Finnish Competition and Consumer Authority

EFFECTS OF TAXI MARKET DEREGULATION:

EVIDENCE FROM A NATURAL EXPERIMENT

Jan Jääskeläinen
Samuli Leppälä
Anni Väättänen

Working Papers 2/2023

Authors: Jääskeläinen, Jan; Leppälä, Samuli; Väättänen, Anni
Publication: Working Papers 2/2023:
Effects of Taxi Market Deregulation: Evidence from a Natural Experiment

Publisher:
Finnish Competition and Consumer Authority
Postal address:
Finnish Competition and Consumer Authority, POB 5, 00531 Helsinki, Finland
Visiting address:
Lintulahdenkuja 2, 00530 Helsinki, Finland
www.kkv.fi

ISSN 2954-1859

Effects of Taxi Market Deregulation: Evidence from a Natural Experiment

Jan Jääskeläinen* Samuli Leppälä* Anni Väättänen*

April 21, 2023†

Abstract

We study the effects of deregulation of the Finnish taxi market using a difference-in-difference framework. We estimate the causal effects of deregulation on consumers, taxi firms, and taxi drivers. Our key finding is that the offered fares have increased in all regions. However, the variation in the fares is significant and consumers choose lower fares when available. Large regions saw an increase in the number of taxi firms post-deregulation, which is reflected in lower average revenue, lower number of employees per firm, and a decrease in average profits. The number of taxi firms in small and medium-sized regions has not changed, but profits have declined despite the increase in fares. We develop a theoretical model to explain this contradictory result.

JEL: C54, D47, L11, L43, L98, R48.

*Finnish Competition and Consumer Authority, Lintulahdenkuja 2, P.O. 5, 00531, Helsinki, firstname.lastname@kkv.fi

†We are grateful to Janne Starck, Finnish Regional State Administrative Agencies and Finnish Transport and Communications Agency for their invaluable help with collecting the data. We thank Tuulia Hakola-Uusitalo, Topi Hokkanen, Joel Karjalainen and Matias Pietola as well as participants of the 43rd Annual Meeting of the Finnish Economic Association and TSE Economics Research Seminar for providing feedback and comments. All remaining errors are our own.

1 Introduction

1.1 Background

The early successes with deregulating industries in 1970s in the United States led to a trend towards deregulation in industrialised countries (Winston, 1993, 1998). Deregulation has been found to increase efficiency, reduce costs, and thus stimulate economic growth. On the other hand, deregulation is not a Panacea; various deregulatory policies have resulted in adverse effects. For example, deregulation of the Swedish taxi sector has been found to reduce security and increase fares (Gärling et al., 1995). There exists no clear consensus as to how deregulation affects different industries.

Although deregulation has been a contentious issue in policy debates for decades, the economic literature on the effects of full economic deregulation (i.e. removing both quantity and price regulation simultaneously) is fairly narrow. We fill this gap by analysing the causal effects of deregulation of the Finnish taxi market. Before 2018, the taxi market in Finland was characterised by strict quantity and fare regulations: licence numbers were decided at the municipality level and fares controlled by a country-wide price ceiling. Both of these restrictions were removed simultaneously.

We take advantage of a natural experiment arising from one of the 19 regions of Finland not implementing the deregulatory legislation. This allows us to estimate the effects of the policy change using a difference-in-differences approach. We estimate the effects of taxi market deregulation on offered fares and various characteristics of taxi firms and taxi drivers. We then build a theoretical model to explain the regional differences in the empirical findings with respect to population density of a region.

We find that taxi market deregulation has on average increased offered fares by 7% in large regions, and by 14 and 15% in medium-sized and small regions, respectively. The variation in offered fares is substantial – in large regions variation is large within a region, whereas in smaller regions the variation comes mainly from variation between the regions. Based on secondary data from the Finnish Transport and Communications Agency, consumers in large regions tend to choose taxi trips priced at the lower end of the distribution, whereas in small regions consumers do not have as much choice and thus end up paying higher fares for their taxi trips.

Large regions saw an increase in the number of taxi firms post-deregulation, which is reflected in lower average revenue, lower number of employees per firm, and a decrease in average profits. The number of taxi firms in small and medium-sized regions, however, has not changed, but profits have declined despite the increase in fares.

The theoretical model shows that two factors can explain the different post-deregulation paths taken by larger and smaller regions: 1) the economies of scale in matching drivers to riders and 2) larger regions having more competition between dispatch centres. Irrespective of whether the dispatch centre market is competitive or monopolistic, the model predicts lower equilibrium fares in larger regions. The outcome – while surprising and contradictory to standard market models – is due to the economies of scale in matching. The differences in taxi firm entry, on the other hand, can be attributed to the different levels of dispatch centre competition. Moreover, publicly funded trips form a large part of the market in smaller regions, which may contribute to the lack of entry by taxi firms. Post-deregulation, the fares for these publicly funded trips have been determined in a competitive procurement process, which has resulted in lower fares than before.

The article is organised as follows. We begin by reviewing the prior literature on deregulation and taxi markets in Section 1.2. We then provide a contextual background on the Finnish taxi market in Section 2. Section 3 introduces our methodology and describes the data. We then present the empirical results in Section 4, and build a theoretical model that explains the empirical findings in Section 5. Section 6 concludes.

1.2 Literature

Most of the earlier literature concerning deregulation draws from the literature on regulation. The traditional theory of economic regulation is that it serves public interest by correcting some market failure and, hence, improves social welfare. That is, government intervention is justified if markets "fail" to meet the ideal of perfect competition. This theory has been criticised for relying heavily on the assumption that regulators are equipped with perfect information, and aim to maximise social welfare. Government regulation is seen as efficient, and can be implemented without substantial costs: somewhat paradoxically the information costs and transaction costs that cause the market failure are not present within regulation (Posner, 1974). Later literature has contradicted this notion by arguing that governments use flawed information as the basis of their regulatory decisions (Sappington and Stiglitz, 1987). The empirical research on the efficiency of regulation has confirmed this concern.[1]

Theoretical research concludes that markets should be deregulated when the cost of regulation exceeds costs stemming from deregulating and the remaining market failure. A trend towards deregulation began in the United States in 1980s, with substantial deregulation in transportation, communications, financial, and energy sectors (Winston, 1998). Winston (1993) reviews some of the literature concerning these early experiments with deregulation, finding that in general economists have succeeded in predicting the effects of deregulation, such as lower fares and increased variation in fares. Deregulation has improved service quality through enhancing technological development. Profits and employee wages have in general declined after deregulation. However, variation in wages has in some cases increased. This could be explained by wages moving closer to the marginal product and fares moving closer to marginal costs and thus the market moving closer to the competitive equilibrium.

Taxis are among the most extensively regulated transportation modes in industrialised countries. This extensive regulation has been justified by imperfect competition. For an industry to be competitive, a large number of firms must face a large number of customers at a given time and place. In the cruising taxi market, this is rarely the case. One of the earliest models of the taxi market by Douglas (1972) portrays how the equilibrium fare in the market is inefficient. He argues that in deregulated cruising taxi market, there will be upward pressure on the fare. Same conclusion is reached by Shreiber (1975), who argues that the cruising market is special in that the consumer meets one taxi at a time, and cannot therefore shop around. This “temporary monopoly” results

[1] For an overview of the literature, see Joskow and Rose (1989).

in higher fares than in a competitive equilibrium.[2] Similarly, Cairns and Liston-Heyes (1996) set up a simple model to conclude that in absence of fare regulation there exists no equilibrium in a taxi market. Hence, free entry and pricing may not be optimal.

However, most of economic taxi market literature supports at least some degree of deregulation (Moore and Balaker, 2006). De Vany (1975) considers a similar model to Douglas (1972) and determines equilibrium output in different regulatory frameworks such as a franchised monopoly, the medallion system and under free entry. He argues that restricted entry implies reduced consumer surplus. Through assessing taxi market restrictions in four UK cities, Beesley (1973) argues in favour of relaxing entry restrictions. By comparing costs and benefits of regulation, he argues that restrictions may impose more costs than benefits. In a similar vein, Beesley and Glaister (1983) argue that although there is a rationale behind regulation, regulators act based on limited information which generally results in inefficient regulations. Frankena and Pautler (1986) argue that there is no rationale for most entry regulations in the taxi market, although some fare and safety regulations may be justified.

The earliest models have been criticised for being unrealistic due to for example their primary focus being on the cruising market (see Williams (1980) and Shreiber (1975)). Taxi markets are characterised by fragmentation, and can roughly be divided into three market segments: the taxi rank, cruising, and dispatch market.[3] It seems obvious that the types of market failures in different market segments can differ, which is why some countries have introduced two-tier systems where different regulations are in place for different market segments (Aarhaug and Skollerud, 2014). Schaller (2007) notes that entry regulation in taxi market may lead to very different results in cab stand/street hail and dispatch markets. Entry regulation may be justified in cruising market, but

[2]With the same logic, we could argue that there exists a temporary monopsony in a situation where a taxi driver and a consumer meet, but it is argued that taxi rides are a type of a credence good, and information asymmetry benefits the supplier.

[3]A fourth segment of the market is contract rides. For example in Finland, taxi rides compensated by social insurance form a large part of the market. We leave these types of rides outside of our analysis. For the effects of deregulation and subsequent procurement on taxi rides reimbursed by the Social Insurance Institution of Finland (Kela), see Ahomäki et al. (2023).

regulation in the dispatch market may lead to deficiencies in taxicab availability. The emergence of ride-hailing platforms has brought yet another dimension into the discussion. The attractive feature of these platforms is that they reduce the matching frictions, and have higher capacity utilisation rates than traditional taxis (Cramer and Krueger, 2016). However, as Fréchette et al. (2019) argue, market segmentation between traditional taxis and ride-hailing platforms may reduce market thickness, and consequently worsen matching frictions.

Partly due to the support economic literature gives to deregulation, various countries have experimented with relaxing taxi market regulation. Because of successes in deregulation in other transportation, such as railroad, intercity bus and airline industries, some US cities extended deregulation into the taxi market as well. Teal and Berglund (1987) argue that deregulation has not achieved the objectives set for it: fares have generally increased and service quality has not improved. Gärling et al. (1995) analyse the short-term effects (8 months) of deregulation of taxi markets in Sweden, coming to fairly similar results as Teal and Berglund (1987). A more recent study by Marell and Westin (2002) extends the analysis to a longer time span, and finds some positive effects with respect to competition and productivity in rural areas of Sweden. The taxi market reform in Finland has gained quite a bit of attention in the recent years, and work in progress by Harju et al. (2023) aims to evaluate the effects of taxi market deregulation on tax avoidance in the taxi industry.

The heterogeneous effects in urban and rural areas is highlighted in other empirical research. Gaunt (1995) studies effects of taxi deregulation in New Zealand, and finds that despite increase in entry and reduction in fares of taxi trips in major cities, there were only minor entry increases and fare reductions in medium-sized cities, and minor reductions in entry and increases in fares in small cities. It is not obvious that the intensity of competition increases automatically with deregulation, which may explain the different effects in rural and urban areas, as well as differences in different sectors of the taxi market (such as street hail vs. dispatch). Morrison (1997) comes to a similar conclusion, arguing that especially consumers in large cities have benefited from better availability and lower fares after deregulation.

The aforementioned countries have imposed “full” deregulation, as in deregulation of both entry and fares. Various countries have conducted policies focused on deregulating one part of the market. For example in Ireland entry restrictions were removed, whilst fare regulations were kept in place. Barrett (2010) finds that entry deregulation has increased output and reduced consumer waiting times in the long run. In the Netherlands entry was similarly freed, and fixed fares were replaced with maximum pricing. The effects seem to be fairly similar to the Irish case: Bakker (2007) concludes that the size of taxi fleet grew substantially after deregulation. Maximum fares were initially meant to be removed after an adjustment period, but because the fares increased substantially faster than the CPI, the maximum fares were kept in place.

A limitation of the literature, as already noted by Winston in 1993, is the absence of a counterfactual approach, and thus the inability to determine whether changes in an industry after deregulation are caused by the regulatory change or other factors. Later literature has not been successful in overcoming this limitation. This study addresses this shortcoming.

2 Taxi markets in Finland

The Act on Transport Services (320/2017) entered into force on the 1st of July 2018, bringing about a multitude of changes into the taxi market. Before the reform, the Finnish taxi market was heavily regulated: quantity, fares, and quality were all strictly controlled.[4] The new Act sought to enhance competition and innovation by significantly lowering entry and quality controls and allowing free pricing.

Before the reform, each municipality was assigned a fixed number of taxi licences. The number was confirmed annually by the regional Centre for Economic Development, Transport, and the Environment (ELY-Centre). In order to obtain a taxi licence, the applicants had to meet specific criteria concerning clean criminal records, good health, and a complete taxi driver's exam. The licences were also linked to a specific vehicle. Because the licence quota was municipality-specific, taxis were only allowed to serve customers in the municipality in which they obtained their licence. If a taxi ride ended in another municipality, the taxi had to immediately return to its own municipality afterwards. The dispatch centres were required to provide services round the clock to ensure the availability of taxis in all geographical regions and at all times.

Deregulation implied that the municipality specific quotas on licences were abolished, meaning that practically anyone who meets the criteria for taxi driver's licence is able to obtain one. The licence is now nationwide instead of being tied to a single area. However, the company must still report a primary operating area. The licence is no longer connected to a specific vehicle, but only to the operator. At the same time, the requirements on clean criminal records were tightened in the Act[5].

Before the reform, taxi fares were controlled by an annually confirmed price ceiling. It was possible to charge less, but because of the strict entry controls and therefore a lack of competition, the maximum fares were de facto prevailing fares in the market.

[4] Repealed Taxi Transport Act 217/2007

[5] The current requirements for obtaining a taxi driving licence can be found from `https://www.traficom.fi/en/services/taxi-driving-licence`

From July 2018 pricing has been free, although the law still requires pricing principles to be transparent and easily available to the consumer.

Some regulatory measures have been (re-)introduced after 2018. Since 2021, taxi operators have been required to operate as a company and consequently obtain a VAT number. An exam for both taxi drivers and entrepreneurs was also made a prerequisite for obtaining a licence. If the fare of the trip is not fixed, it must be based on time and distance and calculated using a taximeter. A fare of an example trip must be available for the consumer in order to allow for an easier comparison of fares.

In 2018, the total turnover of the Finnish taxi market was a little above one billion euros. During 2017, taxi trips comprised 1.2% of passengers and 1.2% of kilometres in total transportation. The most common type of taxi trip is a trip home or to some other location on a night out. The Finnish taxi market is characterised by a large share of publicly financed trips, which make up around 40% of the industry turnover (Traficom, 2020). In rural areas, this figure is even higher. The Social Insurance Institution of Finland (Kela) is the largest public financier of taxi services, and it reimburses taxi trips to a health care provider in the case of illness, pregnancy, childbirth, or rehabilitation. After the reform, Kela has selected regional dispatch centres through public procurement (Ahomäki et al., 2023). It is important to note the high proportion of publicly financed trips since it can affect the behaviour of taxi firms and cause the effects of deregulation to differ from the predicted (Marell and Westin, 2002).

