THE EFFECT OF SINGLE-FARE POLICY IN THE TAXICAB MARKET: THE CASE OF MOSCOW

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Abstract

This paper examines the effect of single-fare policy in the taxicab market in Moscow. In order to address this question it estimates elasticity of demand and the welfare effect of the regulatory policy. It shows that there is strong price competition in the market and that the welfare change is not significant. This study finds no supportive arguments for price control.

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Contents

1 Introduction

The place and role of the state in the economy is a highly debatable issue both in theory and practice. There are several approaches to address it. Classical economics, guided by the well known laissez-faire principle, became popular due to the work of Adam Smith, and thus was opposed to the active state intervention in the economy. However, this view has undergone significant changes across time, mostly because of the occurrence of such events as the Great Depression, that factually buried the illusion of self-correcting economy even among theorists. Since then, some countries, mostly the socialist bloc, became ardent supporters of active role of the state in the economy. However, world history also showed that there is a limit of such intervention and the next step of its development was in the creation of the Washington Consensus, that proposed active deregulation of the economy. Nowadays, because of the recent financial crisis, the world is on the new stage of this spiral, which proposes active intervention to the economy even in some highly liberal countries.

History shows that regulation can be implemented both in highly turbulent time and the period of relatively normal functioning of the economy. It has different forms as well as spreads into different sectors of national economy, in particular, those having natural monopoly element, such as electricity, telecommunications and pipelines, but also to potentially competitive sectors such as transportation industry — airlines, trucking industry and taxicab market. The history of taxi regulation starts as early as in the beginning of the 17th century, when, according to the order of the British king

Charles I, the first taxis (at that time, horse-driven) had to be licensed in order to ensure a certain quality of service; the number of licenses was shortly limited by the British parliament (Dempsey, 1996). Today, there is no consensus about whether regulation of the taxicab industry is necessary; the particularly controversial measure has been the price control. Its opponents argue that regulation may lead to underprovision of taxis if the prices are set too high (Eckert, 1970). The proponents of price regulation say that since, because of the market failures, firms do not compete in prices, government intervention is needed to protect consumers from monopolistic price-setting (Cairns and Liston-Heyes, 1996). However, due to the lack of quantitative empirical studies, this debate remained highly ideological.

Contribution of this work to the policy debate and the literature is twofold. First, unlike the previous studies that used aggregate city-level data, I analyse demand-level data that allows to obtain more realistic estimates of the price elasticity of demand, and thus to make more reasoned conclusions about the degree of the price competition in the market, which is the main criterium of the necessity of price contol. Secondly, I estimate the welfare effect of the recently debated regulatory policy in Moscow and propose policy recommendations based on this analysis.

The paper is organised as follows. In the second chapter, I discuss the transportation situation in Moscow and the reasons for the introduction of the regulatory policy in the taxi market. The third chapter reviews previous studies of the price control in taxicab industry, with an emphasis on the empirical research. In the forth chapter, I present the results of estimation of the elasticity of demand and the change in social welfare after the regulation.

In the conclusion, the results and policy implications are discussed.

2 The History of Taxicab Regulation in Moscow

During the first decade of the 21st century the population of Moscow increased dramatically from 10 million in 2001 to more than 15 million in 2012[1]. Because of the availability of jobs and with the mean wage being much higher than in other Russian regions, many people from all over the country either moved to the capital, or to its suburbs. As of 2008, 700,000 people were estimated to travel every day to their jobplaces in Moscow from the Moscow region. Such fast growth in population required a corresponding reorganization and expansion of the transportation system that, however, did not take place until 2011.

