THE ECONOMIC REASONS FOR PRICE AND ENTRY REGULATION OF TAXICABS

A Comment

By Richard B. Coffman*

In his article in this Journal [1], Professor Chanoch Shreiber argues that price and entry regulations are necessary in the taxicab industry to (a) correct resource misallocation due to lack of price competition in the unregulated industry, (b) correct misallocation due to pollution and congestion externalities, (c) establish "a price differential between cabs and mass transit equal to the difference in the marginal costs" of these two forms of transport, and (d) stabilise the incomes of those permanently employed in the industry.

I question the necessity of price and entry regulations for any of these purposes. Further, I am in substantial disagreement with the positive and normative economic analysis which lies behind Shreiber’s policy proposals. In this comment I will (a) present an alternative to Shreiber’s model of price determination in the taxicab industry, (b) present an alternative to Shreiber’s view that there are no “inherent deficiencies in a system of regulation” (p. 279), and (c) comment briefly on his proposals for specific price and entry regulations.

PRICE DETERMINATION IN THE CAB INDUSTRY
The question how prices are determined in the cab industry is at the heart of Shreiber’s arguments in favour of regulation; so it will be also at the heart of my criticisms of his analysis.

First, Shreiber rejects the notion that in the absence of regulation prices will be determined in the cab industry through competition among firms. Even if the basic structural conditions for competitive industry are met (low concentration ratios and free entry and exit of firms), he says, the spatial nature of the industry will preclude price cutting. Cabs seek customers by cruising. Therefore, customers have no opportunity to shop around for price and then return to the lowest price seller. Thus customers will not shop for price. They will take the first available cab. Any seller who lowered his price would only lower his revenue, not increase the number of passengers who selected his cab rather than others. Cab owners, understanding this, will have no incentive to try to lower prices as a means of generating new business.

Further, Shreiber says, in other industries where sellers operate from fixed

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locations, consumers are willing to invest in searching for lower prices because the information gained can be used to save them money on repeat purchases. The payoff from searching for a lower priced cab, however, is limited to cost savings on the current purchase. This further reduces the incentive for consumers to search for price. Thus, in Shreiber's view, individual cab operators will face highly inelastic demand curves, rather than the infinitely elastic demand curve of the competitive firm. Under these circumstances Shreiber sees only one case where cab operators are liable to compete in price—the case where cabs are so abundant that they pass prospective passengers in groups rather than singly (p. 271).

Second, Shreiber proposes a special theory of price determination to explain the workings of the cab industry. In this theory there is a natural floor on prices, a natural ceiling, and a tendency for prices to rise toward the ceiling. The floor comes at the level where price per ride is so low that even a cab taking on the maximum number of fares possible in each time period cannot generate enough revenue to cover total cost. If price drops to this level (just below Shreiber's $P_1$) firms will leave the industry and price will rise. The price ceiling is in the neighbourhood of Shreiber's $P_1$, which is the price where the quantity demanded of cab rides is so low cabs cruise empty most of the time and pass prospective passengers in groups. Waiting time for customers approaches zero, and cab operators will compete by cutting prices, "but whenever (price) falls below $P_1$ there will be no market forces to drive it further down (p. 271)." Between $P_1$ and $P_2$, cab operators face the previously mentioned inelastic demand curves, and thus will tend to raise prices. The result, then, is that "price will be relatively high and cab occupancy low."

Several criticisms of this analysis can be offered. First, Shreiber's *a priori* dismissal of the possibility of price competition in the cab industry is not convincing. Second, Shreiber's rejection of the competitive model is only *a priori*, and is unsupported by any empirical testing of the predictions of the competitive model. Third, Shreiber's own model of price determination fails to specify equilibrium conditions, and is difficult to make operational. Fourth, the competitive model does a better job than Shreiber's model in explaining much of the data he presents on the workings of an unregulated cab industry. These points will be discussed in the order listed.

*A priori* arguments

First, what *a priori* arguments can be advanced to revive the competitive model? Consider the case of a moderately large fleet operator. In order to overcome Shreiber's barriers to price cutting he need only advertise lower fares (through newspapers, radio, television, and prominent posting on his cabs), and give his cabs a distinctive appearance so that customers can distinguish them from the cabs of his competitors. This will provide valuable information to price-conscious consumers. Cab users will, through even casual observation, form impressions of the relative availability of the now lower-priced cabs; thus they will be aware that there is some rate at which they can trade off waiting time for lower prices. This trade-off rate will be lower than the one they faced before the price cut, and so, by the normal logic of consumer behaviour theory, it is to be predicted that they will reject the
good "short waiting time" in favour of the good "low price." Stated another way, price cutting will generate some new business for the price cutter.

Further, the fleet operator's announcement of lower fares should generate additional business from a source Shrieber has apparently overlooked. That is, a certain amount of cab business is initiated by the customers who phone for a cab rather than hailing one on the street. These customers can switch their business almost costlessly from one firm to another; so any firm should find its demand curve from this segment of the market to be highly sensitive to price.