3 Methodology and Data

3.1 Methodology

We evaluate the causal effects of taxi market deregulation utilising a legal reform that took place in 2018 in all other regions of Finland besides Åland. Åland is an autonomous island region located between Finland and Sweden, and although it is a part of Finland, it enjoys considerable independence in setting some of its own regulations. Prior to the reform, Åland followed the national taxi regulation. While preparing the deregulatory legislation, the Finnish Ministry of Communication and Transportation forgot to inform the provincial government of Åland about the upcoming changes. When Åland was informed about the matter, they considered the preparation time too short and made the decision to uphold the old legislation. Therefore, the fact that Åland was left outside the deregulatory reform was fairly random, making it a reasonable candidate for a control group.

The pre-treatment period consists of years 2013–2017, during which no other taxi market reforms took place. The post-treatment period consists of years 2018–2019.[6] Most of our variables of interest are either annual (firm variables) or depict the situation at the end of a specific year (employee variables). Despite treatment taking place mid 2018, we include the said year in the treatment group since we expect the effects to be already observable. We conduct the analysis also without year 2018 and conclude that our findings do not change.

Our primary goal is to estimate the effects of deregulation in regions similar to Åland. We assess similarity based on area, geographical similarities, population and its density, as well as the presence of an airport and a central hospital. We identify 25 candidate regions that form our main treatment group. Our secondary goal is to expand this analysis into large cities with larger and more complex (post-treatment) taxi markets. We include five large regions in this treatment group. Since Åland has followed the same fare-setting rules that were present at a national level prior to the reform, we are able to study the effects on offered fares regardless of regions' similarity to Åland. The complete list of the regions and their characteristics is shown in Tables A.1 and A.2 in the Appendix.

We divide our analysis into three parts. First, we evaluate the effects of deregulation on offered fares. These offered fares are obtained by searching for taxi trips through mobile applications. Second, we evaluate how profitability has changed for firms and their employees after deregulation. We estimate changes in firms' profits and costs as well as employee wages. We also examine other employee characteristics such as experience,

[6]In 2020, the Covid-19 pandemic significantly altered the market conditions. It is not feasible to assume that the pandemic affected markets in Åland and mainland Finland in the same way. Hence, we limit our firm and employee level analysis to years before the pandemic.

whether they are born abroad, and part-time employment. Third, in section 5 of the paper, we study the mechanisms through which deregulation affected taxi markets in different regions by developing a model which considers population size as a key difference between regions.

The main regression used to estimate the effects is the standard difference-in-differences equation

$$y_{imt} = \alpha + \beta P_t + \gamma T_m + \delta P_t \times T_m + \lambda_m + \theta_t + \psi X_i + \epsilon_{imt}, \quad (1)$$

where P_t indicates post-treatment period, T_m indicates region that received treatment, λ_m represents region fixed effects, θ_t time fixed effects, and X_{imt} contains controls for firms' age.

For the estimates on fares, we modify the regression depicted in Equation 1 slightly. The difference is that we only observe two time periods: regulated maximum fares before the deregulation, and offered fares four years after the deregulation in 2022. Regressions on fares also include additional controls for trip length and whether a dispatch centre operates solely through a mobile application.

To be able to interpret the estimates as causal, we need to ensure that we can confidently assume the control group to represent a counterfactual for the treatment group. We have to be able to assume that the taxi market in Åland would have developed in the same way as the market in mainland Finland in the absence of the reform. We evaluate the validity of this parallel trends assumption by visual inspection as well as statistical tests standard to the literature.

The parallel trends assumption seems to hold fairly well visually: as shown in Figures A.1, A.2 and A.3, the pre-trends for our outcome variables evolve similarly.[7] This indicates that prior nationwide shocks affected all regions under the same legislation in similar ways.

[7]We also use taxi fare as an outcome variable, but the pre-treatment trends are identical since maximum fares were imposed on a national level.

Following Autor (2003), we further evaluate the feasibility of the parallel trends assumption by estimating the regression

$$y_{imt} = \alpha + \gamma T_m + \sum_{t=2014}^{2019} \delta_t (Y_t \times T_m) + \sum_{t=2014}^{2019} \beta_t Y_t + X_{imt} + \epsilon_{imt},$$

where Y_t represent binary variables corresponding to years from 2014 to 2019. The coefficient of interest is thus δ_t, which represents the additional difference in the outcome variable by year stemming from being located in mainland Finland (treatment group). This should not deviate from zero in the pre-treatment years. We plot the coefficients and the corresponding 95% confidence intervals against time. The results are shown in Figures A.4 and A.5. Reassuringly, these are not significantly different from zero for most of the outcome variables and treatment groups.

The primary concern in our study is whether treated regions have spillover effects on the control group. The reform abolished operating regions, and although taxis must have a primary operating region, they are now free to operate anywhere in Finland apart from Åland. This could raise a concern with respect to regional spillover effects. We argue that these spillover effects are unlikely since taxi markets tend to be local. Our regions incorporate significant geographic areas around population centres, which in turn are quite far apart from each other due to Finland being sparsely populated. Spillovers into the control group are unlikely, since Åland is a separate geographic entity as it is an island, and the taxi driver's licence obtained in Mainland Finland cannot be used to offer taxi trips in Åland and vice versa. Therefore we consider that the Stable Unit Treatment Value Assumption is not violated.

We assume the treatment to be equal in all similarly sized regions, since quantity regulation was based on a region's size and the maximum fares were decided at the national level. Due to possible differences in the way quantity regulation was implemented, there is a reason to believe that differently sized regions might have had different treatment. Also, based on previous literature, there seems to be solid evidence that the region size is a confounding variable when examining the effects of taxi deregulation. We address this by presenting our results separately for small, medium-sized, and large regions.

3.2 Data

Firm and employee-level data are obtained from Statistics Finland. The time period we examine is years 2013 to 2019. Firm data includes information from financial statements including revenue, profit and costs. The data also contains information on firm's age, size, and its employees.[8] At the employee level, we observe socio-demographic characteristics such as age, education, and ethnicity, and work-related characteristics such as wages and employment history. Descriptive statistics for the firm-level data aggregated at a treatment group level are shown in Table A.3. Instead of licence holders, we utilise data on individuals who work in the taxi transportation sector, since not everyone who has obtained a taxi licence is actually working in this sector.[9]

To study consumer effects, we manually collected post-treatment fares and times-to-arrival for 5 690 taxi trips in 18 small and medium-sized regions during April of 2022. The trips collected were approximately 5, 15, and 25km in length and they either started or ended in a regional centre, such as an airport, a regional hospital or the city centre. We expanded the data during June and July 2022 by collecting fares and waiting times for those five large regions with ride-hailing platforms such as Uber, Yango, and Bolt present in the market.[10] Based on firm revenue, and not including dispatch centres, these five regions make up 88% of the studied taxi markets. The expanded data contains fares and times-to-arrival for 15 171 taxi trips over the lengths of 1, 2, 3, 4, 5, 7.5, 10, 12.5, 15 and 20 kilometres. We include trips that take place within the city centres, between city centres and the suburbs, and within the suburbs.

During both of the collection periods, we collected identical data from the control group Åland. Due to having only one dispatch centre with a phone application, we

---

[8] Due to data limitations, we observe at most two employers per employee per year. Therefore, it is likely that we underestimate the number of employees per firm, especially after the reform, when working part-time became significantly easier.

[9] The issue with using licence information is that the licences were easy to obtain by simply notifying the government. This meant that some individuals obtained the licence as an option without proper plans to ever drive a taxi. This argument is supported by a survey conducted by the FCCA on taxi licence holders.

[10] These larger regions are Helsinki, Espoo, and Vantaa in the capital region, as well as Tampere and Turku.

obtain one fare and waiting time observation per query. Therefore, the control group data consist of 482 trips collected in April 2022 and 758 trips collected in June and July 2022. However, since these are regulated fares, they can be generalised to other taxi firms in Åland regardless of the method of ordering.

It should be noted that there were no pandemic-related restrictions in place during any of our collection periods in any of the regions studied. However, there was an increase in regulated fares in Åland on June 1st 2022. The local taxi company immediately increased its fares to meet the new regulated limit. Åland was planning higher regulated fares already in March, which together with relatively slow process of writing and updating legislation, speaks in favor of focusing on the updated fares in our analysis. We provide our results using both new and old regulated fares, and our main results are not significantly affected by which fares are used.

Table 1: Descriptive statistics on queries

	Åland	Small regions	Medium regions	Large regions
Observations	1,240.00	256.86	389.20	3,068.20
		(125.18)	(316.27)	(847.53)
Obs. per query	1.02	1.45	2.43	7.22
	(0.15)	(0.81)	(1.70)	(5.82)
Number of dispatch centres	1.00	4.14	5.10	13.80
		(1.77)	(1.73)	(3.19)
5km fare	18.33	23.50	23.45	19.38
	(1.40)	(8.05)	(7.78)	(4.94)
5km time to arrival	4.73	7.95	7.89	8.18
	(2.24)	(6.90)	(5.66)	(5.08)

Notes: Table presents the regional averages categorised by region size, with standard deviation in parentheses. Control group Åland consist of only one region and thus has no variation in region-level variables. Number of dispatch centres portrays the number of dispatch centres or ride-hailing platforms that we used in data collection, and is therefore the number of dispatch centres with mobile applications.

In order to obtain the fares for trips before deregulation, we exploit the knowledge that all taxi firms priced their services at the regulated upper limit. We also know the exact fares and the pricing formula used.[11] Since we know the length and duration of each collected taxi trip, we are able to calculate the pre-treatment fares for each trip.[12] To ensure that the calculated fares accurately reflect the fare before the deregulation, we compare the collected data from Åland, our control group, to the calculated fares using prices set by the current regulation.[13]

The results are presented in Table A.4. The observed fares are very similar to the calculated ones. The minor differences can be explained by the fact that the application used in Åland only gives fare quotes in integers, thus the fares may actually vary by some cents. Furthermore, prior to deregulation as well as under the current regulatory framework of Åland, taxis are allowed to use the waiting price instead of the distance-based price whenever the taxi is moving sufficiently slow, for example due to traffic congestion. This may consequently explain some of the difference, since we use only the length of the trip in our fare calculation. These minor differences should not affect the differences-in-differences estimates since the error is identical in both treatment and control group and, more importantly, the pre-treatment difference in fares is equal to zero.

4 Empirical analysis

4.1 Consumers

We begin by analysing the effects the deregulation had on fares. The main estimation results presented in Table 2 show the change in average offered taxi fares caused by the treatment.

[11] Government Decree on maximum fares charged from customers for taxi transport services (403/2017, 570/2016, 796/2015, 470/2014, 460/2013)

[12] Pre-reform regulated fares were different depending on whether the ride was for 1–2 or 3–4 passengers. Post-reform dispatch centres usually set fares for 1–4 or 5–8 passengers. Our estimates act as a lower bound since we assume 1–2 passengers when calculating pre-reform fares and collecting control group observations.

[13] Åland continues to use the same formula for setting maximum fares that was used prior to deregulation in all of Finland. Furthermore, in publicly financed trips covered based on social sickness insurance there are still maximum fares, which are almost identical to maximum taxi trip fares (Government decree 406/2022, only available in Finnish).

Table 2: DiD estimates on offered fares

	(1) Small regions	(2) Medium regions	(3) Large regions
Treatment	0.032***	0.043***	0.034***
	(0.003)	(0.003)	(0.003)
Post	0.151***	0.151***	0.151***
	(0.005)	(0.005)	(0.005)
Treatment x Post	0.139***	0.153***	0.071***
	(0.006)	(0.006)	(0.005)
Control at baseline	2.082***	2.122***	2.042***
	(0.006)	(0.005)	(0.004)
Observations	5113	9300	32198
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: Table presents differences-in-differences estimates of treatment effects on offered fares (logarithmic). Pre-treatment fares are calculated for each trip using 2017 regulated fares. Time fixed effects include both time-of-day and day-of-week. Standard errors are clustered at regional level and are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Our difference-in-differences estimates show statistically and economically significant increases in average offered fares in all regions. Average offered fares have increased 14% and 15% in small and medium-sized regions, respectively. In large regions, offered fares have increased by 7% on average.

Before deregulation, there was no difference between or variation within offered and realised fares. Post-regulation offered fares vary and not all offered fares are realised. Hence, it is important to not only examine the averages, but also evaluate the spread of options available for the consumers, as well as which of the options the consumers eventually choose.

Fare variation is significant in all regions but the source of variation varies.[14] In small and medium-sized regions, the variation in offered fares comes mainly from variation *between* different regions - the estimated increase in average offered fare varies between 0% and 22%. The region-specific regression results are presented in the Appendix Table A.7. In large regions, the variation in offered fares *within* the region is substantial, meaning that consumers can choose cheaper rides if they wish to.

Unlike offered fares, for which we collected the data, we have only limited information on realised fares. This information is provided to us by the Finnish Transport and Communications Agency (Traficom) and it includes the mean and median fares realised fares as well as the interquartile ranges calculated for the same three region categories consisting of the same 24 regions that we study. The realised fares are calculated during the same time period as our collected data.[15]

Figure 1 plots the median and the interquartile range of observed and realised fares for different lengths in the treatment group, and the median fare in the control group. We observe that there is significant variation in realised fares in large regions denoted by the long interquartile range across all lengths. The entire interquartile range is below the median fare for the control group, and the median realised fare in large regions is at the lower end of the interquartile range. This indicates that consumers choose lower fares when given the option, and that these consumers have benefited from the policy change at least with respect to fares.

The situation is very different in medium-sized and small regions. The interquartile range of realised fares is much smaller than what we observe in offered fares, and it is located on the upper end of the range for offered fares. This indicates that while cheaper alternatives may occasionally exist, they are offered by smaller firms that constitute

[14]The full offered fare spread as well as the pre-reform regulated fares for the respective lengths can be seen in Figure A.6. A similar pattern is observed in the list fares of the dispatch centres. We show in Figure A.7 that the list fares are correlated with the observed fares, meaning that similar fare spread would be observed also when ordering a taxi without using the mobile applications. List fares were collected from firms' websites during June 2022. Some firms, e.g. Uber, do not have list fares available. Other firms, e.g. Yango, state that dynamic pricing will be applied during high demand.