Traditionally, the whole transportation system of Moscow has had a radial structure, so that often the only way to get from one part of the city to another was to go through the city-center. This feature, in addition to the large size of population, also contributed to a huge overload of both roads and highways and the public transport, mainly the underground system. Despite an attempt of the government to alleviate the transportation problem by building new roads and expanding the existing ones, this couldn't offset the rate of growth in the number of cars in the city, that increased from 2 mln in 2000 to over 4.5 mln in 2010 in Moscow alone. Together with the large number of people using cars to commute to work from the suburbs, this put Moscow

[1]The statistical data presented in this chapter has been collected from Russian Federal State Statistics Service (http://www.gks.ru/) and Moscow Department of Transportation (http://dt.mos.ru/)

on the first place in the list of cities with the worst traffic congestion situation in 2012[2]. According to this study, the average travel time increased by 100 to 150% during the morning and evening rush hours, meaning an average per hour delay of 74 minutes. With no separated lines for buses and trolleybuses, and with a very slow and inefficient tramway system, these traffic jams, in turn, made the use of public transport no more attractive than a personal car, due to a very high waiting and travel time and inconvenient connection system. The fastest means of transport remained the Moscow underground, which by the mid-2000s became extremely overloaded; besides, its radial structure also hugely increased the average travel time. By the end of 2000s, the transport situation has unarguably become the most important problem of the city.

Because of the high social pressure, after the new city authorities came to power in 2011, they made their priority the reorganization of the transportation system, primarily aimed at relieving the city of the traffic jams. Apart from further expansion and construction of highways, which many experts deemed unnecessary and even harmful, the new policy included the speeded up construction of new underground stations on the outskirts and new chord metro lines, creation of parking lots near the terminal metro stations, introduction of separated lines for public transport and reorganization of the taxicab market.

Though usually not thought of as prototypical means of public transport, taxis constitute a very important part of the transport systems all over the

[2]http://www.tomtom.com/lib/doc/congestionindex/2013-0322-TomTom-CongestionIndex-2012-Annual-EUR-mi.pdf

world, especially in the big cities. In New York, taxis account for transportation of more than 10% of passengers using public transport, making about 470,000 trips each day[3]; in London over 1.8 mln people travel by taxi every week. The approximate number of taxicabs per one thousand of residents rises to 6.3 in New York, 2.4 in Boston and Chicago and 2.8 in London. In Moscow taxis have been far from playing such an important role, with only 1.3 taxicabs per thousand of people, making overall about 500,000 trips per week. Such low numbers are not surprising since, due to the traffic jams, Moscow taxicab industry could not attract passengers with reduced travel time — most frequently cited reason for taking a taxi.

As the city expected to alleviate the situation on the roads, its policy towards the reorganization of the taxi market had an objective of increasing the number of taxicabs and making their use more convenient by organizing taxi stands near the railway stations and allowing them to use the separated lines. The economic aspect of this policy consisted of restrictions on entry by compulsory issuance of licenses to control quality and to limit the quantity of taxicabs in the future, and introduction of a single fare rate. The latter measure proved to be the most controversial; the antitrust authority immediately issued a recommendation not to regulate the price. However, no economic arguments have been presented from either side of the policy debate. The next chapter reviews arguments for and against taxicab regulation discussed in the economic literature.

[3]www.schallerconsult.com/taxi/taxifb.pdf

3 Previous Studies of the Regulation in Taxicab Market

Most of the research on price regulation in the taxi industry has been theoretical. Those papers examined the simplified models of driver–passenger interaction and argued that due to market failures such as asymmetric information, the equilibrium price will not be achieved in a deregulated market (Stiglitz (1989), Cairns and Liston-Heyes (1996)). Moreover, Arnott (1996) argued that under first-best pricing taxis operate at a loss, and hence, they should be subsidized to avoid underprovision.

The empirical research on the effect of taxicab regulation remains scarce, mainly due to the lack of data. Most of these studies are devoted to the case of the US market. The American taxi industry was not regulated until the 1920s when, during the Great Depression and the rise of unemployment, many people began working as taxi drivers as other jobs were difficult to find. This drastically reduced the quality of the taxicab services. Besides, as the market became extremely competitive, the incumbent taxi companies also started to press for regulation. By the end of 1930s, the taxicab market in the American cities was brought under the regulation of the municipalities (or, in some cases, of the state) who introduced entry restrictions and price control. This regulatory regime ended with the wave of general deregulation of the US economy that started in the 1970s–1980s.

