conclude that the current state of the taxi system of Santiago is far from been socially optimum. The amount of resources used to produce the taxi runs finally consumed is too high. This produces an important reduction in the social benefits obtained from the system operation.

4. ANALYSIS OF TYPICAL REGULATORY POLICIES

In this section we analyze de effect of the application of different typical regulatory policies that are usually applied to urban taxi systems, (see op. cit. Fernandez et al. 2000) with the objective of improving its social performance.

For the case of the taxi system of Santiago de Chile, a regulation tending to obtain the social optimum (point *O* in Figure 2) was discarded from the beginning, given the government policy of not using subsidies but in very especial cases. In this case the so called second best corresponds to operating conditions that are not far away from the social optimum at a not big cost in terms of reduction of social benefits[12] (see Table 3.). Therefore, the following regulatory policies were analyzed in order to obtain a second best condition:

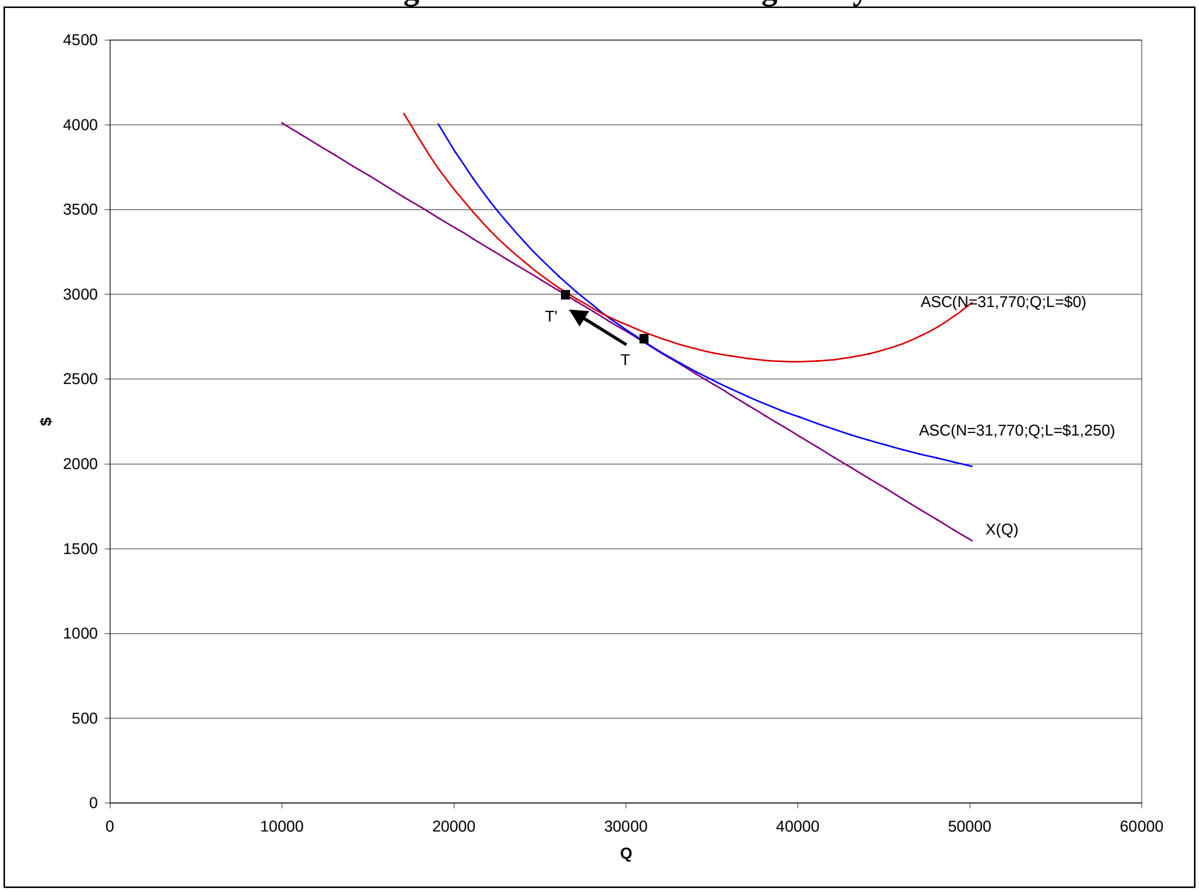
1. Service fare regulation. In this case the average run fare is fixed equal to a value corresponding to the second best state: *f = $946* (see Table 3). Entry and exit to the market are kept free, allowing the fleet to adjust to the new supply requirements (*N = 20,367*). Given the initial financial situation of operators, with zero profits (in the current situation), the fare reduction will generate loses (negative profits) in the short run. This will produce incentives for some of the operators to leave the market until the financial equilibrium is reestablish again with zero profits. This will require that *10,215* taxis (*30,582 – 20,367*) leave the system. On the other hand the fare reduction will produce a consumption increase from *34,238* to *48,000* runs producing (together with the fleet reduction) an increase of occupancy rates that will compensate the lose of income from the fare reduction. Therefore, the system conditions will change from the situation described by point *SA* in Figure 2 to the situation described by point *S*. All the numbers mentioned are taken from Table 3. From the point of view of taxi run consumers, the taxis occupancy rate will produce an increase in waiting time cost from *$213* to *$ 499* (waiting times will increase from 3.99 min. to 9.35 min.). This additional cost will be more than compensated by the fare reduction, and therefore consumption will increase.