[15]Traficom has been collecting data on all taxi trips since April 2022. See Traficom's *Price monitoring of taxi services*, `https://tieto.traficom.fi/en/statistics/price-monitoring-taxi-services`

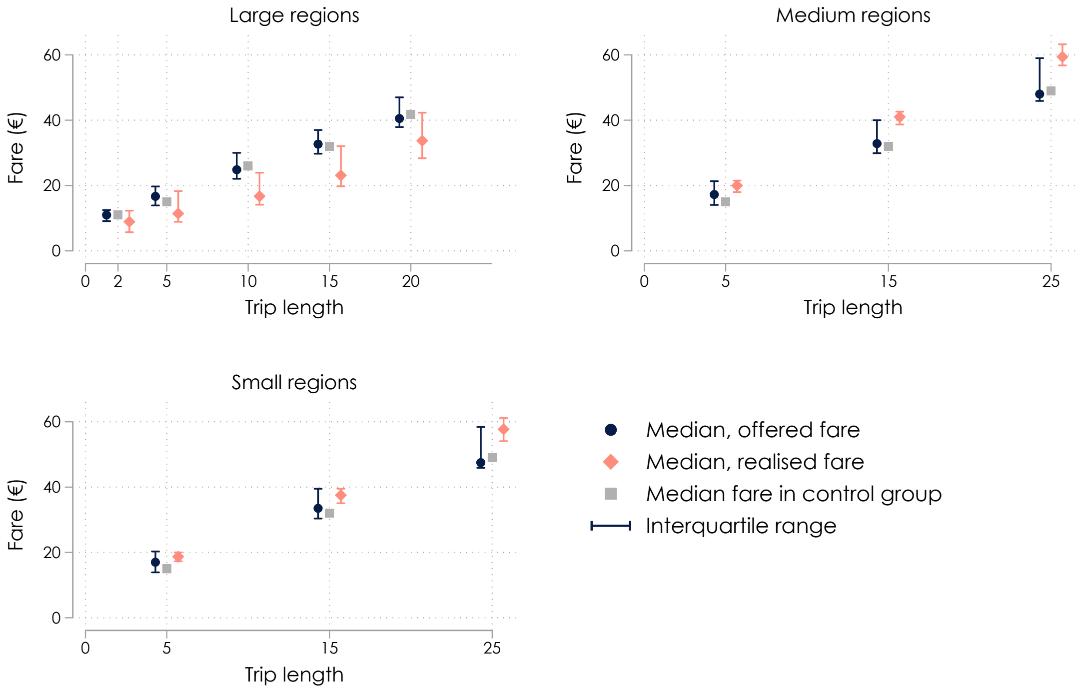

Figure 1: Offered and realised taxicab fares

a fairly insignificant part of the market. Furthermore, the median realised fares are significantly higher than the median observed fares, as well as the median fare in the control group. In medium-sized and small regions consumers are thus forced to pay more than they did pre-regulation for the same trips.

To better understand why certain regions have lower fares, we estimate the correlation between observed variables and the offered fares. We see in Table 3 that in large regions app-only dispatch services offer cheaper rides on average. This is also evident from Traficom's price monitoring, according to which the distribution of realised fares of trips booked through applications is skewed to the left, meaning that consumers tend to choose the cheaper rides. This could be explained by the fact that applications allow for fairly low effort comparison of fares. Furthermore, in large regions, there are more substitutes for taxi rides, such as public transportation, which may imply that consumers have more price elastic demand when it comes to taxi rides. If the offered fares are very high, consumers may choose to use another mode of transportation instead. In smaller and more remote areas this may not be possible, and consequently the taxi firms have more bargaining power.

Table 3: Descriptive regressions on logarithms of fares

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Number of dispatch centers in region	-0.047^{***}	-0.013^{**}	-0.020^{***}
	(0.004)	(0.004)	(0.000)
Trip length (km)	0.052^{***}	0.050^{***}	0.070^{***}
	(0.002)	(0.001)	(0.002)
App-only dispatch	0.101^{***}	-0.110^{*}	-0.404^{*}
	(0.008)	(0.035)	(0.093)
Outside business hours	0.083	0.076^{*}	0.062^{*}
	(0.039)	(0.026)	(0.015)
Friday or Saturday	0.011	0.010	0.012
	(0.007)	(0.006)	(0.007)
Peak demand	0.030	0.012	−0.011
	(0.037)	(0.020)	(0.006)
Pickup at city	0.018	−0.008	−0.030
	(0.020)	(0.012)	(0.016)
Constant	3.057^{***}	2.961^{***}	2.857^{***}
	(0.046)	(0.028)	(0.029)
Observations	1798	3892	15171
Region Fixed Effects	*Yes*	*Yes*	*Yes*

Notes: Dependent variable in all regressions is log(fare). App-only dispatch refers to dispatch centres which only operate through mobile applications. Peak demand is an interaction term of *Outside business hours* and *Friday or Saturday.* Pickup at city is a dummy variable that gets value 0 if pickup location is in a suburb and 1 if close to a city centre. Standard errors are clustered at regional level and are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Another explanation for the regional differences in the effects of deregulation on fares is market concentration. As seen in earlier studies, such as Buri et al. (2022), the effect that deregulation has on fares depends heavily on the level of competition that builds up within the industry. Table 3 shows how the number of dispatch centres within a region is negatively correlated with offered fares. The size of the coefficient is larger in small regions where the absolute number of dispatch centres is also lower. This makes sense since we would expect a more significant impact on competition when moving from 2 to 3 dispatch centres than when moving from 10 to 11. We explore the mechanism through which the policy reform affected different regions differently through a theoretical model in section 5.

4.2 Taxi markets, firms and employees

Next we look at what happened to firms following the deregulation. Figure A.1 depicts the evolution of market level variables by region size. The past development of industry revenue has been fairly stable across all regions, and only in large regions the aggregate revenue seems to increase after the reform. The aggregate number of taxi drivers in the market has been gradually reducing in all regions pre-reform. In large and medium-sized regions the trend has changed after, and the number of drivers has begun to increase. The number of firms has been similarly declining in all regions, but in large regions there is a sharp increase after the deregulation.

The policy change has not led to any significant changes in average revenue in small regions, as can be observed from Table A.9. In medium-sized regions the average revenue has increased by around 5.6%. The average number of employees in medium-sized regions has increased, which may imply higher degree of market concentration (Table A.10). In small regions this effect is not statistically significant.

On the contrary, in large regions, average revenue has decreased by approximately 6%. This can be explained by the fact that there has been an increase in the number of firms after the reform. Since this has not been accompanied by a sufficiently large increase in demand and industry revenue, revenue per firm has reduced (see Figure A.1). Furthermore, as seen from Table A.10, the average number of employees per firm has a negative sign, although this is not statistically significant. Deregulation has likely led to an increase in the number of small firms in large regions.

The difference-in-differences estimates for profit as a percentage of firm revenue can be seen in Table A.11. Profit has decreased in small and large regions, and although the sign is also negative for medium-sized regions, this estimate is not statistically significant. Overall, it can be argued that deregulation has decreased the profitability of the taxi sector. This is somewhat surprising considering the observations we made regarding the evolution of fares. This can in part be explained by the change in costs.

Total costs as a percentage of revenue have increased in all regions (Table A.12). The increase is the most substantial in large regions, about 14%. Some of this increase in small and medium-sized regions can be explained by the increase in fuel costs as seen in Table A.13. Since average revenue has not changed in small regions, it might be that taxis are idle more often than before. On the employee level, we find that income has decreased in small and medium-sized regions by 5 and 10%, respectively (Table A.14). The estimate for large regions is not statistically significant.

When estimating changes in the experience of taxi drivers (Table A.15) we find that the average experience has decreased in medium-sized and large regions. These estimates are lower bounds for the actual effect, since we were able to observe the employee experience only starting from year 2008 and hence the experience is truncated at 5 years. The effect can be explained mainly by new firms and drivers entering the market post-reform.

4.3 Other effects of deregulation

The analysis has so far focused on observable and quantifiable effects of the reform such as fares and firm profits. In reality, the taxi market has evolved also in other ways. These cannot necessarily be categorised as changes caused by the deregulation, but we argue that the increased competition enabled by the change could have, for example, increased the pace at which the market adopted new technologies.

For consumers the market has become either more obscure or more transparent depending on how you hail a taxi. Consumers who use mobile applications to order a taxi have significantly more information available than they had before the reform. Nowadays, most applications provide consumer with exact fare, travel time and time-to-arrival of the taxi, while some also provide the name, photo and consumer ratings of the driver as well as the model and brand of the car that will be arriving.

However, for consumers who hail a taxi off the street or pick one at a taxi rank, the situation has worsened. Under the prior regulation both the fare and the quality of the taxi was pre-determined regardless of where the consumer entered a taxi. Nowadays, both quality and fare can vary significantly between otherwise similar looking cars, and while taxis are required to display the fares clearly in the window of the car, comparing the fares that way can require significant effort from the consumer.

5 Theoretical Framework

We consider a static, steady-state model of ride-hailing in homogeneous space à la Castillo et al. (2022). While Castillo et al. (2022) study surge pricing by a platform, we adapt the model to analyse the persistent differences between local markets of unequal population sizes, both pre- and post-deregulation.

5.1 Model of a Local Taxi Market

Consider the trip demand as $D(p,T) = ar(p)g(T)$, where a is the number of potential riders, $g(T) \in [0,1]$ is the fraction of riders willing to wait for the average pickup time T, and $r(p) \in [0,1]$ is the fraction of riders willing to pay the price p for a trip. Thus, $D(p,T)$ is the number of trips requested in a given area and unit of time. Specifically, assuming that $g(T) = (1+T)^{-1}$ will be convenient for obtaining a closed-form solution to the model.

Assumption 1. *Trip demand is $D(p,T) = ar(p)(1+T)^{-1}$, where $r(p)$ differentiable and decreasing in p ($r' < 0$), $r(0) = 1$, and $r(p) = 0, \forall p \geq \bar{p}$, where $\bar{p}$ is sufficiently large.*

Hence, the pool of potential riders is finite, lower prices and waiting times result in more trip requests, and nobody is willing to pay or wait infinitely. Furthermore, by treating a independently of p and T we make the simplifying assumption that the taxi riders' preferences with respect to the waiting time and their willingness to pay are identical across different local markets within the same period of time. To account for the varying population densities across the local taxi markets, we assume that they have an identical geographical size but different population sizes and, therefore, different numbers of potential riders.[16] As such, the aim of the analysis is to demonstrate that variations in a alone can explain key regional differences both pre- and post-deregulation.

Let N be the total number of taxis in the area during the given time period. If Q is the equilibrium number of trips, t is the average duration of the trip with the rider, T is

[16] Equivalently, one could standardise the population size and vary the geographical size of the market. However, it is more natural to think that the market and the drivers' area of operation are mainly limited by distance.

the average time to reach the rider, and I is the number of idle taxis, the total density of the taxis in steady state is given by the identity

$$N = I + tQ + TQ. \tag{2}$$

That is, taxis are in one of three different states: idle, on their way to a pickup, or driving a passenger. The idle taxis as well as the potential riders are assumed to be identically distributed across the space.

Notice that T is both the average waiting time for the rider as well as the time spent by the driver en route. We assume that the platforms match the trip request to the closest idle taxi. The matching technology is reflected by $T(I)$, which is decreasing in I. That is, the average waiting time is shorter the more idle taxis there are. If the potential riders and idle taxis are uniformly distributed over n-dimensional Euclidean space and the taxis drive in a straight line at a constant speed, then $T(I) \propto I^{-\frac{1}{n}}$ (Castillo et al., 2022).

For the purposes of the model, it is convenient to define the inverse function $I(T)$, which exists by the monotonicity of $T(I)$. By isolating Q in (2) and substituting $I(T)$, we obtain the trip supply

$$S(T, N) = \frac{N - I(T)}{t + T}. \tag{3}$$

We make the following assumption regarding the functional form of the trip supply.

Assumption 2. *Trip supply is* $S(T, N) = (N - T^{-1})(1 + T)^{-1}$ *if* $N - T^{-1} > 0$ *and 0 otherwise.*

Note that $S(T, N)$ is increasing in N, and first increasing and then decreasing in T.[17] By standardising the average trip duration to $t = 1$ and reducing the matching function to its simplest spatial form, $I(T) = T^{-1}$, i.e. a straight line, allows us to obtain a convenient closed-form solution to the market equilibrium. While the existence of an equilibrium can be proved with less structure as in Castillo et al. (2022), the second-order

[17]This last property is what creates the possibility of a bad equilibrium (a "wild goose chase") studied by Castillo et al. (2022).

partial derivatives, which we need for the analysis, are tedious for an implicit function and would nevertheless require additional assumptions to sign.

For the purpose of defining the profits of taxi firms and dispatch centres, let $\tau \in [0,1]$ denote the share of the price collected by the dispatch centre (which is essentially a platform). All taxis are assumed to have the same costs. For simplicity, the taxi firms' profits are considered at the level of a single taxi:

$$\pi = \left((1-\tau)p - c(1+T)\right) q - F, \tag{4}$$

where $q \equiv Q/N$ denotes the number of trips per taxi and $c < \bar{p}$.

In (4), c is a constant unit cost of driving, which is multiplied by the average trip length $t + T$ (where we again assume that $t = 1$), and F is a fixed cost. The fixed cost includes the driver's wage, the rental cost of the vehicle, and any other charges that are independent of whether the taxi is driving or idle. While t is considered exogenous, $c(t+T)$ is also increasing in T, which is endogenous. Driving to the passenger is not directly compensated and yet costs more fuel (and, possibly, results to higher insurance costs through additional mileage).

Proposition 1. *The equilibrium number of trips (Q) and average waiting time (T) are given by*

$$Q(p,N) = \begin{cases} \frac{ar(p)(N-ar(p))}{N-ar(p)+1} & \textit{if } N > ar(p) \textit{ and } \pi \geq 0 \\ 0 & \textit{otherwise} \end{cases}, \tag{5}$$

$$T(p,N) = \begin{cases} \frac{1}{N-ar(p)} & \textit{if } N > ar(p) \textit{ and } \pi \geq 0 \\ +\infty & \textit{otherwise} \end{cases}. \tag{6}$$

All proofs are in Appendix C.

Note that

$$\frac{\partial Q}{\partial p} = \frac{\left((N-ar(p))^2 + N - 2ar(p)\right) r'a}{(N-ar(p)+1)^2} \leq 0 \leftrightarrow p \geq \hat{p},$$

where $\hat{p}$ is defined by

$$r(\hat{p}) = \frac{N - \sqrt{N+1} + 1}{a}.$$

That is, if $p < \hat{p}$, the market is in a wild-goose-chase (WGC) equilibrium (Castillo et al., 2022), where a higher price would both increase the number of rides and decrease the waiting time.

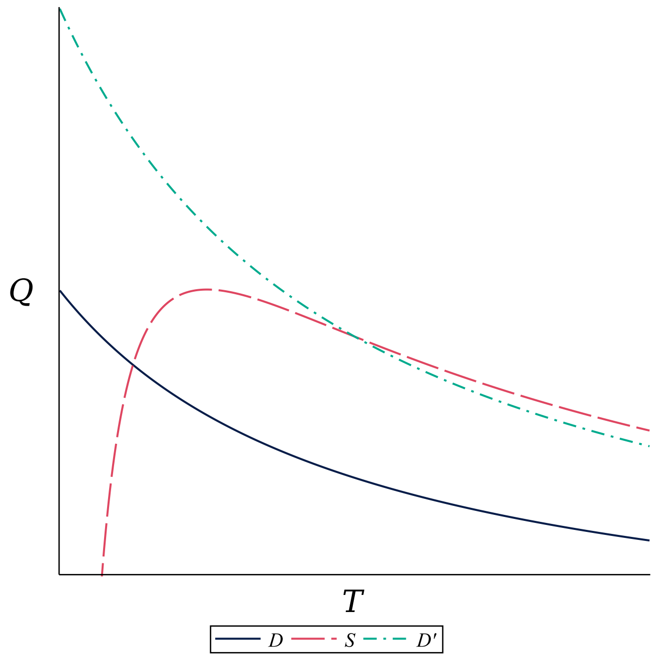

Figure 2: Supply and demand of taxi trips

Figure 2 illustrates the above-mentioned possibility. The figure depicts how the supply and demand of taxi rides depend on T, while other factors then shift these curves up or down. When demand (D) is sufficiently low, it intersects supply (S) in the latter's upward-sloping region. However, when demand is higher (D'), due to a lower price or higher number of potential riders, the intersection takes place in the downward-sloping region of supply.

