Tampere University

Ida Kankaanranta

TAXI MARKET DEREGULATION

The Finnish Case

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ABSTRACT

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The Finnish taxi market was deregulated from the beginning of July 2018, in line with the model of multiple other Western countries, like the United States, Sweden, the Netherlands, Canada, Ireland and England. Market entry and pricing were liberated and numerical limits for the number of taxi vehicles in a certain area were abandoned. The objectives of the reform were more competitive markets, lower prices, improved quality and better availability of taxi services. However, both theoretical models and empirical results from previous deregulative reforms suggest that as taxi markets are not perfectly competitive and uniform, allowing for free market entry and free pricing may result in opposite outcomes.

Taxi rides are an example of credence goods, due to which service providers may have excessive market power. Furthermore, in taxi markets the customer is not likely to face a large amount of service providers or the service provider a large amount of customers at the same time, like in perfectly competitive markets. Hence, there is no equilibrium price in the absence of market interventions. Deregulating taxi market may also affect demand, if for example uncertainty of prices decreases customers' willingness to use taxi services.

This study examines the effects of taxi market deregulation on taxable income, tax revenues and possible tax evasion on the Finnish taxi markets. The study utilizes a seasonally adjusted difference-in-difference analysis with fixed-effects to compare the evolution of financial variables in taxi and bus companies in 2016-2018. The data from Statistics Finland includes detailed information of taxi and bus companies' financial statements and tax records, and thus allows an elaborate analysis of the evolution of the companies' income, costs and tax payments. Former studies have mainly concentrated on demand, price, supply or quality, or studied the effects on taxi drivers' income and market conditions, but tax issues have not been researched notably. This study contributes the existing literature by providing estimates of the tax revenue effects as well.

The results suggest that after deregulating the markets, there has been a drop in taxi companies' reported revenue and tax payments, and this drop is statistically significant when compared to the evolution of bus companies' revenue. However, there is no decrease in labor costs or variable costs of the taxi companies, which suggests that a drop in demand does not explain decreasing tax revenues. The reports of Transport and Communications Agency Traficom also show that the prices of taxi rides have been increasing after the reform, so lower prices should also not cause this drop in tax revenues.

The peculiar results raise a question of a possible increase in tax evasion and clearly demand for more research on the issue. A detailed analysis of all the effects of market reforms should be used as a base for further reforms of taxi markets, and also when considering deregulating other markets as well.

Keywords: taxi market, deregulation, credence goods, optimal taxation, tax salience, third-party information, market reform, market informalisation, tax evasion

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1 Introduction

Starting from the 1980s, a multitude of Western countries have implemented taxi market reforms that have aimed at improving the efficiency of the markets, lowering consumer prices, increasing service supply and quality and promoting competitive markets. The Finnish taxi market deregulation became into force from the beginning of July 2018 and followed the examples of for instance United States, New Zealand, Sweden, Ireland, the Netherlands and Italy. Taxi market typically constitutes a relatively small part of the overall national gross domestic product of the country in question, yet the industry has a significant role in the society's functionality.

This study analyzes the effects of taxi market deregulation in Finland and provides both a detailed description of conceptual framework and taxi market characteristics, and a survey of the so-far detected impacts of the new Transport Service Act. This study especially focuses on the effects on demand, tax revenue and tax evasion, and utilizes elaborate data on taxi and reference group bus companies' financial statements and tax records. Even though tax revenues from the industry are not very large in the big picture, the results are applicable in other markets as well and may help to design more effective policy changes that reduce the incentives to engage in tax evasion.

The new Transport Service Act that has been applied in Finland since July 2018 included several changes to the existing legislation. The old Act contained limitations for the number of taxi companies that were allowed to operate, and these limitations were based on means testing. Maximum prices were pre-set in the Act and revised annually. The new Act liberated market entry and means testing is no longer applied. Pricing became free and also minute-based pricing systems were allowed, whereas the old Act only allowed for fixed starting fees, kilometer-based pricing and standard waiting time fees. The obligation to use taximeters was removed from the Act. The driver must still announce the price or the pricing principles clearly in advance to the trip, but using meters to monitor the accumulation of price is not mandatory if the price is pre-set.

Entering the market as a taxi operator still requires the license to serve as a taxi operator, and the drivers must have valid taxi driver's licences. However, the requirements for obtaining the taxi driver's license were mitigated. The driver do longer has to pass a test of regional knowledge to obtain a license, which before the new Act was mandatory. The objective of alleviating market entry requirements was to help to secure supply and increase competition. Abandoning market entry regulations also caused changes in the publicly supported Kela-ride system. For example school rides or transportation of disabled people are partly or totally paid from public funds. The old Act contained an obligation for the taxi vehicle to have a certain station location, but the new Act does not include any regulation about the places where taxis are allowed to pick up customers. Hence, the old system, in which the same taxi vehicle took the customer to the destination and back, both parts of the trip must now be ordered separately. This may prolong the duration of the trip remarkably.

Tax revenues and a comprehensive tax base are by-products of a well-functioning market and a sound legislation, but the taxi industry in itself is of significant importance for a well-functioning society. In terms of tourism and travelling, taxi services could be seen as a sort of a "business card" of the country. When arriving at the airport, a taxi ride is often the first service the traveller needs. Seamless transportation is a vital part in defining the attractiveness of the country as a living or business environment. Furthermore, the functionality of taxi markets affects service accessibility especially for those who need assistance with mobility.

Deregulation has been rationalized by the expectation of free market entry and increased competition leading to lower

prices and better availability. In many countries, previous regulation has been regarded as a source of ineffectiveness and artificially high prices of taxi licenses, as supply has lagged behind demand (Bergantino and Longobardi 2002, 85-86). According to Frankena and Pautler (1984, 81), entry limitations may result in monopolization, which in turn may give even more bargaining power to the companies if they do not utilize all the licenses in their possession. Flath (2002, 19) in turn argues that collusive pricing may cause prices to stay at an unduly high level, if prices are pre-set but market entry is free. Such arguments ignore the reasons why taxi markets have been regulated in the first place.

However, taxi markets are rarely perfectly competitive as they suffer from inefficiencies caused by asymmetric information. Dulleck and Kerschbamer (2006,6) use taxi rides as an example of the so-called credence goods. A typical characteristic of a credence good is that the customer is not always able to evaluate the type and quality of the service needed and received. Thus, the service provider may have excess market power if there are no corrective market interventions such as regulation. Cairns and Liston-Heyes (1994, 6) argue that in perfectly competitive markets a large amount of service providers and customers confront simultaneously, but in taxi market the customer may face only one service provider at a time, without any certainty of whether or not there will be another option to choose. In their cruising-taxi model they also simulate how there is no equilibrium price for taxi rides as the prerequisites of free competition are not fulfilled (Cairns and Liston-Heyes 1996, 5-9).

Deregulation may also have impacts on the demand side. If deregulation leads to oversupply and deteriorating quality, demand may even decrease. Customers' insecurity of pricing practises or undesired price increases could in theory create a drop in demand too. Furthermore, taxi market actors are typically small-sized enterprises and incomes are often earned as corporate incomes. This, in addition to the problem of reliable ride and fare recording, raises the question of optimal taxation practises in the industry. Changing market circumstances due to the regulation may also alter the incentives for tax evasion, not only by making it more profitable or easier, but also to some extent a means of survival.

This thesis contributes to the existing literature in several ways. First, previous studies have mainly focused on price, supply, demand, quality effects and impacts on the income of taxi drivers. There are also some studies concerning taxi market labor effects (see for example Slavnic and Urban 2008) and market competitiveness (see Schaller 2007, Morrison 1997, and Boutueil, Quillier and Voskoboynikova 2018). The effects on tax revenues or tax evasion, tax deductions or other tax-related issues yet have not been notably addressed. In the Finnish context, the questions concerning tax evasion are especially relevant for example due to abandoning the obligation to use taxi meters. Taxi markets also have several characteristics, that differentiate it from other markets. First, it is typical that the income is self-reported. Second, for example Balafoutas et al. (2011) found that asymmetric information about tariff systems can lead to manipulating bills, if the customers are not aware of the details of the system. In addition, the Finnish tax authority Verohallinto has been interested in the issue.

This study utilizes comprehensive tax data from Statistics Finland to estimate the effects of deregulation on turnover, VAT and net-VAT payments, tax deductions and variable costs, payroll, and social security payments. Based on these estimates, the study aims at assessing the impacts on taxi service demand and tax evasion.

This study proceeds as follows. After the introduction a conceptual framework of factors affecting taxi market outcomes is presented. Next, the study describes the main characteristics of Finnish taxi markets and the Finnish taxi market legislation. Some information on the taxation system of corporate and business income is also provided. The

section is followed by hypotheses of taxi market deregulation effects and the methodology of the study, followed by data description and research design. Chapter 5 presents the results and discusses the outcomes. Chapter 6 concludes.

2 Conceptual framework

2.1 Credence goods, special features of taxi markets and reasons for regulation

The term ”credence good” is often used in the context of different kinds of expert services such as medical or some sort of technical repair services. The concept of credence goods was first introduced by Michael R. Darby and Edi Karni (1973). Two of the pioneers on this field, Dulleck and Kerschbamer (2006) also use taxi services as an example of credence goods, typical for which is that information between customer and service provider is divided asymmetrically. The demand for credence goods is based on customer's reliance on the expert that provides the service. The customer typically has less information about which type of service is the most suitable. The customer may also not be able to detect the quality or type of the service received.

Darby and Karni (1973, 69) distinguish three qualities that are related to a purchase of a credence good. Search qualities are known prior to purchase decision. Experience qualities are recognized only after purchase, but recognition is costless and certain. Credence qualities are costly and difficult to observe or ensure even after purchase and create favorable conditions to fraud. Credence qualities are especially related to goods where output is at least to some extent stochastic, and to goods that are used to produce measurable output together with other goods that are characterizes by uncertain features. (Darby and Karni 1973, 69, 72).

Dulleck and Kerschbamer (2006,7) divide the asymmetric information related problems into two classes. The first one is the inability to inspect, whether or not the customer received a type of service he needed and paid for. The other one is the difficulty to evaluate, which type of service altogether is suitable for the customer's needs. The problems could be classified as overprovision and overcharging. In terms of taxi services, the customer is typically able to determine, which type of service is needed, but the more relevant issue is the difficulty to observe, whether the provided service met the needs of the customer. In other words, the driver may have selected a longer route if the customer is not familiar with the region and thus cannot detect possible extra kilometers. (Dulleck and Kerschbamer 2006, 7).

Wolinsky (1995) and Emons (1997) represent credence goods market models, in which the diagnosis and treatment are separate, and the customer may visit many experts before deciding whether to accept the treatment or not. In Wolinsky's (1995) and Emons' (1997) models, the diagnosis phase of the service chain incurs costs for the customer. In case of taxis, service request is not likely to induce monetary costs to the customer, but there may still be expenses in terms of time. Flath (2002,2) argues that in case of low demand and supply, there is no guarantee that the customer will confront another service provider if the first offer of a ride is rejected. Hence there is a possibility of even larger loss of time and convenience, if the first offer is not accepted.

Darby and Karni (1973) develop a model to investigate the optimal amount of fraud and willingness to engage in fraudulent behavior in competitive markets. The model considers a firm that produces services that have a given distribution of service time, and the customer flow for the firm is stochastic. There is a positive probability of idle working hours when there is no customer waiting in a certain time interval. As the firm produces services, it cannot accumulate inventories during the idle working hours, and variable costs like labor costs are actually fixed for the time intervals without customers. Hence marginal costs for work supplied during idle times decrease compared to situation when nothing is done, and this creates motivation to offer customers more time-consuming services. This creates costs to the customer and poses a risk that the price drives the customer not to use the service again or that the customer will go elsewhere after the diagnosis. To balance the risk of losing the customer and the chance to earn extra profits, the firm

chooses the amount of fraud such that the expected marginal profit of fraud is zero. (Darby and Karni 1973, 72-73).

In the model, the expected profit is given by the profit if the diagnosis is accepted times the probability that it will be admitted, plus the present value of services that the customer will buy in the future times the probability that the customer will indeed return. Algebraically this is formulated as

$$\pi = [P * S - C(S)][(1 - F(S)] + V * [1 - H(S)] \tag{1}$$

where π is the expected present value of over time profits form a certain customer, P is the price of service, S is the total amount of service offered, V is the evaluated present value of forthcoming profits if the customer returns, C(S) are the total variable cost function for offered services, F(S) is the cumulative probability function that the customer will reject the service offer, and H(S) is the probability that the customer will not return in the future. The model implies that in order to have incentives for fraud, the marginal return for the firm of selling extra services must be greater than the marginal cost which is measured as expected loss of business. (Darby and Karni 1973, 73-74).

Darby and Karni (1973, 75) also point out that higher expected future value of the customer decreases the likelihood of a customer to be frauded. In case of perfect competition when V=0, the maximization condition implies that the ratio of marginal versus total profits equals to minus the ratio of marginal versus total probability of getting the service offer accepted. Algebraically,

$$\frac{P - C'(S)}{PS - C(S)} = \frac{F'(S)}{1 - F(S)} \tag{2}$$

The optimal amount of fraud can also be affected by a customer's ability to assess the firm's optimal level of fraudulent behavior. The better informed the customer is, the less is the optimal level of fraud for the service provider. Information affects the cumulative probability functions F(S) and H(S). (Darby and Karni 1973, 74-75).

The model thus indicates that the probability and amount of fraud is determined by the price and the costs of the service, the probability that the customer will purchase the service, and the customer's future value and probability of returning. In case of taxi markets, especially street taxis and cab stands, the future value of a customer is typically low. Furthermore, the increasing the level of customers' information on the service reduces the incentives for fraud.

Emons (1997, 108) takes note of the capacity limits of experts and possibly differing returns from diagnosis and treatment. If the expert has idle capacity, it is profitable to offer and implement unnecessary treatments. If there are too many customers, the expert may end up offering less treatments than needed if diagnoses are more profitable. Emons (1997) presents a model according to which the expert does not have any incentives to fraud the customer by offering too little treatment if the marginal profit from treatment and diagnosis are at the same level. The motivation to offer too much treatment only disappears if there is no idle capacity and the expert has to bear all the marginal costs. This could be achieved through long-time insurance contracts, but the problem is that customers may express moral hazard. The problem of undertreatment could be solved by short-time warranties. (Emons 1997, 108-111.)

The model also indicates that if demand exceeds supply that depends on capacity, experts charge reservation prices that make customers indifferent of whether or not to buy the service. The prices also make experts indifferent between diagnosis and treatment, and the experts do not have incentives for fraud. In this case experts obtain the whole surplus. For taxi markets, the separation of diagnosis and treatment is however not very relevant in most cases. If demand is

excess to capacity, Bertrand-type competition leads the prices to equal marginal costs of zero. Hence, if prices are at the level of marginal costs, unnecessary treatment does not bring any extra returns. Charges depend crucially on the number of active experts and the whole surplus goes to customers. (Emons 1997, 108-109.)

In case of taxi markets the situation is somewhat peculiar. Competition cannot be classified as perfect, as the customer may not have opportunities to compare options de facto, and there may be a very limited amount of service providers available at a time and place. However, the expected future value of a customer can be at least very close to zero, depending on the type of taxi service consumed. Cairns and Liston-Heyes (1994) analyze expressly the markets of cruising taxis, in which case the customer is very unlikely to ever face the same taxi again. This decreases the profit function's dependence on future purchases.

In Emons' model (1997) the profitability differences emerge between diagnosis and treatment, but in taxi markets differing profitability margins could be related to the length of the trips, for instance. Emons (1997, 108) argues that if diagnosis and treatment could be separated, there would be no incentives for fraudulent behavior. In taxi markets this is not possible as it is cheaper to provide services jointly. The longer the trip is and the further from densely populated areas it is taken to, the bigger is the risk for the driver to return without a new customer. On the other hand, if the taxi driver has to queue for customers at taxi stands like airports, in which the queue often works with the first-in-first-out principle, short trips may not be profitable.

Taxi services however are not uniform. Teal and Berglund (1987) analyzed the effects of deregulation in 9 USA cities. The study was mostly concentrated in 6 cities, in which pre-ordered taxi rides formed over 70 percent of the service supply (Teal and Berglund 1987, 40). Baanders and Canoy (2010) studied the effects of deregulation in the Netherlands, and report that the structure of taxi market varied remarkably by region. In 4 main cities of the Netherlands in 2003, street taxis formed 45 percent of the markets, call taxis 25 percent and contract taxis 30 percent, whereas in non-urban areas contract taxis covered 77 percent of the markets, call taxis 17 percent and street taxis only 5 percent (Baanders and Canoy 2010, 4.)

Dispatch systems are often expensive, and the fixed costs would be too high to carry for single operators alone. Cairns and Liston-Heyes (1994, 7) refer to the possibility of taxi driver cooperatives, which can be established to operate a radio or telephone dispatch system, for instance. If taxis are grouped to a firm or cooperative, they also establish a reputation and the activities of single taxis affect the whole firm. Reputation can be one example of reasons to build distinguishing practices of customer service, such as fixing prices. If there are only few cooperatives available, as is often the case, there is a possibility that an oligopolistic equilibrium will emerge. (Cairns and Liston-Heyes 1994, 7.)

In the cruising taxi markets however, there is no equilibrium price. If there would be some equilibrium price p and search costs c above zero, the only potential customers entering the market are those whose valuation of taxi rides exceeds the price at least by the amount of search costs. It can be assumed that service providers know this and will thus quote a higher price for the ride. Hence there is no single equilibrium price. In addition, if the customer does not have de facto opportunities to compare the offers and there is no single equilibrium price but instead a dispersion of prices, the firm charging the lowest fare will not lose its customer by raising its prices slightly. (Cairns and Liston-Heyes, 6-7).

Also Flath (2002) recognizes the problem of missing incentives to offer lower prices than other service providers do. He argues that if all the taxis except for one set the same price, the one setting the highest price will gain the

largest profits. This happens because the search cost may be so high for the customer that waiting for another taxi is not desirable. Again, all the service providers in the market all supposed to be aware of this. (Flath 2002, 2.)

