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Individual Passenger Transport Market: Regulation, Externalities, and Urban Balance

Luiz Alberto Esteves
Chief Economist - CADE

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Individual Passenger Transport Market: Regulation, Externalities, and Urban Balance[1]

Department of Economic Studies - DEE

SEPN 515 Conjunto D, Lote 4, Ed. Carlos Taurisano

70770-504 - Brasília/DF

www.cade.gov.br

[1] All opinions expressed herein are personal and do not represent CADE's official position.

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Paper prepared by

Luiz Alberto Esteves
CADE Chief Economist

Reviewed by:

Ana Carolina Lopes de Carvalho
Marcela Mattiuzzo
Simone Maciel Cuiabano

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Executive summary

This work is a first effort of CADE's Department of Economic Studies (DEE/CADE) to gain a better understanding of the individual passenger transport markets, specifically the taxi and ride-sharing markets. All opinions expressed herein are personal and do not represent the official position of the Administrative Council for Economic Defense - CADE. Pursuant to Article 17 of Law No. 12,529 of November 30, 2011, DEE/CADE is mandated to "conduct studies and prepare economic opinions, on its own initiative or at the request of the Plenary Session, the President, the Reporting Commissioner or the General-Superintendent, ensuring the accuracy and the technical and scientific update of the agency's decisions". This work is part of Proceedings 08700.008971/2015-15, instituted by this Department, on its own initiative.

The text is divided into five sections, including this executive summary. The second section provides the context of the debate brought by the innovation in the individual transport sector involving competition, regulatory, and urban planning aspects. The third section is intended to analyze the individual passenger transport market from the perspective of a partial balance analysis, where a brief review of the literature on the regulation of taxi markets will be presented, as well as a discussion on recent empirical evidence that has challenged urban planners and a discussion on the deregulation theory and practice of these markets. The fourth section analyzes the individual passenger transport market from the perspective of urban balance, i.e., how the traffic and individual passenger transport structure interferes with other relevant variable aspects of urban space. The fifth and final section is devoted to our conclusions.

Based on this debate, we infer that it is necessary to discuss the regulation of the individual passenger transport market, taking into consideration urban balance aspects.

Nevertheless, we may conclude that there is no economic evidence to justify a ban on new providers of individual transport services. Furthermore, economic factors suggest that, from a competitive and consumer perspective, the actions of such new agents tend to be positive.

Contextualization

On June 30, 2015, the City Council of São Paulo approved, in a first vote, a bill authored by Councilman Adilson Amadeu (PTB/SP), which bans the provision of ride-sharing services through Uber - a smartphone application that serves as a platform for matching suppliers and demanders of ride-sharing services. The project was approved at a large advantage: 48 votes in favor and only one vote against it.

On the same day, the Legislative Chamber of the Federal District approved a Bill authored by District Deputy Rodrigo Delmasso (PTN/DF), regulating the use of such types of devices in the Federal District. In practice, however, the regulating project would have the same effects of the ban imposed by the São Paulo city councilors, as it prohibited drivers without a taxi license from providing paid transport using applications, such as Uber. As any other subject related to everyday city life, such decisions were the subject of considerable controversy.

On August 6, Governor Rodrigo Rollemberg (PSB/DF) announced the veto on the Bill of the Federal District; to date, the project of the City of São Paulo waits to be voted on in plenary session and then submitted for evaluation by the city government.

This work is a first effort of DEE/CADE to gain a better understanding of the individual passenger transport markets, specifically for the taxi and ride-sharing markets. The primary motivation for such events has been the possible consequences, especially on competition, of the above decisions.

The rivalry exerted by ride-sharing services has been interpreted by taxi service providers and by some regulatory and legislative authorities as illegal and unfair, resulting in decisions prohibiting and banning applications and ride-sharing services themselves. On the other hand, ride-sharing service providers and consumer groups have argued that the entry in the individual passenger transport market has been blocked by lobbying activities of taxi drivers, made possible by regulatory and legislative capture.

Some antitrust authorities have already formally expressed an opinion on this problem, which has had repercussions on the major economies of the world. In Latin America, for example, the Mexican antitrust authority (*Comisión Federal de Competencia Económica*) issued, in June 2015, a document addressed to the State Governors, the Head of the Federal District and the Legislators of that country with some recommendations, so that local governments recognize the ride-sharing services intermediated by smartphone apps and do not take measures to prohibit or ban such services.

The arguments of the Mexican antitrust authority represent an unneglectable portion of the opinions given by academics, public policy managers and authorities around the world. In other words, applications like Uber satisfactorily address many of the issues that led to the regulation of taxis in the cities, especially those arising from asymmetric information in these markets. This paper provides a brief presentation of the regulation of taxi markets and discusses some specifics of each of its segments (hailing, rank and pre-booking through phone calls), and the arguments for and against the regulation of the new provider entry and prices.

From this perspective, it would not make sense to restrict ride-sharing services through applications, since such services provide an adequate self-regulation mechanism, in addition to serving a market hitherto not covered (or covered unsatisfactorily) by taxis, and also to providing additional competition to the individual passenger transport market. In short, the innovations could broadly address the regulatory problems of taxi markets, as long as the street segments started losing market to the door-to-door segment.[2]

The argument above is again summarized in a decision of a Writ of Mandamus filed by a Uber driver against the constraining authority (President of the Road Transport Department of the State of Rio de Janeiro/RJ), handed down by Judge Bruno Vinícius da Rós Bodart, in case 0346273-34.2015.8.19.0001, of the 1st Public Finance Court of Rio de Janeiro:

[2] In the mid-1990s, the pre-booking segment through phone calls accounted for about 70% of the taxi market in countries like Norway and Sweden (see Bekken, J. & Longva, F. (2003)). The market shares depend, of course, on how the markets are regulated, available taxi ranks, if different segments are governed in a similar (single-tier system) or specific (multiple-tier system) manner, etc.

> "... There is significant evidence that the state initiative is the result of regulatory capture and is not aimed at ensuring the best public interest. Strictly speaking, the legal arguments supporting its ban are weak. On the one hand, there is a well-qualified service that is increasingly being used by society. On the other, there is fierce opposition by governing authorities to such service; this opposition is fomented – it is important to emphasize – by interested groups that, benefitting from the few permissions granted, earn extraordinary income in operating the service".

The benefits to the public interest would be undeniable as they would increase the welfare of society through several mechanisms: (i) the new market would provide a superior substitute for private cars for a particular group of consumers; (ii) the new market would provide an excellent substitute for taxis for a second group of consumers; (iii) the new market would compete with taxis and private cars, possibly reducing the price of taxi rides, car rentals, and even the prices of new and used cars. Not even professionals in the taxi market (not those holding the licenses) would be harmed, since they could also (*ex-post*) use the application services, or (*ex-ante*) contemplate between entering the taxi market or the ride-sharing market[3]. Therefore, the authorities' opposing movement would be justified by regulatory capture, caused by manipulation of the political environment by lobbying groups seeking economic gains, that is, for rent-seeking purposes.