Teal and Berglund (1987) studied the consequences of this deregulation in nine US cities. Contrary to theoretical predictions (Frankena and Pautler, 1986), they found that even in the telephone order segment of the market no price competition had been observed after deregulation. In San Diego one of the largest firms reduced the price, making it nearly 15% lower than the price of the largest company; a similar situation also occured in Seattle. However, this did not lead to a decrease in prices of other taxi companies, neither did it increase the shares of those firms that reduced their fares. On the contrary, fare rates were found to have an upward trend compared to the regulated market that was particularly high in the street segment (the taxi rank market, as opposed to the telephone-order segment). This increase was so tangible that airport authorities had to introduce price ceilings for taxi services.

Teal and Berglund used three different methods to estimate the increase in rates. First, using the data from 1971 to 1984 for 14 regulated and 7 deregulated cities, they computed average cost of a four-mile trip in the telephone-order segment of the market and find that during that period increases in prices were on average the same in the regulated and deregulated cities. Second, they compared trends in prices of a four-mile trip before and after deregulation (in the cities where the market had been deregulated) with the consumer price index as well as the trend in private transport costs and workers' wages. After inflation-adjustment, prices were found to increase over the trend observed prior to deregulation by approximately 5%. Finally, they compared the results of the time-series analysis for both regulated and deregulated cities and showed that under regulatory regime the increase in prices was lower than the inflation-adjusted trend, so that it was not the behaviour of the industry that accounted for the increase in average fare rates after deregulation. Thus, they concluded that deregulation does not necessarily lead to a decrease in prices or to price competition. They also documented a substantial increase in the number of taxicabs (and consequently increased value of assets and decreased market share of incumbent firms in the industry), but they did not observe any improvement in the quality of service, and also found evidence of a decrease in income of the drivers due to a large decrease in productivity.

Similar result was obtained by Shreiber (1975) who studied the price competition in the New York taxi market before regulation using the data from the official report from 1920 to 1975. Shreiber shows that the changes in fare rates in a free market were surprisingly infrequent. He documents only two such changes, where prices decreased by 20% and 27%, both decribed as price wars. Secondly, he compares prices for taxicabs in the 1920s with those in 1960s and shows that they remained approximately the same although the increase in general price level was more than twofold between those years. The author concludes that price competition was not observed in the taxi market.

Another empirical study of the effect of price on demand for taxi services was conducted by Beesley (1979) who looked at the determinant of the growth of taxi market in London. Using time-series aggregated data for 1960–1976, he estimated how the size of the market (total number of taxicabs) is affected by taxi fares, prices of the other means of transport (buses and underground), and other factors. He found that bus and underground fares are insignificant, while the price for taxis is significant and positive; from this he concluded that demand for taxis is price inelastic. However, he also notices that further collection of direct data on demand is needed to estimate its price elasticity.

This paper uses such demand-level data to estimate the determinants of demand for taxis together with the welfare effect of the regulatory policy in Moscow. The econometric model and the results of this estimation are presented in the next chapter.

4 Model and Estimation Results

One part of the reorganization of Moscow taxicab market has been the creation of a single municipal telephone-order center. At present, several such telephone-order centers exist in the city, that distribute orders for a number of companies they cooperate with. The data used in this work has been collected from one of these centers, cooperating with 32 taxicab companies that have a combined market share of approximately 15%. Each company operates from one to three different classes of taxicabs (economy, business and vip). I consider a class-company pair as one product (brand); overall, there are 72 such products. Prospective passengers choose a product based on its price for the first 30 minutes of travel and its rank (from 0 to 10), and after that a taxicab that satisfies these properties and is closer to the location of the customer is chosen. The dataset consists of data on demand (number of taxi orders aggregated by bi-weekly periods) for each class of taxicabs of each company, prices for each period, and firm characteristics, such as its ranking and average number of operating taxicabs. The descriptive statictics on the firms' characteristics is presented in table 1 below. The number of cabs and the ranking of each company do not change in the available data, so I consider three different bi-weekly periods in order to have variation in prices. Market shares are presented for the last of the three periods; there is little variation in them in time. According to the data, firms increase prices simultaneously; however, this does not necessarily mean that there is price competition in the market — for instance, this can reflect firms' response to the increase in prices for fuel.