In the cruising taxi market, it is also likely that the customer will not meet the same taxi again, and hence building a good reputation does not create incentives to offer low prices. Furthermore, taxi rides are typically quite unique in terms of their length and driving time and hence it may be difficult for the customer to assess the fair price based on former trips. Prices may also include several components, like starting fees ans kilometer-based tariffs. The variety of components may make the prices even more complex to evaluate.

In many countries, the asymmetric information problems have been addressed by regulating taxi markets. Moore and Balaker (2006, 110) point out that taxi markets are not the only market suffering from unique market shortcomings, and taxi markets are also not a natural monopoly. There is a large amount of literature both for and against regulation.

Frankena and Pautler (1984, 2) distinguish four types of taxi services, for which market conditions and justifications for regulation differ substantially. They divide the market into cruising cab, taxi stand, radio-dispatch cab and contract cab segments. The five possible areas of regulation are entry restrictions, price regulations, restrictions to types of offered services, requirements for amounts of service provision and quality regulations. Heavy regulation is argued to give taxi firms excess market power, which results in inefficiently low level of demand and supply. Scarcity of supply raises fares and lowers demand. The number of licenses may be too low and this may cause the amount and types of service to be restricted inefficiently. In this kind of a case, the regulation has failed. If supply does not meet the demand, waiting times extend and lower demand even more. Regulations may also drive up costs, if they restrict more effective types of services, like ride sharing, out of selection. Licenses may gain high values, and limitations to the number of taxis may decrease work opportunities of low-skilled work force. (Frankena and Pautler 1984, 7.)

Scant supply and high prices burden especially people with lower income, who according to Frankena and Pautler (1984, 7) typically spend larger relative part of their income on taxi services. It is yet important to distinguish between different sources of funding. In Finland, 40 percent of demand for taxi rides is public demand or at least compensated from public funds (Finnish Competition and Consumer Authority 2020). Publicly paid rides are directed especially for those with lower income and problems with mobility. Thus, the burden of fares may not be totally carried by the service users themselves. Limiting only entry may result in monopoly pricing, the cost of which is eventually carried by the society, but very often entry restrictions are combined with price regulations.

2.2 Pricing theory and demand effects of deregulation

The effects of deregulation on demand depend on several factors. First, the shape of demand curve for taxi services defines how demand reacts to changes in prices. Second, market structure and companies' pricing strategies define how prices change after deregulating the markets. This chapter analyses pricing models of competitive, oligopolistic and monopolistic markets, and motivates possible demand reactions under different pricing regimes. Theoretically, it could be possible that after taxi market deregulation customers perceive that the nature of taxi services has changed due to for example quality issues, which would not cause a shift along the demand curve but instead a shift of the demand curve itself. These effects are however more an empirical question.

Taxi services are here assumed to be a normal good, for which the demand curve is downward-sloping and demand in-

creases when prices decrease. The supply curve is assumed to be upward-sloping so that when prices increase, supply increases. The demand curve of the market is constructed by adding up the individual demand curves of consumers that have demand for taxi services. The supply curves are a sum of individual firms' supply curves.

In competitive markets both consumers and suppliers are assumed to take the price of a good as given so that their own consumption or production decisions do not affect the market price. The equilibrium emerges in a point in which marginal costs equal the price. In other words, equilibrium is determined by the intersection of the demand curve and supply curve. (Varian 1987, 289.)

The possible effects of deregulation can be illustrated graphically. Prior to deregulation of taxi markets, the prices have usually been pre-set by the authorities. The level of supply has thus been determined by the intersection of a horizontal price curve and an upward-sloping marginal cost curve. If the price was set lower than the equilibrium price determined by demand and supply curves, the result would be be excess demand, as the companies only offer services up to the point in which price equals marginal costs. Otherwise they would be making losses. If the markets were competitive, both the prices and demand would increase until demand equals supply. Even though the prices would rise, the change would benefit the consumers because prior to free pricing, customers' willingness to pay exceeded the costs of the firms. If the price was set above the efficient level, supply would have exceeded the demand, which would have eventually reduced the supply to match the demand. If the pre-set price was not a mandatory minimum price, the price level would have adjusted to correspond to the competitive level. In the non-relevant case of pre-set minimum prices, the price level would remain artificially high and the demand would be less than it would be in competitive situation. Thus deregulating the markets would decrease the prices and increase demand, if taxi markets were assumed to be competitive. The price regulations can however usually be assumed to define maximum prices, not both maximum and minimum at the same time.

In taxi markets, there certainly are more than one or just a couple of firms in the market, but unlike in competitive markets, infinite amount of customers does not necessarily confront infinite amount of service providers. As an extreme case, it may be that a single consumer only faces one single service supplier at a time. For example quiet night times at sparsely populated areas may be situations in which the market conditions emerge as more or less monopolistic. Even though the customer would face many suppliers, he may not be able to compare them and the only decision to make is whether or not to accept the offer from the first supplier. This may be the case in the airports or taxi stands, for instance. The markets may also be dominated by few large market actors that form an oligopoly. Thus, the effects of deregulation should be considered in situations where markets are assumed to be monopolistic or oligopolistic.

If the market is dominated by only one firm, the market or industry is said to be monopolistic. Unlike in competitive markets, the monopolist does not take the market price as given, but recognizes its own influence in the market price. A monopoly faces a downward-sloping demand curve. When deciding the price and amount produced, it must take into account that producing more output decreases the price of every unit sold if the company wants to sell everything it produces. The marginal revenue of an extra unit is not just the price of the good, but also includes the minor cumulative decrease in the price of other goods sold. Marginal revenue of one extra unit for a monopoly is thus less than the price.

A monopolist determines the level of output so that marginal costs are equal to marginal revenues. This intersection point defines the level of output, which is less than in competitive equilibrium. The price is however determined

by the demand curve, and thus the price is set higher than in competitive markets. The overall result is that prices are higher but produced amount of output is less than in competitive markets, and the monopoly gains monopoly profits that would not occur if markets were perfectly competitive. Monopoly creates welfare losses, as not all the customers whose willingness to pay equals marginal costs obtain the service or product. Only those customers whose willingness to pay equals the monopoly price buy the service. (Varian 1987;417,422-423.)

The effects of market deregulation on demand and prices depend on whether the pre-set price is set below or above the efficient level that corresponds to the competitive market price. In the presence of pre-set prices, the marginal revenue of a monopoly is no longer determined by the amount of its own output, as producing one more unit does not decrease the price of all other units produced. Hence, if prices are set from outside, the monopoly takes the price as given and chooses the output so that marginal costs equal price, just like in competitive markets. If the pre-set prices corresponded the efficient level, deregulation would lead to increase in prices and reduction is service consumption, if the markets are supposed to be dominated by a monopolist. If the prices were set somewhere between the efficient level and monopoly prices, the result would be the same but not in such a large extent. Only if the prices were originally set above the monopoly prices, deregulation could theoretically result in decrease in prices and increase in service consumption. This case is however not relevant, if the pre-set prices are not absolute minimum prices. Usually the regulated prices only define the maximum prices, so that the companies would be free to set the prices lower. Hence charging the maximum prices would not be optimal for the monopolist, and the prices would have already been at the optimal price level of a monopoly.

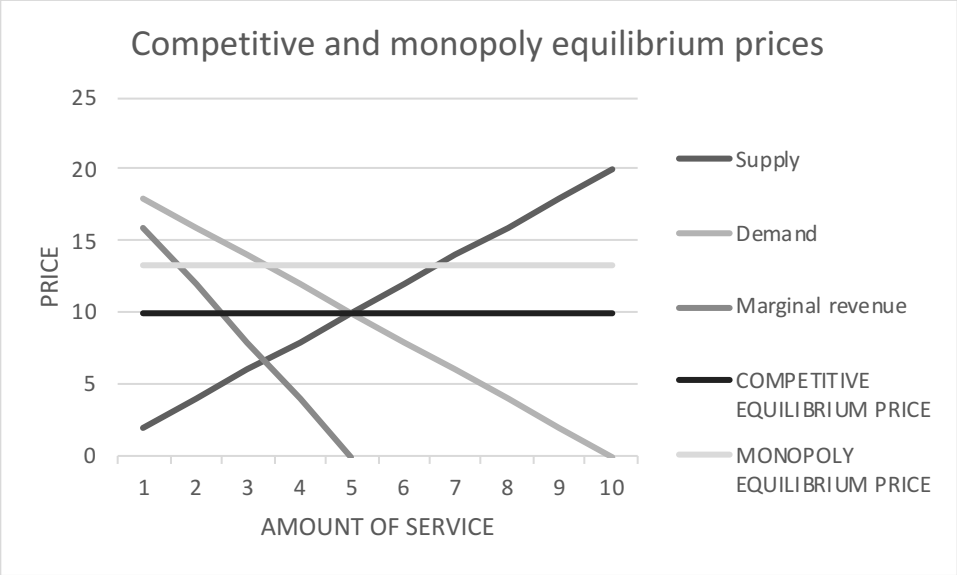

Figure 1: Monopoly equilibrium price

The case of an oligopoly is somewhat more peculiar. Empirical results have shown that deregulation of taxi markets may lead to markets concentrating in the hands of few dominant players, but this may happen also due to too tight regulation. Hence, analysing oligopolies is relevant in the case of taxi markets. Black market phenomena like cartels are also related to oligopolistic markets.

In an oligopolistic market, the firms do not take the market price as given, but instead recognize their own production's impact on the price. Unlike a monopolist, the firms also have to take into account the production of its rivals. The effect of deregulation again depends on the original level to which the prices were set and the structure of the market. If the companies form a cartel, the effects are similar to case of a monopoly. It is also possible that cartels emerge only after deregulation, if free entry results in too weak profitability. If the market conditions cannot provide sufficient income, collusion may be a survival strategy for companies to remain in the market. This issue is discussed in more detail in chapter 2.5.2. Before deregulation companies in the oligopolistic market take the price as given, but after deregulation they face the whole demand curve.

2.3 Empirical results of taxi market deregulation

The main incentives to deregulating taxi markets are usually lower consumer prices, better service availability and quality and increased competition. Theoretical literature offers partially mixed results of advantages and disadvantages of regulation. On the other hand, regulation may create substantial inefficiencies if the market concentrates on few hands and prices remain at an artificially high level. Maximum prices may de facto become minimum prices, and firms may try to maximize their market power by not using their possessed licenses. In perfectly competitive markets intensifying competition should result in lower prices and increasing customer surplus. Taxi markets are however not competitive and suffer from asymmetric information problems, and thus models of perfect competition do not apply to them. Hence one cannot achieve perfectly competitive outcomes directly through deregulation.

Moore and Balaker (2006, 112) summarize the benefits of deregulation presented by Frankena and Pautler (1986). More competition in the market should result in lower fares and better quality, as competition would also encourage taxi drivers to offer better service. New innovations could create totally new markets and niches, if service types would not be restricted. Furthermore, lower prices and better quality could promote demand. (Moore and Balaker 2006, 12.)

These arguments however rely heavily on the idea of increased competition, which according to Flath (2002) and Cairns and Liston-Heyes (1994) will not necessarily emerge because of the nature of taxi markets. Especially this applies to the so-called hail or cruising taxis. In the taxi stands like airports, there is often a large amount of taxis, but in practice the possibilities to compare taxis may be almost nonexistent. It is often an unwritten rule that the first taxi in the line is picked.

Salanova et al. (2011) review the models that have been developed to examine the functioning of taxi markets and their optimal regulation. They divide models to aggregated models that use different parameters, like price and waiting time, to determine supply and demand, and to more sophisticated equilibrium models, that also examine factors like nonlinear pricing, stochastic demand, congestions and other externalities and demand elasticities. They summarize the main results of the models by arguing that there is no optimum model of taxi supply that could serve as a guide to decision maker, and that the data requirements to apply the models in practice are significant. The models also study the markets from drivers' and customers' viewpoints, but effect on the city, like contamination, are ignored. As a conclusion, the authors also suggest that when markets are regulated, market entry should be liberated to ensure supply. Free market entry should however be accompanied by fare regulations and other more specific regulations concerning peak hours and high-demand locations, like airports. (Salanova et al. (2011, 154-155, 160).

The empirically observed effects of deregulation seem to depend on the prevailing market conditions in the countries that have deregulated their taxi markets. If the amount of taxis has not been in line with demand for taxi rides, the

results of deregulation have been positive. Supply has increased, and better service availability has promoted demand to rise even further. In these cases, the increase in the number of taxis has not resulted in oversupply. The gap between supply and demand has been large enough so that the rise in number of taxis has been driven by real demand. According to the empirical literature, deregulation of taxi markets affects supply, price level, service quality and market structure, depending on market conditions and the actual deregulative measures that are implemented.

Schaller (2007, 3) divides regulative regimes into four classes depending on whether there are numerical limits for market entry and whether the qualification requirements apply to independent drivers or are set at the company level. Type A regime is an open entry market, where are no numerical limits for taxis and qualifications must be met by independent drivers, but there are no company-level requirements. Type B regime is an open entry market but with company-level quality requirements. Type C regime includes numerical limits for taxis and the quality requirements apply only to independent drivers. Medallion or plate permit systems are typical for this scheme. Type D regime is a market that has numerical limits for taxis operating in the market, and quality requirements are set at the company-level. For this type of markets, franchise and certificate systems are typical to emerge. (Schaller 2007, 3).

Open entry in the cruising-taxi markets or cab stand markets has consistently led to oversupply and lower income for taxi drivers. Revenues have been insufficient to maintain good vehicle quality. In the United States, abandoning entry limit practices did not improve service availability because the new drivers concentrated on taxi stands. As the supply on those stands was sufficient already prior to deregulation, the result was a remarkable oversupply and reduction in profitability of drivers. Oversupply may also explain why the prices are prone to rise: to maintain acceptable income level, the drivers started to avoid unprofitable short trips and charge fares that secured their income even if there are not many trips to drive. (Schaller 2007, 5.)

In the USA cities that set company-level qualification rules but allowed free market entry, deregulation has also resulted in oversupply at the cab stands. Allowing free entry has had negative impacts on dispatch services as well, even though the new entrants haven't precisely operated in dispatch markets. Many companies have offered both dispatch and taxi stand services, and new entrants in the taxi stand markets have reduced their revenue. Lower profitability has resulted in lower quality of dispatch services, which also have higher fixed costs. Drivers that prior to deregulation had driven both dispatched rides and trips from stands, focused mainly on dispatched rides, as waiting times at the stands became longer. This reduced their revenues and income significantly. (Schaller 2007, 5-8.)

Somewhat contradictory results have been obtained from Ireland, but the reason is mainly the significant lack of supply that prevailed in the markets. In Ireland, the amount of taxi licenses had indeed increased much less than the increase in gross domestic product would have given reason to expect. In 1997 there were 1974 taxi licenses in Dublin, but in relation to the rise in GDP from 1978, there should have been approximately 4200 taxi licenses. Thus, the prices of taxi licenses rose quickly from 3500 Irish pounds in 1980 to 90 000 Irish pounds in 2000. Market entry was expensive and there was not enough supply to meet the demand. After deregulation, the amount of taxis rose 297 % in 2 years. (Barrett 2003).

In many countries that have implemented deregulation, the supply did not lag far behind from demand. In these cases the reforms resulted in remarkable oversupply, decrease in efficiency and a substantial rise in prices. According to Dempsey (1996), on average deregulation resulted in 23 % rise in the number of taxis in the United States. In the Netherlands, the amount of taxi vehicles rose 50 % in 4 years (Baanders and Canoy 2010, 6-8.).

Deregulating the markets has also had substantial effects on the price level of taxi rides. Ireland is however an exception. In Ireland there was no substantial increase in prices, and according to Barrett (2010) this is probably due to maximum prices set in the legislation. Unlike Ireland, most of the countries that deregulated their taxi markets did not implement any maximum price rules.

Teal and Berglund (1987, 42-44) report that in those cities that deregulated their taxi markets in the USA, the prices increased faster than consumer price index, and inflation-adjusted taxes of standard trips rose 5-6 % more than could have been anticipated before deregulation. In the Netherlands, the real prices increased approximately 10 % immediately after deregulation (Baanders and Canoy 2010, 6-8.).

In Sweden the prices rose 86 % from 1997 to 2012, and the annual rise in prices was 4 %. The annual rise in consumer price index was just 2 %, and the overall rise in transportation prices in 1997-2012 was reported to be only half of the rise in taxi prices. (Boutueil, Quillier and Voskoboynikova 2018, 733-734.)

Increased competition may also have some undesirable effects. Boutueil, Quillerier and Voskoboynikova (2018, 735) report on increased amounts of bankruptcies after deregulating Swedish taxi markets. The eventual result was that markets concentrated even more strictly to the hands of few dominant operators. The prices rose remarkably and service provision focused on densely populated areas. (Boutueil, Quillerier and Voskoboynikova 2018, 735.)

Furthermore, deregulation of taxi markets has often had undesirable effects on service quality, and in some countries, like in the Netherlands, this has also lead to lower demand. The effects depend partially on the type and scope of deregulation.

In some USA cities, entry to dispatch markets was liberated, but entry to cab stand markets and street taxi markets was kept under regulation. Under this regime, oversupply has mainly been avoided and service quality has not deteriorated. Drivers have often engaged in franchise systems that allow them to operate in both taxi stand and dispatch markets. However, new large dispatch companies have only very rarely entered the markets, as entry requires notable amounts of capital. To survive in the markets, the companies should be able to build their reputation and fleet sizes quickly. Furthermore, demand in the dispatch markets has often been inelastic if not downright diminishing. (Schaller 8-9.)

Less desirable effects were detected in the Netherlands. The quality of service deteriorated, and from 1999 to 2003, the amount of taxi rides dropped from 30 million to only 18 million in the four biggest cities. (Baanders and Canoy 2010, 6-8.)

Schaller (2007, 9) argues that entry restrictions in the cab stand markets actually help to maintain service quality without impairing availability. Sufficient income enables good vehicle quality, and short waiting times between trips reduce incentives to reject short trips. Entry restrictions may however direct taxi drivers to concentrate on densely populated stands, especially in big cities with busy hail and cab stand markets, which reduces the availability of dispatch services. The problem does not appear as large in cities in which most of the demand is oriented to dispatch markets. Regional differences in availability may also arise if taxis concentrate on dense areas. Regional dispersion has appeared in both regulated and unregulated environments, depending more on the market structure and conditions. The problem has been addressed by combining entry limitations on cab stand markets with company-level quality

requirements but maintaining free entry on dispatch markets. In some cities, the solution has been limiting the permits to operate at certain stands and allowing free entry elsewhere. (Schaller 2007, 12.)