The empirical evidence available about the deregulation of the taxi markets in some developed countries (Ireland, New Zealand, Sweden, Norway, Netherlands, USA, and Canada) from the 1980s showed the following pattern of results (Bekken & Longva, 2003):

- Quality requirements become critical as market entry and prices are deregulated. Even modest quality requirements can create barriers to market entry;

- Prices are not necessarily reduced due to tariff liberalization. Rather, they seem to grow on average and variance. This appears to happen because tariffs are excluded in the regulation. Tariffs seem to increase more where there is less competition, i.e., in taxi ranks and rural areas. In Norway, prices rose after tariffs were deregulated in all ten companies analyzed, ranging from 4.3% to

[3] Freitas, P. (2015). *Quem ganha e quem perde com a liberação dos táxis? Brasil: Economia e Governo.* Mimeo.

21%. The great benefit of tariff liberalization is the diversification of services. Price increases and reductions during different periods tend to follow the logic of the balance between supply and demand;

- The supply of taxis tends to grow when entry restrictions are removed. New taxi drivers focus on the hail and taxi rank segments, since in the door-to-door or pre-booking segment, the trend is that supply increases with existing taxi drivers. About the increase in taxis after market entry deregulation, North American cities showed a growth rate of 18% (Kansas City, 1983-1984) and 127% (San Diego, 1979);

- If tariffs continue to be regulated after market entry deregulation, the individual passenger transport sector (ride-sharing services, for example) will continue to operate as a complement to taxis in the pre-booking segment through telephone calls;

- Gradual deregulation processes seem to have generated better results than the simultaneous deregulation process of market entry and tariffs. This is due to the unexpected effects caused by regulatory changes. The deregulation process of the taxi market in the Netherlands is considered a successful example[4,5], although some say that not all of its goals have been fully achieved;[6]

- The quality loss of vehicle fleet does not seem to be associated with a free market entry, and an adamant regulation does not appear to be able to prevent service quality from deteriorating. However, service quality standards should be addressed regardless of the regulatory model desired.

In short, the partial balance model[7] applied to the issue of deregulating the taxi market is capable of providing facts that are consistent with the reality of the changes observed in deregulated markets. However, in other situations, they

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4 Bekken, J. & Longva, F. (2003). Impact of Taxi Market Regulation. *TOI Report.* Oslo, Norway.

5 OECD (2007). Taxi Services: Competition and Regulation. *Policy Roundtables*. DAF/COMP(2007)42.

6 Baanders, A. & Canoy, M. (2010). Ten Years of Taxi Deregulation in the Netherlands – The Case for Re-regulation and Decentralization. *European Transport Conference*, 2010 Proceedings

7 The partial balance analysis involves the notion that balance prices and quantities in a given market are obtained independently from other markets. In the case discussed herein, this means that prices and quantities sold in the individual passenger transport market are not affected and do not influence the prices and quantities of other markets.

provide predictions that cannot be observed empirically, such as the expected reduction in prices. In practice, what is observed is both a rise in prices and a variation in services. This is because it is generally assumed that the regulator sets right balance prices, and, in fact, in most cases assessed by the literature, maximum prices stopped potential increases.

One way to overcome some problems in assessing the impacts of changes in the individual passenger transport markets is through urban balance analysis, since the partial balance analysis disregards a basic theoretical element of the literature on urban economy[8]: variations in travel costs within urban areas may change (directly and/or indirectly) the layout of cities, as well as the use and occupation of urban soil. In short, they can affect other relevant variables of urban space, such as property prices, residential rents, and even the rate of growth and urban sprawl.

As discussed in the preceding paragraphs, an expected outcome of the legalization of ride-sharing services or the deregulation of the taxi market would be a general reduction in travel costs within the cities[9] (although this does not always occur in practice). As we analyze this fact from the perspective of the neoclassical model of urban economy, the economic implications of such measures would go far beyond those suggested by the partial balance analysis.

In the particular cases of reductions in travel costs, the neoclassical theoretical model describes an increase in the size of the city (this point will be seen in detail in the following sections), i.e., an increase in urban sprawl. The relationship between the travel cost in the cities and urban sprawl is so recognized in the literature that one of the main recommendations of economists to reduce urban sprawl is the introduction of congestion charging in urban zones. In practical terms, this means deliberately increasing the travel cost of people through (public or private) individual passenger transport to prevent other social costs, including for future generations. Moreover, as will be discussed below, empirical evidence and simulations with urban economy computable general models have shown that urban congestion charging can reduce by up to 10% the size of cities.

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[8] More specifically, the neoclassical model of urban economy, known in the specialized literature as 'Alonso-Muth-Mills Model', which will be briefly discussed in the following sections.

[9] Economist Mark Kleiman, for example, released a study which concludes that in the poorer neighborhoods of Los Angeles, Uber cars answer calls in half the time a taxi would, and their rides cost on average 50% less than taxi rides.

The main point in this discussion is that economists and urban planners have strongly considered the hypothesis that compressing the cities (as opposed to their sprawling) is a more efficient and sustainable way to allocate scarce resources and deal with the use and occupation of urban land. Although not consensual, city compression policies have been even recommended by international organizations, such as OECD[10] and the World Bank[11].

Also, from an urban balance analysis perspective, the argument of regulatory capture should be relativized. This results from the fact that urban managers do not prioritize either the individual passenger transport or the taxi markets, which are considered substitutes for private cars, but rather public transportation. These managers have focused their policies on creating incentives for people to replace (public or private) individual passenger transport with public transportation. In this sense, urban managers manipulate "carrots & sticks", that is, they seek to reduce cash costs (subsidies) and opportunity costs (increase in travel speed) of public transport and impose additional costs on vehicles that serve individual passenger transport, such as taxes on car ownership, fees, insurance, congestion charging, bus-only lanes and corridors, license plate driving bans, limited number of taxi licenses, etc. Such policies bear no relation to the regulatory capture in the taxi market.

We will not discuss here if compacted cities are more efficient and sustainable, if urban sprawl is undesirable, or if we should seek to reduce incentives on urban travel through individual transport (public or private) in favor of public transportation. The fact is that these issues are key in the agenda of urban planners and economists, and ignoring this fact can result in potential analytical distortions.

Looking at the issue from an urban balance perspective, we can see that the huge benefits brought by the technology applications used in ride-sharing services are highly efficient in mitigating the problems of asymmetric information in the taxi market. However, their ability to deal with the concerns of urban planners

[10] Material available at http://www.oecd.org/greengrowth/greening-cities-regions/compact-city.htm

[11] Material available at http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1270074782769/Iuchi.pdf

(including urban sprawl and externalities of individual passenger transport consumption) demand further studies.

In short, from an anti-sprawl policy perspective, improving the welfare of a group of consumers by reducing their travel costs through individual transport (public or private) is neither a necessary nor sufficient condition to ensure that society as a whole also enjoys greater welfare, especially when we infer such effects from models of overlapping generations. This is because the consumption of certain goods may generate negative externalities, such as pollution (noise, visual, air, soil and water), public goods congestion, etc.