Characteristics	mean	median	minimum	maximum
By firms				
Average number of taxicabs	129	53	5	710
Rank	8.5	9	6	10
Market share	0.031	0.003	$<$0.001	0.423
By products				
Average number of taxicabs	59	28	1	468
Rank	8.5	9	6	10
Market share	0.014	0.002	$<$0.001	0.282

Table 1: Descriptive statistics

4.1 Logit and IV Logit Estimation

The straightforward way to estimate the price elasticity of demand is to use the logit model. I assume that all consumers have identical preferences over the set of characteristics of taxicab service. Consumer i chooses either to take a taxi of a certain class of a certain company, or she can choose an outside option.

The utility for consumer i of a chosen option j, where $j = 0, ..., 72$ ($j = 0$ stands for an outside option), is

$$U_{ij} = \delta_j + \varepsilon_{ij},$$

where δ_j is the mean utility of the chosen option and ε_{ij} is the idiosyncratic preference shock. Each consumer chooses an option (class and company) that maximizes her utility:

$$j^*(i) = argmax_j(\delta_j + \varepsilon_{ij}).$$

Assume that ε_{ij} are i.i.d. and have type I extreme value distribution: $F(\varepsilon) = \exp(-\exp(-\varepsilon))$, then

$$Pr\{j^*(i) = j\} = \frac{\exp(\delta_j)}{\sum_{k=0}^{72} \exp(\delta_k)}.$$

If we denote $Pr\{j^*(i) = j\} = S_j$ (where S_j is the market share of good j), then

$$\ln S_j - \ln S_0 = \delta_j - \delta_0,$$

where the mean utility of an outside option δ_0 can be normalized to zero. Mean utility of an option j depends on its price p_j (included in logged form for the convenience of interpretation), its observed characteristics x_j, and characteristics ξ_j that are observed only by the consumer, but are not reflected in the data:

$$\delta_j = \alpha \ln p_j + x_j'\beta + \xi_j.$$

Following the theoretical literature, I consider two observed characteristics of taxicab service: its quality and average waiting time. I use the ranking rk_j as a proxy for quality and the average number of operating taxicabs nc_j as a proxy for waiting time. I also add two class dummies dv and db (for the vip class and business class), and two time dummies $d1$ and $d2$ for the first and the last periods. Thus, the model becomes

$$\ln S_j - \ln S_0 = const + \alpha \ln p_j + \beta_1 rk_j + \beta_2 nc_j + \beta_3 d1 + \beta_4 d2 + \beta_5 dv + \beta_6 db + \xi_j.$$

The share of an outside option is usually defined as the total market size minus the sum of the shares of the products that are in the data. In this case, assumptions on the market size have to be made: for example, Bresnahan et al. (1997) take the number of all office-based employees as the market for computers, and Nevo (2000a, b) in estimating demand for ready-to eat cereals assumes that each person in the American population consumes one portion of cereal per day. I restrict the overall market size to the total number of orders of taxicabs in the city. On the one hand, this assumption is quite restrictive because it does not allow people to substitute taxis with other means of transport. On the other hand, it is difficult to make any assumptions about the potential demand for taxis. Besides, some studies (Shreiber (1981), Beesley (1979)) find that cross-price elasticity of demand between taxicab services and other mass public transportation services is very low.

The results of the OLS estimation are presented in table 2 below. The estimated price elasticity of demand is -3.44, which means consumers are very sensitive to changes in price.