As Frankena and Pautler (1994) noted, taxi markets can also be regulated in terms of service provision requirements to ensure service availability. Quality requirements can create de facto barriers to entry, if they incur entry costs large enough to the firms in terms of vehicles, drivers and bureaucracy. Quality requirements may also necessitate fleet sizes that are sufficient to operate comprehensively enough. Large operational cost in turn can prevent profitable business form too small firms, even if entering the market in itself would be possible.

Strict regulation has often been seen as a barrier for new, innovative services like ride-sharing. Ride-sharing could be a cost-effective choice for the customer and lower the costs of taxi rides, but it may also have some undesired effects. New technology has enabled the evolution of ”virtual” services, referring to service forms that are not traditionally classified as certain types of services, but de facto offer the same sort of solutions than the traditional ones. In case of taxi markets, examples include new applications like Uber. In Norway, these applications are permitted by the law, but they face different regulative measures than conventional taxis. Taxi operators need to have a taxi license that authorizes the holder to offer taxi services in a certain area. The license is vehicle- and owner-specific, and the holder of the license may employ a couple of drivers. The permits are based on supply need. However, there are no such regulations for virtual transportation services like Uber. Unlike for official taxis, there are also no requirements of professional qualifications for Uber drivers. (Dotterud Leiren and Aarhaug 2016, 3-6.)

The distinctions create concerns about how the emergence of more competition without any requirements effects the profitability and service supply in official taxi markets. Quality, training and service provision requirements have served as a protection against too low profitability and too tight competition, and on the other hand offered a way to maintain safe and sound services. On the other hand, allowing for new virtual services may help to guarantee the overall supply of transportation services, but it may also risk the availability of assuredly decent services, if operating in the official markets is not profitable enough. The regulations incur costs that do not concern virtual markets. Non-regulated markets that compete with regulated markets also raise a concern on issues like tax evasion, if there is no obligation to use taximeters or any such devices. However, applications that are based on customer reviews may create incentives to provide services of good quality, and also official markets often suffer from quality issues. In Norway, as much as more than a half of taxi customers have had negative experiences with the taxi drivers. Tax evasion problems concern the official markets as well. (Dotterud Leiren and Aarhaug 2016, 9-13.)

The results of taxi market deregulation in terms of effects on supply, demand, price, quality and innovations are hence partially mixed. The design of reforms and corrective measures should be based on empirical estimates obtained from markets that are comparable in terms of market conditions. Reforms should aim at intervening the actual problems present at the market and take into account both theoretical and empirical research.

These peculiar, undesired effects may have several explanations. First, if the increase in competition does not result in lower prices as Cairns and Liston-Heyes (1994) predict, it may be the case that the demand will not rise, other things kept equal. Dempsey (1996) notes that many studies have suggested relatively inelastic demand for taxi services, regardless of prices. He argues that for example tourist or other travelers may be unaware of the price level at destination's taxi markets. In many large cities, rides taken by non-residents can form a large part of the market demand. For example, if the customer on a holiday has already made the decision to use taxi, it may be that he will

not want to use resources to compare prices. The absence of regulation can also increase search costs, both for city's own residents and non-resident customers. (Dempsey 1996, 90-92.)

Cairns and Liston-Heyes (1994, 11) recommend a combination of both price and entry regulation to overcome or at least diminish the asymmetric information related problems. Taxi service providers have features of monopolists because the customer cannot face many service providers simultaneously. They argue that price regulation is essential, but if entry is free, there may be too many service providers on the market and taxis cannot be used at optimal intensity cost. Externalities like congestions may also arise. (Cairns and Liston-Heyes 1994, 6-9.)

The underlying problems of taxi markets can also be addressed through creating more sophisticated price-setting practices or other improvements in the market functioning. For example Yang et al. (2010) instead propose a non-linear fare structure to overcome such problems as long ques at the airports and collusive pricing. In the model, taxi fares consist of two parts, a fixed stating fee and a declining unit price for each additional distance unit (Yang et al 2010, 338, 347-348). Kim et al. (2005) instead argue that by improving taxi companies' information systems, benefits corresponding as big as 20 percent's increase in the fleet size could be achieved in the taxi service quality.

Taxi markets are very heterogeneous and straightforward theoretical models do not necessarily apply in practice, if prerequisites are not met. In the design of regulatory systems or in contrast deregulation, legislator should pay attention to factors like regional differences in population density and demand, the structure of the markets (hail/stand/dispatch-dominated markets), and equivalency of current demand and supply.

2.4 Optimal taxation models and tax evasion

Optimal income taxation system that maximizes tax revenues and minimizes tax evasion is a complex issue. Taxi markets have several characteristics that should be taken into account when designing market reforms, also in terms of taxation. The division of income to earned and corporate income, availability of third-party information of driven rides in the presence or absence of taximeters, income reporting by employer versus the entrepreneur himself, and of course the tax rates all affect the extent of tax revenue and tax compliance. The existing theoretical and empirical literature identifies numerous factors that affect the incentives and extent of tax evasion: the tax rate itself, probability to become audited, the type and size of penalties, the role of third-party information and even cultural, social and personality-related issues. For example, Allingham and Sandmo (1972), Slemorod (2014) and Kleven (2011) have presented models that address optimal tax system and tax evasion. The models have evolved over time to cover more complicated structures of behavior and audit probabilities. The model of Allingham and Sandmo (1972) only analyzed the effect of audit probabilities, but later models also incorporate third party information as a factor that affects the probability to get caught of tax evasion. Models of optimal taxation review not just the incentives and utility of tax evasion but seek to define the optimal taxation system that maximizes both personal and social objective functions.

One of the main objectives of optimal tax systems is to minimize the distortionary effects that arise from taxation. These effects include distortions in demand and supply, which are due to heterogenous taxation of commodities. In case of income taxation, distortions may also arise in terms of labor supply. Audit probabilities in turn affect the possibilities to avoid taxes and hence the work supply decisions.

Only lump-sum taxes that are not affected by taxpayers' behavior do not create these distortions in the standard model of optimal taxation. Heterogenous tax bases direct consumers to substitute products by other products because

taxes cause changes in their relative prices. Hence the consumers end up consuming suboptimal mixtures of commodities that would not have been chosen in the absence of heterogenous taxation. The efficiency costs in turn refer to the costs that exceed the costs that would have arisen from lump-sum tax system. The costs of lump-sum taxes are considered as unavoidable costs that would incur even if the taxes did not cause any distortions. (Slemrod 2014, 13-14.)

The objective of optimal tax system can be defined by taxpayer's aim to minimize the equivalent variation measure of excess tax burden, denoted EB. The EB can be defined as the amount in dollars or other currency that the taxpayer would be willing to give up additionally to the amount of money which is collected through taxes and would return to the taxpayer in a world where there are no taxes.

Slemrod (2014, 14) refers to Auerbach (1985) by stating the EB measure as

$$EB_{ev}(\theta) = E(0, v(0,A)) - E(0, v(\theta,A)) - R(\theta) \tag{3}$$

where E(0,v) is the minimum expenditure that is needed to obtain a utility level v in a world without taxes. $v(\theta$,A) represents the indirect utility of a taxpayer of a tax system that includes tax policy vector θ. A is the exogenous income and v(0,A) is the indirect utility if there are no taxes. R is the tax revenue. The tax system policy vector θ that solves the minimization problem with a restriction of R(θ)G is the same vector that would maximize taxpayer's utility $v(\theta$,A) under the revenue requirement of tax revenues covering the exogenous public expenses G. (Slemrod 2014, 13.)

Slemrod (2014; 15-16) clarifies the dependence of social marginal costs of public funds on taxpayer's behavioral response on a tax instrument. If there are no behavioral responses on a tax instrument θ_{i}, and MECF, the marginal efficiency cost of funds, is one, the tax instrument is equivalent to a lump-sum tax and causes no distortions. The more behavioral response is over zero, the greater is the social marginal cost of public funds. The derivation of MECF proceeds as follows. First, the Lagrangian for the social objective problem is defined

$$L = v(\theta,A) + \lambda[R(\theta) - G] \tag{4}$$

and the first-order conditions to the solution that is not a corner solution is

$$[\partial\theta_{\mathrm{i}}]\ \frac{\partial v(\theta,A)}{(\partial\theta_i)} + \lambda(\theta,A)R_{\theta_i} = 0 \tag{5}$$

In this equation, $\mathrm{R}_{\theta_{\mathrm{i}}}$ is the derivative of revenue, in other words the marginal revenue of tax instrument θi and $\lambda(\theta$,A) is the utility decline that incurs because of revenue requirement increases marginally. The term is also labeled as the social marginal utility cost of public funds. (Slemrod 2014, 15.)

The next step is to define function T that represents tax liability with tax instrument θ and taxpayer's choice variables as arguments. The first-order conditions now take the form

$$[\partial\theta i]\ \frac{\partial v(\theta,A)}{(\partial\theta_{\mathrm{i}}} + \lambda[T_{\theta_i} - (T_{\theta_i} - R_{\theta_i})] = 0 \tag{6}$$

where $\mathrm{T}_{\theta_{\mathrm{i}}}$ is the marginal revenue of a tax instrument if there are supposed to be no behavioral responses to the instrument. The second term, $\mathrm{B}_{\theta_{\mathrm{i}}} \equiv (\mathrm{T}_{\theta_{\mathrm{i}}} - \mathrm{R}_{\theta_{\mathrm{i}}})$ represents the marginal revenue changes due to any and all uncompensated behavioral responses that arise from marginal changes in the tax instrument in question. The marginal effect of a tax instrument on utility is defined as the direct revenue effect $\partial v/\partial\theta = -\alpha\mathrm{T}_{\theta_{\mathrm{i}}}$ and $\alpha \equiv \partial v/\partial$A. Thus marginal efficiency

cost of funds is defined as the ratio of utility decline because of raise in revenue requirements, and the marginal utility of exogenous income. Algebraically,

$$[\partial\theta_i]\, MECF(\theta_i) \equiv \frac{\lambda}{\alpha} = \frac{T_{\theta_i}}{T_{\theta_i} - B_{\theta_i}} = \frac{1}{(1-(B_{\theta_i}/T_{\theta_i})} \tag{7}$$

Thus, MECF is the ratio of social marginal costs and marginal utility of exogenous income. As mentioned before, the value of lambda depends on behavioral responses on taxpayers. (Slemrod 2014, 15-16.)

Raising taxes is not cost-free and creates both administrative costs and compliance costs. Slemrod (2014, 69) clarifies the nature of these costs. Administrative costs arise from the bureaucracy that is needed to operate the system. Costs incur from calculating tax liabilities, keeping records of remittances and checking tax payments. Because all taxpayers are not honest, extra costs arise from the attempt to limit tax evasion. Eventually these costs are born by taxpayers, even though not directly. Typically, administrative costs are discontinuous and have diminishing average costs because they do not depend on the tax rate. Higher tax rates lower the average costs of administration because costs of revising tax base do not change due to higher tax rates. (Slemrod 2014; 69, 74)

Compliance costs instead burden taxpayers personally and are caused by abiding by the tax rules. They can also be borne by third parties that conduct tax payment procedures. Costs arise from obtaining information on tax liability, following the procedures and abiding by the bureaucracy. The magnitude of compliance costs is evaluated to be remarkably, more than ten times higher than the magnitude of administrative costs. Especially the time used to contacting tax authorities, searching for information and keeping records, for instance, increases the burden of compliance costs. There can also be voluntary compliance costs that are caused by attempts to reduce tax liability. (Slemrod 2014; 69, 76)

Allingham and Sandmo (1972) investigate the choice of a taxpayer of whether or not to declare all earned income. The choice is characterized by uncertainty because the taxpayer cannot verify in advance if he is going to be audited. If the taxpayer does not report all income and is still not audited, the utility will be greater than if all income was declared to the authorities. However, if the taxpayer is audited and revealed to have hidden income, the utility will be less than if all the income had been declared. The model supposes a constant tax rate t and a penalty rate π for undeclared income, which is higher than the constant tax rate for declared income. The taxpayer seeks to maximize expected utility function

$$E[U] = (1-p)U(W-tX) + pU(W-tX-\pi(W-X)) \tag{8}$$

in which X is the amount of declared income, W is the amount of all income, t is the constant tax rate, p is the audit probability and π is the penalty tax rate for hidden income. If the taxpayer gets caught in tax evasion, he will have to pay the penalty rate tax of the hidden income. The main result of the model is that the taxpayer will not report all income if the expected tax payment of hidden income, which depend on t, π and the audit probability p, is less than the payment under certain and constant t. If the amount of undeclared income, X, is positive but less than the amount of all income W, it is required that marginal expected utility of X is greater than zero on the point X=0, and less than zero in the point X=W. In other words, if the condition

$$p\pi > t[p + (1-p)\frac{U'(W)}{U'(W(1-t))}] \tag{9}$$

holds and pπ is less than t, all the income will not be declared. (Allingham and Sandmo 1972, 324-326.)

Allingham and Sandmo (1972, 327) also expand the model to cover social impacts, like reputation losses. They use comparative statistics to explore the dependence of declared income on model parameters. The effect of increase in income on declared income is ambiguous, and only in the case in which the penalty rate is at least one, the derivative is positive and would suggest that a rise in earned income would result in rise in declared income if there is an assumption of absolute risk aversion. The model also indicates that the fraction of declared income of all income responses to changes in actual income in a way that depends on the relative risk aversion function. The fraction can either rise, stay constant or decrease depending on whether relative risk aversion is an increasing, constant or decreasing function of income. A rise in penalty rate instead unambiguously increases the fraction of declared income, and so does the rise in audit probability. (Allingham and Sandmo 1972; 327, 329-330.)

The probability to become audited is however likely to be dependent on reported income or other factors and not to be completely exogenous. There is still a problem of defining whether the audit probability or its principle, the probability to evade taxes, rises or decreases with income. This a why the function should include further measures that for example compare the reported income on average income level in a particular profession. Hence, it would be reasonable to define a function p(X), for which p'(X)<0, implying that persons reporting income under the average income in a certain profession are more likely to be audited. The expected utility is now formulated

$$E[U] = [1 - p(X)]U(Y) + p(X)U(Z) \tag{10}$$

where Y=W-tX, Z=W-tX-π(W-X) and p(X) is the audit probability function. The results of the model are uniform with the previous results, which indicate that a rise in penalty rate and audit probability increase the share of declared income, even if audit probability is not defined explicitly as a constant. The difficulty arises from the sequence of decision making, in which the former decisions of income declaration effect the current audit probability. (Allingham and Sandmo 1972, 331-333.)

Allingham and Sandmo (1972, 333) present a dynamic model, in which getting investigated and caught in tax evasion results in investigation of all past periods when the taxpayer has hidden income, and therefore penalties of all hidden income during those periods. In the model, current decisions are affected by past decisions, because past decision have an influence on today's penalty if the tax evasion is detected. In addition, if the taxpayer cheats in the present moment, it actually means delaying the stochastic punishment and can be compared to a sort of mortgaging of future income. The model examines the choices of both myopic person who only pays attention to the first interdependency, and a person that takes into account both interdependencies. The model reveals that for a myopic person there will be situations in which the taxpayer will initially leave some of the income undeclared. The share of declared income of all income will also increase over time. A time-consistent individual that takes into account both past and future aspects, may initially leave some of the income undeclared. At some point of time T, all the income will be declared. Furthermore, a time consistent person will always report more income than a myopic one, if they have similar amount of income. (Allingham and Sandmo 1972, 333-336.)

Kleven et al. (2011) argue that in modern countries, tax compliance is at high level even though audit probabilities and penalty rates are relatively low. Theoretical models concentrate on self-reported income, while in modern countries a large part of income is typically reported by third parties. Kleven et al. (2011, 654-658) extend the standard model presented by Allingham and Sandmo (1972) to take into account the effect of third-party reporting. In the model, the tax payer has a true income $\hat{y}$ and reported income y, and e=$\hat{y}$-y is the undeclared income. The probability

that the hidden income is detected, is defined as p, which is an increasing function of the undeclared income, p=$p(e)$. If the evasion is detected, the tax payer has to pay the evaded tax and the penalty. The tax rate is defined as τ and the penalty rate is θ, both proportional to income. A risk-neutral tax payer maximizes

$$u = (1 - p(e)) * [\hat{y}(1 - \tau) + /taue] + p(e) * [\hat{y}(1 - \tau) - \theta\tau e] \tag{11}$$

In the interior optimum, du/de=0, in other words

$$[p(e) + p'(e) * e](1 + \theta) = 1 \tag{12}$$

The elasticity of detection probability with respect to e is defined as

$$\varepsilon = p'(e)e/p \geq 0 \tag{13}$$

according to which the first-order condition for determining e is

$$p(e) * (1 + \theta) * (1 + \varepsilon(e)) = 1 \tag{14}$$

The left-hand side represents the marginal cost and the right-hand side the marginal benefit of extra dollar of evasion. The model suggests that increase in penalty rate or detection probability leads to lower tax evasion, and that the marginal tax rate does not affect tax evasion. Empirically observed levels of tax evasion are however inconsistent with the model, that would suggest more tax evasion to be optimal for the tax payer. (Kleven et al. 2011, 654-658).

The effect of third-party information can be added to the model by defining $\hat{y} = \hat{y}_t + \hat{y}_s$, in which $\hat{y}_t$ refers to third-party reported income and $\hat{y}_s$ to self-reported income. For third-party reported income, detection probability is close to 1, whereas for self-reported income is very low. The detection probability is low for undeclared income that is smaller than the amount of self-reported income, and very high for hidden income that is larger than the amount of self-reported income. Detection probability also increases sharply around $\hat{y}_s$. The optimal point of tax evasion lies somewhere between 0 and $\hat{y}_s$. At this point, the elasticity of detection probability with respect to evasion/hidden income, is very high, and the optimum is close to the point where third-party reporting of income starts. (Kleven et al. 2011, 654-658).