On the other hand, while recognizing the fact that urban planners, urban economists, and local legislators pursue anti-sprawl policies, the fact is that banning ride-sharing services is still economically unjustified, for two basic reasons:

- As will be seen below, economics provides a set of analytical elements to measure and simulate potential effects resulting from consumption externalities, as well as a list of public policy proposals to mitigate such effects, so that **prohibiting or banning any solution that brings welfare increase to a group of consumers would be unnecessary and counterproductive;**

- We cannot rule out that urban planners and economists can **create the necessary incentives to ensure that the ride-sharing markets operate in a neutrally-sprawl manner or even in line with an anti-sprawl agenda.**

With respect to the first topic above, we can mention, for example, the construction of urban models of computable general balance, in which it is possible to simulate (i) the adverse effects of some specific situations and (ii) how different public policies could mitigate such effects. The policies include introducing or reviewing urban zoning, Pigovian taxation (or subsidies)[12], congestion charging, etc. These tools, combined with information gathered in surveys of origin/destination (OD) and other information obtained by calibrating micro traffic simulation models provide the necessary elements for public policy makers to structure their strategies and

[12] Pigovian taxes or subsidies are used to correct market imperfections, such as negative externalities arising from the consumption of some goods or services.

provide answers more sophisticated than prohibitions and bans on disruptive events[13], such as the introduction of technologies like Uber.

With respect to the second topic, we cannot discard the possibility of a well-structured ride-sharing market also contributing to anti-sprawl policies. For example, the ride-sharing market operates through smartphone apps; hence, it tends to operate exclusively in the individual passenger transport segment, i.e., it does not compete with the taxi rank and hailing segments. Should the ride-sharing market replace a significant portion of private cars, which were previously used to transport people to their workplaces (usually city centers), the demand for parking in city centers would tend to reduce, thus opening room for a higher degree of densification in urban centers and greater city compression.

In short, it would be desirable that local regulators had analytical tools available in engineering, architecture, urbanism, and urban economy to measure and deal with the effects of disruptive innovations affecting the daily life in the cities. On the other hand, it would also be highly desirable that the companies responsible for introducing such innovations provide information and studies to the local authorities that may reduce the asymmetry of information and seek to address a discussion agenda to mitigate the risks and concerns of public authorities.

The arguments in favor of deregulating free entry in and exit from the individual passenger transport market tend to focus on the benefits to consumers of these types of services. However, various types of consumption generate externalities, many of them negative and of which consumers are not even aware[14]. In the absence of a world with market imperfections and consumption externalities, local

[13] Disruptive innovations are characterized, among many factors, by generating abrupt changes in business models, and act as a platform in a two-sided market, linking several suppliers and consumers. Therefore, they ensure an opportunity for the consumer to enjoy imperfect substitutes for hotels and taxis, for example. The online platform tends to reduce the search costs of consumers while allowing more suppliers to enter the market by reducing barriers to entry. Therefore, we may conclude that such platforms improve the match between buyers and sellers effectively. In doing so, these platforms compete with segments where past players offer similar services.

[14] An economic situation involves a consumption externality if the consumer is concerned directly with the consumption of the other agent. Examples: If each family preferred to get around by large cars, and another family felt aggrieved by the vehicle affecting traffic; if each person chose to enjoy long baths, and another felt undermined by the reduction in the volume of water available; if a family chose not to vaccinate their children and pets, and another felt aggrieved to be more vulnerable to viruses; if a person chose to hold a party with loud music throughout the night and the neighbor had the opposite preference about silence, etc. (Varian, H. (2000) *Microeconomia: Princípios Básicos.* Ed. Campus, 5ª ed. Cap. 32)

authorities and legislators should have the minimum information decide how to internalize externalities. For example:

- What is the forecast and the target of the vehicle fleet operating in the ride-sharing market in that city?

- What is the impact of additional cars on the streets? Would it be only the substitution effect of the existing fleet?

- A car dedicated to ride-sharing would replace how many private cars that would take up parking spaces in urban centers?

- If the ride-sharing service adds cars on the streets, what would be an estimated additional fleet? What are the city regions most affected? What are the implications of the additional consumption of public goods? Would it increase traffic congestion and pollution?[15]

- Should there be a risk of increasing the vehicle fleet on the streets, leading to increased traffic congestion and pollution, who would bear the cost of consumption externalities of ride-sharing services?

- Would it be possible to handle the potential adverse effects through simple traffic accommodation? Would additional investments in road infrastructure be required?

- Would it be necessary and/or strategic to redesign the cities' zoning plans to accommodate the new service at the lowest possible social cost? Or would this not be necessary because its impact would be negligible?

The answers to these questions are essential for the local authorities to assess the costs and benefits, and address the deregulation of the individual passenger transport market. Failing to internalize the potential externalities would make the

[15] Some of these issues remain open even in places where Uber has already been operating for some time, such as in New York. Economist Charles Komanoff tried to estimate the effect of the introduction of ride-sharingride-sharing services through applications like Uber, Lyft, and others, and concluded that they were responsible for a reduction of approximately 7% in the average speed in the city.

cost of individual passenger transport services more economical than the socially desirable, and unnecessarily increasing service supply.

As we set aside the economic analysis of partial and general balance, we see that past events suggest that the history of urban transport has been marked by public takeovers[16], that is, such services started out private and then became public due to their market imperfections (asymmetry of information, externalities, etc.). The regulation of taxis was instituted in New York City in response to the fact that during the Great Depression, the number of taxis driving in the city was 30,000 (today, there are a little more than 13,000). Due to large fleets, taxi drivers had to spend long hours in search of customers, creating several problems, such as physical exhaustion of drivers, wear and tear of vehicles, and traffic congestion. On the other hand, history shows that regulatory capture was also present in this process.[17]

The fact that the history of urban transport was marked by public takeovers does not mean that deregulation processes are not successful or that they do not create healthy markets. As seen throughout this paper, the deregulation experience of taxi markets provides examples for all tastes and preferences. From the fact that the taxi markets are historically marked by cyclical processes of regulation and deregulation[18] to the successful Dutch case – considered a benchmark in the specialized literature.

Since the successful and unsuccessful cases of deregulation coexist in the literature, we can infer that the the way through which such processes are conducted plays a fundamental role in these types of policies. However, the process depends on the specifics and the idiosyncrasies of each market to be deregulated. As we shall see throughout this paper, taxi markets rely heavily on other city characteristics, such as the use and occupation of land, public transport network, different distributions of population density in several neighborhoods, etc.

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16 Vuchic, V. (2005). Urban Transit: Operations, Planning and Economics. Hoboken, New Jersey: John Wiley & Sons, Inc.

17 Hodges, G. (2007). Taxi! The Social History of the New York City Cabdriver. Baltimore, Maryland: The Johns Hopkins University Press.

18 Dempsey, P. (1996). Taxi Industry Regulation, Deregulation, and Reregulation: The Paradox of Market Failure. *Transportation Law Journal.* Vol 24 (1): 73-120.

Therefore, a cross-regulatory standard to be applied indiscriminately across heterogeneous cities should be considered with due caution.

One of the arguments that justify the success of the taxi market deregulation process in the Netherlands is that it was gradual. In fact, markets that generate externalities tend to be regulated and structured with "second best"-type policies[19,20,21], often articulated and interrelated to each other[22]. Part of the difficulty of the bargaining process in eliminating regulations stems from this fact, which creates obvious concerns and uncertainty for authorities, without this having, again, any relation to capture. If the literature was unanimous in pointing out deregulation as an invariably better solution, opposing movements would result exclusively from capture, but empirical evidence suggests that this is not the case.

However, if we analyze in detail the Dutch case, maybe we can identify other upside aspects, such as the supermodularity[23] of the strategy. The Dutch not only deregulated the taxi market but also created incentives for such a market to operate in line with other urban policies. For example, the taxi market was encouraged to operate as a modal interconnected to the public transport network of the cities, as opposed to the logic that taxis are substitutes for private cars and that they compete with public transport (an argument that has been challenged by recent empirical evidence). In short, the Dutch combined the benefits brought by the taxi market deregulation (partial balance analysis) with the other objectives of urban planners (urban balance analysis).

