The Effects of Economic Regulation: Evidence from the Istanbul and New York Taxicab Markets

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**Abstract**

This paper empirically investigates the effects of economic regulation in the regulated markets. We develop an innovative cointegration model with structural breaks to test the hypothesis that government regulation increases the price of the regulated good and/or causes the monopoly price. We examine the Istanbul and New York taxicab markets and argue that regulation brings about artificial rents by increasing medallion prices, and an increase in medallion prices gives rises to upward pressure on taxi fares. The evidence presented shows that regulation of the both Istanbul and New York taxicab markets increases medallion prices, and this increase in medallion prices pressures on taxi fares.

Keywords: Taxicabs, entry regulation, price controls, elasticity, cointegration, structural breaks.

**1. Introduction**

Until the present, considerable attention has been paid to understand the economic effects of government regulation[[1]](#footnote-1) on the marketplace. The relevant economic literature on government regulation has introduced theoretically and empirically substantial contributions and evidence for understanding the nature of government regulation in the economy. The theoretical contributions include normative analysis. The normative analysis of regulation attempts to understand how markets fail, when regulation is needed and what the optimal form of regulation is. The public interest theory of regulation as a normative approach justifies the necessity of regulation. The public interest approach argues that government intervention ameliorates market failures such as natural monopolies, externalities, public goods, and information asymmetries (Joskow and Rose 1989)[[2]](#footnote-2). In this context, from the perspective of public interest theory, the principal reason for price and entry regulations is the existence of markets characterized by natural monopolies (Noll 1989, Braeutigam 1989). An unregulated market system, because of the undesirable consequences of natural monopolies, cannot provide price stability and the efficient production of goods. A monopoly is characterized by the presence of a single firm in a market rather than several and some type of economic regulation is required to avoid the monopoly exploit (Ogus 1994; 30).

The public interest theory has been criticized and rebutted over last 40 years by empirical and theoretical studies (Demsetz 1968, Stigler 1971; Posner 1975; Ippolito 1979; Baumol 1977, 1982). Currently, academic works accept that the public interest theory of regulation does not accurately account for market failure phenomena (Domas 2003: 166). The public interest theory of regulation is at least insufficient to explain why government regulation exists. Instead, as a positive analysis of government regulation, the economic theory of regulation has argued that government regulation either has been manipulated by private interest groups for the markets in which they operate (Stigler, 1971), or that it has caused society to incur substantial social costs (Posner 1975). Regulators, like other private agents of economic activity, also maximize their own self-interest. Hence, special interest groups can manipulate regulatory outcomes by pressuring regulators. In other words, as a rule, government regulation is not implemented because it is needed, but because it is demanded by the regulated industry and is operated primarily in favor of the regulated industry (Stigler 1971; Posner 1975; Peltzman 1976, 1993).

Also, regulation produces adverse effects for the regulated industries. It leads to long-term rents for interest groups and deviations from competitive outcomes. Resources are wasted in this process (Parker 2002). In the literature, the effects of regulation on prices, costs, technological change, product quality, and the distribution of income and rents have empirically been investigated by the students of regulatory economics (Joskow and Rose 1989). This empirical contribution constructs the positive analysis of government regulation. In this context, many studies have estimated the effects of regulation on prices (Stigler and Friedland 1962; Kitch, Isaacson, and Kasper 1971; Jarrell 1978; Ippolito 1979). It is generally accepted that regulation that is subject to political influence is rarely implemented to improve economic efficiency. On the contrary, entry and price regulations give rise to an increase in prices and/or an artificial rent for the private pressure groups in the industry by creating a monopolistic structure in the regulated industry (Stigler 1971; Posner 1975; Peltzman 1976; Becker 1983; Kahn 1998; Guasch and Hahn 1999)[[3]](#footnote-3). As a result, insightful theoretical and empirical approaches have been introduced both for and against government regulation (Stigler 1971; Becker 1983; Braeutigam 1989; Laffont and Tirole 1991).

Taxicab markets are excellent examples in which to analyze the economic effects of government regulation in the marketplace. The rationale for economic regulation in taxicab markets is the presence of negative externalities such as congestion and pollution, the public good characteristics of taxis, and information asymmetries[[4]](#footnote-4). Due to these rationales, taxicab markets are subject to quantity restrictions, fare controls, and social regulations as the primary regulatory tools (Çetin and Eryigit 2011; Heyes and Heyes 2007; Seibert 2006; Teal and Berglund 1987; Frankena and Pautler 1984; Shreiber 1975). The taxicab market is not a natural monopoly. It is potentially a competitive industry. Entry restrictions and price controls in taxicab markets have negative effects (Eckert 1970; Beesley and Glaister 1983; Frankena and Pautler 1984; Moore and Balaker 2006). Because regulation in relatively competitive industries such as taxicab markets give rises to increase in prices and above-normal profit (Viscusi et al. 1998), barriers to entry will result in an artificial rent that is greater than the prices of medallions[[5]](#footnote-5) by creating a monopolistic market structure (Tullock 1975). Rents occur because the entry barrier enables prices to be high and medallions can be traded in the market (Turvey 1961). Accordingly, economic regulation in taxicab markets triggers a rent seeking process and causes government failure (Çetin and Oğuz 2010; Moore and Balaker 2006; Frankena and Pautler 1984).

The value of medallions to their owners is a monopoly rent that is artificially produced by restricting the number of taxicabs. This artificial rent captured by medallion owners is greater than the economic profits in comparable industries (Schaller 2006). Thus, an unofficial market for medallions occurs (Friedman 2008). In this regulatory environment, medallion owners will be in favor of regulation of entry and fares, but not deregulation. Because an increase in the number of taxis in conjunction with a probable deregulation will depress individual license values, medallion owners and cab drivers are unanimous in opposing any increase in the number of medallions (Orr 1969; Friedman 2008). The empirical evidence seems that regulation in taxicab markets supports prices above cost and prevents entry from dissipating rents (Viscusi et al. 1998). Regulation inherently performs in favor of medallion owners as producers of this market.