In practice, the structure of total income also plays a role in determining tax evasion. If most of the income is self-reported, all taxes cannot be evaded because the total amount of reported income has to be in line with consumption and changes in wealth. In addition, very low total income, from which most is self-reported, can increase detection probability. (Kleven et al. 2011, 658).

The question of optimal taxation and preventing tax evasion should be a central question in the design of market reforms, and taxi markets are not an exception. The effects of market deregulation on market conditions and tax revenue can actually be linked in several ways. On one hand, theoretical questions like optimal tax rates, audit probabilities, penalties of tax evasion, compliance costs, information source issues and even reputation or culture give a base to assess the optimal taxation system. On the other hand, market reforms can cause changes in the underlying operating conditions of markets and market actors. In Finland, the obligation to use taxi meters has decreased the possibilities to obtain third-party information and thus made market conditions possibly more prone to tax evasion. On the other hand, deregulation typically increases the amount of vehicles and may result in oversupply. Oversupply

causes tighter market conditions and lower profitability, which may affect the incentives to evade taxes.

Slavnic (2011) raises the question of taxi market informalisation due to taxi market deregulation in Sweden. He argues that according to Swedish tax authorities, the annual value of tax evasion and other black market operations is evaluated to be approximately 20-25 percent of the overall turnover of the sector, and that deregulation may be likely to increase the black markets even more. Legislators have striven to reduce tax evasion by increasing control, making regulation more stringent and applying new high-tech methods. However, these preventive measures regard tax evasion as an individual issue, which is influenced by moral and cultural aspects. Structural market features that cause informalisation have been mostly ignored. (Slavnic 2011, 233-234.)

Typically, the economy has been considered to consist of two subsystems, the informal and the formal sector. The informal sector is often seen as a negation to the formal sector and it is considered to be in conflict with legislation. Slavnic (2011, 234) however argues that the perception of strict division into two separate sectors is misleading, and the economy should also be considered as a whole. The propensity to engage in black market transactions may depend on market conditions, and conducting business in the informal sector may be a survival strategy that would not have been chosen if the market conditions were easier. For example very tight competition could result in such a low profitability that informal business is a prerequisite for a company's survival.(Slavnic 2011, 234-235.)

Slavnic (2010, 7-8) describes the transformation of political-economical preferences by a transition from a "de-commodification" to "re-commodification". Until the 1970s, the role of the state was to provide premises for capital accumulation and to promote welfare for all citizens by collective bargaining and mass consumption. This meant that the welfare of a citizen became less dependent on labor value, and this process has been called "de-commodification". Starting from the 1970s and the 1980s, the role of state has been changing as a response to transformations in the economy. The state's status as the "de-commodifying agent" has been replaced by the status of "commodifying agent", and the role as a guarantor of social cohesion has become less remarkable. The significance of the state in producing economic growth has also been diminishing. In addition, equality, security and collective emancipation are according to Slavnic (2010, 8) giving way to values like individualism, natural inequality and market performance. (Slavnic 2010, 7-8.)

These processes create a need for different coping strategies in the new business environment, when the state no longer guarantees equal welfare for all citizens to the same extent. The effect is most noticeable for those who have had weaker premises to cope in an individualistic society. For example low education or insufficient abilities, like language skills, can reinforce the division to labor that does cope with existing market conditions and to labor force that is not able to maintain sufficient income level in the formal sector.

Slavnic (2011, 236) states that the Swedish taxi sector has actually become a separate section of the labor market. For taxi market it is typical that employment is unstable, income and working hours vary and internal relationships within the industry are regulated. When competition has become unrestricted, there are no longer entry limits that would create certain scarcity and maintain prerequisites for sustainable profitability. Hence, as income earning has become even more insecure, informal activities are a way to survive in the market and in the society. When the taxi market of Sweden was deregulated, Slavnic (2011, 246) reports that the survival strategies of ex-monopolists of the industry included also some very undesirable means, like spreading rumours of competitors and breaking competition rules. Criminal actions, like taximeter fixing, bookkeeping crimes and tax evasion also emerged. The appearance of

new, small competitors instead directed the ex-monopolists into deeper cooperation and even cartels. (Slavnic 2011, 236, 246-247.)

Kus (2014) also recognizes the relation between neoliberal reforms that enforce private entrepreneurship, and informalisation. He argues that reforms often reduce the state's effectiveness in enforcing regulations, and this effect has often been ignored. For example in Turkey, deregulation of markets was found to reinforce especially the informal sector, not the formal. Deregulation may create a possibility to conduct private business "in the shadows", without abiding by the regulations. Due to neoliberal reforms in Turkey, the share of unregistered work force and the need for currency in the informal sector increased. (Kus 2014, 287-289.)

2.5 Empirical results of factors affecting tax compliance

The model of Allingham and Sandmo (1972) ignores the possibility of third-party reported income and concentrates only on income that is declared by the taxpayer himself. For wage earners the possibilities of tax evasion are often minor, as most of the record keeping and filing is conducted by employers. Taxpayers that declare their income by themselves, are often entrepreneurs who earn their income as corporate or other business income. In the taxi market, a very remarkable part of taxi drivers work as self-employed entrepreneurs, so the question of third-party information is of high significance. The abandoning of mandatory taximeters also complicates the acquisition of third-party information. For example, Kleven et al. (2011, 651) report that tax evasion rate is close to zero for those whose income is reported by third parties, but remarkable for income that is self-reported. The impact of threat letters and reminders on tax evasion has also been studied by for instance Kleven et al. (2011) and Eerola et al. (2019). These studies underline the effect of third-party information, as the letters and reminders can be seen as a notification od third-party information usage.

In taxi markets, a substantial part of drivers operate as natural person companies or earn their income as corporate income from firms of some other legal form. Thus, the issue of self-reported income tax compliance is of high importance in the industry. The new Transport Service Act of 2018 removed the obligation to use taxi meters, which weakens the authorities' possibilities to observe tax evasion.

Kleven et al. (2011) present a model that suggests the effect of tax enforcement tools such as audits and penalties to be greater for self-reported income than for third-party reported income. Furthermore, marginal tax rates have a larger impact on tax avoidance and evasion on self-reported income than third-party reported income, but the impact is yet quite minor. The authors also argue that as the responses to marginal tax rates are low, it is more efficient to decrease tax evasion by stricter tax enforcement than cutting marginal tax rates. One of the most effective ways to avoid tax evasion is to utilize third-party reporting, because the tax evasion rate for third-party reported income is very low. It can also emerge to be much cheaper than costly audit procedures. (Kleven et al. 2011; 651-652, 689, 691.)

Eerola et al. (2019) analyze the effect of notification letters on income tax compliance in the rental housing market. The researchers identify many different reasons for noncompliance: ignorance and compliance costs, audit probability that is assumed to be low and lack of third-party information. In the experiment, landlords were sent notification letters that aimed at affecting these potential reasons for tax evasion. One of the treatment groups received letters that offered simplified information of rental income declaration requirements. The second group was sent letters that gave a signal of tightened tax enforcement. The third group was informed about the usage of third-party information. The results showed that the letters had an effect on tax compliance, and the influence was more remarkable on the extensive than

on the intensive margin. In other words, the effect on the number of landlords that reported positive rental income was more significant than the effect to the amount of income that was reported. (Eerola et al. 2019; 1-2, 7.)

The effect of treatment letters was strongest on the third group, which received notification letters of third-party information usage. The authors report that the probability to declare positive income increased over 50 % in the treatment year compared to the control group. The results support the view according to which third-party information is one of the best tools to decrease tax evasion. The study also analyzed possible spillover effect of notification letters between landlords in the local markets and also within the families of the landlords. Clear evidence of spillover effects between landlords was not found, but some indication of spillover effects within the families was detected. (Eerola et al. 2019, 2-3.)

The role of third-party information has been widely recognized in the existing literature, and the overall consensus is that usage third-party information should be increased in tax enforcement. Carillo et al. (2017, 162) also note that the effectiveness of third-party information also depends on the extent of information and whether or not gaps can be audited.

Chetty et al. (2007, 1) define the term tax salience as the cost of calculating the after-tax price of a commodity for which the price is announced as a pre-tax price. They argue that a tax that is announced in the price is more salient as calculating the after-tax price of a good requires no extra effort from the consumer. The authors conducted a study in which they tagged some products in a grocery store with after-tax prices and left some goods with pre-tax price tags. They also used a pair of control shops that were demographically similar to the treatment store. The results suggested that the demand for after-tax price tagged products fell by 6-8 percent relative to control groups. The expectation of fully-optimizing customers requires that customers have a demand function of D=f(p+θ), in which θ=1, meaning that the pre-tax prices and taxes have a similar effect on demand. The assumption is tested by deriving a demand function for good x as follows: if the customer is fully-optimizing and has a utility function of the form

$$U(x,y) = a\frac{x^{1-b}}{1-b} + y \tag{15}$$

in which y is normalized as one and the after-tax price is defined as p_t=p(1+t), the demand for x is defined as

$$x^*(p,t) = (\frac{p(1+t)}{a})^{-1/b} \tag{16}$$

If the consumer only regards the pre-tax prices, the demand function for x takes the form

$$\hat{x}(p,t) = (\frac{p}{a})^{-1/b} \tag{17}$$

If θ is defined as the fraction of people who consider full after-tax prices, the aggregate demand for goods is given by

$$x(p,t,\theta) = \theta x^* + (1-\theta)\hat{x} = (1-\theta)(\frac{p}{a})^{-1/b} + \theta(\frac{p(1+t)}{a})^{-1/b} \tag{18}$$

$$= (\frac{p}{a})^{-1/b}[1-\theta+\theta(1+t)^{-1/b}] \tag{19}$$

using Taylor-approximation

$$z^\theta \approx 1-\theta+\theta z \tag{20}$$

for z around 1 the formula simplifies to

$$x(p,t,\theta) = (\frac{p}{a})^{-1/b}(1+t)^{-\theta/b} \tag{21}$$

and in the logarithmic form

$$logx(p,t,\theta) = \alpha + \beta log\ p + \theta\beta log\ (1+t) \tag{22}$$

in which α=1/b and β=1 1/b (the price elasticity of demand). The parameter of interest, θ can be approximated by making the after-tax prices more salient through posting price tags with taxes and estimating the effect on demand by calculating the difference between log-demands in situations where θ=1 and where θ is unknown. The idea is to combine the estimates of demand's price elasticity and the effect of after-tag price tags, and estimate θ based on them. Interestingly, the results of the study indicate that the fraction of people who took into account the whole after-tax price was in this study close to zero. This suggests that calculating after-tax prices causes costs that effect consumption behavior. (Chetty et al. 2007; 1-6, 9-11, 23, 26.)

Kotakorpi and Laamanen (2017) investigate the effects of tax filing practices on taxpayers' reporting behavior. The authors suggest that prefilled tax returns help to reduce tax filing and administrative costs without causing adverse effects on total taxable income. Evidence on income distribution effects was also not detected.(Kotakorpi and Laamanen 2017, 21-25.)

Chetty et al (2009) study the effect of tax salience in case of commodity taxation and analyze the impacts on purchasing behavior. A common presupposition in economics is that consumers are rational and fully optimizing, but empirical results suggest that consumers can make suboptimal decisions and be inattentive to some factors that should affect decisions. Complexity of tax systems may cause consumers to ignore incentives if taking the related information into account is too difficult. In the study, consumers were found to ignore the price-increasing effect of commodity taxes if the taxes were not directly informed in the prices. Consumption basket was perceived to be cheaper than if the taxes were marked to the prices and the prices were announced as after-tax prices. If after-tax prices were announced, the consumers calculated the price of the basket correctly, but if only pre-tax prices were marked, the price was calculated incorrectly. The price perceptions also made a difference in consumption decisions depending on whether the prices were pre- or after-tax prices, even though the price of the basket actually remained the same. The results revealed that demand for products with after-tax prices dropped with approximately 8 percent. The outcome suggests that tax system complexity indeed causes costs to taxpayers, and these costs may have unexpected effects on behavior. Not in all cases taxpayers are able or willing to optimize their behavior, if the cost of optimization is too high. (Chetty et al. 2009, 1145-1146.)

Compliance costs can also differ among businesses of different size categories. For example Slemrod and Venkatesh (2002) report that compliance costs are higher for small- and mid-sized companies than for large companies. Tedds (2010, 31-32) reports that there is a positive correlation between firm size and tax compliance and bigger firms report more of their income to tax authorities than smaller firms.

The amount of income that is available for consumption after taxes affects the incentives to work, but if there is also an option of earning undeclared income, the effect of tax rates may not reduce work but instead direct work performance to the informal sector. Variation between taxation of different income sources may instead create incentives to organize business operations to certain form. In taxi sector, there are both possibilities to leave income unreported

and to make some choices of taxation by corporate form selection. Hence, the effect of tax rates on incentives to pay taxes should be considered also in the taxi markets, both in terms of their relative magnitude but also in terms of differences between taxes of different income sources and company forms.

According to Kirchler et al. (2008, 215-216) theoretical models and empirical studies have provided mixed and partially contrary results. Theoretical models often suggest that increase in tax rates does not alter tax compliance downwards but may even increase it, whereas in empirical studies the results have been mixed or referred to negative effects on tax compliance. Especially increasing marginal tax rates has been found to have a decreasing effect on tax compliance. (Kirchler et al. 2008, 215-216.)

Harju et al. (2019) study the effect of tax rates on missing-miles tax evasion with imported cars. Missing miles refer to the difference between reported miles in the car import declaration and miles measured in inspection. Overstating miles reduces tax liability of an imported car, and thus sets an incentive to exaggerate miles in the self-reported declarations. The phenomenon of overstating miles of imported cars concerns about 10 percent of all imported cars. The results suggest that among those who do not evade taxes on imported cars, the effect of tax rates on imports is much higher than the effect among tax evaders. The amount of imported cars dropped only among non-evaders, whereas tax evaders did not respond to tax rate increase by reducing the number of imported cars. The authors also find evidence that for cars that face higher tax rates, the probability of tax evasion is higher than for those cars that face lower car tax rates. Through information about stricter enforcement, tax evasion can however be decreased. Enforcement improvements caused a downturn in the number of imported cars from which miles were overstated and taxes thus evaded. (Harju et al. 2019; 10-12, 23, 31-32.)

In addition to tax salience effect, Chetty et al. (2009) also report a statistically significant effect of tax rates on consumption decisions. If the taxes are not announced in the prices, the consumers tend to underreact to changes in actual prices. If the prices were announced after-tax prices, the effect would be larger. However, after the experiment of announcing after-tax prices, the prices were again announced as pre-tax prices. The demand increased back to previous levels, which suggests that the customers did not persistently learn to regard after-tax prices, and even though the taxes do have a significant effect on demand as they increase prices, the effect is visible only if after-tax prices are announced. (Chetty et al. 2009, 1165.)

If the market conditions do not enable sufficient sustainable income, the risk of market informalisation and tax evasion increases. Cashin and Unayama (2011) study the effect of VAT rates on consumption and intertemporal substitution. They state that an increase in VAT rates may affect consumption in two ways: first, when consumers anticipate prices to rise, they emphasize current spending but may reduce their consumption in the future. Second, the increase in VAT reduces the purchasing power on income and thus consumption. According to the results, the intertemporal substitution effect was found to be statistically significant just before the VAT increase, but the income effect was not. The effect of intertemporal substitution is especially large for durable goods, and the effect related tho those goods was much larger than their share of average consumption. The result also applies to storable non-durable goods, but the effects for non-durable and non-storable goods were minor. The income effect reduced the consumption of durable goods, but increased the consumption of non-durable goods. The overall effect on state's tax revenue was however negative. Taxi services are categorized as non-durable goods, as they have to be consumed right after purchase. The results suggest that an increase in overall VAT rates is not likely to decrease overall household expenditure and thus the demand side. The effects on supplier side are however not evaluated in cases where the reporting of VAT payments

may have some loopholes. (Cashin and Unayama 2011; 3-4, 9, 23 ,27.)

There is a large scope of tax compliance literature that emphasizes the role of social norms and moral responsibility on tax compliance. For example Alm et al. (1995) highlight issues like sensible usage of collected taxes and rewards from good tax compliance. The perception of taxes as losses or beneficial instruments may be out of high importance and vary across individuals. Tedds (2010,1) reports that the extent of corruption at governmental level is correlated with tax evasion.

Kamleitner et al. (2010) study the factors that effect small business owner's tax compliance. They report that owners of small enterprises are more likely to perceive taxes as undesired losses compared to people perceptions on average. The authors summarize the former literature of small business owner's perceptions on taxes, and report that there have not been found to be any remarkable differences in attitudes towards taxation, but self-employed people felt that there was a larger imbalance between their tax burden and refunds from the state than what not-self-employed felt. The subjective tax burden was perceived to be higher and received benefits lower than for other taxpayers. The taxes are also more often mentally linked to complexity of paying taxes, and complication or even obstacles for business. There are three main factors that affect tax compliance of small business owners: opportunity to evade taxes due to self-reporting, the need for substantial amount of information on tax rules, and tax framing due to receiving gross payments from customers. (Kamleitner et al. 2010, 330, 333-334.)

Tsakumis et al. (2007) investigate the effects of cultural characteristics on tax compliance. Countries that suffer from non-compliance issues are characterized by high uncertainty avoidance, low individualism, low masculinity and high power distance. Uncertainty avoidance refers to a perception of uncertainty or unknown situations among culture members. Individualism is the opposite of collectivism and refers to individuals been seen as unique, whereas in collectivist cultures an individual is seen as a part of community but not as an independent entity. Tsakumis et al. (2007) refer to Husted (1999), according to whom collectivism may be connected to higher corruption as laws are not perceived as universal but they should differ by groups, and the interest of the group may override legislation. Higher individualism instead suggests that persons are viewed as equal and legislation tends to bee tighter, which also leads to better tax compliance. Masculinity emphasizes performance and visible status, whereas feminine cultures emphasize relationships and nurture. Higher masculinity is argued to be related to higher corruption, as the society is seen only as a provider of minimal living standards. Feminine cultures stress equal life quality for everybody, and thus often higher taxes. However the results suggest that higher masculinity is actually related to less tax evasion. Last, power distance is defined as the acceptability of unequal power distribution in institutions and organizations. Higher power distance is argued to be linked to wider tax evasion and corruption and the results of the study agree with the hypothesis. (Tsakumis et al. 2007; 131-140, 144.)