5.2 Pre-Deregulation Equilibrium

Before 2018, fares as well as entry to the Finnish taxi market were regulated. The regulator set price ceilings periodically and, effectively, these were charged throughout the country. The number of licences were not set by an explicit rule. Instead, they were at the discretion of local authorities. Nevertheless, there were approximately 2 licences per 1,000 inhabitants across the country. Therefore, in terms of the model, the pre-deregulation era can be modelled as a situation in which local taxi markets of varying number of potential riders a had the same price p and the same relative number of taxis n such that $N = an$.

Proposition 2. *Consider p and $N = an$ such that an interior equilibrium, $Q(p, N) > 0$, exists. Then*

$$\frac{\partial Q}{\partial a} > 0, \frac{\partial q}{\partial a} > 0, \frac{\partial T}{\partial a} < 0 \text{ and } \frac{\partial \pi}{\partial a} > 0.$$

We see that more populous regions enjoy a greater number of trips and lower waiting times. The latter effect brings an additional benefit by enabling the taxis to complete more trips. That is, considering Q as a function of a, there are increasing returns to scale:

$$Q(ka, p, n) = \frac{k^2 a^2 r(p)(n - r(p))}{ka(n - r(p)) + 1} > kQ(a, p, n), \forall k > 1.$$

Due to these economies of scale and proportionally set number of licences, driving a taxi becomes more profitable in local markets that have a greater population. This is also verified by the pre-deregulation data. This feature of the market also contributes to the fact that the private taxi market is smaller than the publicly funded taxi market in areas of lower population levels (and/or longer distances).

Figure 3 illustrates the pre-deregulation equilibria for two local markets that have the same p and n but different a's. While the number of trips demanded in the large market is higher than in the small market ($D_L > D_S$), the difference is even greater in supply ($S_L > S_S$) due to the economies of scale. Hence the large market enjoys, both relatively and in absolute terms, more rides as well as lower waiting times in the equilibrium. Given the pre-deregulation constraint of having the same p and n for all local markets of varying a, it is also possible that some local markets get stuck in a "perpetual" WGC equilibrium even if the regulator's choice of p and n is second-best socially optimal.

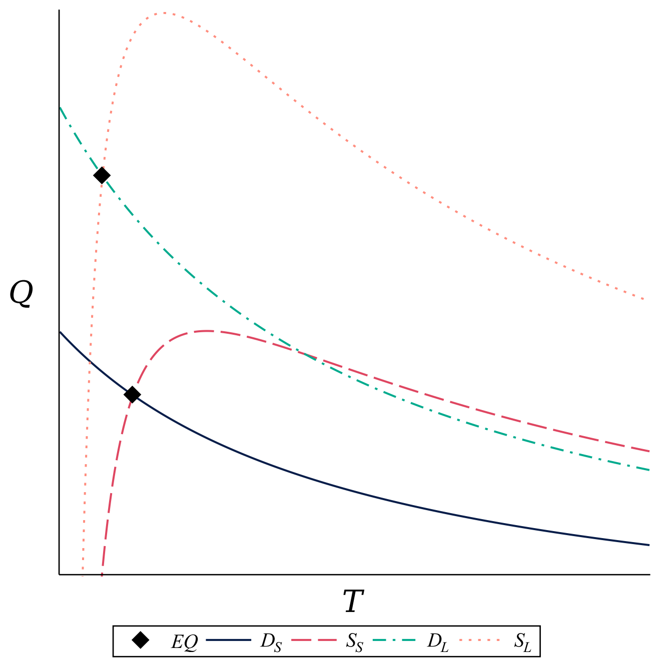

Figure 3: Pre-deregulation equilibria

5.3 Post-Deregulation Equilibrium

The deregulation abolished the price ceilings and restrictions on the number of licences. This also changed the position of the local dispatch centres. Pre-deregulation, the dispatch centres were largely owned by the local taxi firms and usually paid no dividends. As such, their dispatch fee, τp, was set by cost-recovery basis. Post-deregulation, however, they may have obtained pricing power towards both the riders and taxi firms. Among the taxi firms there were new entrants that were not shareholders of the local dispatch centre.

For simplicity, we consider two opposite dispatch centre market structures: a monopoly and competitive industry. This will be sufficient for the purpose of gaining an insight into the effects of deregulation and the role of varying market sizes. Modelling a dispatch centre oligopoly, in contrast, would require much additional structure with respect to competition on both sides of the market and the entry of dispatch centres as well as restrictive assumptions regarding multi- or single-homing of riders and taxis.

Irrespective of the dispatch centre market structure, the post-deregulation taxi firm industry can be considered competitive. As such, the number of taxis depends on the free-entry condition, $\pi = 0$.[18]

While the dispatch centres faced competition, especially in the more populous areas, for simplicity we first consider the problem of a monopoly dispatch centre. This will give us an idea of the pricing incentive and how it varies geographically when unhindered by competition. As such, the problem of the dispatch centre is to maximise the aggregate revenue, τpQ, such that $\pi = 0$. However, by substituting the constraint into the objective function, we see that the centre's problem becomes

$$\max_{p,N} \Pi = pQ - c(1+T)Q - NF. \tag{7}$$

Through p and τ, the dispatch centre is able to control the entry of drivers. Thus, its problem is equivalent to choosing p and N to maximise the aggregate profit and then use τ to transfer it from the taxi firms. Again, we substitute $an = N$ in (7) to analyse the relative number of taxis.

The post-deregulation markets are assumed to be isolated, which implies that irrespective of the dispatch centre market structure there will be no WGC equilibria and the price should always be chosen such that $p > \hat{p}$.[19] At the same time, no rider is willing to pay more than $\bar{p}$. Likewise, we can set a upper bound for N, say,

$$a(\bar{p} - c) - \bar{N}F = 0 \leftrightarrow \bar{N} = \frac{a(\bar{p} - c)}{F}.$$

Since the domains $p \in [\hat{p}, \bar{p}]$ and $N \in [0, \bar{N}]$ are non-empty and compact, by the Bolzano–Weierstrass theorem a maximum exists for the two continuous objective functions, which will be studied shortly.

[18]Ignoring the integer issue is less of a problem in this context since taxis can (and some do) operate part time.

[19]Of course, it is possible that there are temporary WGC equilibria due to supply or demand shocks in the absence of dynamic pricing.

To guarantee the uniqueness of the solutions and to facilitate the comparative statics analyses, we make the following assumption.

Assumption 3. *The Hessian of the aggregate profit,*

$$\mathbf{H}(\mathcal{F}(p,n)), \text{ where } \mathcal{F}(p,n) \equiv pQ(p,n) - c(1+T(p,n))Q(p,n) - anF,$$

is negative definite. Furthermore, $\mathcal{F}(p,n) > 0, \exists p, n > 0$.

Proposition 3. *Let* p^* *and* n^* *denote the unique maximising point of* (7)*. Then,*

$$\frac{\partial p^*}{\partial a} < 0.$$

Furthermore, there exists $\hat{a}$ *such that if* $r'' \equiv d^2r(p)/dp^2 \leq 0$ *and* $a > \hat{a}$*, then*

$$\frac{\partial n^*}{\partial a} < 0.$$

The intuition behind the result is as follows. A higher number of potential riders creates an incentive to increase the price. However, due to the economies of scale, the decrease in the marginal costs outweighs the increase in the marginal revenue. Thus, it becomes optimal to have lower fares in more populous areas. At the same time, due to the scale economies the number of idle taxis is less critical in more populous areas that have the sufficient size. Thus, the relative number of taxis is smaller as the centre sets a higher dispatch fee.

In order to assess whether the inter-regional differences in the post-deregulation prices and the number of taxis are due to market power or general characteristics of the taxi market, we compare the monopoly dispatch centre to a competitive market. Perfect competition and free entry should lead to an outcome where the aggregate profits are zero: $\Pi = 0$. However, the outcome is not uniquely determined as there are infinitely many combinations of p and n that satisfy the zero profit condition. This originates from the fact that there are likewise different combinations of p and T that equate market demand and supply. It is interesting to consider that a competitive taxi markets may have the tendency to lead to a multitude of different outcomes. In any case, the theoretical indeterminacy remains without additional assumptions regarding the pricing strategies, which itself are non-standard in the competitive market framework.

To set aside the issue of indeterminacy, we focus on "maximum entry equilibrium", where the maximum number of taxis enter that the market can bear. Both riders and taxis are assumed to multi-home and the competition between the dispatch centres drives also their profits to zero and $\tau = 0$. Formally, the maximum entry equilibrium is a solution to

$$\max_{p,n} an \text{ s.t. } \mathcal{F}(p,n) = 0. \tag{8}$$

Proposition 4. *Let p^{**} and n^{**} denote the unique maximising point of (8). Then,*

$$\frac{\partial p^{**}}{\partial a} < 0 \text{ and } \frac{\partial n^{**}}{\partial a} > 0.$$

We see from Propositions 3 and 4 that both market structures exhibit a negative relationship between the equilibrium price and population size. Although market power obviously affects the price level, we see that, regardless of it, the model predicts that the post-deregulation prices will diverge and become relatively higher in smaller regions. This is due to the scale economies that are an inherent feature of the matching technology in the taxi market.

However, market power, rather than matching technology, seems to be responsible for regional differences in market entry and nonentry, since Propositions 3 and 4 diverge in this respect. Larger regions saw an increase, and smaller regions saw no change in the number of taxis post-deregulation. The first outcome is consistent with the model if the larger regions are (relatively more) competitive. The second outcome, together with the fact that the prices increased in the smaller regions, is consistent with the model if the smaller regions are (relatively more) non-competitive. In fact, from the data we see that the number of dispatch centres increases with the population size. Although we will not consider the entry of the dispatch centres, the level of competition between dispatch centres may also be attributed to the varying population sizes and distances.

5.4 Other considerations

In addition to market power, the lack of entry in smaller regions despite the increase in consumer prices may also be explained by other factors outside the model. Publicly funded taxi trips to hospitals, etc. play a large role in the Finnish taxi market and, in particular, in the smaller regions where the privately funded market is even smaller due to scale economies. Following the deregulation of the taxi market, there was now public procurement of publicly funded trips. These procurement rounds lead to a significant decrease in the fares and incomes gained from these trips. As such, this may have further decreased the incentive to enter the taxi market in the smaller regions, since there are not enough customers in the private market for firms to choose not to participate in the publicly funded market.

Another change caused by the deregulation was that idle taxis were now free to wait wherever they wanted. Speculatively, this may have led to discoordination and worse distribution of idle taxis, where individual drivers conglomerated too heavily at the central places, but ended up driving longer to their eventual place of pick-up. The increased fuel costs in the data support this possibility.

Another empirical observation from the post-deregulation market is that there is much more price dispersion in the larger regions. Naturally, this is less likely in the smaller regions, simply due to the small number of rival dispatch centres. However, we conjecture that in larger regions with multiple dispatch centres there may exist asymmetric equilibria, where the dispatch centres choose different price points and average waiting times. This would require that the riders are multi-homing, but the drivers are not, which is in fact not uncommon in these places. Nevertheless, extending the model towards this direction is beyond the scope of this paper.

6 Conclusion

Deregulation has been a controversial issue for decades. There exists a body of literature, both theoretical and empirical, discussing the effects of deregulating taxi markets, but no clear consensus has been reached. We examine the effects of deregulation of the taxi market taking advantage of a natural experiment.

Our empirical results indicate that taxi markets of different sizes have evolved very differently following deregulation. The offered fares have on average increased by 7% in large regions and by around 15% in small and medium-sized regions. The variation in the offered fares is significant, especially in large regions. There is evidence that the realised fares in large regions have on average decreased, which would imply that consumers are choosing cheaper rides.

The result that fares have increased relatively more in small regions is fairly consistent with the previous literature (for example, Marell and Westin (2002) and Gaunt (1995)). This could be explained by a multitude of factors: we observe that fares are correlated with, for example, the number of dispatch centres within the area. Moreover, our theoretical analysis shows that when deregulation allows fares to diverge this outcome would happen whether the dispatch centre market is competitive or monopolistic. The outcome, while surprising and contradictory to standard market models, is due to economies of scale in matching. Furthermore, the level of dispatch centre competition can explain why there has been taxi firm entry into large but not medium-sized or small regions.

This is in line with our employee-level findings, where we find that in small and medium-sized regions, the taxi driver income has decreased, while in large regions, the change is not statistically significant. Empirically estimating the effects of deregulation on dispatch centres and thus understanding this part of the market would naturally be the next step in analysing this finding, although this is left for future research since our data do not allow for this kind of examination.

We find that dispatch centres that operate solely through mobile applications offer a cheaper service than their more traditional counterparts. This is in line with previous findings in the literature, such as that ride-hailing platforms are more efficient taxi operators (i.e. they boast a higher capacity utilisation rate) than traditional firms (Cramer and Krueger, 2016). It could furthermore be argued that applications reduce search frictions and transaction costs, therefore increasing efficiency. However, consumers may end up paying for lower fares with a longer time-to-arrival.

We find that the experience of the employees in the taxi sector has decreased in the medium-sized and large regions, which implies that there have been new inexperienced employees entering the market. Future research could assess taxi driver background even further, and it may be especially interesting to evaluate how deregulation has affected employment, namely whether new entrants have previously been employed. This would allow us to better understand the welfare effects of the reform even further.

References

Aarhaug, J. and K. Skollerud (2014): "Taxi: Different Solutions in Different Segments," *Transportation Research Procedia*, 14.

Ahomäki, I., J. Jääskeläinen, V. Pitkänen, A. Sieppi, and A. Väättänen (2023): "Procurement of publicly reimbursed taxi services: Evidence from the Finnish market reform," Working Paper.

Autor, D. H. (2003): "Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing," *Journal of Labor Economics*, 21, 1–42.

Bakker, P. (2007): "Deregulation of the taxi industry: Experiences in The Netherlands," *(De)Regulation of the Taxi Industry, ECMT Round Tables, No. 133.*

Barrett, S. D. (2010): "The sustained impacts of taxi deregulation," *Economic Affairs*, 30, 61–65.

Beesley, M. E. (1973): "Regulation of taxis," *The Economic Journal*, 83, 150–172.