   It is obvious that the same result could be obtained if both the fare and the fleet size are regulated (*f = $946* and *N = 20,367*). However as we saw in the previous paragraph, the fleet adjustment can be automatically regulated by the market if we maintain a free entry/exit policy.

[12] It is also necessary to consider that the application ob subsidies is not economically costless. It is probable in this case that the administrative and allocation costs of a subsidy system compensates an important part of the social loss.

2. Licensing policies. In this case each taxi is required a license to operate. Licensed can be traded in a secondary market; therefore if a new operator wants to enter the market he must buy a license form some current operator. In this case the license becomes a new input necessary for the production of taxi runs and therefore the license cost must be added to the average short and long run average costs considered before in Figure 2. Therefore the corresponding cost curves will shift up and a new free market equilibrium *T'* will be obtained, at the new tangency point between the demand function and the new short run average system cost functions (see Figure 3).

Figure 3: Effects of Licensing Policy



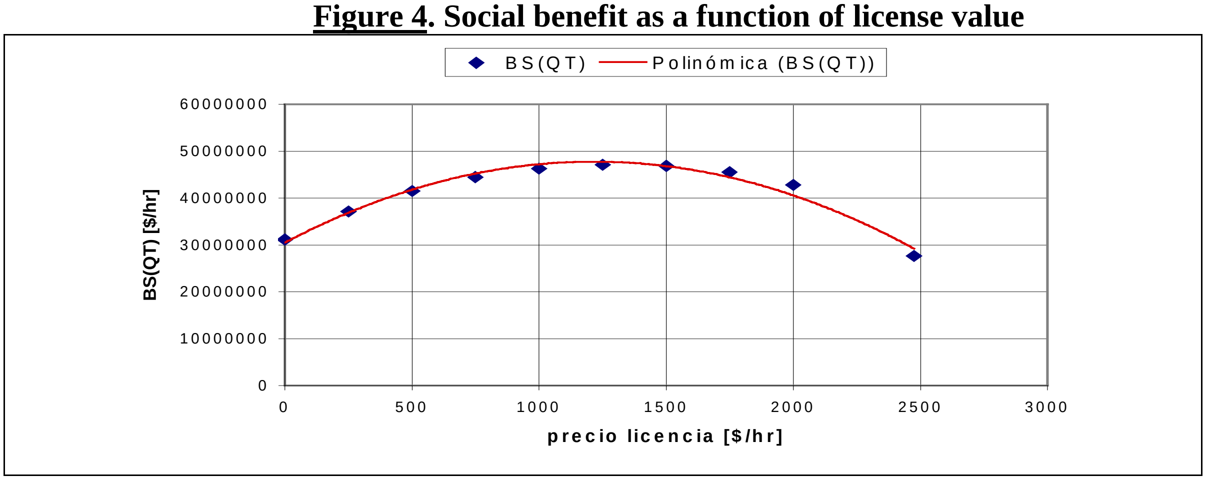
Alternatively, the government can determine a license cost and leave the market regulate the number of taxis, maintaining free entry and exit conditions with a license requirement. Table 4, presents the conditions corresponding to different equilibria, obtained as a consequence of the application of different license prices.