3 The Finnish taxi markets and taxation practices

3.1 The Finnish taxi markets

In 2018 the overall turnover of the Finnish taxi markets was evaluated at 1146 million euros, approximately 40 % of which came from publicly purchased services. The overall turnover of taxi industry accounts for about 0,4 percent of Finland's gross domestic product. Companies located at Uusimaa, Kymenlaakso and Pohjanmaa have the largest average turnover, whereas companies that operate in Kainuu, Satakunta or Pohjois-Karjala have the lowest average turnovers. Driven kilometers per company are divided approximately in the same manner than average turnovers. Most of the taxi companies in the market are small or medium-sized companies, whereas large enterprises are only a small majority. In 2018, the total number of taxi companies was 7293, 25 percent of which made a turnover less than 100 000 euros, 39 percent 100 000- 199 999 euros, 12 percent 200 000- 299 999 euros and only 24 percent 300 000 euros or above per year. Most of the companies are privately-owned enterprises. In October 2019, there were altogether 7912 private companies, 2740 of which were registered after 30.6.2018. The number of ltd:s was 2921 in 2019, with an increase of 1171 companies from the end of June 2018. Other company forms cover only a small part of all companies. In October 2019 the number of other companies was 588, from which 117 had been registered after deregulation. (Traficom 2020b; 6, 48-49, 58.)

Taxi services were the main business for 95 percent of companies that operate in taxi industry. The most common way to get a taxi ride is to call a dispatch center. In 2018 and 2019, more than 30 percent of taxi rides was ordered by phone calls. Among those who have mobility disabilities, the shares were 69 and 50 percent respectively. Taxi stands were the second most common way to obtain a taxi among all passengers, and on the third place was calling directly to a taxi company. However, for customers with mobility disabilities, taxi rides taken from taxi stands formed only 2 percent of total demand in 2018 and 7 percent in 2019, whereas among all customers, the shares were 24 and 25 percent. The so-called hail or cruising-taxis are rare in Finland, and only 3 percent of all rides in 2018 and 2019 were taken from the streets. Rides ordered via internet are even more rare and cover only one percent of the total demand in 2019. (Traficom 2020b; 6, 49, 104.)

The report from Traficom (2020b) revealed that the average taxi service expenses per household have been quite stable in 1985-2016. The relative share of all transportation expenses was only 0,8 percent in 2016. The most common reason to use taxi in 2018 and 2019 was a trip from social evening to home or other location. These trips covered over a half of all the trips. The next common class was other free-time rides, and together with the first common class, these trips formed approximately 85 percent of all trips. (Traficom 2020b; 10, 15, 20-27.)

3.2 Taxi market regulation in Finland before July 2018

Before the deregulation of taxi markets came into force in Finland starting form 1.7.2018, the markets were regulated in terms of both prices and entry. The old Transport Service Act contained numerical limits for entry permits, requirements of 24/7 service and an obligation of fixed station location (Ministry of Transport and Communications, 2019b).

In the old Taxi Law, the licence to provide taxi services was car-specific and for passenger cars only. The new Transport Service Act does not contain any strict regulations of the vehicles used as taxis. Obtaining the license required the applicant to pass a entrepreneurship training and to be able to meet financial obligations. The upper limits of taxi licences were municipality-specific, and confirmed yearly by the Center for Economic Development, Transport

and the Environment that was responsible for the area. The centers also followed the evolution of markets and changes in supply and demand. Furthermore, they were responsible for cancelling taxi licences if the requirements of service provision were not met. (Taxi Law 2.3.2007/217.)

The old law included tighter requirements for taxi drivers than the new Act. To obtain a taxi driver's licence, the driver had to pass a taxi driver's test and a test of local knowledge. In the new Act, the test of local knowledge is no longer required. The requirement was bound to the station location, and the driver obtained a verification of a passed test. The driver also had to complete a training period to get the taxi driver's licence. The permission to work as a taxi driver was granted for five years per time, and if the applicant was over 68 years old, for two years per time. The driver could renew the permission for next five or two years if the further education period for taxi driver was accomplished acceptably. The drivers had to update their skills regularly. (The Law of Taxi Driver's Professional Qualifications 18.9.2009/695.)

In addition, the old Taxi Law included an obligation of confidentiality for taxi drivers. The new Act has no such requirements. The requirement concerned both the holder of the taxi license and persons at the holder's service. The old Law regulated the driving shift order and the first place order in applying for taxi licenses. According to the Law, a new taxi license was first granted to a service provider that applied the permission to a station location smaller than a municipality, if the distance from the municipality center was more than 20 kilometers and there were no valid licenses to the station location beforehand. Otherwise the permissions to conduct taxi business were granted based on work experience as a taxi driver. Every third time the permission was however granted prioritizing applicants who had an existing license or licenses. If there were more applicants than licenses, the permit to conduct taxi business was given to the applicant with least existing permits. (Taxi Law 2.3.2007/217.)

Before the new legislation of taxi markets came into force in July 2018, the maximum prices were set every year by the act of government. The old Government's Act on the Maximum Consumer Prices in Taxi Transportation regulated that the price of the trip had to be based on using taximeter, if there had not been an agreement with the customer to make on exception to the maximum prices set in the Act. If the taximeter or its seal was broken, the price had to be based on basic fee and a fee that was defined by the maximum fee for the trip length. The Act contained detailed maximum fees for different fare classes, and also regulated maximal extra fees. (Government's Act on the Maximum Consumer Prices in Taxi Transportation 403/2017.)

As a whole, the new Act appears as much more loose in terms of market entry and offering taxi services. The requirements of decent quality remained in the new Act, but the demanded amount of education and regional knowledge diminished. The old Taxi Law did not enable part-time working in the industry, but the new Act does. A large part of taxi rides in Finland are publicly paid an are based on for example Social Services Act. Because of the procurement system of public services, the drives, dispatch centers or taxi companies may also have some sensitive information, like information on customers state of health or disabilities. In some cases, the information of customer's whereabouts or movements could theoretically be sensitive, even though it would not be related to issues like health. For example personal status or publicity could possibly create a need for confidentiality. The old Taxi Law included the obligation of confidentiality, whereas the new one does not.

3.3 Taxi market deregulation in Finland

Taxi markets were deregulated in Finland starting form 1.7.2018 through the reform of Transport Service Act. The aim of the new Act was to secure comprehensive services that correspond to customers' needs. The objectives of the new legislation were to ensure service availability, enforce competition in the industry, and to foster competitiveness of the service providers, at both domestic and international markets. Digitalization has a strong role in the reform, and the new Act requires that service providers open their information databases for service development. The objective is that transportation would become more seamless than before. One strong motive for the reform was to stop the decrease of service provider numbers, which was a large problem especially in rural areas. Ensuring availability was one the main reasons to ease market entry by removing numerical limit for taxi licenses and abandoning the obligation to pass the taxi driver's regional knowledge test. (Ministry of Transport and Communications, 2019a.)

The survey of consumer perceptions after deregulation has revealed that the share of customers that were very satisfied to the availability of taxi services at their home region has grown after the reform, but so has the share of very unsatisfied. Taxi availability was considered better in those areas that were more densely populated, and especially people in more rural areas experienced that the availability had got worse after deregulation in 2018. (Traficom 2020b; 10, 15, 20-27.)

Other objectives for the reform were savings of 10 percent in publicly supported transports starting from year 2017. In addition to increasing competition, promoting impartiality of competition is mentioned as a target of the reform. Anne Berner, Minister of Transportation and Communications during the period in which the Act was designed and agreed on, remarked that she perceived the new Act as an important means to respond to the challenges of climate change. She also stated that flexible legislation is needed to make all the parts of transportation chains to function together. ((Ministry of Transport and Communications, 2017.)

The new Act no longer contains numerical limits for the number of taxis, and market entry was liberated. Price regulations were abandoned and there are no precise maximum prices in the new Act, even though the authorities were left with some options to define maximum prices for certain services. In addition, usage of taximeters is not required in the Act. Taximeter has to be used only if the pricing is based on trip length or time, but if the price is stated before the trip or is fixed, usage is not mandatory (Vehicles Act 11.12.2002/1090). Prices or pricing principles must be informed to the customer before the trip, but there is no requirement of literal form. Providing taxi services is subject to a permit, but prerequisites for obtaining the permit were relieved. The permit to offer taxi services can be admitted for a legal entity or a natural person, and it is valid for ten years from the date of admission. A person that operates as a taxi driver, must have a valid driver's license and a valid taxi driver's license. To obtain the taxi driver's license, the applicant must pass a taxi driver's test organized by Finnish Transport and Communications Agency Traficom. By the new Act, the test of regional knowledge is no more required, and provision of public and private services are allowed by the same permission. (Transport Service Act 320/2017.)

The new Transport Service Act also caused changes to the compensation practices of rides funded by Social Insurance Institution of Finland (Kela). Simultaneously with the Act, Kela conducted a new acquisition procedure of publicly supported rides. Before the new Act, it was possible for Kela to compensate round-trips for customers that were entitled to Kela-supported taxi rides. The same taxi that took the customer to the destination, waited for the customer during the visit, and only outward journey and the waiting time were compensated. Because of the station rules, taxi driver wasn't often allowed to take another customer from nearby during the waiting time. After abandoning

taxi station regulations, taxi drivers are allowed to take customers from anywhere they want. This is why there are no longer principles to compensate for waiting times and round-trips, and hence outward and return journeys have to be ordered as separate entities. (Kela 2019.)

After the new Act came into force, Kela compensates only journeys that have been ordered from certain dispatch centers that have been elected through competitive bidding. According to Kela's service description of dispatch centers that is related to acquisition contracts of Kela-supported rides, dispatch centers are obligated to combine rides that are taken to destinations close to each other, especially if they are taken to remote places. For instance, the maximum time the customer may have to wait in place before medical reception is one hour, and the maximum waiting time for return trip after reception is one hour. Hence, one trip is allowed to involve max two hours of in-place waiting. When the trips are combined, the trip for the single customer is allowed to be twice as long as it would have been without combining the journey with other customer's trips. (Kela 2018.)

Simultaneously with the Transport Service Act, the new Car Tax Act and the reform of Vehicles Act also came in to force 1.7.2018 and contained some chances concerning taxi vehicles. The tax discount for ordinary taxis will be abandoned step by step, but unobstructed taxis will remain tax-exempt. If the first registration of a vehicle in Finland is for licensed taxi usage and the car is mostly used as a taxi vehicle, the tax can be lowered by 1200-3000 euros, depending on the registration time. If the vehicle is registered latest at 30.6.2019, the discount is up to 3000 euros, and if the registration is made until 30.6.2022, the discount is 1200 euros at maximum. After 1.7.2022 there will be no discounts for normal taxi vehicles. Vehicles that are first registered in Finland for licensed taxi usage and are unobstructed or excepted to school- or nursery school rides, remain tax-free. Imported cars are allowed to be used as taxi vehicles as well, but the deductions for ordinary taxis that will eventually be abandoned, only concern vehicles that are first registered in Finland to be used as taxis. If the vehicle's first registration in Finland has not been for taxi usage, there is no entitlement for car tax discount. (Verohallinto 2020b, Car Tax Act 29.12.1994/1482.)

From the viewpoint of tax evasion and tax salience, the new Transport Service Act has both possibly negative and positive features. The Act requires the price to be announced as an after-tax price, which should prevent tax salience. However, if the price cannot be announced before the trip, the driver will have to announce the pricing principles instead, which may require the customer to make only directive estimations of the actual price. If the customer underestimates the length of price of the trip, he may end up paying a price that eventually does not correspond to his willingness to pay. Varying pricing principles among different taxi operators may also be ignored, by accident or because of inattention. On the other hand, price variation may increase the complexity of evaluating prices, which could result in decreasing demand due to uncertainty. In both cases, the customer may end up worse off than if the prices were pre-stated and equal among all taxis.

The abandoned obligation to use taximeters clearly reduces the opportunities to utilize third-party information in taxation. First, if driven miles are not recorded, the driver may not report the income and thus file VAT-payments. The driver can either include the tax on customer prices, but refrain from paying the tax forward, or charge the customer a lower price to obtain a ride. As the taxi markets are not competitive, there may not be any incentives to leave the tax unclaimed from the customer. Furthermore, if driven miles and payments are not recorded, they are not visible in the company's turnover. If the driver earns salary, there are no incentives to leave rides unreported, but if the income is earned as corporate earnings, unreported turnover and profits reduce the tax liability and increase the net income of the driver or company owner.

3.4 Business income taxation

The taxation of business income depends on organisational form. Wages are taxed according to a progressive earned income tax scale, but the income from a business partnership is divided to be taxed partly as earned income and partly as capital income. The division depends on the net assets of the business partnership. A natural person enterprise can apply a maximum of 20 % previous year's net assets worth to be taxed as unearned income, and the rest is taxes as earned income (Tuloverolaki 30.12.1992/1535.)

For general and limited partnership companies, the revenue from a source of income is divided to be taxed as income shares of business partners. The division is based on partners' shares on previous year's net assets. These income shares are further divided into capital and earned income after making an entrepreneurial deduction of 5 % from the income share. 20 percent of the value of business partner's personal share of previous year's net assets is taxed as unearned income, and the rest is taxed as earned income. Capital gains of the business partnership are however always taxed as capital income. Unearned income is taxed according to the capital income tax rate of 30 percent up to 30 000 euros, and for unearned income over 30 000 euros, the tax rate is 34 percent. The higher tax rate only applies to the amount of income that is over 30 000 euros, income up to 30 000 is taxed according to the lower rate independently of the overall capital income amount. (Verohallinto 2020c, Tuloverolaki 30.12.1992/1535.)

Ltd:s and cooperatives are independent taxable entities with income tax rate of 20 percent (Verohallinto 2020d). The taxation of company owners depends on whether the Ltd is listed or not. If the dividends from an unlisted Ltd are below 150 000 euros, the company paying the dividend will commit a withholding of 7,5 percent, and if the dividends exceed 150 000, the tax rate for the excess amount of dividends is 28 percent. The dividend is divided into unearned and earned income based on the mathematical value of the shares. The mathematical value of a share is obtained by deducting previous year's debts from assets and dividing the difference by the number of shares. If the amount of dividends is maximum 8 percent of the mathematical value of shares, the dividends are regarded as capital income dividends. If the dividends are less or equal to 150 000 euros, 25 percent is taxed as taxable capital income and 75 percent is tax free. For dividends over 150 000 euros, 85 percent of the excess amount of dividends is taxable capital income and 15 percent is tax free. If the amount of dividends form an unlisted company exceeds 8 percent of the mathematical value of shareholder's shares, the excess part that exceeds the limit of 8 percent is regarded as earned income share. 75 percent of the earned income share is taxed as earned income and 25 percent is tax free. The tax rate is progressive. (Verohallinto 2020d,[48], Tuloverolaki 30.12.1992/1535.)

If the company is listed, the taxation of dividends is simpler. 85 percent of dividends are taxed as capital income and 15 percent is tax free. Up to 30 000 euros, the tax rate is 30 percent and for the excess part the rate is 34 percent. In practice, the company paying the dividends makes a withholding of 25,5 percent before paying the dividends, and the receiver does not have to file taxes from the dividends. (Verohallinto 2020d, Tuloverolaki 30.12.1992/1535.)

In case of Ltd taxi companies, the companies are usually not listed. In June 2020, there are no taxi companies listed in the head list of Nasdaq Helsinki. Most of the companies are natural person companies or business partnerships, and in 2018 there were only 32 Ltd companies out of the total number of 7293 taxi companies (Traficom 2020b). Income taxes are however not the only tax that affect taxi industry, and providing taxi services also requires capital. Maybe the most remarkable asset requirement for taxi business is a car or a fleet of vehicles. All taxi vehicles must be registered to be used in licensed activities (Verohallinto 2020b).

3.5 Legislation on value added taxes

According to the VAT law (Arvonlisäverolaki 30.12.1993/1501) of Finland, a seller of a product or a service is obliged to pay value added taxes from the sales price unless regulated otherwise. If the turnover of an accounting period is less than 10 000 euros, the seller is not tax liable if he has not been marked to be liable based on his own announcement. If business activity is conducted by a consortium of two or more partners and the consortium is established for business purposes, tax liability concerns the consortium. Principally, tax liability is generated when the product is delivered or service is accomplished. Taking a commodity for personal use also creates tax liability.The general VAT rate is 24 percent. The tax rate for passenger transportation is 10 percent and this rate applies principally to taxi and bus services that are used by human passengers. For other transportation the rate is 24 percent.(Arvonlisäverolaki 30.12.1993/1501.)

VAT is a tax that must be paid and declared until the due date of the firm's tax season. The general due date is the 12th of every month, and the tax season of a company can last a month, a quarter or a year. If the tax is paid monthly, the tax of a certain month must be declared and paid until the 12th of the second following month after the month from which the tax is paid. The same rule applies to quarterly paid VATs. If the tax is paid yearly, the declaration and payment must be done until the end of the following year's February. If the taxes are paid or announced late, the tax liable will have to pay a fee for delay. Even if the business unit or entity does not have any tax liable business, the declaration must be made if the unit or entity is registered to be tax liable. (Verohallinto 2020a.)

A tax liable business unit or entity is entitled to deduct a tax paid from a commodity that is purchased from another tax liable unit or entity and that is acquired to be used in taxable business. The requirement for tax deductions is that the buyer has a legally valid receipt or other verification that works as a receipt. (Arvonlisäverolaki 30.12.1993/1501.)

A taxi driver must keep a driving diary to show how much the vehicle has been used in business activities. The diary must also contain information on driving income divided into cash income, credit income and other income. Records of the taximeters produce driving diaries automatically, but if the vehicle does not have a taximeter, the diary must be held otherwise. Taxi and bus companies are entitled to deduct VATs included in gasoline purchases, car wash costs and repair costs. The deductions are made from the VAT-payment accrual of the company. Other possible deductions, like depreciation of a vehicle, are made from turnover when calculating profits and income taxes. (Verohallinto 2020b.)