The previous paragraphs have suggested that there are a priori reasons for predicting that price competition may emerge in the cab industry. Whether it does actually emerge, of course, depends on whether or not it is profitable, which in turn depends on the costs of advertising and cab differentiation and on the size of consumers' response to the lowering of price. However, even if there were no easy a priori arguments in favour of the competitive model, there would be no good reason to reject it on a priori grounds. This argument will now be developed as my second criticism of Shrieber's analysis of price determination.

Need for empirical testing

My second point is essentially a methodological one. Shrieber rejects the competitive model because he feels its assumption of price competition as a form of business conduct is inappropriate in the cab industry, rather than because the model has failed to perform well in empirical tests of its predictions in this industry. This seems to be the kind of methodology which Milton Friedman warned us against so long ago [2]. Whether or not one accepts Friedman's position that predictive ability should be the sole test of a theory, there can be little dispute that empirical testing is of primary importance in evaluating any theory. It therefore seems difficult to make a good case for rejecting a major economic model, such as the competitive model, on a priori grounds in any particular case. Doubts about the relevance of a received model's assumptions in a particular case may stimulate a search for alternative models or analytical frameworks; but ideally this search should lead to confrontation of the competing models in a series of empirical tests, not to a priori rejection of some models, and subsequent marshalling of data related to those remaining.

Equilibrium and Statics

Perhaps it is the lack of empirical orientation which opens Shrieber to my third criticism. An empirically oriented, positive economist develops his models in terms which make them amenable to testing. This generally implies specifying equilibrium conditions for a system of equations and then working out testable propositions through comparative statics. From that perspective Shrieber's model of the cab industry seems somewhat vague, since it contains neither equilibrium conditions nor explicit comparative statics predictions.

The problems become apparent as soon as we ask where price is to settle in Shrieber's model. The model offers only a range of possible equilibrium prices, $P_1$ to $P_2$, with no indication of what forces determine which price within this range will prevail. A careful reading seems to suggest that price should settle at $P_1$, since there is pressure for prices to rise if below this level, and, as previously explained,
price competition if prices go above it. Unfortunately, however, the level \( P_1 \) is not clearly defined or specified in the model.

Shreiber identifies \( P_1 \) (and the corresponding number of rides, \( R_1 \)) as follows: "When empty cabs are so abundant that they pass passengers in groups the waiting time must be close to 0. This situation corresponds to the section of the demand curve above the price \( P_1 \) — the range where the relation between price and availability ceases (p. 271)" and "As the number of rides per cab decreases a point will be reached (call it \( R_1 \)) where fewer rides per cab will not increase cab availability . . . (below \( R_1 \)) average waiting time will be reduced to a level approaching zero" (p. 270).

Note that the critical \( P_1R_1 \) combination is not identified as the point where waiting time equals zero. Rather, it is the point beyond which waiting time approaches zero. This is not very helpful, since waiting time approaches zero continuously as price rises from level \( P_1 \). Clearly the key question is how close to zero waiting time has to come before competition breaks out. In its present form Shreiber's proposition that price competition will not occur until waiting time approaches zero is not a testable proposition, since it could not be refuted by any conceivable evidence. The same problem is found in Shreiber's other approach to identifying the range above \( P_1 \): it is not clear what operational meaning is to be attached to the notion that this range is identified with "groups" of cabs passing waiting passengers. The same sort of question has to be asked again. How big does the group have to be before price competition occurs? The term seems to imply a considerable number of cabs, but then three is also a group. If Shreiber's model is interpreted as predicting competition whenever two or three cabs converge on a customer, it would seem to predict competition as a frequent, rather than rare, occurrence, especially in off-peak hours around major business districts, and much of the time around bus, train, and air terminals. However the term "groups" is interpreted, though, my main complaint is that it has been left open to interpretation, and thus the theory advanced by Shreiber does not produce any potentially refutable propositions about the equilibrium level of price in the cab industry.

The situation is somewhat better with regard to comparative statics predictions, although here too the lack of precision about exactly where \( P_1 \) is creates problems. These aside, though, Shreiber's model would appear to predict that price would not fall in response to rightward supply shifts or leftward demand shifts except in the special circumstance that cab occupancy was extremely low, and waiting time "close" to zero. Furthermore, once price had fallen to \( P_1 \), there would be no further tendency for it to fall, and if it fell below that level there would be a tendency for it to rise again.

**Comparison with competitive model**

In contrast, the competitive model predicts that price will fall in response to the relevant parameter shifts, no matter what the initial price level. This difference in the predictions of the two models means they can conceivably be subjected to empirical test. Shreiber provides some data which is relevant to choosing between the two models. My interpretation of that data leads me to my fourth criticism of Shreiber's analysis, which is, that Shreiber's model performs less well than the
competitive model in explaining price behaviour in at least once instance of a free market situation.