This preliminary result suggests that firms in fact do compete in prices. The simple OLS regression however gives a biased estimate of the coefficients in the demand equation because the price can be correlated with the unob-

Variable	Coefficient	St. deviation
const	8.69	3.62
ln(price)	-3.45	0.62
quality of service	0.37	0.001
waiting time	0.02	0.09
time dummy 1	-0.31	0.19
time dummy 2	0.30	0.19
business class dummy	0.25	0.35
vip class dummy	0.14	0.20

Table 2: OLS result. $R^2 = 0.72$ Dependent variable: log(share). 216 observations.

served characteristics in the error term. For instance, some firms may better monitor the demand in a way that they have more information in which areas or the city the demand is higher in a given time of the day, so that they would be able to locate more taxicabs in that areas. This would potentially increase their market shares through the reduced waiting time. At the same time, these firms may set on average higher prices.

One way to overcome this problem is to use instrumental variables for price. Berry, Levinsohn and Pakes (1995) suggested that the price of good j produced by the firm f partially depends on the average characteristics of the competing products of other firms, as well as on the average characteristics of the other products of this firm, and at the same time neither of these characteristics influences the demand for the product j directly. Thus, average waiting time and quality of taxi services of other companies and of other classes of taxicabs in this firm: $\sum\limits_{i \neq j, i \in P_f} nc_i$, $\sum\limits_{i \neq j, i \in P_f} rk_i$, $\sum\limits_{i \notin P_f} nc_i$ and $\sum\limits_{i \notin P_f} rk_i$ can be used as instruments for the price p_j (where P_f is the set of products of firm f producing product j). An OLS regression of p_j on these characteristics gives the value of F-statistic of 11.77, which is greater than 10, which means that the instruments are strong (Wooldridge, 2003).

The results of the GMM estimation of the IV logit model are presented in table 3 below. This estimation gives an even higher coefficient on (log of) price, since it accounts for the positive correlation between the price of a service and its unobserved characteristics. The estimated price elasticity suggests that if a company decreases price for a taxi trip of a given class by 1% then the market share of this class/firm product grows by 17%. In this situation the firm has a strong incentive to decrease the price as long as its capacity is not fully used. This result suggests that there is no reason to introduce the single-fare policy if its main goal is to prevent companies from establishing prices higher than the equilibrium price, since the equilibrium price will be established in the market without the government intervention. I also performed robustness test by comparing this result to the results of regressions for each of the three periods separately. These results are robust. The elasticity in the model is identified by the cross-sectional variation.

To evaluate the effect of the future policy, I estimate the predicted change in social welfare, i.e. compare the consumer and producer surplus under the current prices (prices in the last of the three periods in the data) and under the future single price for the economy and business classes. This price is given

Variable	Coefficient	St. deviation
const	86.86	15.00
ln(price)	-17.06	2.59
quality of service	0.60	0.13
waiting time	0.02	0.001
time dummy 1	-1.56	0.47
time dummy 2	1.76	0.44
business class dummy	2.25	0.46
vip class dummy	6.27	1.29

Table 3: IV Logit Results. GMM estimation. Dependent variable: log(share). 216 observations.

in the policy description; the fares for the vip class will not be regulated. The descriptive statistics on the fare rates is presented in the table 4 below.

Class	mean	minimum	maximum	regulated
economy	12.3	10.6	15	14.5
business	14.2	11.6	18.3	14.5
both classes	13.3	10.6	18.3	14.5

Table 4: Descriptive statistics for prices for the first 30 minutes of travel, in US dollars.