4 Data and Methods

4.1 Hypotheses of the effects of taxi market deregulation

Based on the theoretical and empirical review presented above, deregulating taxi markets may have multiple, partially intersecting effects that also depend on the original conditions in the markets. First, if the supply does not lag far behind demand before the reform takes place, both the theory and empirical work suggest that the prices will rise. This study does not especially concentrate on price evolution, but some information on price level is presented to assess the result. Second, empirical research suggests that demand is not very likely to increase if there is originally no gap between supply and demand. The demand in taxi markets has actually been estimated to be quite inelastic and stable (Dempsey 1996), so an increase in supply does not necessarily mean an increase in demand. On the other hand, uncertainty among customers could also result in a decrease in demand, but if a large part of the demand is for example public and hence quite inflexible and inelastic, rapid changes in the demand are maybe not very likely.

Allowing open entry has scaled up the amount of service providers in every country that has implemented deregulation, and the emergence of new market actors has decreased the profitability of the industry. Because of the non-rivalrous nature of the market, the prices do not adjust downwards and the demand is not likely to rise. This may result in informalisation of the market and cause an increase in the share of black market actions. If the deregulation also includes abandonment of some monitoring tools, like taximeters, it reduces the availability of third-party information, which increases the incentives to tax evasion even more. If tax evasion increases, it should emerge as a decrease in reported turnover, but leave the costs of the industry unchanged, if the decrease in turnover is not due to decrease in demand. If the demand would diminish so that it lowers the income of the firms, companies should also adjust their payroll costs and purchases to match the new demand conditions. On a large scale, it is maybe not very likely that the whole industry would leave also deductions undone and payroll costs unreported, so that they would match turnover rates if there is tax evasion. Tax evasion would not directly benefit hired work force, so it is unlikely that there would be possibilities to hide salaries in such large extent. Payroll and other costs also lower the taxes paid on profits, so it is more reasonable to report all costs but leave only income unreported. It is also unlikely that single firms would leave their tax deductions undone, because they diminish the VAT-tax burden.

Table 1: Summary of the hypotheses of deregulation effects

Changes to prior legislation	**Expected effects**
Removal of maximum prices	No decrease in prices, possibly an increase
	No decrease in turnover if demand is stable
Removal of numerical entry limits	Increase in taxi numbers
	No increase in competition
	Decrease in effectiveness and rider income
	Market informalisation due to unsustainable business conditions
	Market concentration
Removal of station location obligation	Concentration in dense areas, supply decrease in sparsely populated areas
Removal of obligation to use taximeter	Increased incentives to undeclare income

4.2 Methodology

In economics, difference-in-difference analysis is a widely-used method to assess the effects of policy reforms and regimes. For example, if one wants to study the effects of a new legislation on some industry, one must find a way to distinguish the changes the new legislation caused from those changes that would have happened anyway. For instance, the turnover of a company typically evolves over time and is not fixed year after year. These kind of trends must be distinguished from those effects that are caused by the reform or some other change that is studied.

The idea is to compare two groups that are assumed to share similar trends except for some "treatment". The groups may still have some differences that do not change over time. A DiD-estimator measures the difference between the outcome of two groups, the treated and the non-treated. First, the method controls for differences within comparison groups caused by change in time, and then compares the difference in those differences. For example, a fixed-effect model for y_{it} could take the form

$$y_{it} = \delta r_{it} + \mu_t + \alpha_i + u_{it} \tag{23}$$

in which y_{it} is the time- and individual-dependent outcome, r_{it}=1 if an individual receives treatment at time t, μ_t is the time-spesific effect, α_i is the individual effect and u_{it} is the residual term. Taking a first difference produces

$$\Delta y_{it} = \delta \Delta r_{it} + \Delta \mu_t + \Delta u_{it} \tag{24}$$

The DiD-estimate can be formulated as

$$\hat{\delta} = \Delta y_{i.treated} - \Delta y_{i.nontreated} \tag{25}$$

Hence, the DiD-estimator gives the treatment effect after individual characteristics are controlled for. The assumption is that the outcome would have been the same in both groups if there had been no treatment, and hence the groups must be as closely comparable as possible, and have no other such differences that could affect the results. (Verbeek 2008, 388-390).

The idea of an individual-level fixed-effects regression is to control undetectable individual characteristics that do not change over time in a panel data analysis. In this study, individual characteristics refer to firm-level features and DiD-analysis is conducted with a firm-level data. For example, if the objective is to extract the effect of a dummy variable to a dependent variable from panel-data analysis, the individual constant term can be defined to include both a real constant and a term that varies between individuals. The varying part of the individual constant thus includes the effects of undetectable variables, such as in the case of firms. A fixed-effects regression that measures the effect of a dummy variable and includes other variables that represent time and observable individual characteristics, could hence take the form

$$y_{it} = \alpha_i + \lambda_t + \rho * D_{it} + X'_{it} * \beta + \varepsilon_{it} \tag{26}$$

where y_{it} is the time- and individual-dependent outcome, λ_t is the time effect, D_{it} is the dummy variable that varies across individuals and may change over time, X'_{it}:s are the observable individual characteristics that may affect the outcome and must thus be controlled for if they are correlated with the error terms, and ε_{it}:s are the individual error terms. In this equation, α_i is defined as

$$\alpha_i = A'_i * \gamma \tag{27}$$

where α is an individual-specific constant term and and A'_i represent the individually varying characteristics that do not change over time but may affect the outcome variable. (Angrist and Pischke 2009.)

The regressor variable may however vary more on the aggregate level between observation groups than on the individual level. For example, tax rates may be constant within a country but vary across countries. The source of omitted variables bias in the results may be variables that are undetectable and group-related, not individual-related. (Angrist and Pischke 2009.)

In time-series data, panel data or cross-section data, observation groups may also have common trends, and if those trends are not controlled for, the results are biased. For instance, one may want to study the effects of a political reform on a certain industry's profits that may also be affected by other factors, such as changes in consumption behavior or other trends. The idea of DiD-analysis is to compare the evolution of two groups that share common trends except for the political change (Dimick and Ryan 2014, 2401-2402). Thus, if one supposes that the two industries or other groups of interest would have evolved similarly without the reform or other change, the effect of the change can be evaluated by subtracting the difference between comparison periods in control group from the difference in treatment group (Dimick and Ryan 2014, 2401-2402).

Abadie (2005) explains the intuition of difference-in-difference estimator as follows: Y_{it} represents the individual outcome variable for individual at time t. One observes the population before and after treatment, in periods t=0 and t=1. A share of this population is exposed to a treatment, and a dummy $D(i,t)$ that takes values 1 and 0 defines whether the individual is part of the treatment group. Treated individuals obtain value $D(i,t)$=1 and others that belong to the control group obtain value 0. At time t=0, $D(i,0)$=0 for the whole population. The outcome variable is supposed to be generated by

$$Y_{it} = \delta(t) + \alpha * D(i,t) + \eta(i) + \nu(i,t), \tag{28}$$

in which $\delta(t)$ is a time-varying component, α is the treatment effect, $\eta(i)$ is an individual-specific component and $\nu(i,t)$ is a transitory shock that is an individual-level component and has a mean zero in each period. There is a possibility of within-individual correlation in the shock component, but the selection to treatment group does not depend on individual shocks. The shock component, time-varying component and individual-specific component are not observed, only the outcome and treatment variables are detected. The condition of independence between transitory shocks and selection to treatment group implies that

$$P(D(i,1) = 1|\nu(i,t)) = P(D(i,1)) = 1, t = 0,1 \tag{29}$$

By adding and subtracting

$$E[\eta(i)|D(i,1)] \tag{30}$$

one obtains

$$Y_{it} = \delta(t) + \alpha * D(i,t) + E[\eta(i)|D(i,1)] + \varepsilon(i,t) \tag{31}$$

where

$$\varepsilon(i,t) = \eta(i) - E[\eta(i)|D(i,1)] + \nu(i,t) \tag{32}$$

Defining

$$\mu = E[\eta(i)|D(i,1) = 0] + \delta(0),\ \tau = E[\eta(i)|D(i,1) = 1] - E[\eta(i)|D(i,1) = 0] \text{ and } \delta = \delta(1) - \delta(0) \tag{33}$$

one obtains

$$Y_{it} = \mu + \tau * D(i,1) + \delta * t + \alpha * D(i,t) + \varepsilon(i,t) \tag{34}$$

All the parameters are estimated by least squares estimator, and the model allows all kinds of dependencies between individual-specific and treatment components. Treatment components refer to the factors that separate the groups from each other, like policy changes. As there is the underlying condition of independence between individual shock component and treatment component, α can be estimated by

$$\alpha = E[Y_{i,1}|D(i,1)=1] - E[Y_{i,1}|D(i,1)=0] - E[Y_{i,0}|D(i,1)=1] - E[Y_{i,0}|D(i,1)=0] \tag{35}$$

Under the independence assumption, the average outcome for the treated would have had the same variation as the average outcome for untreated, if treatment was absent. However, in some cases there may be some dependence between individual shocks and treatment selection, which should be accounted for. (Abadie 2005, 2-6.)

Even though individuals would be assigned to treatment and control groups randomly, a panel data may not be independent across observations, and there may be correlation within groups (Angrist and Pischke 2009, 308). It is a popular practise to adjust standard errors for within-firm or within-time correlations when conducting an econometric analysis with panel data (Thompson 2006). Abadie et al. (2017,1) refer to previous research arguing that it is often feasible to use as large clusters as possible, but they also argue that in some cases too aggregate level clustering leads to worse results than using smaller clusters. Hence, the level and type of clustering should be chosen to respond to the nature of error dependencies.

OLS-estimator is consistent even if standard errors in the model are clustered or express some type of dependence, but statistical inference may be misleading as standard errors of the estimator become inconsistent. False standard errors affect the t-values that are the base for conclusions.

Thompson (2006) sheds light for the issue by arguing that for example firm-specific, persistent shocks may cause within-firm correlation on standard errors. More common shocks that apply to all firms can instead create within-time correlation. Statistical theory and empirical results also have suggested that clustering standard errors for both time- and firm-level within-group correlations increases the accuracy of economic panel data analyses if there are at least 25 firms and time periods. More robust standard errors decrease the bias in inference but increase the variance, which may cause results to be interpreted as statistically significant even though they are not. (Thompson 2006;1,4,10.)

If one supposes a panel regression to take the form

$$y_{it} = x'_{it}\beta + \varepsilon_{it} \tag{36}$$

where y_{it} is the dependent variable, ε_{it} is the error term, β:s are the coefficients, x_{it} is the vector of independent variables, and i represents the individual observed and t the time, the errors are allowed to be heteroskedastic and the coefficients are still valid. The errors are however supposed to have zero conditional means, E(ε_{it}—x_{it})=0. The assumption of firm-clustered standard errors implies that the errors may be correlated across time for a firm that is observed several times in the data. This can be expressed $E(\varepsilon_{it}\varepsilon_{ik}|x_{it}x_{ik}) \neq 0$. The errors may also be clustered within time or there may be common persistent shocks. If robust standard errors are not used and errors are not adjusted to account for correlations between observations, standard errors can be too small and this may lead to too large t-

statistics values. The choice of clustering method should depend on the source of the correlation, and thus if there is both within-firm and within-time correlation, both should be accounted for. However, unnecessary clustering may lead to excess variances. One can also use firm-level fixed-effects regression, but this may ignore some relevant forms of correlation. (Thompson 2006, 2-3.)

4.3 Data description and research design

4.4 Data

The data for the study was obtained from Finnish statistics authority Statistics Finland. The data enabled analyzing the effects of deregulation on financial variables including taxi companies' turnover, VAT-payments, tax deductions, variable costs, payroll, employer's social security payments and net-VAT payments. In addition, the evolution of numbers of taxi and bus companies was surveyed before and after the deregulation in July 2018.

The data is a combination of monthly firm-level tax records from 2016-2018 and yearly firm-level accounting data from 1986-2018, both provided by Statistics Finland. Tax records include firm-level information on monthly revenue, income under four different VAT-rates, tax deductions, employer's social security payments and payroll data. The VAT payments of a company were calculated as a sum of VAT payments from three different tax rates. Tax deductions are VATs that are included to purchases that a company has made to be used in business actions. The company is entitled to deduct these VATs from its own VAT payments, so that value added taxes do not become repeated. The net-VAT payments were calculated by deducting tax deductions from VAT-payments. Variable costs were calculated by dividing tax deductions by general VAT rate 24 percent, which gives a good proxy for costs based on deductions. Tax deductions variable may also take negative values if the amount of purchases in the firm exceeds its sales. The results were checked for robustness to verify that the negative values do not have a statistically significant impact on the results. Accounting data provided information of firm-level industry classification and legal form, which were used to extract and compare relevant companies from the data.

This study concentrates on data covering years 2016-2018 and compares the evolution of variables temporally near to the political change. The study also utilizes data of taxi rides' price evolution to assess the compatibility of financial variables' evolution and price trends. Price data is provided by Finnish Transport and Communications Agency Traficom. Traficom's taxi price index covers a period from 2015 to the beginning of 2020. Q2/2018-Q1/2020.

Bus industry is used as a control group for taxi industry and the study utilizes seasonally adjusted regression and difference-in-difference analysis to extract the effects of deregulation. Bus companies are chosen to serve as a control group, because the markets for taxi and bus rides have several common characteristics, and bus companies are supposed to be the closest possible comparison group. The cost drivers for taxi and bus companies are very similar and include for instance gasoline-, vehicle- and employment costs. If there are changes in the development of costs, they should be visible at both industries. It is also likely that the salaries in these industries do not separate very far behind from each other (after controlling for differences in requirements). Otherwise oversupply of labor in the other industry would drive the salaries back to the equilibrium level, in which there are workers for both industries.

Buses and taxis are often not direct competitors, but they still operate partially at the same markets and may serve as parts of a common transportation chain. It is also likely that if there are changes in overall demand for transportation services, these changes would be visible in both industries.

4.5 Difference-in-Difference analysis

This study utilizes a seasonally adjusted fixed-effects regression analysis with firm-clustered standard errors. The effects of taxi market deregulation are extracted by a difference-in-difference analysis between two subperiods, pre- and post-deregulation periods and between two groups, treatment group taxi companies and control group bus companies. The impact of the legal form of a taxi company is also controlled. As the data expresses seasonality in terms of months, it is first adjusted for seasonal fluctuations. The study uses logarithmic variables.

First, the data is adjusted for seasonality by utilizing residualization. The following regression is estimated:

$$Y_{f,month} = \alpha + \beta_m * \sum_{m=2}^{12} D_m + \varepsilon_{fm} \tag{37}$$

In the equation, $Y_{f,month}$ is the outcome variable in logarithmic form, α is a constant term, D_m are the dummy-variables that controls for months and takes values 1 and 0 for months 2-12. Month 1, January, served as a control and was omitted from the regression.ε_{fm} represents the error terms. Next, the residual from the regression from formula (37) is stored and used as the dependent variable in the following analyses.

The regression coefficients for time effects are obtained from the following regression

$$\hat{y}_{ft} = \alpha + \eta_f + \sum_{r=-30}^{6} D_t * \beta_t + \varepsilon_{ft} \tag{38}$$

in which y_{ft} is the firm- and time dependent stored residual that is obtained from seasonal adjustment regression. The regression is estimated separately for both industries, taxis and buses, to describe development in each industry over time. D_t and its coefficients β_t describe the evolution of the industries. η_f is the fixed-effect term for firms. There are 36 time dummies of the observation periods from 1/2016 to 12/2018. Month 30, meaning 6/2018, is the last period before deregulation came into force. DiD-estimates between taxi and bus industries, compared to 6/2018, are also estimated and plotted in the results. The DiD-estimates are estimated by the regression

$$\hat{y}_{ft} = \alpha + \eta_f + \sum_{t=-30}^{6} D_t * \beta_t + D_i\gamma + D_i * \sum_{t=-30}^{6} D_t\delta_t + \varepsilon_{ft} \tag{39}$$

in which y_{ft} is the firm- and time dependent stored residual from seasonal adjustment regression, α is the constant term, η_f is the fixed-effect term for firms, β_t are the coefficients for time-effects, δs are the coefficient for interaction terms of industry- and time-dummies (dynamic treatment effects), and ε_{ft} is the error term. Month 30, June 2018 is omitted and serves as a reference time and the subscript i refers to industry. Taxis are the treated group obtaining value 1 in the dummy, and buses serve as a control group and obtain value 0.

Simple DiD-estimates for pre- and post-deregulation periods are obtained from an analysis between taxi and bus industries. Estimates are produced by a regression of the form

$$\hat{y}_{ft} = \alpha + \eta_f + \sum_{t=-30}^{6} D_t * \beta_t + \gamma D_i + \rho D_{period} + \delta(D_{industry} * D_{period}) + \varepsilon_{ft} \tag{40}$$

where y is the stored residual of variable after seasonal adjustment (residualization), α is the constant term, η_f is the fixed-effect term for firms, D_{period} is the pre-post dummy for time periods, $D_{industry}$ is the industry dummy,

$D_{industry}$*D_{period} are the interaction terms of pre-post and industry dummies and ε_{ft}:s are the error terms depending on firm and time. $D_{industry}$-dummy takes values 0 an 1, in which 0 represents bus companies and value 1 taxi companies. D_{period}-dummy takes value 0 and 1. Value 0 represents periods before deregulation and value 1 periods after deregulation came into force. Observations from 7/2018 hence obtain the value 1. Firm-clustered standard errors are used to account for within-firm correlations in the error term.

To estimate the effects of deregulation comparing taxi companies of different legal forms to bus companies, the following regression is estimated:

$$\hat{y}_{ft} = \alpha + \eta_f + \sum_{t=-30}^{6} D_t * \beta_t + \gamma_l D_{legal} + \rho D_{period} + \delta_l (D_{legal} * D_{period}) + \varepsilon_{ft} \tag{41}$$

In this equation, $_{ft}$ is the stored residual of variable after seasonal adjustment (residualization), η_f represents the firm-level fixed-effect term, α is the constant term, D_{period} is the pre-post dummy for time periods before and after regulation such that months from 7.2018 obtain value 1,, D_{legal} are the dummies for taxi companies of certain legal form (buses as the reference group), D_{legal}*D_{period} are the interaction terms of pre-post and legal form dummies and ε_{ft}:s are the error terms depending on legal form and period. D_{legal}-dummy takes values from 0 to 4, in which 0 represents bus companies, value 1 natural person taxi companies, value 2 general or limited partnership companies, value 3 Ltd companies and value 4 other companies. D_{period}-dummy takes value 0 and 1. Value 0 represents periods before deregulation and value 1 periods after deregulation. Firm-clustered standard errors are used to account for within-firm correlations in the error term.