As pointed out by Viscusi et al. (1998), this appears to be a classic example of the economic theory of regulation. Whereas medallion owners gain an artificial rent from regulation of entry and taxi fares, consumers take a loss from it. In the presence of such regulatory process, because medallion owners are more effective in getting regulation put in place than are consumers in preventing regulation, we can expect that medallion owners as private interest groups in the market would manipulate the regulation of taxi fares (Frankena and Paulter 1984; Svorny 1999). Since, the cost of organizing political support for regulation is much lower for medallion owners. Now, fares will be also manipulated by regulation. Generally, the economic theory of regulation shows that whereas prices (fares) are regulated on inflation rates in the recovery period, they are determined under inflation rates in the recession terms (Viscusi et al. 1998). Accordingly, in our model, we expect that fares regulated in the New York Taxicab Market exceed inflation rates during the recovery periods, while they fall below inflation rates during the economic downturn periods.

The effects of governmental regulation on medallion prices and taxi fares in taxicab markets have been investigated for decades. Many studies have found a relationship between economic regulation and high medallion prices in taxicab markets. It has been argued that restricting the number of taxicabs can only serve to increase the prices of medallions by restricting the supply of taxicabs compared to the number that would otherwise be provided (Çetin and Oğuz 2010; Cumming 2009; OECD 2007; Moore and Balaker 2006; Koehler 2005; Barrett 2003; Frankena and Pautler 1984; Tullock 1975; Kitch, Isaacson, and Kasper 1971; Turvey 1961). However, there is no empirical evidence showing that government regulation influences medallion prices and thus the increase in medallion prices affects taxi fares. The paper consists of five main sections including an introduction. Section two describes the regulatory processes in the Istanbul taxicab market. Section three includes a presentation of the regulatory history of the case of New York. Section four empirically analyzes the economic effects of government regulation in the Istanbul and New York taxicab market. The paper ends with the fifth section that includes conclusions.

**2. The Regulatory Endowment in the Istanbul Taxicab Market**

In Turkey, everyone who wants to become a taxicab driver must be a member of the Chamber of Drivers in that city. Moreover, entry and exit for the drivers into and from the market are free. In all cities, municipalities determine the number of taxicabs and taxi fares. 21 out of 81 cities have entry restrictions to taxicab markets. Other cities do not have any entry regulation due to the lack of demand. Taxi fares change across the country and regulated locally. Taxis are yellow colored and have the letter ‘T’ on their plate.

The regulatory structure does not make any distinction between economic and social regulations[[6]](#footnote-6) in Turkey. This situation is valid for the Istanbul taxicab market as well. The market is only regulated through entry restrictions and fare regulations. Market conditions determine working hours and conditions. Apart from very general guidelines there are no strict rules that regulate the working conditions of the market. Taxis are free to cruise in the city. Some of them are also affiliated with taxi-stands, which also provide dispatching services. This does not stem from any regulation, but rather a choice of taxi drivers to reduce their cruising costs. In street corners and around shopping center, taxis establish taxi-stands due to the profitability.

Generally, drivers do not have any restrictions on their use of taxis after they get their licenses. For example, there are no background searches for applicants before entering the market, as opposed to common practice in European countries. There is no criminal record check, written or oral interview, local area knowledge test, medical certificate nor a strict enforcement of driver license requirements for taxi drivers. The regulatory structure does not include any specification in the safety and attribute standards of taxicabs, as seen in New York and more strictly, in London.

However, the Istanbul Metropolitan Municipality (IMM) strictly restricts entry to taxicab market through a medallion system. Entry regulation started in Istanbul in 1991, with a decision of the IMM. According to this decision, the number of taxicabs was restricted by approximately 18,000 medallions and has remained constant until this day. On the other hand, the IMM has permitted the transfer of medallions (licenses to operate right) within the market. Existing owners have the right to sell or rent their medallions in the market with no restrictions. There are no legal limits on the number of taxi medallions one person can hold.

Lastly, the market is regulated by fare controls. The IMM regulates taxi fares through a transportation co-ordination committee. The committee determines initial fares and fares per km and declares a fare tariff annually or bi-annually. A taximeter calculates the price of each trip according to this fare tariff. Customers are charged on the basis of the distance they traveled and the time they spend in a taxi.

In a recent study, Çetin and Oğuz (2010) anecdotally analyzed the aftermaths of regulation in the Istanbul taxicab market. They argue that the case of Istanbul has brought about the perils of bad regulation. Accordingly, the fundamental issue in Istanbul is entry regulation that continues since 1991. Although entry regulation is justified to reduce traffic congestion, the existence of approximately 20,000 taxis that work illegally in the market due to entry restriction disproves the effectiveness of the current regulatory structure. While the taxi/population ratio (the number of taxis per thousand people) in Istanbul was 2.5 in 1991, this ratio fell to 1.4 as of 2010, because the population increased in subsequent years and the number of taxis remained constant. For that reason, as in many metropolitan cities of the world, entry regulation in the Istanbul taxicab market has increased the selling prices of medallions as well. Whereas a medallion price was around $104,000 as of 1999, it reached approximately $400,000 today.

According to Çetin and Oğuz (2010), the regulatory cycle gives rise to an artificial rent and triggers a rent-seeking society in the Istanbul taxicab market. Medallion owners spend their resources to capture these rents, but not to engage in the productive discovery processes. The most important evidence revealing the presence of a rent-seeking society in the market is the absence of an attempt for social regulations. The market players such as the IMM, the Chamber of the Drivers, license owners or drivers have not yet initiated to improve the structure of the market regarding social regulations. Rather, they only engage in entry restriction and price controls. We think that the absence of social regulations in the market is one of the most crucial defects of the regulatory structure. The market is only regulated by entry restriction and fare controls of the IMM and medallion owners only engage in to extract rent created by means of the medallion system. Consequently, the absence of social regulation gives rise to taxi owners and drivers to neglect the quality of service[[7]](#footnote-7).