The data is for the New York City cab industry during what Shreiber refers to as an unregulated period, from about 1920 to 1937. The figures relevant for my purposes are for the years 1920 to 1933. They are as follows. The price for a cab trip of 2.4 miles (and a waiting time of three minutes) was $1.15 from 1920 to 1922, “90c thereafter until July 1924, (and) 66c from July 1924 to October 1933” (p. 274). It seems unlikely that this pattern of prices can be explained by Shreiber’s model. In Shreiber’s terms the price of $1.15 for the period of 1920-1922 should be considered to be $P_1$, since there was no tendency for it to either rise or fall. However, suddenly in 1922 price began to fall, and it did not stop until finding a new level 21.7% lower than previously. Apparently this is to be considered a new level for $P_1$, since price held steady here for two years. At the end of that time, however, price dropped another 26.7%, and then held steady for nine years.

Thus Shreiber’s model, which predicts a persistent tendency for price to rise and only rare marginal downward adjustments in price, is confronted with a thirteen-year period in which price did not rise at all, and in which price in fact fell 42.6% over a two-year period; the fall must be ascribed to two sizable falls in the natural price ceiling, $P_1$, a phenomenon which Shreiber's model does not predict or explain.

The competitive model, on the other hand, could obviously generate predictions which would be consistent with this thirteen-year price pattern. What is more interesting, though, is that the competitive model can offer an explanation to show why price adjustments were made in infrequent, substantial jumps during the period, rather than as continuous, marginal adjustments. The explanation begins with an important piece of information which Shreiber omitted from his article, but which he has supplied to me in personal discussion of the questions I am raising here. Shreiber has informed me that during this time price changes, while not requiring the approval of any city agency, could be legally made only through the mechanism of having a Police Department representative reset the meter in individual cabs. A fee was charged for this service. This puts a new light on the problem of price determination during the “unregulated” period, because the existence of this legal requirement raises a barrier to price competition. Any firm wishing to change prices would face both out-of-pocket costs of the fee and opportunity costs of down time for cabs. These costs may have been substantial in the 1920s. At least, the same costs appear to be substantial today: according to an article in the *New York Times* (15 March 1977, p. 28) cab owners estimate a cost of $90 per meter to recalibrate for new fare levels announced by the regulatory authorities. Cost barriers of this sort would almost certainly be sufficient to eliminate some potentially important forms of price competition such as peak/off-peak pricing. It is more important for our purposes that it would probably forestall frequent price adjustment to slowly changing market conditions. Since changing prices was a costly operation, firms would want to avoid unnecessary price changes. Specifically, they would want to avoid changing prices in response to temporary, short-lived changes in the market equilibrium price. Otherwise they would have to incur price-changing costs both coming and going, as pricedeviated from and then returned to its long-run equilibrium level.
Price changing would only become profitable when enough evidence had accumulated to convince firms that there was a high probability that long-run equilibrium price had changed by a substantial amount. Quite clearly, the observed thirteen-year pattern of prices in the New York City case is consistent with the operation of this form of price adjustment in the context of a substantial downward drift of the long-run equilibrium price, followed by a period of little change in fundamental economic forces affecting the industry. Of course, whether in fact such a pattern of parameter changes occurred is a problem for more detailed empirical study.

INHERENT DEFICIENCIES IN A SYSTEM OF REGULATION

Shreiber's a priori rejection of the competitive model and his replacement of it with an ad hoc model which treats price as indeterminant lead him to the conclusion that prices are "arbitrary" in the unregulated industry, and from there to advocacy of price regulation as a means of improving resource allocation. Unfortunately, though, he is very unspecific about what would constitute an improvement in resource allocation, and vague on how improvements are to be achieved in practice. Here is what he says: "Price regulation is therefore needed to achieve a satisfactory price/availability combination . . . The most desirable price/availability combination would depend on what the (regulatory) agency seeks to achieve . . . Whatever the goal of regulation, it can certainly, if properly administered, bring about better resource allocation and passenger satisfaction than an arbitrary price." (pp. 271-2—italics mine).

But economics does not deal with "satisfactory" resource allocation; it deals with carefully specified concepts of optimality, sub-optimality, and second best solutions. Further, optimal allocation depends not on what regulators seek to achieve, but on consumers' marginal rates of substitution in consumption, producers' marginal rates of input substitution, and marginal rates of product transformation, all given the resource endowments and technology and the distribution of income. Finally, whether one institution—regulation—can be expected to generate higher levels of social welfare (somehow defined) than another—the market—is a problem involving matters more basic than "proper administration." Specifically, it involves positive questions of the equilibrium behaviour patterns of each institution, and of how that behaviour will affect resource allocation in the industry in question.