Beesley, M. E. and S. Glaister (1983): "Information for regulating: the case of taxis," *The Economic Journal*, 93, 594–615.

Buri, R., M. Heinonen, J. Kanervo, and J. Karjalainen (2022): "The effects of entry deregulation: evidence from passenger transport," FCCA Working Papers 1/2022, Finnish Competition and Consumer Authority.

Cairns, R. D. and C. Liston-Heyes (1996): "Competition and regulation in the taxi industry," *Journal of Public Economics*, 59, 1–15.

Castillo, J. C., D. T. Knoepfle, and E. G. Weyl (2022): "Matching in ride hailing: Wild goose chases and how to solve them," *Available at SSRN 2890666.*

Cramer, J. and A. B. Krueger (2016): "Disruptive Change in the Taxi Business: The Case of Uber," *American Economic Review*, 106, 177–82.

De Vany, A. S. (1975): "Capacity utilization under alternative regulatory restraints: an analysis of taxi markets," *Journal of Political Economy*, 83, 83–94.

Douglas, G. W. (1972): "Price regulation and optimal service standards: The taxicab industry," *Journal of Transport Economics and Policy*, 116–127.

Frankena, M. W. and P. A. Pautler (1986): "Taxicab regulation: an economic analysis," *Rsch. in L. & Econ.*, 9, 129.

Fréchette, G. R., A. Lizzeri, and T. Salz (2019): "Frictions in a Competitive, Regulated Market: Evidence from Taxis," *American Economic Review*, 109, 2954–92.

Gärling, T., T. Laitila, A. Marell, and K. Westin (1995): "A note on the short-term effects of deregulation of the Swedish taxi-cab industry," *Journal of Transport Economics and Policy*, 29, 209–214.

Gaunt, C. (1995): "The impact of taxi deregulation on small urban areas: some New Zealand evidence," *Transport Policy*, 2, 257–262.

Harju, J., I. Kankaanranta, and K. Kotakorpi (2023): "Taxi Market Deregulation: Effects on Prices, Demand and Tax Evasion," Mimeo.

Joskow, P. L. and N. L. Rose (1989): "The effects of economic regulation," *Handbook of Industrial Organization*, 2, 1449–1506.

Marell, A. and K. Westin (2002): "The Effects of Taxicab Deregulation in Rural Areas of Sweden," *Journal of Transport Geography*, 10, 135–144.

Moore, A. and T. Balaker (2006): "Do economists reach a conclusion on taxi deregulation?" *Econ Journal Watch*, 3, 109–132.

Morrison, P. S. (1997): "Restructuring effects of deregulation: the case of the New Zealand taxi industry," *Environment and Planning A*, 29, 913–928.

Posner, R. A. (1974): "Theories of economic regulation," NBER Working Papers 0041, National Bureau of Economic Research.

Sappington, D. E. and J. E. Stiglitz (1987): "Privatization, information and incentives," *Journal of Policy Analysis and Management*, 6, 567–585.

Schaller, B. (2007): "Entry controls in taxi regulation: Implications of US and Canadian experience for taxi regulation and deregulation," *Transport Policy*, 14, 490–506.

Shreiber, C. (1975): "The economic reasons for price and entry regugation of taxicabs," *Journal of Transport Economics and Policy*, 268–279.

Teal, R. F. and M. Berglund (1987): "The Impacts of Taxicab Deregulation in the USA," *Journal of Transport Economics and Policy*, 21, 37–56.

Traficom (2020): "Taksiliikenteen vaikutusten seuranta," Traficomin julkaisuja 3/2020.

Williams, D. J. (1980): "The economic reasons for price and entry regulation of taxicabs: A comment," *Journal of Transport Economics and Policy*, 14, 105–112.

Winston, C. (1993): "Economic Deregulation: Days of Reckoning for Microeconomists," *Journal of Economic Literature*, 31, 1263–1289.

——— (1998): "U.S. Industry Adjustment to Economic Deregulation," *Journal of Economic Perspectives*, 12, 89–110.

Online appendix

A Tables

Table A.1: Subgroup division

Control	Treatment				
Åland	**Small regions**	Municipalities	**Medium regions**	Municipalities	**Large regions**
Eckerö	Pietarsaari	*Kruunupyy, Luoto, Pedersöre, Pietarsaari, Uusikaarlepyy*	Hämeenlinna	*Hattula, Hämeenlinna, Janakkala*	*Helsinki*
Finström	Kokkola	*Kokkola, Kannus*	Kouvola	*Kouvola*	*Espoo*
Geta	Vakka-Suomi	*Kustavi, Laitila, Pyhäranta, Taivassalo, Uusikapunki, Vehmaa*	Lappeenranta	*Lappeenranta, Lemi, Luumäki, Savitaipale, Taipalsaari*	*Vantaa*
Hammarland	Turunmaa	*Kemiönsaari, Parainen*	Kuopio	*Kuopio, Siilinjärvi*	*Tampere*
Jomala	Raasepori	*Hanko, Inkoo, Raasepori*	Joensuu	*Heinävesi, Ilomantsi, Joensuu, Juuka, Kontiolahti, Liperi, Outokumpu, Polvijärvi*	*Turku*
Lemland	Mikkeli	*Hirvensalmi, Kangasniemi, Mikkeli, Mäntyharju, Pertunmaa, Puumala*	Rovaniemi	*Rovaniemi, Ranua*	
Lumparland	Kemi-Tornio	*Kemi, Keminmaa, Simo, Tervola, Tornio*	Pori	*Harjavalta, Huittinen, Kokemäki, Merikarvia, Nakkila, Pomarkku, Pori, Ulvila*	
Mariehamn	Suupohja	*Kaskinen, Kristiinankaupunki, Närpiö*	Vaasa	*Kalajoki, Laihia, Maalahti, Mustasaari, Vaasa, Vöyri*	
Saltvik	Raahe	*Pyhäjoki, Raahe, Siikajoki*	Jyväskylä	*Hankasalmi, Jyväskylä, Laukaa, Muurame, Petäjävesi, Toivakka, Uurainen*	
Sund	Loviisa	*Lapinjärvi, Loviisa*	Oulu	*Hailuoto, Kempele, Liminka, Lumijoki, Muhos, Oulu, Tyrnävä*	
	Porvoo	*Askola, Myrskylä, Porvoo, Pukkila*			
	Pieksämäki	*Juva, Pieksämäki*			
	Kotka-Hamina	*Hamina, Kotka, Miehikkälä, Pyhtää, Vironlahti*			
	Imatra	*Imatra, Parikkala, Rautjärvi, Ruokolahti*			
	Forssa	*Forssa, Humppila, Jokioinen, Tammela, Ypäjä*			

Notes: List of regions in control and treatment groups. We compare Åland to small and medium-sized regions as well as large regions.

Table A.2: Characteristics of the control and treatment region by region size

	Control	Treatment		
	Åland	Small regions	Medium regions	Large regions
Population	27 716	45 551	143 022	317 282
	(0.0)	(18494.0)	(54074.8)	(187797.0)
Population density (pop/km^2)	27.2	21.5	33.2	1223.6
	(0.0)	(11.6)	(13.3)	(1026.7)
Median income (€)	25 751	21 245	21 514	23 725
	(1923.5)	(1494.4)	(1964.6)	(2650.0)
Area (km^2)	5866.4	4240.4	7132.9	496.0
	(0.0)	(1763.1)	(3282.3)	(216.8)
of which land (%)	17.4	60.4	73.0	68.9
	(0.0)	(0.189)	(0.158)	(0.260)
Industry revenue (*/100 000*)	96.6	568.4	2440	21800
	(0.00)	(591.0)	(2520)	(18500)
Number of sub-regions	1	15	10	5
Number of municipalities	10	56	49	5

Notes: Population, population density, area, and average number of taxi firms are the means of a region. Population density is calculated by dividing population by the land area of the region. Median income represents the mean of regions' median income. Statistics are obtained from Statistics Finland.

Table A.3: Firm characteristics by region size

	Small regions	Medium regions	Large regions	Åland
Number of firms	65.221	164.929	656.710	51.000
	(25.401)	(59.144)	(344.006)	(0.000)
Firm age	16.135	15.319	11.204	9.417
	(10.320)	(10.692)	(11.330)	(7.569)
Revenue	126921.237	148145.659	128887.152	96452.333
	(138224.031)	(291985.774)	(284634.903)	(90235.310)
Profit as a percentage	0.292	0.260	0.298	0.321
of revenue	(0.228)	(0.512)	(1.614)	(0.211)
Employees	1.496	1.891	1.502	0.941
	(1.752)	(4.485)	(4.213)	(1.142)
Experience in years	6.993	6.830	6.076	5.792
	(2.905)	(3.087)	(3.326)	(2.828)
Observations	443	831	1196	24

Notes: Number of firms is a regional variable. Firm age, revenue, profit, employee count and experience are firm-level variables, which are averaged at a regional level.

Table A.4: Difference between observed and calculated fares (in €)

	Real	Calculated	Difference
1km	8.32	8.61	-0.29
	(1.53)	(0.00)	(0.22)
2km	11.02	10.62	0.40
	(0.47)	(0.00)	(0.07)
3km	12.12	12.63	-0.51
	(0.59)	(0.00)	(0.08)
4km	14.64	14.64	0.00
	(0.60)	(0.00)	(0.08)
5km	17.58	17.45	0.13
	(0.61)	(0.00)	(0.09)
7.5km	22.94	22.08	0.85
	(2.13)	(0.41)	(0.36)
10km	26.89	27.60	-0.71
	(1.25)	(0.30)	(0.19)
12.5km	31.58	31.72	-0.14
	(0.70)	(0.00)	(0.10)
15km	34.20	35.74	-1.54
	(0.64)	(0.00)	(0.09)
20km	46.14	47.80	-1.66
	(2.39)	(0.00)	(0.34)
25km	52.71	55.24	-2.53
	(2.16)	(0.00)	(0.44)

Notes: Table presents the difference between observed and calculated fares in Åland. Calculated fares do not include waiting fees, which are applicable whenever a taxi is driving slower (e.g. due to traffic congestion). The calculated fares include additional fuel fare added in June following a sharp increase in fuel prices.

Table A.5: DiD estimates on offered fares in large regions

	(1) Espoo	(2) Helsinki	(3) Tampere	(4) Turku	(5) Vantaa
Treatment	0.048***	0.047***	0.028***	0.016***	0.038***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Post	0.151***	0.151***	0.151***	0.151***	0.151***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)
Treatment x Post	0.020**	0.103***	0.123***	0.147***	-0.013*
	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)
Control at baseline	2.047***	2.035***	2.039***	1.995***	2.037***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
Observations	7772	9362	4874	7626	8288
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Notes: Table presents differences-in-differences estimates of treatment effects on offered fares for each large region. Pre-treatment fares are calculated for each trip using 2017 regulated fares. Time fixed effects include both time-of-day and day-of-week. Robuster standard errors (hc3) are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.6: DiD estimates on offered fares in medium regions

	(1) Hämeenlinna	(2) Joensuu	(3) Jyväskylä	(4) Kouvola	(5) Kuopio	(6) Lappeenranta	(7) Oulu	(8) Pori	(9) Rovaniemi	(10) Vaasa
Treatment	0.031***	0.031***	0.037***	0.019*	0.037***	0.040***	0.015***	0.033***	0.029***	0.032***
	(0.007)	(0.004)	(0.003)	(0.009)	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.009)
Post	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Treatment x Post	0.208***	0.083***	0.133***	0.005	0.092***	0.155***	0.158***	0.171***	0.202***	0.107***
	(0.016)	(0.011)	(0.009)	(0.016)	(0.009)	(0.012)	(0.008)	(0.006)	(0.006)	(0.017)
Control at baseline	1.990***	2.016***	2.027***	1.986***	2.022***	2.002***	2.028***	2.022***	2.070***	1.989***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Observations	1748	2144	2462	1628	2446	1836	2634	2518	3756	1772
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table presents differences-in-differences estimates of treatment effects on offered fares for each medium region. Pre-treatment fares are calculated for each trip using 2017 regulated fares. Time fixed effects include both time-of-day and day-of-week. Robuster standard errors (hc3) are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.7: DiD estimates on offered fares in small regions

	(1) Kemi-Tornio	(2) Kokkola	(3) Mikkeli	(4) Raahe	(5) Raasepori	(6) Turunmaa	(7) Vakka-Suomi
Treatment	0.017***	0.025***	0.028***	0.033***	0.044***	0.015***	0.022***
	(0.003)	(0.006)	(0.004)	(0.005)	(0.007)	(0.004)	(0.003)
Post	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***	0.151***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Treatment x Post	0.169***	0.068***	0.102***	0.217***	0.095***	0.129***	0.130***
	(0.008)	(0.011)	(0.009)	(0.011)	(0.025)	(0.007)	(0.007)
Control at baseline	2.022***	1.991***	2.009***	2.012***	1.994***	2.003***	2.023***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Observations	2226	1734	1988	1989	1742	2102	2428
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Table presents differences-in-differences estimates of treatment effects on offered fares for each small region. Pre-treatment fares are calculated for each trip using 2017 regulated fares. Time fixed effects include both time-of-day and day-of-week. Robuster standard errors (hc3) are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.8: Availability of taxi firms by region

Region	Mean	Median	Min	Max
Åland	1.00	1.00	1.00	1.00
Espoo	0.57	0.77	0.01	1.00
Helsinki	0.64	0.77	0.02	1.00
Hämeenlinna	0.29	0.09	0.03	0.94
Joensuu	0.89	0.89	0.84	0.94
Jyväskylä	0.36	0.29	0.00	0.96
Kemi-Tornio	0.58	0.76	0.02	0.97
Kokkola	0.52	0.52	0.07	0.97
Kouvola	0.42	0.16	0.09	1.00
Kuopio	0.37	0.32	0.01	0.89
Lappeenranta	0.60	0.69	0.18	0.92
Mikkeli	0.44	0.30	0.01	1.00
Oulu	0.35	0.20	0.15	1.00
Pori	0.64	0.67	0.24	0.99
Raahe	1.00	1.00	1.00	1.00
Raasepori	0.62	0.62	0.62	0.63
Rovaniemi	0.56	0.53	0.01	0.90
Tampere	0.52	0.56	0.08	1.00
Turku	0.77	0.85	0.36	1.00
Turunmaa	0.48	0.44	0.16	0.87
Vaasa	0.35	0.11	0.07	0.86
Vakka-Suomi	0.78	0.73	0.61	0.99
Vantaa	0.56	0.55	0.02	1.00

Notes: Table presents taxi availability for each region. Availability is measured for each dispatch centre and represents the share of queries when dispatch centre had available taxis. It does not take time-to-arrival into account.

Table A.9: Revenue

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	2047.023	59956.342**	52964.441***
	(4225.947)	(17777.092)	(810.115)
Post	27898.176***	21977.121***	23214.604*
	(3533.036)	(1952.691)	(5767.806)
Treatment x Post	2538.766	10634.547*	-6704.333*
	(3818.515)	(4195.530)	(2011.200)
Control at baseline	277882.103	1903070.785	110346.740***
	(143422.020)	(1144951.220)	(6527.124)
Observations	5373	9350	11535
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is a firm's revenue.