A related issue concerning taxi fare regulation is tax-avoidance. According to the related tax laws in Turkey, incomes from both providing taxi services and medallion sales are liable to a lump-sum tax. Accordingly, taxi and medallion owners must declare their revenues to the tax authority at the end of every year and pay tax based on their revenue levels. However, neither medallion sales, nor taxi fares are *de facto* taxed in Turkey because taxi drivers and medallion owners tend to be dishonest in the disclosure of their revenues. Governments have failed to take this issue seriously.

**3. Regulatory History of the New York Taxicab Market**

By Local Law No. 12 of 1971, the New York City Taxi and Limousine Commission (TLC) was established as the regulator responsible for regulating the New York taxicab market. The aim of the TLC is to ensure *“the development and improvement of taxi … service in New York City …, and to establish certain rates and standards”.* Currently, to this end, the TLC sets taxi fares and determines how many medallions will be issued. Moreover, it licenses those seeking to become taxi drivers and operate a vehicle in the market, adopts rules that drivers and cab owners must obey, adjudicates rule infractions and consumer complaints, and subjects each taxicab to an extensive inspection three times a year[[8]](#footnote-8) (Schaller and Gilbert 1996b; TLC 2009).

The New York medallion system has a predetermined ceiling[[9]](#footnote-9). Accordingly, in New York, the TLC determines the maximum number of cabs. There is a static restriction on the number of taxis. However, the regulatory structure allows licenses to be traded within the market (Bekken 2007). Licenses have also been sold at public auctions. Anyone may bid for a taxicab license in the public auction, and the highest bidder who satisfies all of the criteria for a taxicab license wins the license and the right to transfer it. Although medallions have gradually been released by the public auction, this does not mean that entry into the market has been deregulated.

Until 1937, entry into the New York taxicab market was free and taxi fares were not regulated, except for a requirement to use meters (Schreiber 1975; Schaller 2006). Under the Haas Act of 1937, New York City[[10]](#footnote-10) limited the number of taxis to 13,595. The number of taxicab medallions in New York City decreased to 11,787 in 1964 because taxi owners who had received licenses during World War II retired and their licenses were not reissued. The number of licenses remained constant until May 1996 (Schaller and Gilbert 1996a). Through three sets of auctions that took place under a court order between May 1996 and September 1997, the number of medallions was increased by 400 (Guri 2005: 157; Frankena and Pautler 1984: 77). As of September 1997, there were 12,187 licenses in the market. The TLC, which had not held any auctions between 1997 and 2004, auctioned licenses again in 2004. Since then, nine auctions have been held, and a total of 1,109 new taxi medallions were distributed. There are currently almost 13,300 medallions, none of whom possesses significant market power. They provide transportation for passengers via street hails. Yellow Medallion Taxicabs are the official taxis of New York City.

Taxi fares that are regulated by the TLC have three important components, an initial charge, a mileage charge per-kilometer rate, and a wait time rate[[11]](#footnote-11). The fare change in 2004 is one of the most remarkable. Fares that had not changed dramatically prior to 2004 increased; the initial fare rose from $2.00 to $2.50 and the price per mile from $1.50 to $2.00. When we analyze this change in detail, we can see that the average fare increased substantially, from $6.85 to $8.65. However, the initial and per mile fares have not changed since May 2004. However, while the unit fare rates have not changed since 2004, the TLC changed the “wait time” from $0.40 per 120 seconds to $0.40 per 60 seconds but did not change the “wait time rate”. Hence, the effective wait time rate changed to $0.80 per 120 seconds, and the average fare increased from $8.65 to $9.61 with the increase in wait time in November 2006 (Schaller 2006). This rate is the current rate.

A crucial component of New York taxicab regulation is medallion prices. Entry regulation in the market has increased medallion prices since 1947. Medallions first became valuable after World War II, as demand for taxi service grew while the number of taxies was capped (Schaller 2006). While the medallion price for an individual owner was $5,000 in 1950, $28,000 in 1970, and $128,400 in 1990, it reached $601,000 in 2010. However, although medallion prices follow a strong upward trend, significant declines were also experienced during economic slowdowns in the late 1960s and the early 1970s and the recessions in the early 1980s and early 1990s. Ultimately, medallion prices declined two more times between the spring of 1998 and mid-2001. However, after 2001, they continued to rise and remain around $650,000 today.

**4. The Empirical Analysis**

Previous studies regarding taxicab regulation have generally been conducted to show that there is only an anecdotal linkage between high medallion prices and barriers to entry (Cetin and Oguz, 2010; OECD, 2007; Moore and Balaker, 2006; Koehler, 2005; Barrett, 2003; Frankena and Pautler, 1984). We attempt to find a cointegration between the number of medallions, medallion prices, and taxi fares. We develop an innovative method to estimate the effect of economic regulation on real medallion prices and real taxi fares. In doing so, the paper aims to contribute empirical evidence to the regulatory economics literature. To investigate this cointegration, the Istanbul and New York taxicab markets are rather characteristic. Market entry and taxi fares are regulated by the municipality in Istanbul and the TLC in New York, and medallion prices exhibit a positive trend, which is often the case for goods prices in regulated markets.

*4.1. Data*

In this paper, we use annual data spanning the period 1947-2010 for New York, and the data come from a variety of sources such as Schaller (2006), the TLC’s annual reports, the U.S. Census Bureau and the U.S. Bureau of Labor Statistics. The number of taxies, taxi fares, and individual medallion prices prior to 2006 are taken from Schaller (2006). The remaining figures concerning these variables are obtained from the TLC’s annual reports (2007, 2008, 2009, 2010, and 2011). The data regarding population and inflation rates are obtained from the U.S. Census Bureau and U.S. Bureau of Labor Statistics, respectively.