Tabla 4: Different license price effects

License Price [$/hr]	Fleet size [taxis]	Runs consumption [runs/hr]	Waiting time [min]	Consumers surplus [$/hr]	Licenses Value [$/hr]	Social Welfare [$/hr]
0	30,780	31,848	3.8	31,133,955	0	31,133,955
250	27,200	31,441	4.5	30,343,438	6,800,000	37,143,438
500	24,200	30,942	5.3	29,388,192	12,100,000	41,488,192
750	21,600	30,337	6.1	28,250,240	16,200,000	44,450,240
1,000	19,400	29,580	7.1	26,858,356	19,400,000	46,258,356
1,250	17,500	28,664	8.1	25,219,822	21,875,000	47,094,822
1,500	15,700	27,548	9.4	23,294,587	23,550,000	46,844,587
1,750	14,000	26,158	10.9	21,003,761	24,500,000	45,503,761
2,000	12,300	24,350	12.8	18,201,069	24,600,000	42,801,069
2,170	10,116	17,938	14.2	9,813,943	21,951,832	31,765,775

With a license cost equal to zero we obtain the current situation (or what we called before a free market equilibrium). We can observe that as the license increases from a minimum of *$250* per hour to a maximum of *$2,170*, the following effects are obtained: i) market equilibriums are obtained with increasingly reduced number of taxis; from a maximum of *30,780* taxis, in the current situation (zero cost license), to a minimum of *10,116* with the most expensive license, ii) the number of runs consumed decreases; form *31,848* to *17,938*, iii) passengers waiting times increase; from *3.8 min.* to *14.2 min.*, iv) consumer surplus decreases from a maximum of *$31,133,955* to a minimum of *$9,813,943*. v) Income received from licenses increases up to a maximum of *$24,600,000* and then decreases, vi) total social benefit obtained, firstly increases up to *$47,094,822* and then decreases. We can observe that the license price that maximizes social benefit is *$1,250*. We call this the "optimum license". The variation in the total social benefit obtained with the change in license value is graphically presented in Figure 4.

Figure 4. Social benefit as a function of license value



3. Fleet regulation. In this case the authority fixes the number of taxis that can operate. To be effective this number must be lower than the current number of taxis in the

system. The effects of fleet regulation in the range of 27,200 to 10,116 taxis was calculated and is presented in Table 5.

From the operational point of view the reduction in the number of taxis produces: i) an increase of passengers waiting times produced by the reduction of taxis availability; as we can see in the table, waiting time increases from *3.95* min. for a fleet size of *27,200* taxis, to *9.8*7 min. for *10,116* taxis, ii) a reduction of the average run travel time, because road congestion is reduced. From the economic point of view we can see that: i) fares increase significantly from $1,880 in the current situation to a maximum of $3,346 when fleet size is *10,116*; at the same time the number of runs consumed decreases from *34,238*, to only *6,364*, ii) the social benefit decreases significantly, from *$13,682,068* to *$1,235,265*. It is interesting observing that with a fleet size fixed to the amount corresponding to social optimum (*22,317* taxis, see Table 3) the social benefit obtained is only about *$7,000,000* (only a *9%* of the benefit corresponding to the social optimum).

As we can see the fleet size regulation is a bad policy from the social perspective. This is consistent with the conclusions obtained in theoretical studies (Fernandez et al. 2000). When, fleet size is fixed (to a size lower than the market equilibrium) taxi operators obtain a monopoly power to increase fares. The higher the fleet reduction, with respect to the market equilibrium, the higher the monopoly power and the social losses produced. Operators obtain only transitory benefits, because as fares increase and runs consumed are reduced, short run average system costs increase faster than fares, until both become equal; then the fare increase process is stopped, because further fare increases would produce loses (average cost higher than fare). The only way to avoid such situation is by fixing fares, additionally to fleet size. But, as we saw before, if fares are fixed equal to the values corresponding to a social optimum or a second best, fleet size regulation is not necessary; a consistent fleet size will be obtained if free entry/exit is maintained.

A synthesis of the results obtained with different regulatory policies analyzed is presented in Table 5. It is important to notice that in all the cases analyzed taxi operators obtain zero profits (income from fares exactly cover total cost incurred). In the first three cases (Second best fare, optimum license and free market equilibrium) the operators surplus are eliminated by the fleet adjustment process; new taxi entries are produced until profits are eliminated. In the last case (fleet size regulation) transitory profits are eliminated because the fares are increased until they are equal to long run average system costs; the operators greedy defeats there very purpose of obtaining profits.