This section of my paper is devoted to elaborating the final point made in the above paragraph. We can start by observing that it is not sensible to advocate government regulation simply because an unregulated industry fails to operate as a perfectly competitive industry should. Regulation may also operate imperfectly, and perhaps create an even larger welfare loss than would have been suffered in the absence of regulation. For example, a regulatory agency may be "captured" by the regulatees, who will then turn the power of the state to their own ends, perhaps creating and protecting monopoly power which would not have existed in the unregulated industry.
Analysis of the behaviour of regulatory agencies and regulated industries is a subject which has received much attention in the growing field of property rights economics [3], [4], [5], [6], [7]. While traditional micro-economic theory dealt almost exclusively with the behaviour of profit-seeking firms, modern property rights theory is concerned with formal models of a wider spectrum of economic organisation. These include traditional single owner firms, partnerships, corporations (both regulated and unregulated), Russian communal farms, Yugoslavian worker co-operatives, and bureaucratic and regulatory agencies of governments of all kinds. The models in this field have in common the notion that decision makers are utility maximisers with several arguments in their utility functions, who face constraints on their behaviour determined by the nature of the institutions they operate in. The equilibrium behaviour patterns of these institutions will, then, ultimately depend on the costs and benefits of various courses of action to the utility maximising individuals who people them.

This framework has been applied by Professor Ross D. Eckert in a study of the behaviour of cab industry regulators [8]. Eckert has hypothesised that the effects of cab regulation will vary with the choice of regulatory method—permanent regulatory agencies run by career bureaucrats, or regulatory commissions consisting of members appointed for limited terms. He assumes that "utility is a function of numerous items such as (the regulator's) personal prestige, wealth, convenience, and working conditions, and his desire to please other officials and voters, expand his agency's budget, and implement his conception of the public interest" (p. 84). A difference between the relative behaviour of bureaucrats and of commissioners is predicted because of differences in the cost-reward structure facing them. Since bureaucrats' salaries are usually directly related to the size of the organisation, career bureaucrats will find it worth while to 'seek to regulate additional firms and to complicate procedures by imposing new regulatory requirements on all firms, as both actions would justify larger budgets and salaries' (p.84). On the other hand, "commissioners, owing to their generally shorter time in office, will value less than will (bureaucrats) whatever future salary gains they could collar by voting for expanded regulation" (p.85), and thus "economic theory implies that it would be less expensive (more rewarding) for the commissioner, relative to the civil service official, to simplify, neglect or refrain from devoting more time to regulation" (p.86).

This reasoning leads Eckert to the predictions that "commissioners will more often choose to restrict entry of new firms and to reduce the disagreements among existing firms to make their duties less onerous. That is, monopoly or monopolistic restrictions should be more common in markets regulated by commissioners than in those regulated by bureaucratic agencies . . . such 'regulation' may sometimes be indistinguishable from self-regulation (cartelisation) by the operators" (p.87). Eckert conducts empirical tests of four implications of his theory, and finds results generally consistent with the theory. Further, a number of other studies have given empirical support to the property rights approach to the study of economic organisation.\(^1\) It is thus instructive to compare the view of the regulatory process which emerges from this theory with the views espoused by Shreiber.

PRICE AND ENTRY REGULATION OF TAXICABS

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The property rights approach
The property rights approach suggests that it is extremely unlikely that regulatory agencies will single-mindedly pursue economic efficiency or the public interest. Even if these things are valued "goods" to regulators, they will not be the only things valued, and regulators will be willing to trade them off for income, prestige, an easy life, and so on. The equilibrium allocation of the resources at the regulators' command will be found where the ratio of marginal utility to price is the same for all goods which enter the regulators' utility functions. A realistic empirical judgement might be that in practice the relative cost to regulators of not pursuing the public interest is quite low in many cases, and so it would be unusual to find a regulatory agency devoting the greater part of its resources to the public interest.

Shreiber is much more optimistic. Reviewing the operation of the New York City system of cab regulation, he finds unsatisfactory performance: "The changes in rates that have taken place from 1937 to the present were made not for regulating cab occupancy and availability, but rather for the purpose of raising cab drivers' earnings or the profitability of cab ownership" (p. 278). However, his conclusion is that "The shortcomings of the New York City system of price/entry regulation are a result of poor administration, and not of any inherent deficiencies of a system of regulation" (p. 279). Would that this were true; and would that Shreiber could produce either theoretical or empirical support for his position.

OTHER USES OF PRICE AND ENTRY REGULATIONS

The final task of this paper is to comment on Shreiber's proposals to correct externalities, adjust relative prices in the transport sector, and stabilise cab drivers' incomes.

Air pollution and traffic congestion
Shreiber is correct in identifying air pollution and traffic congestion as externalities of cab operation. However, it is unlikely that he is correct in his argument that this implies that regulation of cab prices and entry can correct the misallocation associated with these externalities. Cabs are not the only sources of pollution and congestion. Congestion is also caused by private cars and trucks and city buses and other vehicles. Pollution comes from all these sources, and also from public utilities, industrial concerns, private homes, apartment buildings, and office buildings.