For Istanbul, the data we used in this study are quarterly and cover the period 1989:4-2010:1. The variables under consideration are log of the number of taxies per thousand people , log of real taxi medallion prices , which were interpolated to obtain quarterly series from 1989:4-2006:4 using Baxter (1998) method, and consumer prices based inflation  for Istanbul. The data was obtained from Central Bank of Republic of Turkey, Turkish Statistical Institute (TurkStat), TUBITAK (2007) and Bagcilar Oto Center[[12]](#footnote-12).

The variables under consideration are real taxi medallion prices, the number of taxies per thousand people  and real taxi average fares[[13]](#footnote-13). All of the variables are used in logarithmic form.

*4.2. Methodology*

In this study, we empirically analyze the long-run relationships between taxi medallion prices, the number of taxies per thousand people and average taxi fares within a Johansen, Mosconi, and Nielsen (2000) cointegration framework that accounts for structural breaks in the time series. For this purpose, we consider a vector autoregressive (VAR) system containing a group of endogenous variables: taxi medallion prices, the number of taxis per thousand people and fares. Before proceeding with the cointegration analysis, however, the univariate time series properties of the variables must be examined. In this context, the introduction of the recent minimum Lagrange multipliers (LM) structural break unit root tests proposed by Lee and Strazicich (2003, 2004) seems to be an appropriate procedure for investigating the univariate properties of the variables.

The minimum LM unit root tests with one break and two breaks that are proposed by Lee and Strazicich (2003, 2004) are versions of the Schmidt and Phillips (1992) unit root test, modified by incorporating structural break(s) in mean Model A (Crash Model) and Model C (Changing Level and Growth Model), which were identified in Perron (1989). The LM unit root test for real medallion prices, for example, can be obtained from the following regression:

 (1)

where  is the first difference operator;  is vector of the exogenous variables; , ; are coefficients in the regression of  on ,  is given by  (see Schmidt and Phillips, 1992); and  and  denote the first observations of  and , respectively. The lag terms are included to correct for serial correlation. Model A allows for shifts in level and is described by , where,  for , , and zero otherwise. The time period when a break occurs is denoted . Model C includes two changes in level and trend and is described by where  for ,  and zero otherwise. The unit root hypothesis is tested via the ratio of , denoted as  in equation (1). Denoting the break fractions as , the LM test statistic can be defined as:

 . (2)

Critical values for Model A and Model C are given in Lee and Strazicich (2003, 2004). It should be noted that when there are no breaks in the series, the critical values are the same as those in Schmidt and Phillips (1992).

Given the non-stationarity of the variables, and , the cointegration framework of Johansen, Mosconi, and Nielsen (2000), which is a slight modification of the vector error correction model (VECM) based cointegration analysis proposed by Johansen (1988), provides a natural way of estimating the long-run relationship(s) among them.

Let  be a vector of endogenous I(1) variables with  cointegrating relationships. The VECM, which was proposed by Johansen, Mosconi, and Nielsen (2000), can be written as:

 (3)

where is lag length; is a vector of  dummy variables with for  and zero otherwise and the first  observation of  is set to zero;  is the effective sample of the th period. The indicator variable  is a dummy variable for the th observation in the th period—that is  if  and zero otherwise. Intervention dummies, , are included to make the residuals well-behaved, following Hendry and Mizon (1993). The vector  is the cointegrating vector and represents the long-run relationship,  is avector representing the speeds of adjustment toward the long-run equilibrium, and  is a matrix of  dimensional long-run trend parameters. The short-run parameters are  of order ,  of order  for ,  of order for  and , and  of order  for . The innovations  are assumed to be independently and identically distributed with zero mean and symmetric and positive definite variance-covariance matrix —that is, .

Equation (3), which is a linear trend model in which the trend and level of the cointegration relationship changes from period to period, is represented as. The likelihood ratio test against an  alternative  cointegration relationship  hypothesis is:

, (4)

where  are squared sample canonical correlations and .

In a cointegration relationship, there is no linear trend, but if only a breaking level exists, the model given in equation (3) can be transformed as in Johansen, Mosconi, and Nielsen (2000) and is denoted . The critical values for both  and  models are derived from the - distribution, as proposed in Johansen, Mosconi, and Nielsen (2000).

Given the cointegration rank, further restrictions on the VECM can be tested using likelihood ratio (LR) testing. Harris and Sollis (2003) employed these tests within a standard framework. In our study, *LR* tests are extended for use in the models proposed by Johansen, Mosconi, and Nielsen (2000) as in Dawson and Sanjuan (2005).

Assume that one cointegrating vector and two level and trend breaks exist for the system such that:

, (5)

, (6)

and:

. (7)

First, we test whether each variable exists in the cointegration space. The hypothesis of individual exclusion of , for example, is:

 (8)

and the likelihood ratio test statistics have a  distribution (). Second, we test for weak exogeneity. To test for weak exogeneity of , for example, the null hypothesis is:

 (9)

and . Here, rejection of the null hypothesis that  refers to the notion that .

Under the expectation that two cointegrating vectors are established in the system, at least two restrictions per cointegrating vector are required for exact identification of the long-run relationships (Pesaran and Shin 2002). In this case, linear restrictions can be employed to identify the long-run relationships in terms of economic expectations. The following describes the long-run coefficient matrix for ,  and 

 . (10)

By identifying the long-run equations, correctly estimated parameters can be interpreted as long-run elasticities, as all of the variables are used in logarithmic form (Johansen 2005).