Table A.10: Employees

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	0.003	0.820***	1.014***
	(0.058)	(0.126)	(0.051)
Post	0.012	-0.055	-0.072
	(0.048)	(0.033)	(0.160)
Treatment x Post	0.027	0.195*	-0.185
	(0.051)	(0.069)	(0.074)
Control at baseline	3.416	9.160	1.464***
	(1.672)	(5.224)	(0.178)
Observations	5373	9350	11535
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is a firm's number of employees.

Table A.11: Profit as a percentage of revenue

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	0.025***	0.057***	0.039***
	(0.005)	(0.005)	(0.004)
Post	0.045**	0.024	0.006
	(0.012)	(0.027)	(0.021)
Treatment x Post	-0.057***	-0.056	-0.114*
	(0.011)	(0.026)	(0.038)
Control at baseline	0.019	0.036	0.010
	(0.047)	(0.073)	(0.008)
Observations	5362	9322	11490
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is a firm's profit as a percentage of their revenue.

Table A.12: Costs as a percentage of revenue

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	-0.009*	-0.061***	-0.085***
	(0.004)	(0.005)	(0.001)
Post	0.012*	-0.006	0.049**
	(0.005)	(0.019)	(0.010)
Treatment x Post	0.016*	0.055*	0.055**
	(0.007)	(0.018)	(0.013)
Control at baseline	0.375***	0.608*	0.399***
	(0.052)	(0.197)	(0.004)
Observations	5361	9323	11490
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is total costs as a percentage revenue.

Table A.13: Fuel costs as a percentage of revenue

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	0.020***	0.018***	-0.005
	(0.001)	(0.002)	(0.002)
Post	-0.008*	-0.012*	-0.014***
	(0.004)	(0.004)	(0.001)
Treatment x Post	0.017***	0.016***	0.006
	(0.003)	(0.002)	(0.003)
Control at baseline	0.060	0.309	0.017***
	(0.033)	(0.145)	(0.002)
Observations	5360	9318	11486
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is fuel costs as a percentage of revenue.

Table A.14: Income

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	3980.817***	708.059	2805.086***
	(463.679)	(416.227)	(244.189)
Post	2210.796**	1686.260***	1473.727**
	(664.027)	(298.129)	(271.813)
Treatment x Post	-1674.586*	-3599.719***	-1351.449
	(609.165)	(479.704)	(632.587)
Control at baseline	30894.742***	35142.207***	30662.335***
	(1854.419)	(2682.278)	(367.722)
Observations	8952	17499	26095
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is taxi driver income.

Table A.15: Experience in the taxi sector in years

	(1) Small regions	(2) Medium regions	(3) Large municipalities
Treatment	0.375***	0.241***	0.441***
	(0.035)	(0.044)	(0.042)
Post	0.247***	0.126**	0.140*
	(0.052)	(0.037)	(0.039)
Treatment x Post	-0.059	-0.292***	-0.084*
	(0.056)	(0.049)	(0.031)
Control at baseline	3.714***	3.510***	4.378***
	(0.193)	(0.200)	(0.040)
Observations	9137	17674	26288
Time Fixed Effects	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The table reports the coefficients of interest of the standard difference-in-differences regression specified in Equation 1, where the dependent variable is taxi driver's experience in years.