Economic efficiency requires that any given target level of air quality or traffic congestion be achieved in the least-cost way, which means comparing the marginal costs of externality reduction from each source, rather than arbitrarily singling out one source for special treatment. If, as it seems likely, marginal cost curves for externality reduction for all sources are positively sloped, the cost of Shreiber's method of pollution and congestion control would probably be quite high compared with alternative methods involving reductions in the levels of many externality creating activities.
Relative prices in the transport sector

According to Shreiber, "the price on most mass transit systems exceeds the marginal cost of a ride there . . . As long (as this is so), the price of cab rides should also exceed the marginal cost by the same amount, in order to avoid over-use of cabs and under-use of subways and buses. This result can be achieved by raising cab fares and restricting entry" (p. 8). If this is so, why stop there? If price exceeds marginal cost for mass transit, the price ratio is incorrect not just for transit versus cabs, but for transit versus private automobiles, apartments, apples, peanuts, and all other goods which compete with transit for the consumer's dollar. Why not raise all these prices as well? The answer is obvious; the basic problem lies in the transit industry and the price correction should probably be made there, rather than in all other industries. If Shreiber wants an arbitrary price to criticise and correct, he could do worse than to turn his attention from the unregulated cab industry to the regulated transit industry.

Stabilisation of cab drivers' incomes

During recessions the demand curve for cab rides shifts to the left as consumer incomes fall. At the same time the supply of cab rides shifts to the right as the unemployed from other industries set themselves up as cab drivers and small-time operators. Shreiber is opposed to this process of market adjustment: "The disadvantage of such fluctuations is that they will bring about a larger supply of cabs when there is less demand for them (i.e., in times of recession) and a smaller supply of cabs when the demand for them rises (in times of prosperity)" (p. 275). Further, he dislikes the effects this has on the distribution of income: "Cyclical fluctuations will tend to hurt those who make cab driving their permanent job — their income will necessarily decline sharply in times of recession. Restrictions (on entry) are needed to provide some income stability for these drivers" (p. 276).

This is a counsel which goes counter to considerations of economic efficiency, and which has little to recommend it as a method of income redistribution. If markets are to allocate resources in a Pareto optimal manner, then prices and quantities must be free to fluctuate in response to real changes in parameters, such as those which occur during fluctuations in aggregate demand. To restrict the cyclical inter-industry movements of labour is to misallocate resources and thus to impose a welfare cost on the economy. Further, there is no need to pay this welfare cost as a price for stabilising the incomes of cab drivers, since there are other less costly methods of stabilisation, such a direct, open income subsidies.

However, I see no good reason to single out cab drivers for income maintenance efforts. I find it somewhat puzzling that Shreiber has no sympathy for the plight of the unemployed construction workers, clerks, and factory workers whom he would prohibit from earning income in the cab industry. If there is a good argument for subsidising people on the basis of their occupations I have yet to hear it; income level is, of course, the standard basis for income supplements. Finally, I, at least, am convinced that we have enough theoretical, empirical, and practical experience with such things as rent control, agricultural price supports, minimum wage laws, fair trade laws, and so forth, to know that there is great waste and inefficiency associated with piecemeal, ad hoc, attempts to redistribute income by interfering in the workings of individual markets.
SUMMARY AND CONCLUSION

Professor Shreiber's rejection of the competitive model as a viable approach to explaining price determination in the taxi industry is not convincing (a) on a priori grounds, since, contrary to his arguments, good a priori grounds can be found for expecting price competition to exist as a form of business conduct in the industry; (b) on methodological grounds, since empirical rather than a priori tests are appropriate for evaluating alternative theories; (c) on methodological grounds again, since the theory he proposes to put in the place of the competitive model has not yet been stated in operational terms; (d) on empirical grounds, since the price data he presents on the unregulated era for the New York City taxi industry shows patterns not predicted by his theory.

Even if Shreiber's model of the taxi industry did not involve any of the problems just listed, his policy proposal for price and entry regulations to correct misallocation in the industry would be open to serious question, because recent theoretical and empirical work suggests a strong likelihood that regulatory agencies will themselves systematically misallocate resources, as indeed the taxi authorities seem to have been doing in Shreiber's study city, New York.

Finally, Shreiber's other proposals for price and entry regulation seem inappropriate because (a) pollution and congestion externalities are most efficiently dealt with by adjusting the levels of most, if not all, offending activities rather than by placing the full burden of adjustment on a single activity; (b) inequalities in the price/marginal cost ratios between the taxi and mass transit industries are probably best corrected in the transit rather than the taxi industry; (c) occupation is an inappropriate basis for the redistribution of income, and interference with market-determined prices an inefficient method.

I therefore conclude that Professor Shreiber's proposed new analysis of the taxicab industry has not succeeded in giving economists any reason to drop taxicab regulation, in theory or practice, from their list of classic cases of unnecessary, misguided, and harmful government regulation of industry.

REFERENCES

A Rejoinder

By Chanoch Shreiber†

Supply and demand analysis is inapplicable to the cruising taxicab market. The conditions for reaching equilibrium, specified in supply and demand analysis, cannot exist in the case of taxicabs, and the point of interaction between the supply and demand for taxicab rides is not an equilibrium position.