*4.3. Empirical Results*

*4.3.1. The Case of New York*

As mentioned in the data and methodology section, we begin the empirical analysis by testing for (non)stationarity properties of the series using Lee and Strazicich (2003, 2004) unit root tests. Before testing the (non)stationarity properties of the series, however, it is useful to plot the variables individually over time. Figure 1 shows the time plots of real taxi medallion prices, the number of taxies per thousand people and real average taxi fares for New York City.

As we can see from Figure 1, real taxi medallion prices have a positive trend over time. However, the number of taxies per thousand people has a negative trend in the 1981-2003 period, while it has a positive trend for the 1947-1980 and 2004-2010 periods. Additionally, the real average taxi fare series is relatively stable until it jumps in 1971. However, the trend of taxi fares is negative in the period 1971-2003, while it is positive in the post-2004 period.

Figure 1 Time graphs of the series for the case of New York.



Before performing the Johanse, Mosconi, and Nielsen (2000) cointegration procedure, we tested the (non)stationarity properties of the series in the presence of structural breaks using Lee and Strazicich (2003, 2004) minimum LM unit root tests with one and two breaks. The unit root test results are reported in Table 1.

From to Table 1, we can see that all variables are non-stationary in their levels. Additionally, Table 1 indicates that 1967 and 2001 were estimated to be structural breaks in real medallion prices, which can be associated with the slowed economic growth in the US in 1967 and the September 11 terrorist attacks in 2001. Accordingly, we estimate that the slowed growth in 1967 and the terrorist attacks and the subsequent recession in New York City in 2001 reduced medallion prices. As noted by Schaller (2006), the recession in the late 1960s and early 1970s led to sharp declines in the demand for taxi service in New York City. A total of 6,800 taxi licenses, almost 75% of the taxi fleet in the city, were sold to individual drivers by their owners. Thus, the recession led to a structural break in medallion prices in 1967. In addition to the terrorist attacks in 2001, we also estimate that the economic slowdown in New York City that began a few months before the September 11 terrorist attacks to be a structural break in medallion prices in 2001[[14]](#footnote-14). Accordingly, the economic slowdown reduced medallion prices between the spring of 1998 and mid-2001 (Schaller 2006). However, after both 1967 and 2001, medallion prices continued to rise. Under these circumstances, we can infer that medallion prices are sensitive to economic fluctuations like other investment assets[[15]](#footnote-15), although medallion prices have showed a very strong upward trend since 1950.

Table 1. Lee and Strazicich (2003, 2004) unit root test results for the case of New York

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Series | Model | Lag | Break times |  | -statistics | Critical values |
|  |  *C* | 7 | 19672001 | 0.30.8 | -4.48 | -5.65\* |
|  |  *C* | 10 | 19802003 | 0.50.8 | -5.56 | -5.73 |
|  |  *C* | 0 | 19702003 | 0.40.8 | -3.75 | -5.65 |

\* Critical values at the 5 % significance level were obtained from Lee and Strazicich (2003, 2004).

Additionally, 1980 and 2003 are clearly structural breaks in the number of taxies per thousand people. We estimate that the reasons for the structural break in 1980 are the decline in the number of medallions from 1964 to 1996 and the increase in New York City’s population after 1980. As mentioned above, the number of medallions declined from 13,566 in 1937 to 11,787 in 1980, and this figure remained constant until 1996. Furthermore, the population declined from 7,894,862 in 1970 to 7,071,639 in 1980 and then rose, reaching 7,322,564 in 1990 and 8,008,278 in 2000. This increase in the population caused a decrease and a structural break in the number of taxies per thousand people in 1980. After 1980, the number of taxies per thousand people continued to decline until 2003 because the population continued to rise, and entry to the market has not been deregulated. Instead, nine auctions have taken place since 2004, and a total of 1,109 medallions were gradually released through these auctions, although 400 new medallions were issued by auctions in 1996 and 1997. For that reason, we estimate that this gradual increase in the number of medallions results in a structural break in the number of taxies per thousand people after 2003.

The empirical analysis shows that 1970 and 2003 were structural breaks in real average taxi fares. We argue that the reason for the structural break in taxi fares in 1970 is the oil crisis of 1970, which particularly affected the United States. Accordingly, the oil crisis of 1970 caused high taxi fares during the 1970s by triggering inflation, although fares declined after 1970 until 2003. The findings show another structural break for taxi fares in 2003, which shifts the trend in taxi fares. We estimate that the reason for this structural break in taxi fares is the dramatic increase in average taxi fares from $6.85 to $8.65 that took place in May 2004[[16]](#footnote-16).

Figure 2 represents the time plots of the series with structural breaks. The shaded areas in the diagrams cover the inter-break data.

Figure 2 Time graphs of the series with structural breaks for the case of New York.



After investigating the (non)stationarity properties of the series, cointegration between the variables for the 1967–2001 break pair was tested using the Johansen, Mosconi, and Nielsen (2000) cointegration procedure. The minimum value of the Akaike Information Criterion (AIC) was adopted to select the optimum lag length, and the lag length was estimated to be . Table 2 presents the results of the Johansen, Mosconi, and Nielsen (2000) trace statistics for the 1967-2001 break pair. Table 2 shows the two cointegrating vectors  for the model , implying changes in level and trend in the long-run.[[17]](#footnote-17) Because the residuals obtained from the models are normally distributed, intervention dummies were not required.[[18]](#footnote-18) The LR-statistics of the VECM restriction tests for the 1967-2001 pair of breaks are reported in Table 3.

Table 2. Johansen, Mosconi, and Nielsen (2000) trace statistics for pair of breaks 1967-2001 for the case of New York

|  |  |
| --- | --- |
|  | Model  |
|  | 121.46 (70.96)\* |
|  | 51.77 (45.52) |
|  | 18.51 (23.57) |

\* Critical values in parentheses at the 95% confidence level can be approximated by -distribution, as explained in Johansen, Mosconi, and Nielsen (2000).