First, I calculate the change in producer surplus. In each period, producer surplus is given by $\sum_j (p_j - mc_j) Y S_j$, where Y is the size of the market. Since there is no way to estimate the marginal cost directly, its value can be calculated from the equilibrium conditions: each firm maximizes its profit $\sum_{j \in P_f} (p_j - mc_j) Y S_j$, hence, the first-order condition yields

$$S_j + \sum_{k \in P_f} (p_k - mc_k) \frac{\partial S_k}{\partial p_j} = 0,$$

which gives

$$mc_j = p - A^{-1} S,$$

where A is the matrix of price elasticities of the products of the same firm: $a_{ij} = -\frac{\partial S_j}{\partial p_i}$ if $i \in P_f$ (where f is the firm producing product j) and 0 otherwise. These price elasticities can be calculated directly from the specification of the logit model:

$$\frac{\partial S_j}{\partial p_j} = \frac{\partial(\exp(\delta_j)/\sum_k \exp(\delta_k))}{\partial p_j} = -\alpha' S_j (1 - S_j),$$

and

$$\frac{\partial S_j}{\partial p_l} = \frac{\partial(\exp(\delta_j)/\sum_k \exp(\delta_k))}{\partial p_l} = \alpha' S_j S_l,$$

where α' is the coefficient of price (instead of log(price)) in the IV logit model. The estimated marginal costs are positive and close to prices in magnitude which is consistent with profit-maximization strategy of firms. Assuming that marginal cost does not change in time, the predicted change in producer surplus can be calculated as

$$\sum_j (p_j^{post} - mc_j) S_j^{post} Y - (p_j^{pre} - mc_j) S_j^{pre} Y,$$

where the superscripts denote the time period. Future prices are calculated from the equilibrium condition. The future market shares S_j^{post} are also estimated from the specification of the logit model:

$$S_j = \frac{\exp(\delta_j^{post})}{\sum_{k=0}^{72} \exp(\delta_k^{post})},$$

where δ_j^{post} is the mean utility of option j under the new price policy. The estimated change in producer welfare is approximately \$18,000 for a bi-weekly period.

Secondly, I estimate the change in consumer surplus. The utility that consumer i gets from choosing option j is not observed directly, so I calculate the expected consumer surplus

$$E(CS_i) = \frac{1}{\alpha_i} E(\max_j(\delta_{ij} + \varepsilon_{ij})) = \frac{1}{\alpha_i} \ln(\sum_{j=0}^{72} \exp \delta_{ij}) + C,$$

where α_i is the marginal utility of income of consumer i (so that α_i equals the (negative of) the coefficient of price variable in the logit model) and ε_{ij} have extreme value distribution (Train, 2002). Then the change in consumer surplus equals the compensating variation

$$\Delta E(CS_i) = \frac{1}{\alpha_i}(\ln(\sum_{j=0}^{72} \exp \delta_{ij}^{post}) - \ln(\sum_{j=0}^{72} \exp \delta_{ij}^{pre})),$$

where δ_{ij}^{pre} and δ_{ij}^{post} are mean utilities under current prices and under the regulated price respectively.

The value of $\Delta E(CS_i)$ is found to be very close to zero (-0.001 US dollar per one individual), so that even multiplied by the total number of customers does not constitute a considerable loss in welfare. Thus, the regulatory policy produces a positive, but very small change in total welfare. This result is predictable, since the regulated price is just above the average price in a deregulated market, so in the short-term price control should not produce a considerable change in total welfare. The possible long-term consequences of the policy are discussed later in this work.

4.2 Nested Logit Results

Though IV logit gives a more reliable value of price elasticity than simple OLS estimation, it still yields unrealistic substitution patterns. For instance, it suggests that the ratio of shares of any two products is constant with respect to the change of demand for a third product: the value of

$$\frac{S_1}{S_2} = \exp[-\alpha(p_1 - p_2) + (x_1 - x_2)'\beta + (\xi_1 - \xi_2)]$$

does not depend on the characteristics of other products in the market. This means that, for instance, if the price for some third product increases, then consumers will substitute it with products 1 and 2 in proportion with their original market shares irrespectively of how similar they are to this third product. This is usually not true, since in reality consumers are more likely to substitute product 3 with a product (1 or 2) whose characteristics are closer to the characteristics of product 3.