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19 Baumol, W. (1972). On Taxation and the Control of Externalities. *The American Economic Review.* Vol 62 (3): 307-322.

20 Lipsey, R. (1956). The General Theory of Second Best. *The Review of Economic Studies.* Vol 24 (1): 11-32.

21 Markovits, R. (1998). Second-Best Theory and Law & Economics: An Introduction*. Chicago-Kent Law Review*. Vol 73 (1): 3-10.

22 Bennear, L. & Stavins, R. (2007). Second-best Theory and the Use of Multiple Policy Instruments. *Environmental and Resource Economics*. Vol. 37: 111-129.

23 Milgrom, P. & Roberts, J. (1995). Complementarities and fit strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics.* Vol 19 (2-3): 179-208.

Partial Balance Analysis

Market and Regulation

Taxi markets have a long history of regulation, and this practice has been the rule, although several major cities have experienced different forms of deregulation from the 1980s. The discussion on the deregulation of these markets is now invigorated due to the development of smartphone applications, which have been able to address many issues that are commonly justified to regulate the sector.[24]

First, it is necessary to clarify that the taxi market is generally divided into three segments: (i) the taxi rank segment, (ii) the hailing segment; and (iii) the door-to-door segment, also known as pre-booking, taxi-booking or phone booking segment, in which ride-sharing service providers also operate. Not all cities have markets with all types of segments.

The regulation of taxi markets is mainly driven by the characteristics of the rank and hailing segments since the major constraints and market failures happen in them. Overall, taxis are regulated to address the following concerns:

- Public Safety: physical protection of consumers and third parties and vehicle adjustments. This implies establishing minimum standards for drivers and vehicles;

- Economic protection of consumers: preventing consumers from incurring losses in bargaining situations deemed disproportionately disadvantageous. For example, taxi drivers charging in a favorable bargaining situation prices significantly higher than what they would charge in a situation with less bargaining conditions;

- Traffic congestion: taxis are regulated to avoid significant traffic congestion in urban centers. In many cases, taxi markets in urban centers are regulated to operate through taxi ranks, thus preventing cabs from driving in search of

[24] Much of the discussion dealt with in this section was based on the following references: [1] Bekken, J. & Longva, F. (2003). Impact of Taxi Market Regulation. *TOI Report.* Oslo, Norway; and [2] Toner, J. (1992). Regulation in the Taxi Industry. *ITS Working Paper* 381, Institute for Transport Studies, University of Leeds, Leeds.

passengers. Therefore, taxi licenses can be limited according to the number of available urban spaces for taxi ranks;

- Performance: regulators can work with different combinations of available ranks, maximum fares and a number of licenses to ensure a market that operates under a desired level of performance.

Authorities, in turn, can pursue four different types of policies for their taxi markets: (i) market solution, where there is no entry and price regulation; (ii) market entry restrictions without price regulation; (iii) free market entry, with price regulation; and (iv) market entry and price regulation.

*The arguments in favor of **market entry regulation** include:*

- Free entry would entail an excessive demand for space in taxi ranks;

- High cost of fleet tracking;

- Excessive entry would reduce taxi occupancy rate, creating pressures for price increases to balance the flows of revenues and expenses;

- The entry of part-time drivers can create a disproportionately higher supply at peak times or in places where rides are more attractive (e.g., at airports);

- There may be more pressure to increase the prices of unattractive rides for market-entering part-time drivers.

*The arguments against the **market entry regulation** include:*

- Regulation is expensive;

- Regulation provides power and protection positions;

- Regulation creates a premium for license holders;

- Controls applied to the taxi market are not applied to other similar markets.

*The arguments in favor of **price regulation** include:*

- The spatial structure of the taxi rank and hailing segments inhibits price competition;
- The demand curve for each driver is price inelastic
- Equity argument: some areas of a city are more attractive than others;
- Matter of Public Policy: the price competition between drivers in the same taxi rank would be physically and practically impossible.

*The arguments against **price regulation** include:*

- Other markets similar to taxi markets do not have any price regulation;
- Measuring optimum prices is not a trivial task and tends to generate distortions in the allocation of resources;
- Regulatory capture.

As mentioned earlier, the rank and hailing segments tend to raise greater concern to regulators, especially in respect of the physical and economic safety of passengers, plus the fact that these segments demand a lot of physical space in the cities (for taxi stands) or negatively contribute to traffic congestion (hailing segment). As a result, some places are regulated by a single-tier system. Other places, by a two-tier system, in which the regulation applicable to the door-to-door or pre-booking segment is different from the one applicable to the rank and hailing segments.[25] Also, rank segments operate through informal institutional rules, that is, customers are served on a first-in, first-out basis. Of course, under such mechanisms, a taxi rank with a row of 30 vehicles or one single vehicle makes any bargaining process completely irrelevant.

[25] Aarhaug, J. & Skollerud, K. (2013). Taxi: Different Solutions in Different Segments. *European Transport Conference.* Frankfurt, Germany.

The pre-booking market through telephone calls is less problematic in many respects, as the companies responsible for coordinating the provision of services can create private self-regulatory mechanisms to enhance the security of the service, obtain a reputation for good service, grant discounts, in addition to incurring increased competition with other providers in the same segment. Additionally, this segment tends to reduce the space occupation problems regarding taxi ranks and the number of taxi drivers on the streets looking for passengers.

Technological developments of smartphone applications, including the ability to view the profile of drivers and decline rides, rate the services, track vehicle movements through GPS technology, know the price of the ride in advance, and make payments electronically on the same software platform have actually addressed many of the concerns that have historically encouraged the regulation of taxis.

However, it is worth noting that the most problematic segments of the taxi market are the rank and hailing segments. This means that for these new technologies to satisfactorily address the regulatory problems of this sector as a whole, it is necessary that the taxi ranks and hailing segments lose their market share to the pre-booking segment over time.

The Taxi Market Revisited

One of the main priorities of urban managers is public transportation. There is a clear focus on policies that can create incentives for people to replace individual passenger transport (public or private) with public transportation. Accordingly, urban managers manipulate "carrots & sticks," that is, they seek to reduce cash costs (rates) and opportunity costs (travel time) of public transport and impose additional costs on vehicles serving individual passenger transport, such as taxes on vehicle ownership, fees, insurance, congestion charging, bus-only lanes and corridors, rotation policy of license plate, limited number of taxi licenses, etc.

The fact is that urban managers do not prioritize either individual passenger transport or taxi markets, which are considered substitutes for private cars. In the case of urban managers in developing countries, where the public transport infrastructure is very limited, achieving the goals is an extremely complex and difficult task, since the collective passenger transport is considered quite an inferior substitute for individual passenger transport even in countries with the best urban transport infrastructure in the world.[26] In short, monitoring the impact, visibility and volume of material and human resources allocated to discuss the regulatory aspects of individual passenger transport must cause some degree of frustration in urban managers.

However, some empirical studies have suggested that taxis play a much more important role in integrated urban transport networks than expected. In fact, evidence has shown that taxis "would play more in favor than against" public transport. Two studies deserve special attention.