B Figures

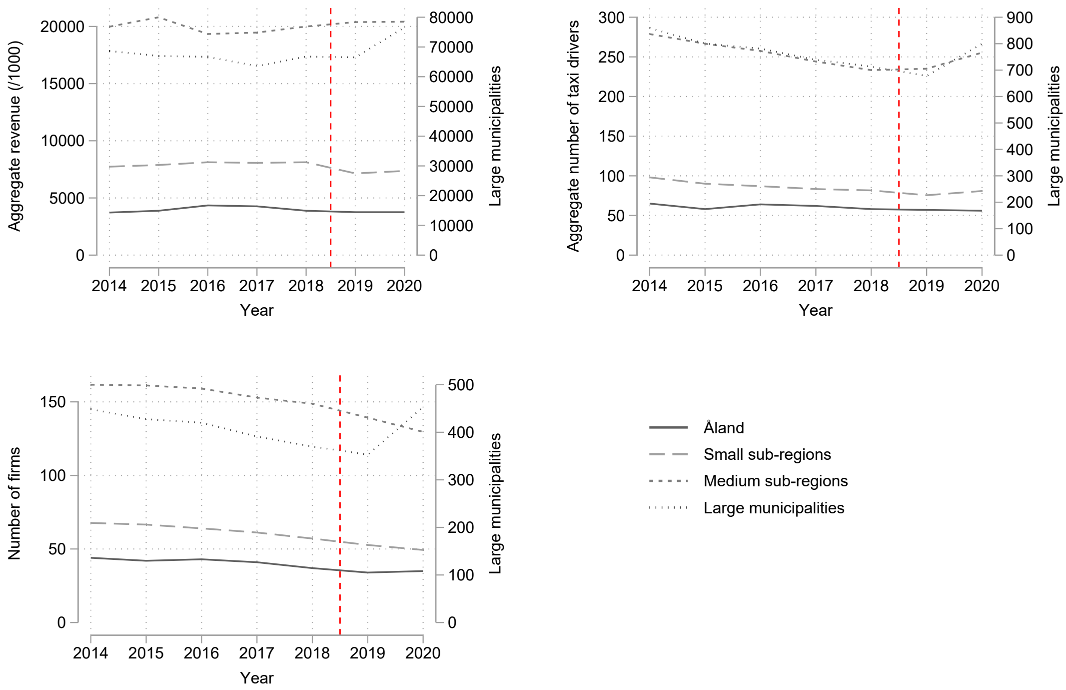

Figure A.1: Evolution of market level variables

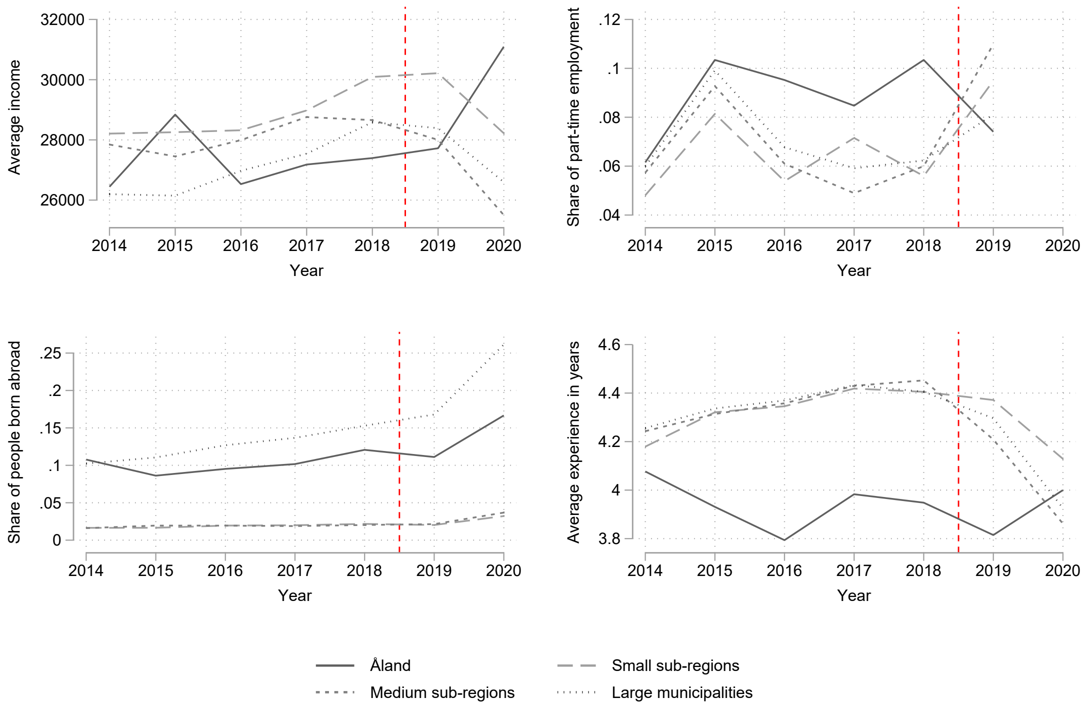

Figure A.2: Evolution of employee level variables

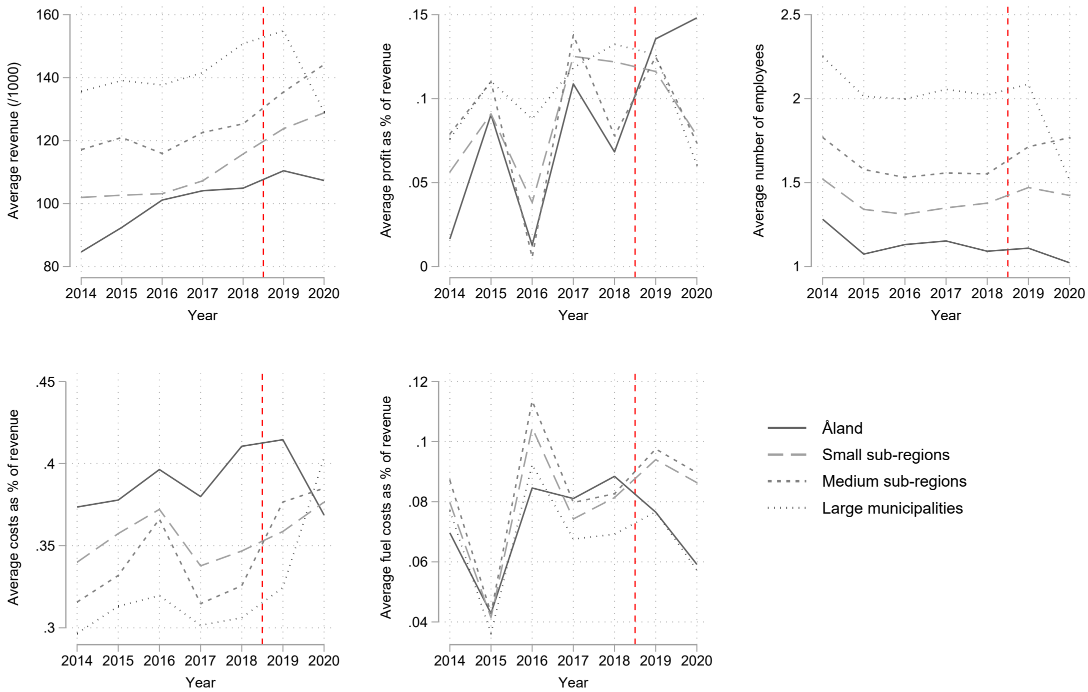

Figure A.3: Evolution of firm level variables

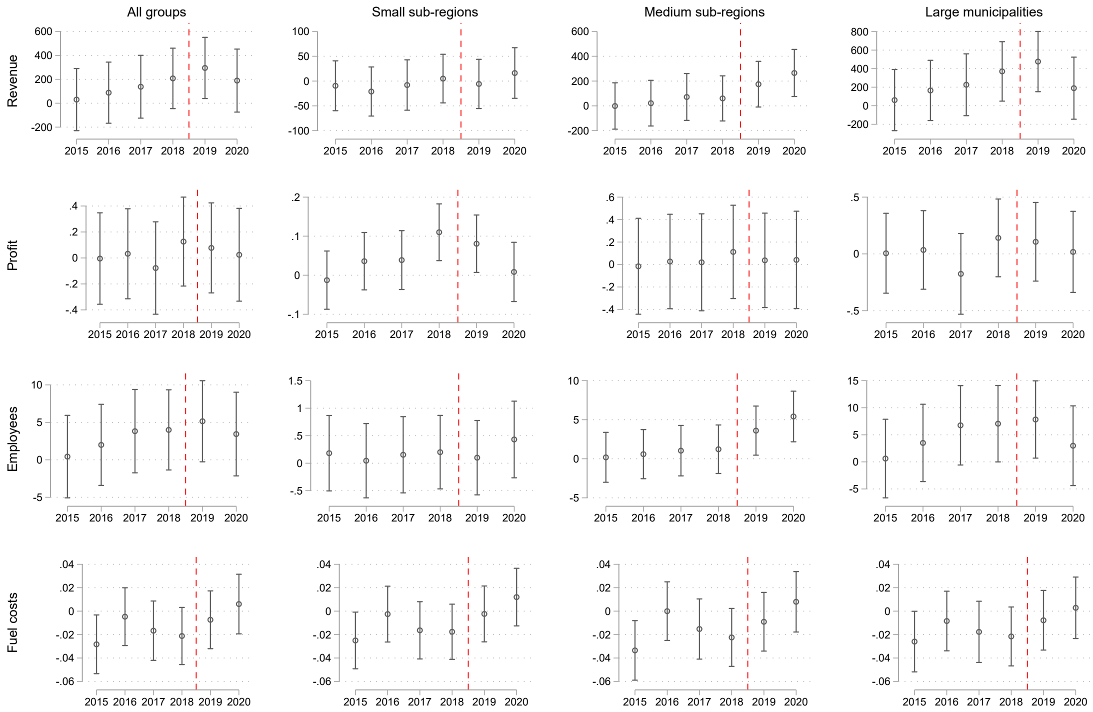

Figure A.4: Testing of parallel trends assumption for firms

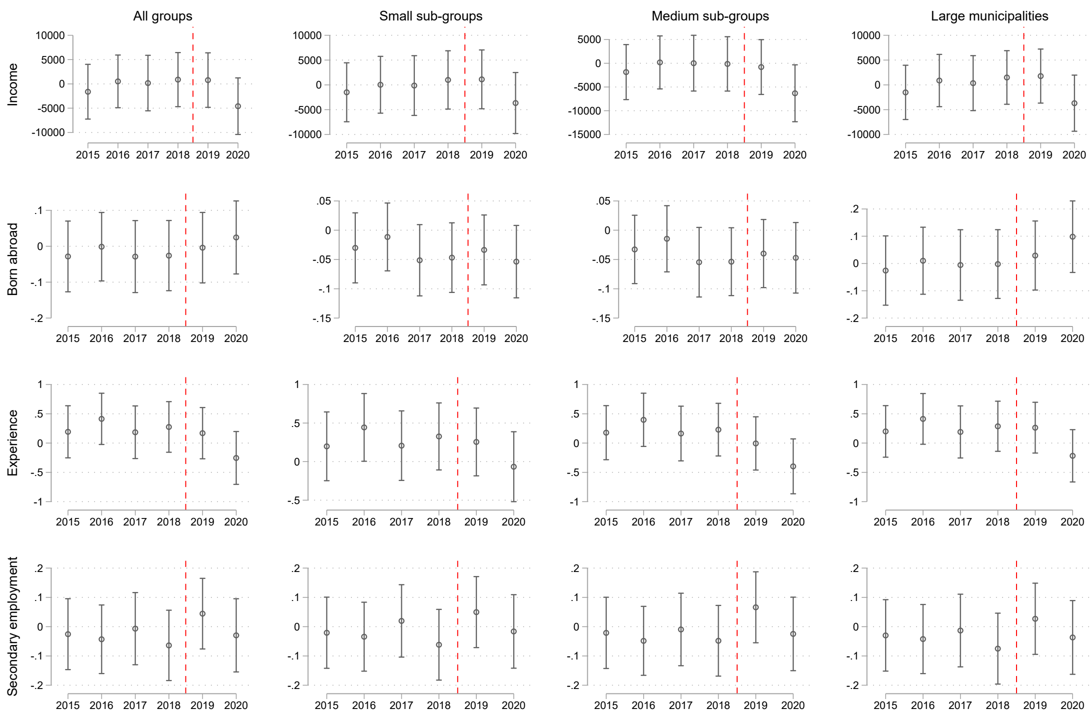

Figure A.5: Testing of parallel trends assumption for employees

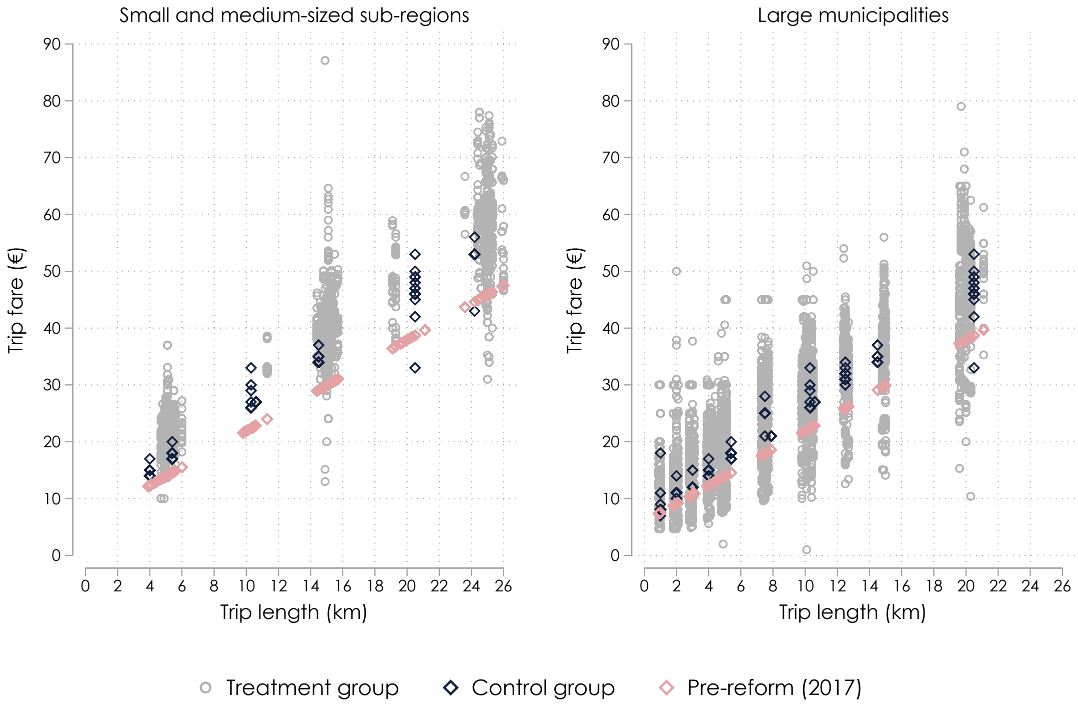

Figure A.6: Spread of offered fares for business hours

Notes: Figures present all observed fares sorted by trip length. Control group observation collected in June and July are used. Pre-reform fares are calculated using regulated fares from 2017.

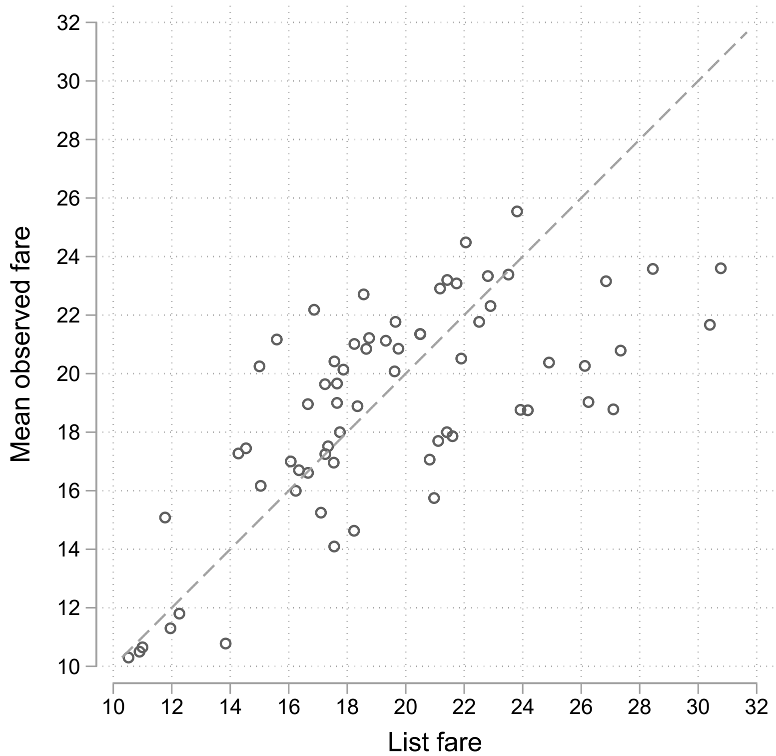

Figure A.7: Correlation between observed fares and fares calculated using list fares, 5km trips

Notes: Each observation is a pair of an average observed 5km fare and list fare for each dispatch centre in our data.

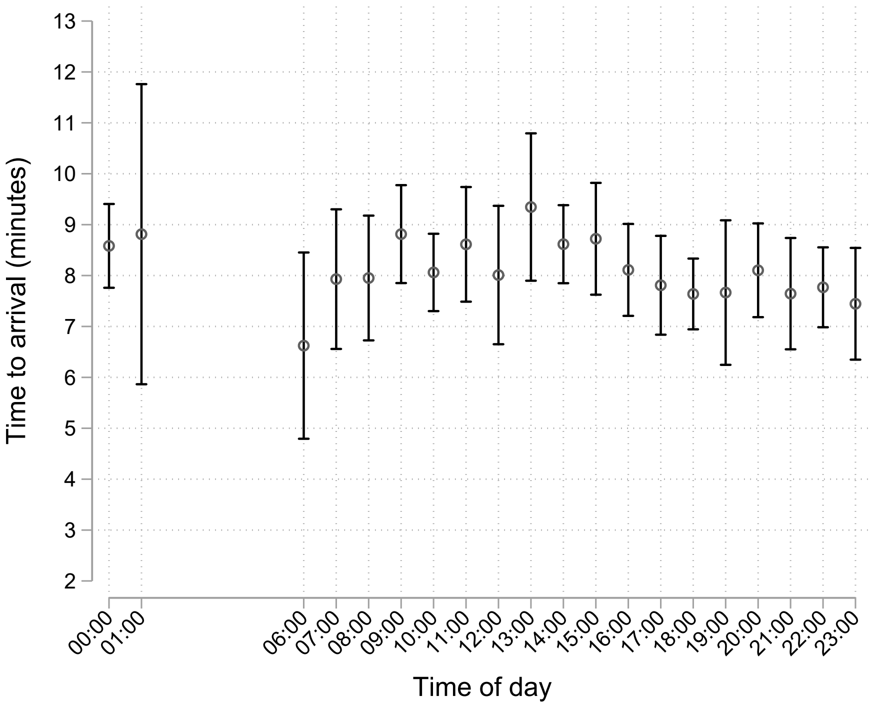

Figure A.8: Marginal means of time to arrival

Notes: Marginal means are estimated by regressing time to arrival on time of day dummy variables as well as the set of controls used, for example, in Table 3.

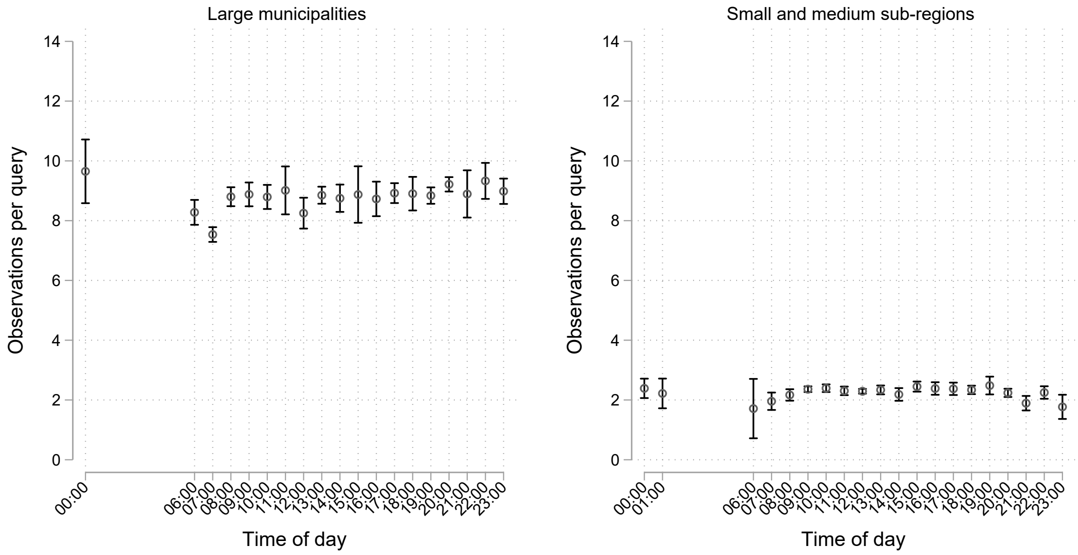

Figure A.9: Marginal means of number of observations per query

Notes: Marginal means are estimated by regressing distinct observations per query time of day dummy variables as well as the set of controls used, for example, in Table 3.

C Proofs

Proof of Proposition 1. Set

$$D(p,T) = \frac{ar(p)}{1+T} = \frac{N - 1/T}{1+T} = S(p,T). \tag{9}$$

By solving (9) for T, we obtain (6). Then, substitute (6) in $D(p,T)$ and denote this by $Q(p,N)$ to obtain (5).

For $D(p,T)$ and $S(p,T)$ to intersect in the positive region of T and Q, it is required that $N > ar(p)$. Otherwise, the market does not exist, $Q = 0$, and the waiting time is infinite, $T = +\infty$. Furthermore, the profit per taxi needs to be non-negative, $\pi \geq 0$, in any interior equilibrium, which depends also on τ, c and F. □

Proof of Proposition 2. Substitute $an = N$ in (5) and (6) to obtain

$$Q(a,p,n) = \frac{a^2 r(p)(n - r(p))}{a(n - r(p)) + 1}, \tag{10}$$

$$q(a,p,n) = \frac{Q(p,n)}{an} = \frac{ar(p)(n - r(p))}{(a(n - r(p)) + 1)n}, \tag{11}$$

and

$$T(a,p,n) = \frac{1}{a(n - r(p))}. \tag{12}$$

Differentiating (10),(11) and (12) with respect to a yields

$$\frac{\partial Q}{\partial a} = \frac{ar(p)(n - r(p))(a(n - r(p)) + 2)}{(a(n - r(p)) + 1)^2} > 0, \frac{\partial q}{\partial a} = \frac{r(p)(n - r(p))}{(a(n - r(p)) + 1)^2 n} > 0$$

and

$$\frac{\partial T}{\partial a} = -\frac{1}{a^2(n - r(p))} < 0.$$

Finally, substitute (10) and (12) in (4) to obtain

$$\pi(p,n) = \frac{(1-\tau)par(p)(n - r(p))}{(a(n - r(p)) + 1)n} - \frac{cr(p)}{n} - F. \tag{13}$$

Differentiating (13) with respect to a yields

$$\frac{\partial \pi}{\partial a} = \frac{(1-\tau)pr(p)(n-r(p))}{(a(n-r(p))+1)^2 n} > 0.$$

□

The following lemma will be used in the proofs of Propositions 3 and 4.

Lemma 1. $\partial \mathcal{F}(p,n)/\partial p = 0$ *implies that*

$$r' = \frac{ar(p)(n-r(p))(a(n-r(p))+1)}{p(na+1)-(p-c)(a(n-r(p))+1)^2} < -\frac{r(p)}{p}.$$

Proof. First, note that

$$\frac{\partial \mathcal{F}(p,n)}{\partial p} = (ar(p)(n-r(p))(a(n-r(p))+1) - r'(p(na+1)-(p-c)(a(n-r(p))+1)^2))$$

$$\times \frac{a}{(a(n-r(p))+1)^2} = 0 \leftrightarrow r' = \frac{ar(p)(n-r(p))(a(n-r(p))+1)}{p(na+1)-(p-c)(a(n-r(p))+1)^2} < -\frac{r(p)}{p}$$

and

$$\frac{\partial \mathcal{F}(p,n)}{\partial p} + car' < 0 \leftrightarrow$$

$$p\left(a(n-r(p))^2+n-2r(p)\right)r' + r(p)\left(n-r(p)\right)\left(a(n-r(p)+1\right) < 0. \tag{14}$$

Since in (14)

$$\left(a(n-r(p))^2+n-2r(p)\right) < \left(n-r(p)\right)\left(a(n-r(p)+1\right) \leftrightarrow r(p) > 0,$$

it is necessary that $r' < -r(p)/p$. □

Proof of Proposition 3. Let $\mathcal{F}_i$ and $\mathcal{F}_{ij}$ denote first- and second-order partial derivatives of (7) with respect to variables i and j, where $i,j \in \{p,n,a\}$.

By Assumption (3), the first-order conditions,

$$\mathcal{F}_p = \frac{\left(p\left(a(n-r(p))^2+n-2r(p)\right)r' + r(p)\left(n-r(p)\right)\left(a(n-r(p))+1\right)\right)a^2}{\left(a(n-r(p))+1\right)^2} - car' = 0$$

and

$$\mathcal{F}_n = \frac{p\,a^2 r(p)}{\left(a(n-r(p))+1\right)^2} - aF = 0,$$

define the unique maximising point p^* and n^*.

By Cramer's rule,

$$\frac{\partial p^*}{\partial a} = \frac{\begin{vmatrix} -\mathcal{F}_{pa} & \mathcal{F}_{pn} \\ -\mathcal{F}_{na} & \mathcal{F}_{nn} \end{vmatrix}}{D} \tag{15}$$

and

$$\frac{\partial n^*}{\partial a} = \frac{\begin{vmatrix} \mathcal{F}_{pp} & -\mathcal{F}_{pa} \\ \mathcal{F}_{pn} & -\mathcal{F}_{na} \end{vmatrix}}{D}, \tag{16}$$

where

$$D = \begin{vmatrix} \mathcal{F}_{pp} & \mathcal{F}_{pn} \\ \mathcal{F}_{pn} & \mathcal{F}_{nn} \end{vmatrix} > 0$$

by Assumption (3). Thus, (15) and (16) have the same sign as their numerators.