One way to overcome this problem would be to use random-coefficients logit model (introduced by Berry, Levinsohn and Pakes (1995)) to have more realistic substitution patterns: this model allows different consumers to have different preferences over the set of the observed characteristics of the products, so that consumers switch with a higher probability to products that are closer substitutes to their current choice. Consumers are simulated based on the distribution of certain characteristics in the population; this data can be taken from the population surveys. Random-coefficients model would also allow to separate the welfare effect for different groups of individuals (consumers are usually distinguished by characteristics such as age and income). Unfortunately, no suitable data on the distribution of income has been collected for the population of Moscow.

Another way to deal with this substitution problem is to use nested logit model (McFadden, 1981): to divide products into groups ("nests") so that the products with similar characteristics are in the same nest. I introduce two such nests by separating the outside option from all the other options (denote its nest G_0): if a taxicab company belonging to a telephone-order center reduces the price for its services, consumers who used to order taxi using this center are more likely to move from their current choice to the services of this firm than those consumers who used to choose an outside option (e.g. services of companies not belonging to this center). Formally, assume that utilities of any two alternatives within one nest are positively correlated: $U_{ij} = \delta_{ij} + \varepsilon_{ij}$, where the error vector has cumulative distribution

$$\exp(-(\exp(-\sum_{j \in G_T} \varepsilon_{ij}/\rho_1))^{\rho_1} - (\exp(-\varepsilon_{i0}/\rho_0))^{\rho_0}),$$

where $\rho_k > 0$ is the measure of degree of independence in group k, $k \in$

$\{0, 1\}$. The share of a class/company product j within the group G_T different from the outside option is

$$S_j = \frac{\exp(\frac{\delta_j}{\rho_1})}{\sum_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1})}.$$

Parameter ρ_1 allows for the utilities of products inside one group to be positively correlated (error terms are correlated inside each nest and independent between the nests). Then

$$\ln S_j = const + \frac{\beta}{\rho_1} x_j + \frac{\alpha}{\rho_1} \ln(p_j) + \varepsilon_j. \tag{1}$$

The shares of the group G_0 (with the outside option) and the second group G_T are given by

$$S_0 = \frac{\gamma \exp(\delta_0)}{\gamma \exp(\delta_0) + (\sum_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1}))^{\rho_1}},$$

and

$$S_T = \frac{(\sum_{i=1}^{72} \exp(\frac{\delta_0}{\rho_1}))^{\rho_1}}{\gamma \exp(\delta_0) + (\sum_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1}))^{\rho_1}},$$

where γ affects substitution between the nests. The value of δ_0 is usually normalized to 0, so that $\exp(\delta_0) = 1$.

The values of ρ_1 and γ can be estimated from the equation

$$\ln(S_T) - \ln(S_0) = \rho_1 \ln(\sum_{i=1}^{72} exp(\frac{\delta_i}{\rho_1})) - \delta_0 + \ln \gamma,$$

for the three periods observed in the data. The obtained values of parameters are $\gamma = 0.8$, $\rho_1 = 0.5$. Both are marginally significant (at 10%).

Table 5 presents the results of the GMM estimation of equation (1). The price elasticity of demand in group G_T is -17.53, which is a little higher than the elasticity obtained from the logit model. This confirms that consumers are very price-sensitive and thus that firms do compete in prices.

Variable	Coefficient	St. deviation
const	91.47	16.18
ln(price)	-17.53	2.79
quality of service	0.58	0.001
waiting time	0.02	0.13
time dummy 1	-1.65	0.48
time dummy 2	1.91	0.45
business class dummy	2.32	0.49
vip class dummy	6.40	1.35

Table 5: Nested Logit Results. GMM estimation. Dependent variable: log(share).