The first empirical study was conducted in 2012 by Juan Francisco Saldarriaga, during his master's degree program in urban planning at Columbia University in New York. Saldarriaga obtained a representative sample of 200,000 taxi trips in New York City. The results obtained by the author can be viewed in a video shared on VIMEO, titled "New York City Taxi Activity: Origin and Destination Densities".[27]The more challenging finding of his research is the asymmetry

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[26] Steg, L. (2003). Can public transport compete with the private car? *IATSS Research.* Vol 27 (2): 27-35.

[27] See link at: https://vimeo.com/35433719

observed in the origin and destination densities in the early morning and late afternoon. The interpretation of the findings is provided by David King, professor of urban planning at Columbia University, as follows: if taxis were near-perfect substitutes for private vehicles, we would expect a symmetry in the origin and destination densities in the early morning and late afternoon, and the effect of an image reflected in a mirror. However, this is not what we can see in Saldarriaga's video.

This phenomenon has serious implications for urban transport policy, as King points out:

> "This matters because it means individual's travel journeys are multimodal. If we want to have transit oriented cities we have to plan for high quality, door-to-door services that allow spontaneous one-way travel. For all of the billions of dollars we have spent on fixed-route transit and the built environment we haven't spent any time thinking about how taxis (and related services) can help us reach our goals[28]."

Saldarriaga's research findings are in line with the empirical study previously developed by Schaller (2005)[29], who developed an econometric model applied to 118 North-American cities, with the purpose of verifying the main determining factors of the demand for taxis in those cities. Schaller (2005) notes that the main source of demand for taxi trips comes from workers who use such services to access subway stations. The second source is from families with no cars, and the third, rides to airports.

This characteristic suggests that a license-restricting policy can, to some extent, operate in the opposite direction desired by urban planners. In other words, instead of reducing travel costs by public transport, such as the subway, it would create a perverse incentive for the public to replace the modal combination "individual transport plus public transport" with an exclusively individual transport.

This fact suggests that a review of the taxi market entry regulation demands a detailed analysis. However, the fact that the largest travel demands for taxis come from people commuting daily from their homes to work (not necessarily from work

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[28] See: http://www.citylab.com/commute/2012/02/táxis-part-transit-system/1133/

[29] Schaller, B. (2005). The Regression Model of the Number of taxicabs in U.S. Cities. *Journal of Public Transportation,* Vol 8 (5): 63-78;

to home, as was seen in Saldarriaga's findings) can be a problem when rates are deregulated, since empirical evidence suggests that this type of deregulation tends to increase the variance of ride prices (including depending on the day and time of the ride). Assuming regular consumers are risk averse, introducing such a measure without proper financial compensation (price reduction) can leave consumers worse off.

Deregulation Impact: Theory

As mentioned in the previous section, the taxi market is regulated in almost all countries of the world. Formats are varied, but the most restrictive regulation includes price, supply, and quality controls. It has been seen that many of the problems justifying the regulation of taxi markets have been addressed quite well with the new technologies available in smartphone apps. This has enabled the entry of new suppliers to the individual passenger transport market, such as in the case of ride-sharing service drivers.

The rivalry exerted by ride-sharing services has been interpreted by taxi service providers and by some local and legislative authorities as illegal and unfair, resulting in decisions to prohibit and ban applications and ride-sharing services themselves. On the other hand, ride-sharing service providers and consumer groups have argued that the entry to the individual transport passenger market has been blocked by lobbyist activity of taxi drivers, made possible by regulatory and legislative capture.

Some antitrust authorities have already formally expressed their opinion on this issue, which has had repercussions in the major economies of the world. For example, in June 2015, the Mexican antitrust authority (COFECE) issued a document addressed to State Governors, the Head of the Federal District and Mexican Legislators with some recommendations, among which we should highlight the following:

> "La normativa vigente en nuestro país no contempla esta nueva modalidad de servicios de transporte que deriva de los avances tecnológicos y de los esfuerzos de innovación. Como se ha expuesto con antelación, el desarrollo de aplicaciones móviles para el transporte de pasajeros resuelve problemas de asimetrías de información y problemas de coordinación entre conductores y pasajeros, contribuye a la movilidad urbana, fomenta la innovación y, en general, ofrece opciones eficientes de consumo que generan bienestar social. En consecuencia, esta COMISIÓN recomienda que se reconozca, a través de la vía que corresponda, una nueva categoría o modalidad para la prestación de este servicio innovador que tiene impacto relevante en la dinámica social."

The arguments of the Mexican antitrust authority represent an unneglectable portion of the opinions given by academics, public policy managers and authorities

around the world. In other words, applications like Uber satisfactorily address many of the problems that led to the regulation of taxis in the cities, especially those arising from asymmetric information in these markets.

Accordingly, the benefits to public interest would be undeniable because they would increase the welfare of society through several mechanisms: (i) the new market would provide a superior substitute for private cars for a particular group of consumers; (ii) the new market would provide a superior substitute for taxis for a second group of consumers; (iii) the new market would compete with taxis and private cars, possibly reducing the price of taxi rides, car rentals and even the prices of new and used cars. Not even professionals in the taxi market (not those holding the licenses) would be harmed, since they could also (*ex-post*) use the application services, or *(ex-ante)* decide between entering the taxi market or the ride-sharing market. The authorities' opposing movement would be justified by regulatory capture, caused by manipulation of the political environment by lobbying groups seeking economic gains, that is, for rent-seeking purposes, in the forms covered by Tullock (1967)[30] and Kruger (1974)[31].

Also, the market power guaranteed by restricting licenses would compromise the quality of the services provided by taxi drivers because of a mechanism known in economics literature as X-inefficiency. This is a concept introduced by Harvey Leibenstein[32], which suggests that market imperfections enable existing suppliers not to seek to maximize efficiency and profits, but rather to accommodate, in a lenient way, some degree of inefficiency due to the absence of competitive pressures. This type of argument has been used on a recurring basis to justify the fact that the services provided by taxi drivers would present supposedly lower quality than those provided by ride-sharing service drivers.

[30] Tullock, G. (1967). The Welfare Costs of Tariffs, Monopolies, and Theft. *Western Economic Journal,* vol.5 (3): 224-232.
[31] Krueger, A. (1974). The Political Economy of the Rent-Seeking Society. *American Economic Review,* vol. 64 (3): 291-303.
[32] Leibenstein, H. (1966). Allocative Efficiency vs. X-Efficiency. *American Economic Review,* vol.56 (3): 392-415.