Solve $\mathcal{F}_p = 0$ for c and substitute in $\mathcal{F}_{pa}$ to obtain

$$\mathcal{F}_{pa} = \frac{\left(p\left(n^2 a + n - (na+2)\,r(p)\right) r' + r(p)\,(n-r(p))\,(a(n-r(p))+1)\right) a}{\left(a(n-r(p))+1\right)^3}. \tag{17}$$

Since

$$\mathcal{F}_p + r' ac =$$

$$\frac{\left(p\left(a(n-r(p))^2 + n - 2r(p)\right) r' + r(p)\,(n-r(p))\,(a(n-r(p))+1)\right) a^2}{\left(a(n-r(p))+1\right)^2} < 0$$

and

$$n^2 a + n - (na+2)\,r(p) > a(n-r(p))^2 + n - 2r(p) \leftrightarrow r(p)\,a\,(n-r(p)) > 0,$$

also $\mathcal{F}_{pa} < 0$.

Similarly, solve $\mathcal{F}_n = 0$ for F and substitute in $\mathcal{F}_{na}$ to obtain

$$\mathcal{F}_{na} = -\frac{(a(n-r(p))-1)\,r(p)\,pa}{(a(n-r(p))+1)^3}. \tag{18}$$

Using (17) and (18), the numerator of (15) simplifies to

$$-\mathcal{F}_{pa}\mathcal{F}_{nn} + \mathcal{F}_{na}\mathcal{F}_{pn} = \frac{p\,a^3 r(p)\,(r'p + r(p))}{(a(n-r(p))+1)^4} < 0,$$

where the negative sign is implied by Lemma 1 as $r'p + r(p) < 0$.

For the next part of the proof, note that

$$\mathcal{F}_{pn} = \frac{a^2\,(pr'\,(a(n+r(p))+1) + r(p)\,(a(n-r(p))+1))}{(a(n-r(p))+1)^3} < 0,$$

since $r'p+r(p) < 0$ and $a(n+r(p))+1 > a(n-r(p))+1$, and that $\mathcal{F}_{pp} < 0$ by Assumption 3. Thus, the numerator of (16),

$$-\mathcal{F}_{na}\mathcal{F}_{pp} + \mathcal{F}_{pa}\mathcal{F}_{pn}, \tag{19}$$

is positive if

$$\mathcal{F}_{na} \geq 0 \leftrightarrow a \leq \frac{1}{n-r(p)}.$$

Hence, it is necessary (but not sufficient) for $\partial n^*/\partial a < 0$ that $a > 1/(n-r(p))$, so suppose this is the case.

Note that

$$\mathcal{F}_{pp} = \frac{2\left((a(n-r(p))+1)\left(a(n-r(p))^2 + n - 2r(p)\right) - (na+1)\,pr'\right) r'a^2}{(a(n-r(p))+1)^3} + Z,$$

where

$$Z \equiv -\frac{ar''}{(a(n-r(p))+1)^2}(p(na+1) - (p-c)(a(n-r(p))+1)^2).$$

Since

$$p(na+1) - (p-c)(a(n-r(p))+1)^2 < 0$$

by Lemma 1,

$$Z \leq 0 \leftrightarrow r'' \leq 0.$$

Given the assumptions that $\mathcal{F}_{na} < 0$ and $r'' \leq 0$, (19) is less than or equal to

$$-\mathcal{F}_{na}(\mathcal{F}_{pp} - Z) + \mathcal{F}_{pa}\mathcal{F}_{pn}. \tag{20}$$

Using (17) and (18), (20) simplifies to

$$\frac{a^3 \left(n\,p^2\,(r')^2 + pr(p)\left(2a\,(n - r(p))^2 + r(p)\right) r' + (r\,(p))^2\,(n - r\,(p))\right)}{(a(n - r(p)) + 1)^4},$$

which has the same sign as

$$n\,p^2\,(r')^2 + pr(p)\left(2a\,(n - r(p))^2 + r(p)\right) r' + (r\,(p))^2\,(n - r\,(p)) \tag{21}$$

in its numerator.

Now, consider (21) as a quadratic function of r', which is negative between its two roots

$$r'_{1,2} = \frac{r(p)}{2np}\left(-2a\,(n - r(p))^2 - r(p) \pm \sqrt{A}\right) < 0, \tag{22}$$

where

$$A = 4\left(a\,(n - r(p))^2 + \frac{r(p)}{2}\right)^2 - 4n\,(n - r(p))$$

and

$$A > 0 \leftrightarrow a > \frac{2\sqrt{n(n - r(p))} - r(p)}{2\,(n - r(p))^2}.$$

Using Lemma 1, note that

$$\frac{\partial r'}{\partial a} = \frac{Br(p)(n - r(p))}{C^2} > 0,$$

where

$$B = r(p)\,a^2 p\,(n - r(p)) + (a(n - r(p)) + 1)^2\,c > 0$$

and

$$C = p(na+1) - (p-c)(a(n-r(p))+1)^2.$$

As such, there are hypothetically two a's that coincide with the roots (22). However, the larger root is unattainable and beyond the parameter range determined by Lemma 1:

$$r_1' = \frac{r(p)}{2np}\left(-2a\left(n-r(p)\right)^2 - r(p) + \sqrt{A}\right) > -\frac{r(p)}{p}$$

$$\leftrightarrow -2a\left(n-r(p)\right)^2 + 2n - r(p) + \sqrt{A} > 0 \leftrightarrow A - \left(-2a\left(n-r(p)\right)^2 + 2n - r(p)\right)^2 > 0$$

$$\leftrightarrow 8n\left(n-r(p)\right)\left(a(n-r(p))-1\right) > 0 \leftrightarrow a > \frac{1}{n-r(p)}.$$

Thus, there is some $\hat{a}$ that coincides with the smaller root,

$$r_2' = \frac{r(p)}{2np}\left(-2a\left(n-r(p)\right)^2 - r(p) - \sqrt{A}\right),$$

in (22) and (21) is negative for all $a > \hat{a}$.

□

Proof of Proposition 4. The Lagrangian of (8) is

$$L = na + \lambda\mathcal{F}(p,n). \tag{23}$$

By Assumption (3), the only critical point of $\mathcal{F}(p,n)$ is far away from the boundary of the constraint set. Hence, the constraint qualification will be satisfied at any candidate for a solution. Since $\mathcal{F}(p,n)$ is strictly concave by Assumption (3), (23) (as a sum of concave and strictly concave functions) is also strictly concave and the first-order conditions,

$$L_n = a + \lambda\mathcal{F}_n = 0, \tag{24}$$

$$L_p = \lambda\mathcal{F}_p = 0, \tag{25}$$

$$L_\lambda = \mathcal{F}(p,n) = 0, \tag{26}$$

yield a unique global maximum. Furthermore, it is necessary that $\mathcal{F}_n < 0$ for the constraint to be active.

By combining (24), (25) and (26), we have two equations that define p^{**} and n^{**}:

$$\mathcal{F}_p = 0, \tag{27}$$

$$\mathcal{F}(p, n) = 0. \tag{28}$$

By Cramer's rule,

$$\frac{\partial p^{**}}{\partial a} = \frac{\begin{vmatrix} -\mathcal{F}_{pa} & \mathcal{F}_{pn} \\ -\mathcal{F}_a & \mathcal{F}_n \end{vmatrix}}{E} \tag{29}$$

and

$$\frac{\partial n^{**}}{\partial a} = \frac{\begin{vmatrix} \mathcal{F}_{pp} & -\mathcal{F}_{pa} \\ \mathcal{F}_p & -\mathcal{F}_a \end{vmatrix}}{E}, \tag{30}$$

where

$$E = \begin{vmatrix} \mathcal{F}_{pp} & \mathcal{F}_{pn} \\ \mathcal{F}_p & \mathcal{F}_n \end{vmatrix} = \mathcal{F}_{pp}\mathcal{F}_n > 0$$

by strict concavity of $\mathcal{F}(p, n)$, (27), and $\mathcal{F}_n < 0$. Thus, (29) and (30) have the same sign as their numerators.

Solve $\mathcal{F}_p = 0$ for c and substitute in $\mathcal{F}_{pa}$ to obtain

$$\mathcal{F}_{pa} = \frac{\left(p\left(n^2 a + n - (na+2)\, r(p)\right) r' + r(p)\,(n - r(p))\,(a(n - r(p)) + 1)\right) a}{(a(n - r(p)) + 1)^3}.$$

Since

$$\mathcal{F}_p + r' ac =$$

$$\frac{\left(p\left(a(n - r(p))^2 + n - 2r(p)\right) r' + r(p)\,(n - r(p))\,(a(n - r(p)) + 1)\right) a^2}{(a(n - r(p)) + 1)^2} < 0$$

and

$$n^2 a + n - (na+2)\, r(p) > a(n - r(p))^2 + n - 2r(p) \leftrightarrow r(p)\, a\,(n - r(p)) > 0,$$

also $\mathcal{F}_{pa} < 0$.

Solve $\mathcal{F}(p,n) = 0$ for F and substitute in $\mathcal{F}_a$ to obtain

$$\mathcal{F}_a = \frac{par(p)\,(n - r(p))}{(a(n - r(p)) + 1)^2} > 0.$$

Note that

$$\mathcal{F}_{pn} = \frac{a^2\,(p\,(a(n + r(p)) + 1)\,r' + r(p)\,(a(n - r(p)) + 1))}{(a(n - r(p)) + 1)^3} < 0,$$

since

$$a(n + r(p)) + 1 > a(n - r(p)) + 1$$

and, by Lemma 1, $pr' + r(p) < 0$.

Given that $\mathcal{F}_n < 0, \mathcal{F}_{pa} < 0, \mathcal{F}_a > 0$ and $\mathcal{F}_{pn} < 0$, the numerator of (29) is negative:

$$-\mathcal{F}_n\mathcal{F}_{pa} + \mathcal{F}_a\mathcal{F}_{pn} < 0.$$

Finally, since $\mathcal{F}_p = 0, \mathcal{F}_a > 0$ and $\mathcal{F}_{pp} < 0$, the numerator of (30) is positive:

$$-\mathcal{F}_a\mathcal{F}_{pp} > 0.$$

□

D Availability of taxis

We collect data on the availability and time-to-arrival (TTA) of taxis. Unlike the fares, we do not have data on TTA from the pretreatment period. However, there is evidence that there was a serious shortage of taxis during high-demand hours, especially in large cities.[20] Therefore, our main objective is to examine the availability and whether it changes at different times of the day and week. We also assess whether the observable variables seem to correlate with TTA.

The dependent variable in the first four regressions (1)–(4) in Table A.16 is the time to arrival. We find that ordering a taxi in a city or urban centre is correlated with significantly shorter time to arrival. This makes sense, since there tend to be more taxis around where services are located. This is in line with the estimate for *distance to a taxi rank* being significantly and positively correlated with TTA. This might indicate that taxis are still on call at the stations. The distance from the taxi rank is only available for large regions.

When looking at large regions, we also find a significant difference between dispatch centres that only allow ordering through their applications (i.e., they do not wait at the taxi ranks) and other taxi firms. The time-to-arrival seems to be on average 1.5 minutes higher for app-only firms. Interestingly, the fare appears to correlate significantly with TTA only in medium-sized regions, where a higher fare means a lower TTA. The fact that this is not the case in large regions is surprising, but could be due in part to app-only dispatch centres that capture this effect, as their services are significantly cheaper, as shown in Table 3.

Finally, peak demand hours are correlated with approximately 30 seconds faster average time to arrival when focussing on large regions. We further study how the time of day correlates with TTA by looking at the estimated marginal means of time-to-arrival by time of day presented in Figure A.8. We find that, if anything, there seems to be a slightly shorter average time to arrival during peak hours (that is, around the time

[20]There are numerous news articles from the regulated period reporting about long queues at taxi ranks (e.g. https://yle.fi/uutiset/3-6162938 (in Finnish)).

Table A.16: Descriptive regressions on time-to-arrival

	Time to arrival				Minimum time to arrival per query			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All regions	Small regions	Medium regions	Large municipalities	All regions	Small regions	Medium regions	Large municipalities
Pickup at city	-4.846***	-6.004**	-6.200***	-3.100**	-4.579***	-6.160**	-5.642***	-1.406**
	(0.621)	(1.118)	(0.745)	(0.585)	(0.567)	(1.060)	(0.837)	(0.264)
Outside business hours	0.049	1.439	0.953	-0.044	-0.034	1.351*	0.723	0.106
	(0.235)	(0.826)	(0.627)	(0.222)	(0.475)	(0.505)	(0.885)	(0.058)
Friday or saturday	0.901***	0.674	0.091	0.862**	0.386	1.040	-0.093	0.111
	(0.194)	(0.827)	(0.147)	(0.169)	(0.287)	(0.975)	(0.230)	(0.061)
Peak demand	-1.567***	-0.427	-0.370	-1.323*	-0.657	-0.700	-0.155	-0.758**
	(0.341)	(1.072)	(0.944)	(0.332)	(0.663)	(1.373)	(1.161)	(0.118)
Number of firms per region	0.060	2.834***	1.276***	0.302***	-0.037	2.378***	0.743***	-0.010
	(0.115)	(0.275)	(0.125)	(0.018)	(0.151)	(0.101)	(0.095)	(0.014)
Trip length (km)	0.143	0.645	0.548**	-0.157	0.301	0.572**	0.214	-0.055
	(0.142)	(0.321)	(0.156)	(0.064)	(0.149)	(0.118)	(0.119)	(0.056)
Trip length squared	0.002	-0.017*	-0.004	0.006*	-0.005	-0.016*	-0.003	0.005
	(0.004)	(0.005)	(0.003)	(0.001)	(0.004)	(0.005)	(0.004)	(0.004)
App-only dispatch	0.611	-1.258	-1.262	1.432**				
	(0.336)	(0.656)	(1.049)	(0.283)				
Fare	-0.038	-0.037	-0.172*	0.042				
	(0.032)	(0.119)	(0.066)	(0.031)				
Distance from rank to pickup				0.848***				0.848**
				(0.073)				(0.133)
Constant	9.909***	-9.426**	3.813	5.151***	6.709***	-8.554***	3.029*	3.571***
	(1.883)	(2.088)	(2.033)	(0.530)	(1.712)	(0.967)	(1.070)	(0.309)
Observations	19592	1798	3892	12353	5411	1134	1597	1426
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable in regressions (1) - (4) is time-to-arrival and in (5) - (8) it is the shortest time-to-arrival in each query. App-only dispatch refers to dispatch centres which only operate through mobile applications. Peak demand is an interaction term of *Outside business hours* and *Friday or Saturday*. Pickup at city is a dummy variable that gets value 0 if pickup location is in a suburb and 1 if close to a city centre. Distance from rank to pickup is only available for large regions which have public information on the locations of taxi ranks. Standard errors are clustered at regional level and are presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

restaurants close), indicating that supply responds to demand peaks. Furthermore, the number of available cars does not differ between different times of the day (Figure A.9).