5 Estimation Results

5.1 Descriptive statistics

Figure 2 shows how the amount of taxi companies has been decreasing during 2016-2018. After the new Transport Service Act came into force in July 2018, the amount of taxi companies has continued to diminish. No such trend is observable in bus company numbers. Figure 3 describes the distribution of taxi companies to different legal forms. The percentages have been quite stable throughout the survey period. After July 2018, there seems to be only small percentage changes in the distribution, but the changes are extremely minor.

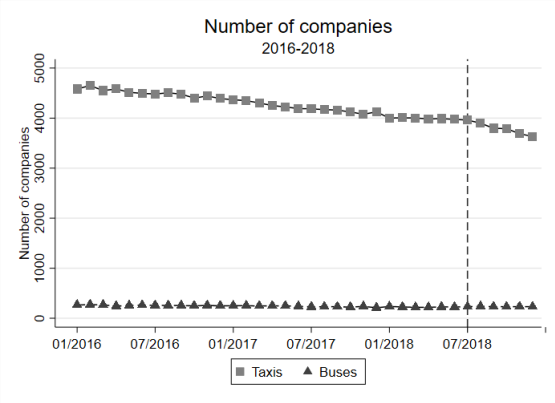

Figure 2: Monthly evolution of company numbers

Notes: This figure plots monthly evolution of taxi and bus company numbers. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

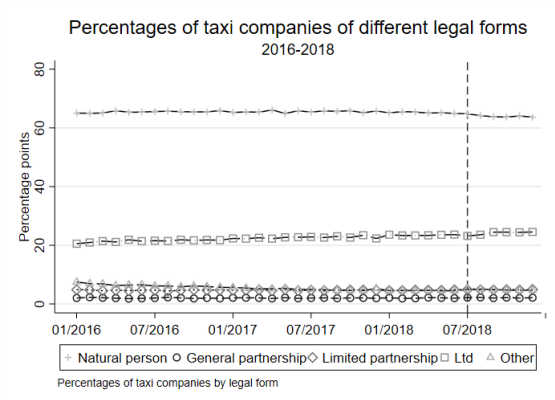

Figure 3: Monthly evolution of taxi company numbers in percentages

Notes: This figure plots monthly evolution of the number of taxi companies measured in percentages. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

Table 2 presents summary statistics for control and treatment group for the whole survey period 2016-2018. The table shows that on average, bus companies have remarkably larger revenue and the amount of payroll, social security payments and VAT-payments is many times larger than for taxi companies. However, bus companies also have much larger tax deductions both in absolute and relative terms compared to their VAT-payments. On average, net-VAT payments from bus companies are negative, whereas for taxi companies they are positive. Variable costs are slightly

less than 40 percent relative to turnover for taxi companies and about 50 percent for bus companies. The proxy of variable costs is based on tax deductions. Payroll costs are approximately 30 percent relative to revenue for taxi companies and almost 40 percent for bus companies. The difference of almost 10 percent in the relative share of payroll costs between taxi and bus companies does not directly disclose any differences in the labor intensity of treatment and control groups. Bus companies are typically larger than taxi companies and thus have more hired workforce than taxi companies, that are more likely to be small enterprises, in which the profits are raised as corporate income and entrepreneurs themselves work as drivers.

Table 2: Summary statistics for treatment and control groups, year 2016-2018

		Revenue	VAT-payments	Net-VAT -payments	Variable costs	Payroll	Employer's social security payments
Treatment							
	Mean	12 517,92	1 311,93	158,75	4 804,9	4 104,00	56,33
	Std Dev	37 671,43	4 508,11	3 177,79	21 510,83	11 411,93	159,01
	N	150 640	150 640	150 640	150 640	102 968	101 794
Control							
	Mean	70 312,40	6 977,36	-1 477,08	35 226,86	28 199,60	382,40
	Std Dev	246 695,68	24 380,81	18 156,80	14 3658,74	111 525	1 653,80
	N	8 645	8 645	8 645	8 645	6596	6554
All							
	Mean	15 654,65	1 619,41	69,97	6 456,01	5 554,62	76,05
	Std Dev	69 399,10	7 288,74	5 251,48	40 063,41	30 065,45	441,83
	N	159 285	159 285	14 9285	159 285	109 564	108 348

Notes: This table summary statistics of financial variables for treatment group taxis and control group buses. A major part of the observations concerns taxi companies, in terms of revenue the amount is slightly over 150 00 out of approximately 159 000. On average, monthly revenue per company appears remarkably larger for bus companies than for taxi companies, which also applies to payroll. However, on average bus companies have much higher variable costs, both in absolute numbers and relative to their revenue. Whereas taxi companies on average have positive net-VAT payments, bus companies have negative net-VAT payments. Variable costs and net-VAT payments are calculated based on tax deductions.

Figure 4 presents a graphical illustration of the evolution of financial variables' means in logs. All the variables seem to express monthly seasonality. The drop in employer's social security payments in January 2017 is due to the so-called competitiveness agreement, a collective agreement that was closed in summer 2016. The agreement lowered employer's pension contributions in all industries by 1,2 percentages in 2017-2018 and employer's unemployment insurance payments by 0,85 percentages (SAK 2020). The mean of net-VAT payments for buses is positive for only about a year's period from the beginning of 2017 to the beginning of 2018.

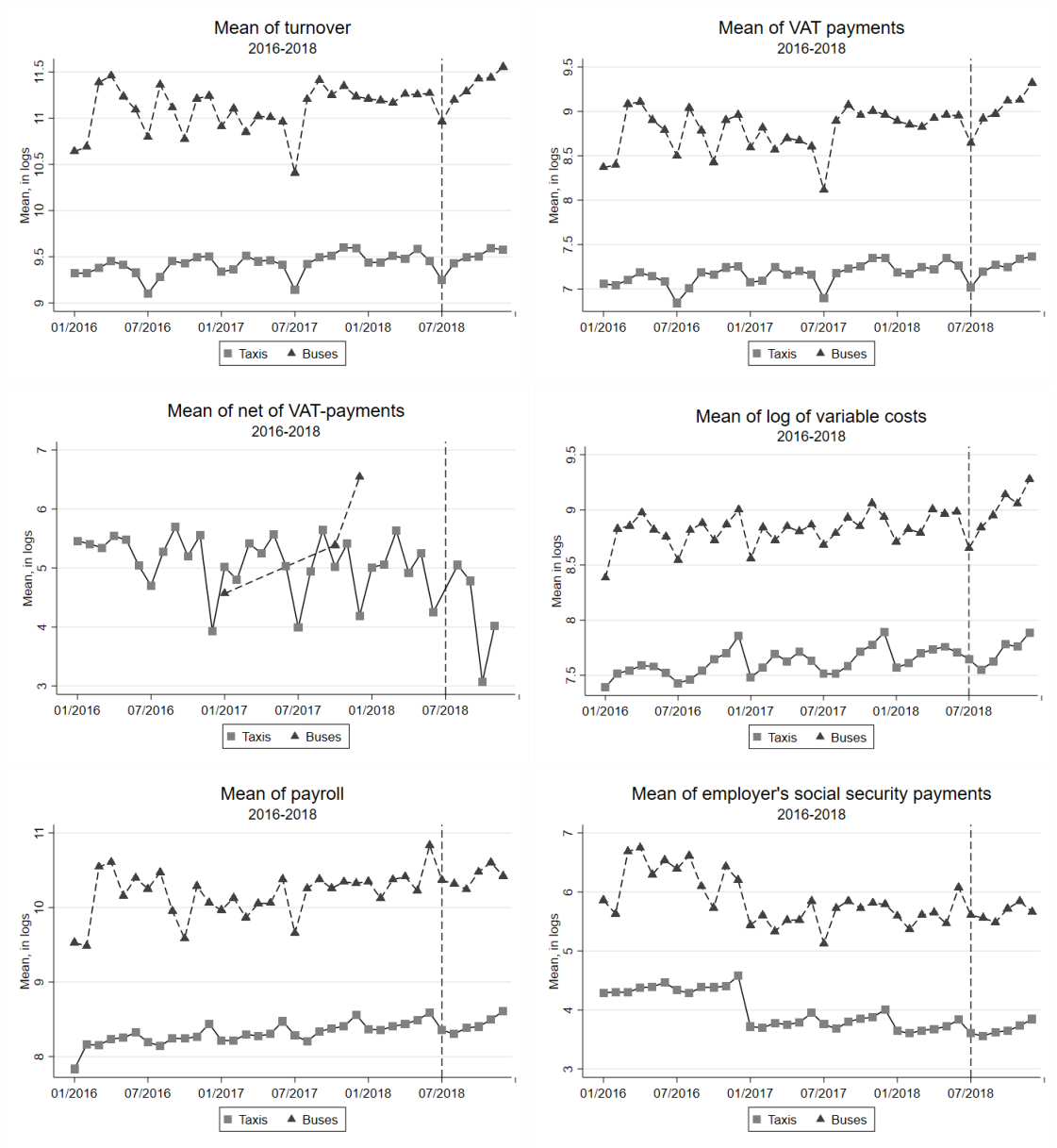

Figure 4: Monthly evolution of financial variables' means in logs, year 2016-2018

Notes: This figure plots monthly evolution of financial variables' means in logs. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and is marked with the dashed line.

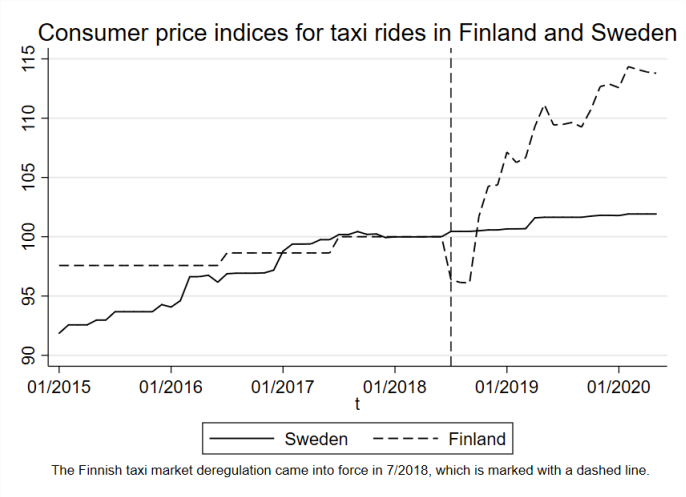

Figure 5: Monthly evolution of taxi service price index, source Traficom

Notes: This figure plots monthly evolution of taxi service price index. Taxi market deregulation applies from the beginning of Jul 2018. The data is obtained from Traficom.

Figure 5 presents the monthly evolution of the taxi service price index. The figure shows that until the end of period 2016-2018, the prices of taxi services had increased with approximately 5 percent compared to the pre-deregulation period. After the end of 2018, the prices have continued to rise. The graph reveals that right after the deregulation came into force, prices first fell slightly, but soon after that jumped above the original level. There may be some seasonality in monthly prices, but the trend seems to be clearly upwards. In Sweden, the price evolution has been much more stable, even though prices have increased almost 10 percent in the past 5 years. The increase however has not been as sharp as in Finland. Visually assessed, the mean of taxi companies' revenue has not however increased (figure 3) even though there seems to be a rise in service prices. Figure 4 also gives no clear indications of the underlying reasons for price increases. There seems not to be any remarkable changes in tax deductible costs, payroll or employer's social security payments that would give reason to suppose that the rise of prices would be cost-based.

Appendix A Figure 1 presents the evolution of financial variables monthly aggregate levels in logs grouped by industry. The figure shows that even though on average bus companies' revenue, VAT and net-VAT payments, payroll sum, tax deductions and social security payments are much higher than those of taxi companies, taxi industry is much larger than bus industry. Hence the aggregate levels of all the variables are higher for taxi industry. Taxi industry produces a positive net-VAT revenue throughout the survey period 2016-2018, whereas for bus industry, the aggregate industry net-tax revenue is positive for only a short period of time, from January 2017 to January 2018.

5.2 Regression analysis

The coefficients of a seasonally adjusted regression (equation 38) are plotted separately for taxi and bus industries in Figure 6. The figure presents estimates for seasonally adjusted log-turnover, log of variable costs and log of payroll. For bus companies, the estimates do not appear to be statistically significant, but for taxi companies the coefficients of log-turnover seem to be negative and significant compared to June 2018. The same applies to payroll and variable costs, although the estimates are not far from zero.

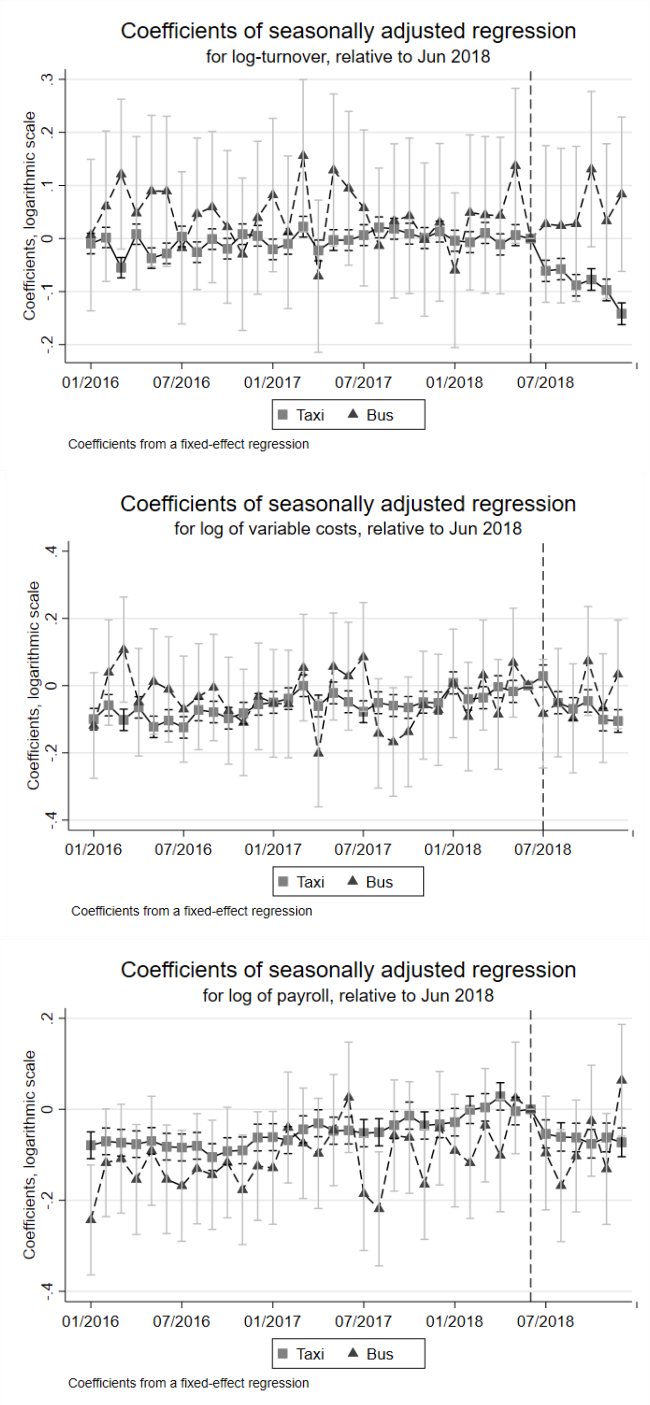

Figure 6: Coefficients of a seasonally adjusted fixed effect regressions for taxi and bus companies

Notes: This figure plots coefficients from a seasonally adjusted fixed effect regression of financial variables for taxi and bus companies. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

5.3 Difference in Difference Estimates

Figure 7 plots difference-in-difference estimates of equation 39 (the coefficients of interaction terms of industry/treatment dummy and time-dummies) between taxi and bus companies. June 2018 serves as a reference point and is omitted

from the regression. Only the estimates for log-revenue seem to be statistically significant. This suggests that even though there seems to have been a change in taxi companies' revenue compared to bus companies, this does not apply to payroll costs or tax deductions. Only the very last DiD-estimates seem to be on the limits of statistical significance, but only one observation does not give a strong base to make any assumptions of the forthcoming evolution of these variables.

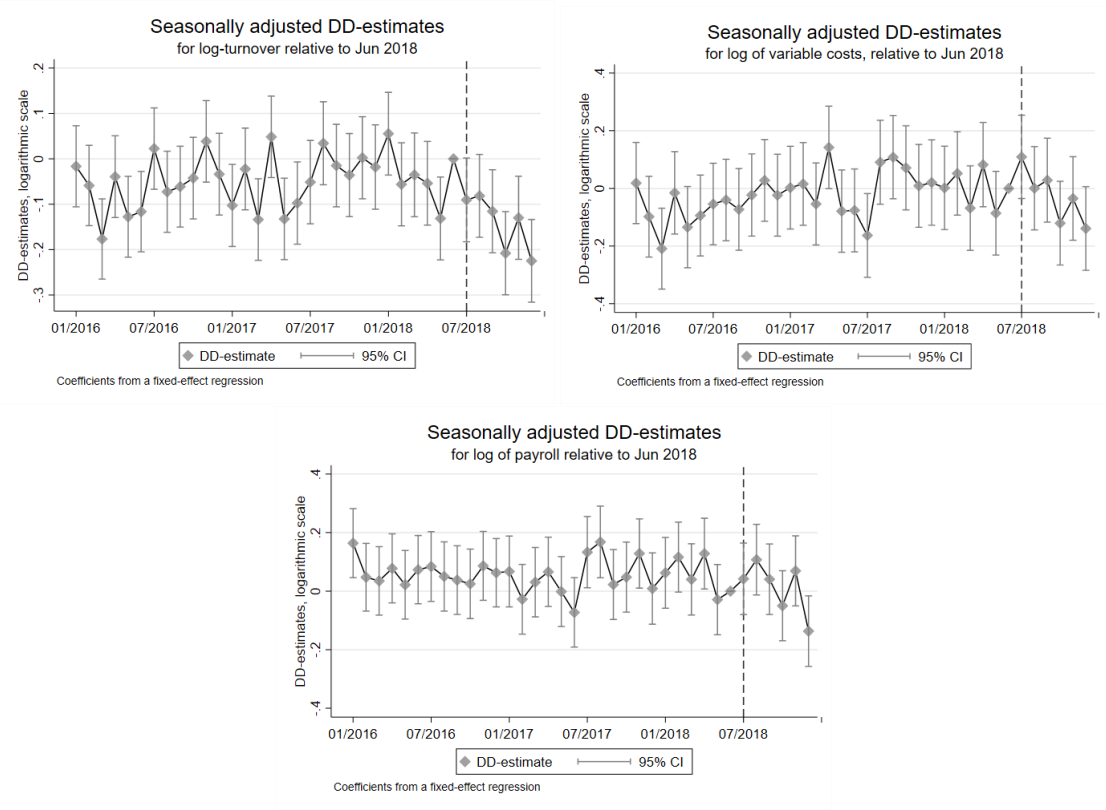

Figure 7: Coefficients of a seasonally adjusted difference-in-difference regressions of taxi and bus companies

Notes: This figure plots coefficients from a seasonally adjusted difference-in-difference regressions of log-revenue for taxi and bus companies. Regressions are defined as fixed effects regressions. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

Furthermore, although there are some statistically significant estimates for log-revenue before June 2018, there does not seem to be any clear trend upwards or downwards, and the 95 % confidence interval includes zero in most cases. The same applies to log of variable costs and for log of payroll. The estimates for periods before deregulation are not statistically significant compared to June 2018.