Deregulation Impact: Practice

As already mentioned, the taxi market started out private, underwent a public takeover, and currently goes through cycles of regulation and deregulation. Also, empirical evidence available on taxi market deregulation in some developed countries (Ireland, New Zealand, Sweden, Norway, Netherlands, USA, and Canada) from the 1980s showed the following pattern of results (Bekken & Longva, 2003):

- Quality requirements become critical as market entry and prices are deregulated. Even modest quality requirements can create barriers to market entry;

- Prices are not necessarily reduced due to tariff liberalization. On the contrary, they seem to grow on average and variance. This appears to be because tariffs are excluded in the regulation. Tariffs seem to increase more where there is less competition, i.e., in taxi ranks and rural areas. In Norway, prices increased after tariffs were deregulated in all ten companies analyzed, ranging from 4.3% to 21%. The great benefit of tariff liberalization is the diversification of services. Price increases and reductions during different periods tend to follow the logic of the balance between supply and demand;

- The supply of taxis tends to grow when entry restrictions are removed. New taxi drivers focus on the hail and rank segments, since in the door-to-door segment the trend is that supply increases with existing taxi drivers. Concerning the increase in taxis after market entry deregulation, North-American cities showed a growth rate of 18% (Kansas City, 1983-1984) and 127% (San Diego, 1979);

- If tariffs continue to be regulated after market entry deregulation, the individual passenger transport sector (ride-sharing services, for example) will continue to operate as a complement to taxis in the pre-booking segment through telephone calls;

- Gradual deregulation processes seem to have generated better results than simultaneous deregulation process of market entry and tariffs. This is due to the unexpected effects caused by regulatory changes. The deregulation process of

the taxi market in the Netherlands is considered a successful example, although some say that not all of its goals have been fully achieved;

- The quality loss of vehicle fleet does not seem to be associated with free market entry, and an adamant regulation does not appear to be able to prevent service quality from deteriorating. However, service quality standards should be addressed regardless of the regulatory model desired.

In short, the partial balance model applied to the issue of deregulating the taxi market is capable of providing facts that are consistent with the reality of the changes observed in deregulated markets. However, in other situations, they provide predictions that cannot be empirically observed, such as the expected reduction in prices. In practice, what is observed is both a rise in prices and a variation in services. This is because it is generally assumed that the regulator sets right balance prices, and, in fact, in most cases assessed by the literature, maximum prices stopped potential increases.

Urban Balance Analysis

The Neoclassical Model of Urban Balance

From an economics standpoint, the city's formation stems from the concentration of jobs, which in turn implies the spatial concentration of households in the vicinity of workplaces. The two main economic forces that lead to urban concentration are economies of scale and economies of agglomeration. Economies of scale occur within firms and are related to the fact that the marginal cost of production declines as the level of production increases. Economies of agglomeration are external to the firm and result from the internalization of benefits earned by its proximity to other firms (customers and suppliers), as well as a large provision structure of public goods.

Economies of scale and economies of agglomeration are the main determining facts to decide on the firms' location. The costs of transport (of goods or persons) also influence the decision on the firms' location and may lead or even enhance the spatial concentration of jobs. Therefore, we can infer that transport costs can play (directly or indirectly) a key role in spatial concentration, city layout and the use and occupation of urban soil. The purpose of this section is to present the neoclassical model of urban economy, which intends, as one of its consequences, to show how passenger transport costs in cities can shape, transform, or change their layout.

Academic works on urban economy began in the 1960s. Seminal contributions are attributed to Alonso (1964)[33], Muth (1969)[34], and Mills (1967)[35], for which reason the neoclassical model of urban economy is known as Alonso-Muth-Mills, or monocentric urban model. The main objective of these models was to provide stylized facts, or provide a theoretical approach to urban phenomena, empirically observable, such as: compared to peripheral regions, city centers are more densely populated, with smaller households, taller buildings and higher prices by square meter; dwellings in central areas consist mostly of apartment buildings, while in the suburbs they are mostly represented by houses.

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33 Alonso, W. (1964). *Location and land use. Cambridge:* Harvard University Press;

34 Muth, RF (1969). *Cities and housing.* Chicago: University of Chicago Press;

35 Mills, E.S. (1972a). *Studies in the structure of the urban economy.* Baltimore: Johns Hopkins University Press.

As we will see, the Alonso-Muth-Mills neoclassical model of urban economy provides a good approximation of monocentric cities. Moreover, the model has been criticized on account of the fact that the cities have been increasingly becoming polycentric over the past decades. However, I share the view of Kraus (2006)[36] that even with difficulties in providing a satisfactory theoretical approach to the reality of polycentric cities, the monocentric aspect remains a good approximation for a large part of the urban areas of the world; and the economic forces that arise from monocentric cities are equally essential to analyze the cases of polycentric cities; therefore, the monocentric model provides a good starting point for analytical purposes.

The mathematical model presented throughout this section was developed by Brueckner (1987)[37], however, a more simplified version (graphical approach) can be found in Brueckner (2011).[38]

[36] Kraus, M. (2006). "Monocentric cities." In *A companion to urban economics.* Arnott & McMillen (Ed.). Cambridge: Blackwell Publishing;

[37] Brueckner, J. (1987). "The structure of urban equilibria: the unified treatment of the Muth-Mills model." In *Handbook of Regional and Urban Economics.* Mills (Ed.). Amsterdam: Elsevier Science

[38] Brueckner, J. (2011). *Lectures on urban economics.* Cambridge: MIT Press;

The Alonso-Muth-Mills Model

In the stylized city represented by the model, each resident commutes to work in the city center, herein referred to as the Central Business District, or CBD. The round-trip cost per kilometer to work is equal to *t,* so that the cost to travel at a radial distance of *x* km from the CBD is *tx* per period (CBD is the point where *x* = 0).

Consumers are homogeneous regarding tastes and preferences (similar utility functions) and are paid equally, with an income equal to *y* per period. Consumer preferences are represented by a utility function strictly *quasi-concave v*(*c,q*), where *c* is the consumption of a basket of goods and services and *q* is the housing consumption, specified in square meters of physical space.[39]

The price of the basket of goods and services (cash) is the same anywhere in the city, but the price of renting *q* square meters of housing is equal to *p* and varies according to the resident's housing location. As consumers are identical, the urban balance must involve identical utility levels for all city residents, regardless of how near or far they are from the CBD. The spatial variation of *p* is the key component for the equalization of utilities among residents in any parts of the city, i.e., it ensures that an individual who dwells in the CBD, where *x* = 0, is given the same utility of an individual who dwells in the suburbs, where *x*> 0.

Given the above assumptions, the local/consumer problem is:

$$\max_{\{q\}} v(c,q) = u \qquad [1]$$

Subject to $c + pq = y - tx$

The first order condition of this type of utility maximization problem subject to a budget constraint is well known in the literature:

$$\frac{v_2(c,q)}{v_1(c,q)} = p \qquad [2]$$

Where the subscripts denote partial derivatives.

[39] To simplify, the only attribute considered to rent a place is a physical space in square meters.

In equation [2] we have the situation in which the marginal rate of substitution between *q* and *c* is equal to the ratio between their prices. Graphically, this is equal to the well-known point of tangency of the utility function with the line of budget constraint.

The additional requirement of spatial balance is that the resulting consumer basket should ensure the same *u* utility for any of the city inhabitants/consumers, namely:

$$v(y - tx - pq, q) = u \qquad [3]$$

With the system of equations [2] and [3], it is possible to find the values for the unknown factors of the model: *p* and *q*. Such solution values depend on the other parameters *x, y, t* and *u*. In short, the travel cost *t* affects property prices (rents), as well as the demand for square meters of housing in the city.

The nature of the dependence of *p* and *q* on the parameters *x, y, t* and *u* may be mathematically derived from the total difference from equations [2] and [3], for example:

$$\frac{\partial u}{\partial c}\frac{\partial c}{\partial x} + \frac{\partial u}{\partial q}\frac{\partial q}{\partial x} = -v_1\left(t + \frac{\partial p}{\partial x}q + \frac{\partial q}{\partial x}p\right) + v_2\frac{\partial q}{\partial x} = 0 \qquad [4]$$

We know from equation [2] that $v_2(c, q) = pv_1(c, q)$, so that:

$$\frac{\partial p}{\partial x} = -\frac{t}{q} < 0 \qquad [5]$$

In short, the rental price per square meter of housing is a decreasing function of the distance to the CBD.