The equilibrium under supply and demand analysis is reached when the amount offered is equal to the amount taken and the amount taken is equal to the amount demanded. The equality between offered, taken and demanded cannot ever exist in the cruising taxicab market. The unavoidable lack of perfect synchronisation between passengers and available cabs makes such equality impossible.

The intersection of the supply and demand for taxicab rides is not a point of equilibrium. At the intersection, the amount of rides offered will be equal to the amount of rides demanded, but the market won’t be cleared. As a consequence of the less than perfect synchronisation, cab occupancy at the point of intersection will be less than 100% and the demand of some customers will necessarily be left unsatisfied.

AN ALTERNATIVE MODEL

The inapplicability of supply and demand requires an alternative method to analyse the taxicab market. We have offered one such method in our previous article and will present yet another here. The conclusion reached is the same, but we believe that here we enlarge on our previous presentation and help to clarify those points that might previously have been obscure.

In our analysis of the taxicab market we will make the following assumptions: (1) Cruising is the only method of operation; (2) All operators are small and in competition among themselves; (3) The cost of operating a cab depends on time alone, regardless of how many rides are made, e.g. the cost is $10 per hour of cab operation regardless of the rate of occupancy; (4) All cab operators (and potential operators) have the same cost; (5) The fare is a function of time and not distance (this assumption will hold even when the fare is a function of the distance, provided that the speed at which cabs drive while occupied is uniform). In our explanation we will use a numerical illustration in which we assume operating costs of $10 per hour and a ride length of 10 minutes. (We define a ride as a service unit of a fixed duration.) A cab in operation offers the maximum rides that can be made in the period referred to—six rides per hour in our example. In order to break even, the hourly revenue, which is a product of the number of rides taken and the price, must

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equal the cost—$10 in our example. If total revenue exceeds costs, more cabs will enter the market and thereby reduce the rate of occupancy until the breakeven position is reached. If costs exceed revenue, cabs will leave the industry and the rate of occupancy will rise until the breakeven position is attained.

In Figure 1, we combine the demand for cabs with what we term Rides Offered Curve. The Rides Offered Curve describes, at each given price, the number of rides that will be offered at that price. Our rides offered curve, unlike a supply curve, is dependent on the demand curve. To construct the rides offered curve we need to know the ratio between cabs and passengers needed to produce the breakeven number of rides per cab at each price. We will use our numerical illustration to explain the construction of the Rides Offered Curve.
The lowest possible price at which a cab could break even is $1\frac{1}{2}$. This price is also the lowest price on the rides offered curve. In order to break even at that price, cabs must operate at full occupancy. (In our previous article we called the breakeven/full occupancy price $P_f$). Now assume that the amount demanded at this $1\frac{1}{2}$ price is 60,000 rides. To ascertain the location of the rides offered curve at this price we need to know the ratio between customers and cabs needed to ensure full occupancy. Obviously, because of the less than perfect synchronisation, customers must be much more numerous than cabs to ensure full occupancy. If we assume that the ratio of customers to cabs needed to produce full occupancy is 10 to 1 (i.e. 10 rides demanded for each ride offered), the number of rides offered at the lowest price in our example should be 6,000 rides per hour and the number of cabs 1,000. If more than 1,000 cabs were in operation at this price, full occupancy would not be achieved. Cabs would not cover their costs, and some would leave until 1,000 were left.

At a higher price than $1\frac{1}{2}$ cabs would not need to operate at full occupancy. At the price of $2$, for example, each cab should be making five rides to break even. Still, until the intersection, the breakeven number of rides per hour associated with each price is not achieved unless the amount demanded exceeds the amount offered. At the intersection, the amount demanded is exactly equal to the amount offered, but the amount taken (which is equal to the amount offered multiplied by the rate of occupancy) is still less than the amount demanded. Unsatisfied demand still exists. The demand will be fully satisfied only at a price above the intersection, let's say at $P_o$. Staring at $P_o$, and at higher prices, the ratio between the amount demanded and the amount offered will correspond to the rate of occupancy. This is so because, at and above this price, the amount demanded is assumed to be equal to the number of rides actually taken. If, for example, $P_o$ is $2.50$, the rate of occupancy at that price will be $\frac{4}{6}$ (4 is the breakeven number of rides associated with $2.50$ and 6 is the number of rides offered by each cab), and the ratio between the amount demanded and the amount offered will be the same, that is, 2:3.

At $P_o$ and prices higher than $P_o$ the demand is satisfied, but average passenger waiting time will vary at each price. Average passenger waiting time depends on both the number of cabs and the rate of occupancy. The larger the number of cabs covering a certain area and the lower the rate of occupancy, the shorter will be average passenger waiting time. As explained previously, under free market conditions, with no barrier to entry, the rate of occupancy must decline as prices rise. The number of cabs, when each operator exactly covers his costs, is equal to total industry revenue divided by the cost of operation ($10 per hour in our example). Whether higher prices above $P_o$ will result in larger industry revenue depends on the elasticity of demand\(^1\). If, as we argued in our previous article, the demand for taxicab rides is inelastic in the relevant range of prices, then higher prices will result in larger industry revenue.