Table 3 shows that, for the 1967-2001 break pair, each variable remains in the cointegration space. This implies that stationarities come from linear combinations of the variables with broken level and trend. In addition, the lower panel of Table 3 shows that the number of taxies per thousand people is weakly exogenous, while the others are endogenous.

Table 3. VECM-restriction tests statistics for 1967-2001 pair of breaks for the case of New York

|  |  |  |
| --- | --- | --- |
| Null Hypotheses |  | -statistics |
|  |  |  |
| *Individual exclusion of:* |  |  |
|  |  | 16.03 (0.00)\* |
|  |  | 10.36 (0.00) |
|  |  | 40.23 (0.00) |
|  |  |  |
| *Weak exogeneity of:* |  |  |
|  |  | 13.89 (0.00) |
|  |  | 3.72 (0.15) |
|  |  | 50.81 (0.00) |

\* Marginal significance levels are in parentheses.

Because two cointegrating vectors are established in the system, at least two restrictions per cointegrating vector are required for the exact identification of the long-run relationships. To identify the long-run relationships for the model, we employed the restrictions below in terms of our economic expectations as follows:

 (11)

In the restrictions matrix above, the first line of restrictions implies that real average taxi fares are set equal to zero in the real medallion prices equation. The second required restriction is, which indicates that the medallion prices are normalized. The second row normalizes real average taxi fares to negative one, with the number of taxies per thousand constrained to zero.

By identifying the long-run equations correctly, these estimates can be interpreted as long-run elasticities (Johansen 2005). Table 4 reports the identified long-run equations and identification test results.[[19]](#footnote-19)

Table 4. Identified long-run and adjustment coefficients matrices and identification test result

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| IdentifiedEquations |  |  |  |  |  |  |  |  |  |  |
| Medallion prices | 1 | -0.46 | 0 | 0.07 | 0.03 | 0.10 | -0.46 | - | - | 5.58 |
| Average fares | 0.12 | 0 | 1 | -0.02 | -0.04 | 0.11 | - | - | 0.51 | *p-value*=0.06 |

The upper panel of Table 4 shows that the number of taxies has a negative effect on real medallion prices, with a one percent decrease in the number of taxies resulting in a 0.45% increase in medallion prices. In the average taxi fares equation, real medallion prices have a positive effect on taxi fares, with a one percent increase in medallion prices resulting in a 0.12 % increase in fares.

*4.3.2. The Case of Istanbul*

According to Figure 3, it can be said that while real medallion prices have a positive trend, the number of taxies represents a negative trend over time due to the entry restrictions. Additionally, after the Central Bank of Turkey began implementing an inflation-targeting regime in the beginning of 2002, inflation stabilized around single digit rates starting in 2004.

Figure 3 Time graphs of the series for the case of Istanbul



Before investigating the long-run relationships between the variables, in the study, we tested non-stationarity properties of the series in the presence of structural breaks using Lee and Strazicich (2003, 2004) minimum LM unit root test with one and two breaks. Unit root test results were reported in Table 5.

Table 5 Lee and Strazicich (2003, 2004) unit root test results for the case of Istanbul

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Series* | *Model* | *Lag* | *Break times* |  | -*statistics* | *Critical values* |
|  | *Model A* | 11 | - | - | -1.169 | -3.06 |
|  | *Model C* | 9 | 1994:12000:3 | 0.20.6 | -5.17 | -5.74\* |
|  | *Model C* | 1 | 2001:3 | 0.5 | -4.45 | -4.51 |

\* Critical values at the 5 % significance level were obtained from Lee and Strazicich (2003, 2004), and Schmidt and Phillips (1992).

Table 5 indicates that all variables are non-stationary in their levels. Additionally, Table 5 indicates that 1994:1 and 2000:3 were estimated as structural breaks for real medallion prices, which can be associated with 1994 and 2000-2001 economic crises in Turkey. Also, it can be clearly seen that 2000-2001 economic crises occurred as a structural break in inflation. Accordingly, the economic crises in 1994 and 2001 reduced medallion prices. After the recession, prices continued to rise. For the number of taxies per thousand people, however, we could not estimate any structural break. Figure 4 represents the time graph of the series with structural breaks. The shaded areas in the diagrams cover the post-break and inter-break data. Structural breaks show that medallion prices are sensible to crises in the economy. The prices in which real medallion prices did not increase were years of economic crisis in 1994 and 2000.

Figure 4 Time graphs of the series with structural breaks for the case of Istanbul

****

Since the economic crises in 1994 and 2000-2001 estimated as structural breaks for taxi medallion prices and inflation, after investigating the non-stationarity of the series the analysis was extended by testing cointegration between the variables with the pair of breaks 1994:1-2001:1. The minimum value of Akaike Information Criterion (AIC) was adopted in order to select the optimum lag length and lag length was estimated as . Table 6 presents the results of Johansen *et al.* (2000) trace statistics for the pair of breaks 1994:1-2001:1.

Table 6 Johansen *et al.* (2000) trace statistics for pair of breaks 1994:1-2001:1 for the case of Istanbul

|  |  |  |
| --- | --- | --- |
|  | *Model*  | *Model*  |
|  | 63.80 (51.68)\* | 87.83 (74.19) |
|  | 32.51 (32.25) | 48.14 (47.99) |
|  | 11.70 (16.22)\*\* | 15.95 (24.74) |

\* Critical values in parentheses at the 95% confidence level can be approximated by Γ-distribution, as explained in Johansen *et al.* (2000).

\*\* Denotes the first that the null is not rejected in Models  and .

Table 6 shows the two cointegrating vectors  for the model, implying changes in level in the long-run. To choose the appropriate model here, the Pantula principle was applied, and because the residuals obtained from the models are normally distributed, intervention dummies were not required.[[20]](#footnote-20) The LR-statistics of the VECM restriction tests for were reported in Tables 7.