Table 5: Effects of fleet size regulation (License Price = $0/hr)

Fleet size [taxis]	Runs consumption [runs/hr]	fare [$]	Waiting time [min]	Social Welfare [$/hr]
27,200	21,180	2703	3.95	13,682,068
24,200	17,443	2920	4.34	9,279,877
21,600	14,843	3063	4.79	6,719,597
19,400	12,916	3162	5.28	5,088,103
17,500	11,397	3232	5.81	3,961,694
15,700	10,057	3286	6.44	3,084,869
14,000	8,865	3324	7.18	2,396,941
12,300	7,735	3347	8.15	1,824,822
10,116	6,364	3346	9.87	1,235,265

Comparing the results presented in Table 5, we can conclude that second best fare regulation and optimum licensing produce higher social benefits than a free market policy, like the applied to the Santiago case until 1998. However, the two regulatory policies considered have a completely different structure of benefits. Second best fare regulation produces a significantly higher social benefit and all of it goes to consumers; optimum licensing reduces the benefits obtained by consumers in the free market equilibrium (from *$35,983,000* to *$25,219,822*), but produces license values. From the social point of view the first policy is clearly superior. The worst policy, as mentioned before, is always the fleet size regulation. The best possible result of fleet size regulation will be obtained when the fleet size is fixed equal to the value corresponding to a free market equilibrium. Therefore, a free market policy (free fare and free entry) is at least as good as the best possible fleet size regulation policy.
The values corresponding to the main operational variables for the policies analyzed are presented in Table 6.

Tabla 6: Social Welfare of each policy

Ranking	Regulation Policy	Consumer surplus [$/Hr]	Licenses Value [$/Hr]	Social Welfare [$/Hr]
1	Second best fare	63,074,470	0	63,074,470
2	Optimum license	25,219,822	21,875,000	47,094,822
3	Free market	35,983,000	0	35,983,000
4	Fleet size (N=27,200)	13,682,068	0	13,682,068

The first important observation is that the four policies reported have very similar fleet sizes (for three of the cases the value is the same). However, there are important differences in terms of fare value and generalized price between the first two policies and the last two policies; there are also important differences of runs consumed.

5. CONCLUDING REMARKS AND RECOMMENDATIONS.

From the analysis performed we can conclude that the second best produces a social benefit that is very close (1.41% less) that the obtained in the social optimum state. On the other hand, it generates a social benefits increase of *75.3%*, with respect to the current situation (or free market equilibrium). Therefore, and given that it does not require subsidies, it appears as the most attractive policy to implement. The implementation of this policy will require fixing the fares equal to *f = $946*, and keep a free entry/exit policy. Obviously, the fare reduction from the current situation (*f = $1,880*) and the short run loses that this will generate to current operators, will surely produce some political problems with them. This should be considered in order to design a feasible implementation policy, (acceptable for taxi operators). An specific alternative could be that the government recognizes the rights of current operators and therefore offers to pay a reasonable compensation to some of them, to leave the market. The number of operators compensations should be consistent with the adjustment in fleet size that must be produced to reach a second best state.

Fleet size regulation policies clearly produce the worst results from the social point of view. The benefits obtained are clearly lower than those obtained with the other policies analyzed. In special this policy is in general considerably worse than a free market policy (produces significantly lower social benefits) and therefore should never be applied.

Licensing policies like those analyzed in this work, though superior to fleet size regulation, are clearly worse than second best fare regulation, considering the social benefits generated.

Finally, the application of a fare regulation policy could produce some important implementation problems if they are not complemented with additional regulations that guaranty a minimum service quality. Otherwise, operators could reduce service quality, using cheaper vehicles and low salary drivers, in order to reduce production costs and increasing profits. Notice that to calculate the regulated fares a service quality level must be defined (vehicle type and driver salary). Therefore, the use of a fare regulation policy should always be accompanied by the implementation of technical requirements (to vehicles and drivers) to make sure that the level of service quality assumed for the fare determination is guarantied. Otherwise, the regulation policy will be undefined because, a given fare value is only justified by a given quality of service.

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