The same exercise can be applied to verify the impact of an increase in *x* on *q,* so that the solution is equal to:

$$\frac{\partial q}{\partial x} = \theta\frac{\partial p}{\partial x} > 0 \qquad [6]$$

Where $\theta < 0$ is the slope of the offset demand curve.

From equation [6] we see that the square meters of housing are an increasing function of the distance to the CBD, i.e., the houses in the suburbs and outskirts of the city tend to be larger (regarding square meters per capita) than dwellings located in the CBD. In short, the model provides a quite satisfactory theoretical approach to the empirical evidence found in most monocentric cities around the world.

The author provides a section of the article only for deriving the effects of the rising cost of round-trip travel per kilometer from work *(t)* on the model of the key variables. The results are summarized below:

- All journeys within the city will become more expensive, and the city will reduce its size in response;

- The following will increase: (i) the price per square meter of residential rents; and (ii) the structural density in the CBD. On the other hand, the values of these same variables to the farthest points of the CBD will be reduced, i.e., in the suburbs and outskirts of the city;

- The size of housing in the CBD will decrease, but may grow in the suburbs and outskirts of the city;

When it comes to transport regulations in cities, we must clearly know what effects such regulatory act will have on the travel cost of people because such an act not only will impact the transport market but will also have potential implications on other urban space variables, such as the use and occupation of urban soil. The next section will seek to clarify in more detail the effects of travel cost variations in an urban area.

Urban Sprawl and Externalities

In general, urban sprawl is characterized by some patterns of use and occupation of urban soil, including: (i) the development of areas with low population density, usually through the use and occupation of areas until then cultivable in the outskirts of the cities; (ii) the scattered development effect, i.e., the emphasis on segmentation and specialization of soil use, where large areas are dedicated exclusively to commercial or industrial use, or residential use, as opposed to mixed compositions found in the central areas of the cities; and (iii) the leapfrog development effect, i.e., vacant land areas between urban agglomerations located on the outskirts of the cities. This effect is usually motivated by real estate speculation issues.[40]

The problems associated with urban sprawl may be of an economic, environmental[41] and even public health[42] nature. Among the environmental problems, one deserving special attention is the increased stormwater runoff, besides the worsening generated by city sprawl in the suburbs, where water sources generally concentrate.[43]. Other environmental problems include: reduction in species diversity, increased risk of floods and flooding, excessive removal of native vegetation, fragmentation of ecosystems, etc.

With respect to the health problems associated with urban sprawl, we can list: increased rate of diseases associated with physical inactivity (heart diseases, diabetes, colon cancer, and osteoporosis), reduced air quality (respiratory and heart diseases and some types of cancer), car accidents (traumas and injuries, fatal or not), social isolation and stress (mental health impacts).

Returning to the central point of the discussion, we have found that the reduction of travel costs within a city – arising, for example, from increased competition, deregulation, with free market entry and exit of competitors – can bring great

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[40] Archer, R. (1973). Land Speculation and scattered development; failures in the urban-fringe land market. *Urban Studies,* vol.10: 367-372;

[41] Johnson, M. (2001). Environment impacts of urban sprawl: a survey of the literature and proposed agenda. *Environment and Planning.* Vol. 33: 717-735;

[42] Alberta Health Services (2009). Urban sprawl and health. Health public police information sheet. Available at: http://www.albertahealthservices.ca/poph/hi-poph-hpp-info-urban-sprawl.pdf

[43] This topic is dealt with in enough detail in: Tucci, C. (2005). "Gestão de águas pluviais urbanas." *Mimeo* Ministério das Cidades - Global Water Partnership - World Bank - Unesco.

benefits to consumers, but cannot rule out the possibility of side effects to the welfare of all city dwellers.

Arguments of partial balance favorable to the expansion of the ride-sharing service market through smartphone apps rest solely on the benefits to the group of consumers in that market. However, the central question is: should local managers and legislators focus on public policies based exclusively on maximizing the welfare of certain groups of consumers?

In short, from an anti-sprawl and urban policy perspective, improving the welfare of a group of consumers by reducing their travel costs through individual transport (public or private) is not a necessary and sufficient condition for the whole society to enjoy greater welfare, especially when we infer such effects from dynamical models with overlapping generations. This is because the consumption of certain goods may generate negative externalities such as pollution (noise, visual, air, soil and water), public goods congestion, etc.

Various types of consumption generate externalities, many of them negative and many of which consumers are not even aware of or capable of measuring in order to internalize. The failure to internalize externalities may result in various economic inefficiencies, since market prices are lower than socially desirable ones because they do not compensate for the welfare loss caused by the externality (consumption is subsidized by the value of externalities).

Another implication of markets with externalities is that lower prices tend to generate larger quantities sold (balance between supply and demand). More resources than socially desirable ones (capital, labor, etc.) are then allocated to that market, while they could be used more efficiently in other sectors.

General Urban Balance and Urban Policies

Economics, engineering, architecture, and urbanism provide a set of analytical elements for measuring and simulating the potential effects of changes in the urban transport supply structure (individual or collective) of passengers, their implications, and a list of mitigating public policy proposals of possible adverse effects.

Urban prediction models known as Land Use Transport Interaction, or LUTI models, are mathematical simulation models that combine theory, data, and algorithms that provide an abstract representation of the interaction between transport and urban land use.[44,45] These models are available in the literature since the first half of the 1960s, when Ira Lowry developed the work entitled *"The Model of Metropolis*," published as a memo for the Rand Corporation.[46] The Lowry model was part of an economic study for the Pittsburgh region and was formed by a system of equations with three sectors: basic sector (made up of industrial, commercial and administrative establishments, exporters of goods and services to households and businesses not residing in the modeled region); a retailer sector (comprising industrial, commercial and administrative establishments, providers of goods and services for families, and companies residing in the modeled region); and a residential sector. The model described the spatial organization of activities and sought to model policy impacts and changes in population growth, the pattern of employment and transport system efficiency.

From the 1960s up to the present, there were three generations of LUTI type models. The first generation appeared between the 1960s and 1970s, and could be divided into three types: (i) spatial and gravitational models, based on the theory of spatial interaction, which is part of the classic work of Lowry; (ii) mathematical programming models based on optimization techniques; and (iii) models based on input-output matrices. The second generation models date from the 1980s and 1990s, and represent models of discrete choice, based on the random utility theory

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[44] Torrens, P. (2000). How land-use transportation models work, *Centre for Advanced Spatial Analysis,* London.

[45] Coppola, P. et al. (2013). LUTI Model for the Metropolitan Area of Santander. *Journal of Urban Planning and Development.* Vol.139: 153-165;

[46] A digital version of the original article can be found at: http://www.casa.ucl.ac.uk/rits/lowry.pdf

of McFadden (1974).[47] Finally, the third-generation models come from the second half of the 1980s and are characterized by being highly disaggregated and dynamic models, enabling the construction of micro simulation exercises.

One of the LUTI type models best known among economists is the Regional Economy, Land Use, and Transportation Model, or RELU-TRAN Model[48], developed by Alex Anas, professor of economics at New York State University in Buffalo. The great advantage of the RELU-TRAN Model is the government sector, which enables the control of various fiscal instruments, such as income tax, property tax, Pigovian tax on traffic congestion, urban center toll charging, parking fees, and fuel taxes. The government sector in the RELU-TRAN Model also enables control over zoning policy, extension of the green belt, etc.