Table 7 VECM-restriction tests statistics for 1994:1–2001:1 pair of breaks for the case of Istanbul

|  |  |  |
| --- | --- | --- |
| *Null Hypotheses* |  | *-statistics* |
|  |  |  |
| *Individual exclusion of:* |  |  |
|  |  | 7.67 (0.02)\* |
|  |  | 11.08 (0.00) |
|  |  | 6.83 (0.03) |
|  |  |  |
| *Weak exogeneity of:* |  |  |
|  |  | 3.60 (0.16) |
|  |  | 9.67 (0.00) |
|  |  | 14.72 (0.00) |

\* Marginal significance levels are in parentheses.

Table 7 shows that, for the pair of breaks, each variable maintains in cointegration space. This implies that stationarities come from linear combinations of the variables with broken level. In addition, the lower panel of Table 7 shows that the number of taxies is weakly exogenous, while the others are endogenous.

As in the long-run equations above, these estimates can be interpreted as long-run elasticities (Johansen, 2005). Table 8 reports the identified long-run equations and identification test results.

Table 8 Identified long-run coefficient matrix and identification test result for the case of Istanbul

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  *Identified Equations* |  |  |  |  |  |  |  |  |  |  |
| *Medallion Prices* | -0.71 | 1 | 0 | 4.07 | 4.43 | 5.17 | -0.06 | - | - | 2.65 *p-value*=0.27 |
| *Inflation* | 0 | 0.32 | 1 | 12.29 | 14.28 | 2.59 | - | - | -0.48 |

It can be clearly seen from Table 8 that the price elasticity of taxi medallions with respect to the number of taxies per thousand people is -0.71. There is a negative relationship between the number of taxies per thousand people and real medallion prices in Istanbul. According to the estimates above, a 1 % decrease in the number of taxies per thousand people results in a 0.71 % increase in real medallion prices. For the inflation equation, we can say that real medallion prices have an inflationary pressure, with a 1 % increase in real medallion prices resulting in a 0.32 % increase in inflation.

**5. Conclusion**

By developing a cointegration model with structural breaks to investigate the effects of government regulation, this paper provides a unique empirical support for the regulatory economics literature. We can interpret the findings as follows. First, our innovative model presents strong evidence suggesting that regulation induces adverse effects in the cases of the both Istanbul and New York taxicab market. Given a negative and inelastic relationship between the number of medallions and medallion prices, once market entry is restricted, there is a positive and inelastic relationship between medallion prices and taxi fares. In other words, regulation causes an increase in medallion prices, and this increase in medallion prices drives up taxi fares when the number of taxies is restricted by government regulation. In that case, we can infer that government regulation in the Istanbul and New York taxicab markets causes an artificial or monopolistic rent through medallion prices for medallion owners, who constitute an interest group, in keeping with the economic theory of regulation. Additionally, taxi fares are regulated in favor of the regulated industry because government regulation gives rise to higher fares than what would emerge in the absence of such regulation. In this context, we have found empirical evidence that is consistent with both the approaches and findings of the theoretical and empirical literature regarding the effects of government regulation.

Second, in the case of the New York taxicab market, we estimate that a 1% decrease in the number of taxis in the market causes a 0.45% increase or artificial rent over real medallion prices. This result can be interpreted as the long-run elasticity of medallion prices. Accordingly, real medallion prices respond negatively to a change in the number of taxis, real medallion prices decline by approximately 0.45% to a 1% increase in the number of taxis. This evidence coincides with both the arguments of our model and the literature, which asserts that entry regulation increases the regulated good’s (the medallion’s) price. On the other hand, in the case of Istanbul, we estimate that a 1 % decrease in the number of taxis in the market brings about a 0.71 % increase or artificial rent over real medallion prices. This result can be interpreted as a long-run elasticity of medallion prices. Accordingly, real medallion prices are negatively sensitive around 0.71 % to a 1 % change in the number of taxis.

Third, the findings show that the elasticity of taxi fares (the sensitivity of taxi fares) to changes in medallion prices is 0.12 the case of New York. Accordingly, we estimate that a 1% increase in real medallion prices causes a 0.12% increase in taxi fares. This evidence can also be interpreted as the long-run elasticity of taxi fares. For the case of Istanbul, the sensitivity of fares with respect to changes in medallion prices is 0.32. In other words, a 1 % increase in real medallion prices brings about a 0.32 % increase in taxi fares.

Fourth, an important contribution that our analysis makes to the literature is that the model estimates structural breaks in medallion prices, taxi fares, and the number of taxies per thousand people. For example, in the case of New York, we find structural breaks in real medallion prices in 1967 and 2001, in the number of taxies per thousand people in 1980 and 2003, and in taxi fares in 1970 and 2003. The estimates regarding structural breaks show that medallion prices, taxi fares, and the number of taxies per thousand people fluctuate with changes in economic conditions. The most important of these estimates for the relevant literature are the structural breaks in medallion prices. Because structural breaks in medallion prices show that medallion prices are sensitive to economic fluctuations, medallions are used as market investment tools by their owners.

Fifth, if we compare the findings in this paper for the case of New York with the findings of the Istanbul taxicab market, we understand that the effects of a strict regulation case as in Istanbul differentiate from a partial deregulation case as in New York. Whereas the case of Istanbul is a strict regulation one due to entry into the market has been hindered since 1991, the New York taxicab market is a partial deregulation case. Accordingly, whereas a 1% decrease in the number of taxis in Istanbul as the case of the strict regulation brings about a 0.71% increase in real medallion prices, a 1% decrease in the number of taxis in New York as the case of the partial deregulation causes a 0.45% increase in real medallion prices. Similarly, a 1% increase in real medallion prices as a result of government regulation leads to 0.32% and 0.12% increase in taxi fares in Istanbul and New York, respectively. The findings show that the regulated taxi fares and medallion prices in the case of the partial deregulation are less sensitive to government regulation, while they are more sensitive to regulatory interventions in the case of the strict regulation.