Since the number of cabs will increase and the rate of occupancy decrease as

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\(^1\) This is equal to the cost, $10 per hour, divided by the maximum number of rides that can be made, which we assumed to be six.

\(^2\) At prices below $P_o$, higher prices will not reduce the number of rides taken because not all the demand is satisfied. Increase in price at the range below $P_o$ will necessarily raise industry revenue.
prices rise, higher prices will bring about a reduction in average passenger waiting time. The inverse relation between prices and waiting time is correct up to that price where waiting time is reduced to 0. As in our previous article, we will call this price $P_1$. At $P_1$ cabs will be so abundant, in relation to passenters, as to reduce average waiting time to zero.

In the taxicab industry there is no unique price that will emerge as the market price. The exact market price will be determined randomly but, for reasons described below, will most likely be in the range of higher prices, with short waiting time, i.e. close to $P_1$.

Assume that the going market price happened to be fixed at a high level with short waiting time. We argue that this price, no matter how it came about, will stick.

Since we assume competition, no cab operator will have any incentive to cut his price unless by so doing he will raise his revenue. We argue that a cut in price by one operator will reduce his revenue rather than increase it, and therefore none of them will lower their prices. If only one cab owner, acting independently, proceeds to lower his price, he will gain only a negligible amount of business, if anything at all. Passengers knowing that there is only one cab (or even a few) that charge a lower rate will not turn down a higher rate cab to wait around for that one cab. The probability that this particular low rate cab will pass within a reasonable time is practically nil. No rational passenger will therefore wait for the lower rate cab. The only situation in which an individual will gain additional business through lowering his price is when he travels together with another cab and passes a passenger who notices simultaneously both him and that other cab. If, however, the passenger does not see both cabs at the same time, he will most likely hail the first one that he sees, even if the other cab is only a short distance away. Then the lower price will not help.

Coffman's argument that a moderate-sized fleet operator could generate business through advertising is inapplicable to cruising. Advertising will only make customers aware of the existence of the lower rate operator. In our analysis we assume that knowledge. However, even with that knowledge, as long as the market share of the operator is small, customers will not turn down other cabs because of the low probability that they will be passed within a reasonable time by one of the cabs of this operator. It is true, of course, that by lowering the price an operator can generate additional telephone business; but, knowing that the only possible additional business that can come from lowering the price will be from telephone, he most likely will not make the price cut across the board, but rather will offer discounts to those customers who order cabs by phone.

Our conclusion that one out of many operators will not raise his revenue by independently cutting price will hold true even where there are some operators with more than one cab, as long as none of them has a substantial share of the market. An operator that has, say, 3 per cent of the market cannot expect a rational passenger to turn down all the 97 per cent higher rate cabs and wait for one of his cabs. To do so would extend the waiting time to unreasonable lenghts.

\footnote{Average waiting time will probably approach asymptotically O as prices rise, but will not reach O. $P_1$, therefore should be interpreted as a price at which the waiting time is very close to O, after which the reduction in waiting time is infinitesimal.}
The analysis will be different if oligopoly structure is assumed, i.e. if there are operators with a large market share. In such a market, operators are likely to agree to fix the price at a point where the elasticity of demand is unitary. Occasional price wars can still be expected.

While a high price with low waiting time is likely to stick in a free market, a low price with low waiting time will not. If the average passenger waiting time is long the cab operator who, independently of the others, raises his price moderately will increase his revenue. Any passenger who turns down this high-rate cab when he comes across it will double, on the average, his waiting time. If the waiting time is already substantial, most passengers are not likely to do so, especially if the difference in price is small. As more cabs raise their price, the probability of finding a lower rate cab decreases, and passengers who reject the higher rate will more than double their waiting time. Prices therefore will creep upward over time until a short waiting time is reached.

High price, as long as it does not lead to an average waiting time close to zero, is likely to stick. If waiting time is close to zero, it implies that cabs cruise so close to each other as to enable passengers to see them simultaneously and choose between them without raising the waiting time. Under such circumstances price cutting is likely, and a high price, where waiting time is close to zero, cannot therefore be expected to stick.

WAITING TIME AND DEMAND
In our presentation so far, the demand for rides was a function of the price alone, and independent of the average passenger waiting time. Probably this is more or less correct in the range of high prices with short waiting time. At low prices, where waiting time is long, a rise in price will have two effects which will work in opposing directions. On the one hand, some passengers will stop using cabs because of the higher price: but other customers (or potential customers) will now increase their demand because of the lower waiting time. The positive effect that the lower waiting time has on the demand will reinforce the upward push of prices in a free market.

FREE MARKET VERSUS REGULATION
According to the theory of perfect competition, the price that will emerge in a perfectly competitive market will be at the point at which the amount demanded and the amount offered are equal. If the lack of perfect synchronisation between available cabs and passengers is conceded, this price will not emerge in the cab market, nor will it be a desirable price. If the amount of rides offered just equals the amount demanded, this will lead not only to extremely long waiting time, but also to actual shortage. This kind of price is neither good nor one that will stick.