The vast majority of cities do not have LUTI-type simulation models, even many of the cities located in major industrialized economies. However, technological progress has led to the production and marketing of computers and software capable of handling large amounts of data at declining costs. The very difficulty in obtaining data has been challenged by new techniques and methodologies to collect urban data over the Internet (data mining[49] and web scraping[50]), in addition to the very georeferenced data on services provided through smartphone apps.

It would be desirable for local authorities to seek to improve as much as possible their mechanisms for collecting and processing information, as well as their instruments of analytical intelligence, so that they can provide faster, efficient and effective responses to disruptive events that directly or indirectly impact the daily life of the cities.

The construction of such intelligence is critical for local authorities and legislators to have information to support public policy formulation, decision making, and responses to idiosyncratic shocks (natural disasters, for example) and disruptive

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[47] McFadden, D. (1974). *Conditional logit analysis of qualitative choice behavior,* P. Zarembka, ed., Academic Press, New York.

[48] See details on the institutional page of the project: https://sites.google.com/site/alexanashomepage/the-relu-tran-model-and-its-applications

[49] Behnisch, M. and Alfred Ultsch (2008). Urban Data Mining Using Emergent SOM. In Data Analysis, Machine Learning and Applications. Preisach et al. (Ed.), Springer Berlin Heidelberg, Germany.

[50] Examples of projects available on the institutional page of D-Lab of the University of California, Berkeley: http://dlab.berkeley.edu/

events. In the specific case of managing the formation policy of a structured market of ride-sharing services, answering some questions is fundamental:

- What is the forecast and the target of the vehicle fleet operating in the ride-sharing market in that city?

- What is the impact of additional cars on the streets? Would it be only the substitution effect of the existing fleet?

- A car dedicated to ride-sharing would replace how many private cars that would take up parking spaces in urban centers?

- If the ride-sharing service adds cars on the streets, which would be an estimated additional fleet? What are the most affected city regions? What are the implications of the additional consumption of public goods? Would it increase traffic congestion and pollution?

- Should there be a risk of increasing vehicle fleet on the streets, leading to increased traffic congestion and pollution, who would bear the cost of consumption externalities of ride-sharing services?

- Would it be possible to handle the potential adverse effects through simple traffic accommodation? Would additional investments in road infrastructure be required?

- Would it be necessary and/or strategic to redesign the cities' zoning plans to accommodate the new service at the lowest possible social cost? Or would this not be necessary because its impact would be negligible?

The answers to these questions are essential for local authorities to assess the costs and benefits and address the deregulation of the individual passenger transport market. Failing to internalize the potential externalities would make the cost of individual passenger transport services more economical than socially desirable, and unnecessarily increase service supply. In short, the whole society would bear the burden of externality in favor of the increased welfare of consumers of the individual passenger transport services.

Conclusions

Throughout this paper, we have seen that the technological solutions provided by smartphone apps have addressed a number of issues that have justified and historically served as favorable arguments for the regulation of taxis, particularly concerning the pre-booking segment. The self-regulation imposed on ride-sharing services by technology companies have guaranteed credibility of good services, and also created rivalry to taxi markets, causing controversial reactions by local authorities and legislators, in addition to taxi drivers themselves. This fact has led society to reflect on the real need to maintain a regulation of such a market.

The logic of deregulation and search for liberalizing policies fundamentally stems from an economic perspective of partial balance, similar to the classical microeconomic analysis of welfare, where consumer surplus is clearly reduced due to the dead weight of the restrictions imposed by regulation. Consumers tolerate regulation by considering that the market is flawed, mainly due to asymmetric information. However, when such flaws are resolved, regulation loses meaning, and an opposing movement of regulators would be primarily motivated by regulatory capture.

This argument is very powerful in two hypothesis: (i) technological advances will limit the taxi market to the pre-booking segment through telephone calls, and (ii) travel consumption through individual passenger transport does not generate negative externalities. The first case seems to be less restrictive because, as mentioned throughout this text, in the mid-1990s this segment already accounted for 70% of the taxi market in developed countries.

Limiting an assessment to the partial balance analysis implies disregarding the fact that changes in travel costs within urban areas can change the layout of cities, as well as the use and occupation of urban soil. In short, it can affect other relevant variables of urban space, such as property prices, residential rents and even the growth rate and urban sprawl, and other externalities such as increased potential for congestion of public goods and different types of pollution.

From the perspective of urban balance analysis, the very argument of regulatory capture should be put into perspective. Urban managers tend to focus on policies that can create incentives for people to replace individual passenger transport (public or private) with collective transportation. Accordingly, they seek to reduce cash costs (subsidies) and opportunity costs (increase in travel speed) of public collective transport and impose additional costs on vehicles serving individual passenger transport. Such policies bear no relation with capture in the taxi market.

As we set aside the economic analysis of partial and general balance, we see that past events suggest that the history of urban transport has been marked by public takeovers, i.e., such services were born private and became public because of their market imperfections (asymmetric information, externalities, etc.). The very regulation of taxis was instituted in New York City in response to the large number of taxis driving for long hours in search of customers, creating several problems. On the other hand, history shows that regulatory capture was also present in this process.

On the other hand, as seen in this paper, the deregulation experience of taxi markets provides examples for all tastes and preferences, from the fact that taxi markets are historically marked by cyclical processes of regulation and deregulation, to the successful Dutch case – considered a benchmark in the literature.

Since successful and unsuccessful cases of deregulation coexist in the literature, we can infer that the way through which such processes are conducted plays a fundamental role in these types of policies. However, the process depends on the specifics and the idiosyncrasies of each market to be deregulated. It has been seen throughout this study that taxi markets rely heavily on other characteristics of the cities, such as the use and occupation of land, public transport network, different distributions of population densities in many neighborhoods, etc. Therefore, a cross-regulatory standard to be applied indiscriminately across heterogeneous cities should be considered with due caution.

One of the arguments that justify the success of the taxi market deregulation process in the Netherlands is that it was gradual. In fact, markets that generate externalities tend to be regulated and structured with "second best"-type policies,

often articulated and interrelated. Part of the difficulty of the bargaining process in eliminating regulations stems from this fact, which creates obvious concerns and uncertainty for authorities, without this having, again, any relation to capture. If the literature was unanimous in pointing out deregulation as an invariably better solution, opposing movements would result exclusively from capture, but empirical evidence suggests that this is not the case.

However, if we analyze in detail the Dutch case, maybe we can identify other positive aspects, such as the supermodularity of the strategy. The Dutch not only deregulated the taxi market, but also created incentives for such a market to operate in line with other urban policies. For example, the taxi market was encouraged to operate as a modal interconnected to the public transport network of the cities, as opposed to the logic that taxis are substitutes for private cars and that they compete with public transport (an argument that has been challenged by recent empirical evidence). In short, the Dutch combined the benefits brought by the taxi market deregulation (partial balance analysis) with the other objectives of urban planners (urban balance analysis).

Finally, discussions on the regulation of the individual passenger transport market are necessary because there is no economic evidence to justify a ban on new private transport services. Furthermore, economic factors suggest that, from a competition and consumer perspective, the actions of new agents tend to be positive.

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