Finally, all of these findings are not well-known results in the literature. This means that this evidence is a novel contribution to the study of government regulation. For that reason, the findings of the paper can be used to decide a probable policy change concerning the regulatory process in the Istanbul and New York taxicab markets, and our model could be run to estimate the effects of government regulation in other markets with different regulatory regimes.

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1. By “government regulation” we refer to economic regulations such as entry restrictions and price controls. Additionally, by “the economic effects”, we mean the effects of regulation on prices and fares. In that sense, the analysis in the paper does not include social regulations regarding service quality, safety, and security and their effects on taxi markets. [↑](#footnote-ref-1)
2. For a detailed discussion of the rationales for or theories of economic regulation, see Noll (1989) and Joskow and Rose (1989). [↑](#footnote-ref-2)
3. Peltzman (1976) and Becker (1983) of these studies develop a model on the political influence of interest groups and the role of politicians as regulator in the regulatory process. [↑](#footnote-ref-3)
4. In the literature, it has been argued that there are further reasons for regulating taxicab markets. Economies of scale, declining marginal costs, predatory pricing, and excessive competition arguments are sometimes used to justify government regulation of taxicabs. However, these rationales are weaker than aforementioned arguments and their theoretical structures are contested vigorously because it is not possible to empirically show economies of scale in taxicab markets (Pagano and McKnight 1983), and technological innovations have made these arguments outdated for cities like New York, where corporations control most of the market (Harris 2002). [↑](#footnote-ref-4)
5. In this paper, we focus on medallions and their prices, because entry regulation influences directly medallions and they can be traded in the secondary market. [↑](#footnote-ref-5)
6. Whereas social regulations include safety and security regulations, maintenance requirements, drivers’ training levels and so on, economic regulations mean price controls and quantity restrictions. [↑](#footnote-ref-6)
7. See for a more detailed discussion about the aftermaths of regulatory process in the Istanbul taxicab market Çetin and Oğuz (2010). [↑](#footnote-ref-7)
8. The TLC is also responsible for the regulation of commuter vans, paratransit vehicles, and certain luxury limousines. The commission’s board has nine members, eight of whom are unsalaried commissioners. The salaried chair/commissioner presides over regularly scheduled public meetings and is the head of the agency (TLC 2009). [↑](#footnote-ref-8)
9. There are three methods for issuing licenses in taxicab markets: a predetermined ceiling system, objective criteria, and subjective criteria. See Bekken (2007) for a more detailed discussion of this issue. [↑](#footnote-ref-9)
10. In most US cities, taxi markets were under the control of municipal or state regulation by the late 1920s or 1930s (Teal and Berglund 1987). The reason was the extremely competitive conditions following the Great Depression. The competitive conditions in the New York taxi market after the Great Depression were a result of the low cost of entering the taxi industry at a time when other jobs were hard to find (Guri 2003; 256). For that reason, New York City introduced the New York medallion system in 1937. [↑](#footnote-ref-10)
11. The fares charged by private hired vehicles are not regulated. In New York, most companies charge by zone, but when they do use a meter, it must be inspected by an approved center at regular intervals (Darbera 2007) [↑](#footnote-ref-11)
12. Bagcilar Auto Center is a central place for the medallion market. Some owners hold 80 to 100 medallions in their hands (Çetin and Oğuz, 2010). [↑](#footnote-ref-12)
13. Average fares used in this paper are calculated following the methodology of Schaller (2006). This method of calculating fares is uniform throughout the U.S. and conforms to federal standards for taxi meters. Accordingly, the cab fare is $2.50 for the first 1/5 of a mile and 40 cents per additional unit. A unit is composed of distance (one unit equals 1/5 mile) and/or wait time (one unit equals 60 seconds). When a cab moves at more than 12 mph, the meter clocks distance. When a cab is stopped or is moving at less than 12 mph, the meter clocks time. There is also a $1 surcharge for trips beginning from 4 p.m. to 8 p.m. and a 50-cent surcharge for trips starting between 8 p.m. and 6 a.m. Trips between John F. Kennedy International Airport and Manhattan are charged at a flat rate of $45 plus any tolls. There is a $15 surcharge for trips to Newark Liberty International Airport (Schaller 2006: 16). However, the method we use to calculate average fares does not include any surcharges. Finally, we produce real average fares by deflating average fares. [↑](#footnote-ref-13)
14. Taxi ridership declined by 3% due to the economic downturn in New York City in 2001 (Schaller 2006). [↑](#footnote-ref-14)
15. The medallion’s value to its owner can be assessed in a manner similar to an investment in the stock market. Accordingly, economic fluctuations will affect the prices of the medallions (Cumming 2009). [↑](#footnote-ref-15)
16. This increase in taxi fares does not include any surcharges. For a more detailed discussion of the fare increase in 2004, see Schaller (2006). [↑](#footnote-ref-16)
17. To select between models and , the trend polynomial test was applied and  was found to be the appropriate model. [↑](#footnote-ref-17)
18. Multivariate normality test statistics for skewness, kurtosis and joint are 0.92 (p-value= 0.46), 3.41 (p-value= 0.07) and 7.07 (p-value=0.22), respectively. These results imply that the model is normally distributed. [↑](#footnote-ref-18)
19. Two types of restriction matrices can be tested here. However, the first restriction matrix, the one implying real medallion prices placed at the right side of the second equation, is not rejected; while the other matrix, in which the real average prices placed at the right side of the second equation, is. Therefore, only test results of the first restriction matrix and the identified long-run equations were reported in this study. [↑](#footnote-ref-19)
20. Multivariate normality test statistics for skewness, kurtosis and joint are 2.79 (*p-value*= 0.25), 5.07 (*p-value*= 0.08) and 7.89 (0.09). These results imply that the model is normally distributed. [↑](#footnote-ref-20)