If the perfect competition model is inapplicable both in predicting how the price will be determined and as a justification for the resultant price, an alternative method must be sought to analyse what is likely to happen. We have offered such
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an analysis. Our conclusion is that there is no equilibrium price in the taxicab market. Instead, there is inverse relation between prices and availability and many possible combinations of price/waiting time. In a competitive free market, the price/waiting time combination will be randomly determined and, in all likelihood, will be a combination of high price and very short waiting time.

The combination of price/waiting time, under free market conditions, is arbitrary. Even in the extreme situation when all passengers prefer a lower price/longer waiting time combination, this will not materialise in a free market. Fixing the price through regulation can be better geared to suit passenger choice of price/waiting time than an arbitrarily determined combination which will result from a free market. How the regulatory agency should determine the price is a difficult question, for which we do not have an exact answer. Our approach is pragmatic. The regulatory agency should ascertain all the price/waiting time alternatives which are possible and then, by polling customers or by some experimentation, fix the one which is most satisfactory to the majority of the customers.

A CORRECTION AND ADDITION TO THE PREVIOUS ARTICLE

In our previous article we used isorevenue curve and market demand in combination to explain price determination in the taxicab industry. The isorevenue curve described all the combinations of price and number of rides which will produce revenue equal to hourly operating costs (e.g., $10 in our numerical illustration). We then stated that the number of cabs at each price will be equal to the amount of rides demanded at that price divided by the number of rides that each cab must make at that price in order to break even. For example, in our numerical illustration, if the amount demanded is 20,000 rides at the price of $5, each cab, in order to break even, will have to make 2 rides per hour and the total number of cabs in the market will be 10,000. This last assertion is correct only if we start with the price at which the amount demanded is equal to the amount taken, i.e. at the price that we termed $P_0$. At lower prices than $P_0$ the amount taken is less than the amount demanded, and the number of cabs could not be determined by dividing the amount demanded by the breakeven number of rides per cab at that price. Instead, the number of cabs at those prices is equal to the amount of rides actually taken at each price, divided by the breakeven number of rides.

Another shortcoming in our previous article was that we failed to mention that at the lowest possible breakeven price (termed $P_1$, there and $11\frac{1}{2}$ here) the amount demanded must exceed the amount offered, and that the shortage will continue even at prices higher than $P_1$ until the price is reached at which the amount taken is equal to the amount demanded — what we call here $P_0$.

Our last point is to correct an omission. In describing the New York City experience in the pre-regulation period, we said that prices were lowered twice in the period 1920 to 1924, and thereafter remained the same until 1933, when they were raised. Unfortunately, we failed to offer an explanation for these price changes. We correct this deficiency now.

The cost of automobiles declined in the period of the early 1920s, and this
brought about a reduction in the cost of cab operation. The reduction in cost, coupled with stable fares, brought about abnormal profits and induced an influx of cabs into the industry. The increase in the number of cabs reduced waiting time to near zero, and the cut in price that our model predicts in such a case followed. After the two reductions in price the number of cabs declined sharply. At the previous higher price operators, after entrance to the industry was completed, just covered their costs. When the price was cut, losses developed and cabs left the industry until the level of occupancy needed to break even under the lower price was reached.

The increase in price that took place in 1933 was intended to cover a tax of 5 cents imposed by the city on each taxicab ride. This tax was subsequently declared illegal by the courts and was cancelled, but the new price was retained and remained in effect until 1952.

In the period 1920-1937, the free market period, four different commissions were appointed (one by the State and three by the city) to investigate the chronic oversupply of cabs that plagued the city during this period. Judging from that fact, and the colourful descriptions in the New York Times on the abundancy of cabs, we had at that time the situation which our model predicts. The fact that from 1924 onward prices were never reduced, despite the "over supply" of cabs, supports our conclusion that high prices and very short waiting time will stick.4

CONCLUSIONS

Under the conditions of free entry the rate of cab occupancy is a function only of price (assuming costs remain the same). Higher prices will result in lower occupancy. If the demand for rides is inelastic in the relevant range, then higher prices will result in both lower occupancy and more cabs. Availability of cabs, if the demand is inelastic, depends therefore, in a free entry market, on price. Higher prices will lead to better availability, and vice versa.

There are many possible combinations of price/average waiting time. In a free market the exact combination will be randomly determined but is almost sure to be one of high price/short average waiting time.

The combination of price/waiting time in a free market is arbitrary and might be unsatisfactory to all or most customers. To correct this, regulation of the price can be used. Leaving entry free and fixing the price will automatically determine the average waiting time.

4The explanation given by Coffman for the infrequent change in prices over this period is ironic. It is unreasonable to expect that cab operators will delay changing their prices for many years in order to save the small charge involved in resetting their meters. The general level of prices during the four years of the great depression, 1929-1933, it should be remembered, declined drastically, while cab fares remained unchanged.