To estimate the change in producer surplus, I calculate the own- and cross-price elasticities. The probability of choosing option j is the product of two probabilities: the one of choosing option j from group T (denote it $\hat{S}_j$), and the probability of choosing group T (denoted $\hat{S_T}$):

$$S_j = P(j^*(i) = j|\delta) = \; = P(j^*(i) = j|j^*(i) \in G_T, \delta) \times P(j^*(i) \in G_T|\delta),$$

i.e. share of option j can be expressed as

$$S_j = \frac{\exp(\frac{\delta_j}{\rho_1})}{\sum\limits_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1})} \times \frac{(\sum\limits_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1}))^{\rho_1}}{\gamma + (\sum\limits_{i=1}^{72} \exp(\frac{\delta_i}{\rho_1}))^{\rho_1}}.$$

Differentiating this expression with respect to prices gives the elasticities:

$$\frac{\partial S_j}{\partial p_j} = \alpha' \hat{S}_j \hat{S}_T (\hat{S}_j (1 - \hat{S}_T) + \frac{1}{\rho_1}(1 - \hat{S}_j))$$

and

$$\frac{\partial S_j}{\partial p_i} = \alpha' \hat{S}_j \hat{S}_i \hat{S}_T (1 - \hat{S}_T - \frac{1}{\rho_1} \hat{S}_T),$$

where α' is the coefficient obtained from the GMM estimation of the model with price (instead of log(price)) as independent variable. Under this estimation, the change in producer surplus becomes positive with the value of approximately \$80,000 (per bi-weekly period). This welfare increase still small compared to the total size of the market, however it is greater than in the logit model. The difference with the logit result can be explained by the fact that nested logit allows for a higher correlation within the group G_T, and so consumers do not switch to the outside good too often in responce to an average increase in price under the regulation.

Consumer surplus for the nested logit model is given by

$$CS = \rho_1 \ln(\exp(A_0/\rho_1) + \exp(A_T/\rho_1)) + Y,$$

where A_0 and A_T are expected utilities of nests G_0 and G_T, respectively

(Anderson and de Palma, 1991), and Y is the income of the individual. Since the utility of the outside good δ_0 is normalized to zero, the change in expected consumer surplus becomes the same as in the logit model:

$$\Delta E(CS) = \frac{1}{\alpha}(\ln(\sum_{j=1}^{72} \exp \delta_j^{post}) - \ln(\sum_{j=1}^{72} \exp \delta_j^{pre})).$$

The value of this expression is slightly lower (in absolute terms) than the one obtained from the logit model, but again negative and very close to zero. Thus, the conclusions of the logit model remain valid.

5 Conclusion

This paper examined the problem of price regulation in the taxicab market on the example of Moscow. In order to address this question, I estimated the demand using logit and nested logit models, that showed similar results. Overall, they can be reduced to the following: first, there is price competition in the market; second, welfare effect of the single-fare policy is insignificant, since the future regulated price is just slightly above current average market price. The former result is quite different from those obtained in previous studies (Beesley (1979), Shreiber (1975)); this contradiction can be explained by the fact that for the first time in such studies demand-level data has been used.

According to these results, several policy implications arise. First of all, the existence of strong price competition among market players breaks the often-cited argument of the policy makers about the need for price regulation, as it means that in reality firms are not likely to set prices above equilibrium. The elasticity of demand has been estimated only for the telephone-order segment of the market where the price competition is naturally stronger than in the street segment, because of possible market failures such as incomplete information and the negative effect of the waiting time for another taxicab. However, introduction of fixed prices is not necessary to address these issues: first, quality control, such as the requirement to display prices on the taxicabs, reduces the information problems. Second, with the development of new technologies, such as applications for mobile phones, the share of the street segment can be expected to decrease, thus further reducing the need for government intervention.

In the long-term, in responce to price control, companies may switch to other forms of competition, such as, for example, competition in quality, as it happened after the regulation of the airline industry in the US in the 1940-1970s, when the airline companies substantially increased their quality of service because they were not allowed to attract customers with low prices (Viscusi, Vernon and Harrington, 2005). However, it is unlikely to expect any significant changes in case of taxi market, as this analysis shows that at present taxicab firms already strongly compete in quality. Thus, this study does not find sufficient economic justification for the price regulation in the case of Moscow taxicab industry.

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