Table 3 presents the results from a difference-in-difference regression (equation 66) that compares taxi and bus industries before and after taxi market deregulation came into force. The results show that compared to bus industry, there has been a change in taxi companies' revenue after June 2018. The interaction terms of pre-post- and industry dummies are significant for seasonally adjusted log-revenue, log of VAT payments and log of net-VAT payments. All of the estimates are negative, the interaction term for log of net-VAT payments having the largest absolute value. The DiD-estimates for log of variable costs, log-payroll or log of employer's social security payments are not statistically

significant, so even though turnover, VAT payments and net-VAT payments have evolved differently than on bus industry, there is no difference in the evolution of cost variables. The analysis is next supplemented with a more detailed analysis of DiD-estimates based on taxi companies legal forms to check whether the company form has an effect in the estimates.

Table 3: Pre-post difference-in difference estimates for taxi companies compared to buses

Variable		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Revenue							
Interaction term	δ	**-0,122**	(0,034)	**-3,583**	0,000***	-0,189	-0,055
Industry dummy	γ	-0,049	(0,076)	-0,645	0,519	-0,198	0,100
Pre-post dummy	ρ	-0,013	(0,035)	-0,387	0,699	-0,081	0,054
Constant	α	0,059	(0,073)	0,817	0,414	-0,083	0,202
VAT							
Interaction term	δ	**-0,129**	0,039	**-3,328**	0,001**	-0,204	-0,053
Industry dummy	γ	-0,081	0,078	-1,047	0,295	-0,234	0,071
Pre-post dummy	ρ	-0,002	0,039	-0,046	0,964	-0,079	0,075
Constant	α	0,099	0,075	1,335	0,182	-0,047	0,246
Net-VAT							
Interaction term	δ	**-0,166**	(0,058)	**-2,841**	0,005*	-0,280	-0,051
Industry dummy	γ	-0,003	(0,256)	-0,013	0,990	-0,506	0,499
Pre-post dummy	ρ	-0,041	(0,062)	-0,662	0,508	-0,163	0,081
Constant	α	0,044	(0,248)	0,178	0,859	-0,441	0,530
Payroll							
Interaction term	δ	-0,047	(0,036)	-1,307	0,191	-0,118	0,024
Industry dummy	γ	-0,033	(0,085)	-0,390	0,697	-0,199	0,133
Pre-post dummy	ρ	-0,020	(0,038)	-0,534	0,593	-0,094	0,054
Constant	α	0,086	(0,081)	1,069	0,285	-0,072	0,245
Variable costs							
Interaction term	δ	-0,021	(0,040)	-0,508	0,611	-0,100	0,059
Industry dummy	γ	0,130	(0,103)	1,260	0,208	-0,072	0,333
Pre-post dummy	ρ	-0,077	(0,042)	-1,837	0,066	-0,159	0,005
Constant	α	-0,067	(0,099)	-0,678	0,498	-0,261	0,127
Social security payments							
Interaction term	δ	-0,043	(0,036)	-1,204	0,229	-0,113	0,027
Industry dummy	γ	-0,054	(0,080)	-0,668	0,504	-0,211	0,104
Pre-post dummy	ρ	-0,048	(0,038)	-1,287	0,198	-0,122	0,025
Constant	α	**-0,29**4	(0,077)	**-3,837**	0,000***	-0,444	-0,144

Notes: This table shows the estimates of seasonally adjusted fixed-effects difference-in-difference analysis with firm-clustered standard errors. The coefficients are obtained from formula (38).

Tables 4 and 5 present the results of difference-in-difference analysis between taxi and bus industries in which taxi companies are separated by legal form. Within-group correlations are controlled by firm-clustered standard errors. The analysis compares taxi companies of different legal forms to all bus companies. In tables 5 and 6, group 1 represents natural person taxi companies, group 2 general or limited partnership companies, group 3 ltd companies and group 4 other companies. Buses serve as a control group for. The pre-post dummy gets value 1 in the post-deregulation period

and 0 in the pre-deregulation period.

Table 4: Difference-in difference estimates for taxi companies of different legal forms compared to buses

Revenue		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	**-0,135**	(0,034)	**-3,914**	0,000***	-0,203	-0,067
Interaction term 2	δ_2	**-0,090**	(0,042)	**-2,124**	0,034*	-0,173	-0,007
Interaction term 3	δ_3	**-0,131**	(0,037)	**-3,502**	0,000***	-0,204	-0,058
Interaction term 4	δ_4	-0,038	(0,085)	-0,449	0,653	-0,204	0,128
Legal form dummy 1 : natural person taxi	γ_1	-0,140	(0,118)	-1,179	0,238	-0,372	0,092
Legal form dummy 2: Partnership taxi	γ_2	0,007	(0,063)	0,116	0,908	-0,117	0,132
Legal form dummy 3 : Ltd taxi	γ_3	0,112	(0,053)	2,099	0,036	0,007	0,216
Legal form dummy 4 : other company form taxi	γ_4	-0,245	(0,132)	-1,859	0,063	-0,504	0,013
Pre-post dummy	ρ	-0,007	(0,035)	-0,207	0,836	-0,076	0,061
Constant	α	0,090	(0,084)	1,073	0,283	-0,074	0,254

VAT		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	**-0,140**	(0,039)	**-3,579**	0,000***	-0,217	-0,063
Interaction term 2	δ_2	**-0,094**	(0,046)	**-2,061**	0,039*	-0,184	-0,005
Interaction term 3	δ_3	**-0,133**	(0,042)	**-3,200**	0,001**	-0,215	-0,052
Interaction term 4	δ_4	-0,067	(0,083)	-0,800	0,423	-0,230	0,097
Legal form dummy 1 : natural person taxi	γ_1	-0,145	(0,129)	-1,129	0,259	-0,397	0,107
Legal form dummy 2: Partnership taxi	γ_2	-0,056	(0,062)	-0,914	0,360	-0,177	0,064
Legal form dummy 3 : Ltd taxi	γ_3	0,038	(0,049)	0,772	0,440	-0,058	0,133
Legal form dummy 4 : other company form taxi	γ_4	-0,182	(0,141)	-1,291	0,197	-0,458	0,094
Pre-post dummy	ρ	0,003	(0,040)	0,079	0,937	-0,074	0,081
Constant	α	0,120	(0,091)	1,320	0,187	-0,058	0,297

Net-VAT		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	**-0,178**	(0,060)	**-2,978**	0,003**	-0,295	-0,061
Interaction term 2	δ_2	-0,097	(0,071)	-1,365	0,172	-0,237	0,042
Interaction term 3	δ_3	**-0,143**	(0,063)	**-2,269**	0,023*	-0,266	-0,019
Interaction term 4	δ_4	0,051	(0,106)	0,487	0,626	-0,155	0,258
Legal form dummy 1 : natural person taxi	γ_1	-0,053	(0,447)	-0,118	0,906	-0,928	0,823
Legal form dummy 2: Partnership taxi	γ_2	0,231	(0,269)	0,858	0,391	-0,297	0,759
Legal form dummy 3 : Ltd taxi	γ_3	-0,031	(0,228)	-0,135	0,893	-0,478	0,416
Legal form dummy 4 : other company form taxi	γ_4	-0,096	(0,463)	-0,208	0,835	-1,003	0,811
Pre-post dummy	ρ	-0,046	(0,063)	-0,732	0,464	-0,170	0,078
Constant	α	0,073	(0,332)	0,218	0,827	-0,579	0,724

Notes: This table shows the estimates of seasonally adjusted fixed-effects difference-in-difference analysis with firm-clustered standard errors. The estimates are based on formula (39)

In terms of revenue, the estimates for interaction terms of pre-post dummy and legal form taxi company dummies 1-3 are negative and statistically significant. Only the estimates for interaction term of pre-post dummy and other legal form taxi company dummy is not statistically significant, and the same applies to VAT-payments. In case of revenue, VAT and net-VAT, the first interaction term that represents the interaction of pre-post dummy and natural person taxi company dummy gets the largest negative value. In other words, compared to bus companies, revenue, VAT and net-VAT payments of natural person taxi companies have dropped, and the percentual drop has been larger than the drop for other company forms. However, the difference to ltd companies is quite minor. Compared to bus companies, revenue, VAT and net-VAT payments of Ltd taxi companies have dropped after the deregulation. The percentual drop is almost as large as for natural person taxi companies. In case of net-VAT payments, it appears that the estimate for interaction terms of pre-post dummy and partnership or other form taxi companies are not statistically significant.

Table 5: Difference-in difference estimates for taxi companies of different legal forms compared to buses

Variable costs		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	-0,015	(0,041)	-0,375	0,708	-0,096	0,065
Interaction term 2	δ_2	0,051	(0,053)	0,964	0,335	-0,053	0,156
Interaction term 3	δ_3	-0,050	(0,046)	-1,081	0,280	-0,141	0,041
Interaction term 4	δ_4	-0,120	(0,108)	-1,109	0,267	-0,332	0,092
Legal form dummy 1 : natural person taxi	γ_1	0,093	(0,117)	0,794	0,427	-0,137	0,323
Legal form dummy 2: Partnership taxi	γ_2	-0,224	(0,236)	-0,950	0,342	-0,686	0,238
Legal form dummy 3 : Ltd taxi	γ_3	**0,429**	(0,203)	**2,119**	0,034*	0,032	0,827
Legal form dummy 4 : other company form taxi	γ_4	0,021	(0,176)	0,119	0,905	-0,325	0,367
Pre-post dummy	ρ	-0,077	(0,042)	-1,812	0,070	-0,160	0,006
Constant	α	-0,079	(0,097)	-0,809	0,418	-0,270	0,112

Payroll		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	-0,027	(0,037)	-0,732	0,464	-0,101	0,046
Interaction term 2	δ_2	0,005	(0,056)	0,095	0,924	-0,104	0,115
Interaction term 3	δ_3	-0,075	(0,039)	-1,913	0,056	-0,151	0,002
Interaction term 4	δ_4	-0,047	(0,097)	-0,486	0,627	-0,237	0,143
Legal form dummy 1 : natural person taxi	γ_1	-0,037	(0,165)	-0,225	0,822	-0,360	0,286
Legal form dummy 2: Partnership taxi	γ_2	-0,108	(0,083)	-1,310	0,190	-0,271	0,054
Legal form dummy 3 : Ltd taxi	γ_3	0,009	(0,066)	0,139	0,889	-0,119	0,138
Legal form dummy 4 : other company form taxi	γ_4	-0,017	(0,178)	-0,095	0,925	-0,365	0,331
Pre-post dummy	ρ	-0,026	(0,038)	-0,688	0,492	-0,101	0,049
Constant	α	0,082	(0,104)	0,790	0,429	-0,122	0,286

Social security payments		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	-0,020	(0,037)	-0,552	0,581	-0,093	0,052
Interaction term 2	δ_2	0,031	(0,056)	0,553	0,580	-0,079	0,142
Interaction term 3	δ_3	**-0,089**	(0,039)	**-2,313**	0,021*	-0,165	-0,014
Interaction term 4	δ_4	0,015	(0,078)	0,188	0,851	-0,138	0,167
Legal form dummy 1 : natural person taxi	γ_1	-0,079	(0,154)	-0,511	0,610	-0,381	0,224
Legal form dummy 2: Partnership taxi	γ_2	-0,118	(0,088)	-1,343	0,179	-0,291	0,054
Legal form dummy 3 : Ltd taxi	γ_3	0,014	(0,070)	0,200	0,841	-0,123	0,151
Legal form dummy 4 : other company form taxi	γ_4	-0,021	(0,166)	-0,125	0,900	-0,346	0,304
Pre-post dummy	ρ	-0,052	(0,038)	-1,373	0,170	-0,127	0,022
Constant	α	-0,293	(0,098)	-2,995	0,003	-0,485	-0,101

Notes: This table shows the estimates of seasonally adjusted fixed-effects difference-in-difference analysis with firm-clustered standard errors. The estimates are based on formula (65).

Table 5 presents the same difference-in-difference estimates for variable costs, payroll and employer's social security payments. The results show that there are no changes after deregulation in taxi companies variable costs, payroll or social security payments compared to bus companies. None of the estimates for interaction terms is statistically significant. Thus, according to both industry-level analysis and estimates grouped by legal forms of taxi companies, it seems that even though there has been a change in taxi companies revenue and hence in VAT-payments, the deregulation has not caused any changes to tax deductions due to changes in variable costs, payroll or social security payments. There are some differences between companies of different legal forms, but generally speaking, the industry-level results apply quite uniformly to all company forms and there is no single company form that would have experienced a drastic change that alone would explain the DiD-estimates of the whole industry. It seems that there has been a change in taxi markets' functioning in general. Only one DiD-estimate, the interaction term of pre-post dummy and legal form dummy 3 that represents Ltd taxis for social security payments, is negative and statistically significant. In case of variable costs, the legal form dummy 3 appears to be statistically significant, but it alone does not indicate that

deregulation of the markets would have increased the costs.

The result of lower income but no decrease in costs is peculiar and needs more investigation. The decrease in revenue could be due to lower prices or lower demand. The price index of taxi rides does not support the assumption of price decrease, rather the opposite. Lower demand should lead to lower employment costs, if the taxis do not drive empty or hold excess workforce. This should also decrease other variable costs like gasoline expenses and other vehicle-related costs, which should be visible in tax deductions and variable costs -variables (the estimates concerning tax deductions are presented in Appendix A). However, so far the follow-up studies of taxi markets provided by Traficom for instance, have not given any indications of decrease in demand. Such a rapid diminishing of demand would be quite surprising also because approximately 40 percent of demand is public and thus not very flexible. As the prices have not decreased, it is probably not very likely that the public sector would have gained lot of savings from the industry and thus affected the overall turnover rates of the industry.

5.4 Discussion

The deregulation of Finnish taxi markets came into force starting from 1.7.2018, and according to reports from Finnish Transport and Communications Authority Traficom, there has not been any decrease in prices. The results of this study suggest that compared to bus industry, there has been a drop in taxi companies' revenue, VAT payments and net-VAT payments after the reform. This drop is however not due to increase in costs or decrease in fares. Unaffected tax deductions, employer's social security payments and payroll costs also give no indications of decrease in demand.

The results indicate that the decrease in VAT and net-VAT payments is due to a drop in revenue, not a rise in cost variables. If the costs would have increased, it should have been visible in the development of payroll costs and variable costs. Higher gasoline expenses, repair costs or other vehicle-related costs would have increased variable costs, and changes in employment would have increased payroll costs and employer's social security payments. In addition, a drop only in demand without other changes would have probably caused a drop in variable and employment costs, if taxi companies would have simply just adjusted to the new market conditions by adjusting labor- and variable cost input.

At least in the light of current information, there have not presumably been any large changes in demand, and prices have increased instead of decreasing. In addition, lower demand should result in lower operating expenses, like payroll costs and tax deductions. Hence these possible explanations do not seem to shed light on the issue. As the new Act undeniably increased the incentives and possibilities for tax evasion by abandoning the obligation of taximeters, the results give a reason to suspect whether the drop in taxi industry's turnover is due to unreported income. The new legislation only requires the usage of taxi meters when the price is based on measurable pricing bases, but if the price is pre-fixed, the usage of a taximeter is not mandatory. This gives a strong motivation to leave some fares unreported.

Offering fixed-priced, short trips in limited and densely populated areas may also be an easy and cost-effective way to enter the market, or secure sufficient cash flow. Offering fixed-price trips saves the operator from installing for example taxi meters and other measuring devices, which is allowed according to the new law, if the prices are fixed.

Very often the supply of services has expressly concentrated on dense areas and decreased in sparsely populated regions. If demand does not grow and a small area gains more service suppliers, there are less customer for more taxis. It may be that fixed prices are a safer choice than measure-based pricing for taxi drivers, if they help to lower the

risk of unprofitable trips. Unprofitability could be due to driving back empty, or getting a very short trip and having to queue again for another customer. Fixed fares and limited operating areas may help to overcome these problems. Furthermore, fixed fares may help to diminish price uncertainty in the customer side. Fixed fares can be experienced as convenient by customers, who may have been afraid of wild and uncontrolled pricing practices after the deregulation came into force. Hence a company offering pre-set prices for rides can be perceived as a safe option.

One possible explanation for the phenomenon is increase in unreported income due to abandoned obligation to use taximeters. If open entry has deteriorated the efficiency and profitability of the industry, tax evasion may also be a coping strategy in a market in which sustainable, formal business is no longer profitable enough.

6 Conclusions

Taxi markets cannot be classified as a perfectly competitive markets, as they suffer from problems caused by asymmetric information. Taxi services are an example of credence goods, in case of which the service supplier has more information of a commodity needed and provided than what the customer has. This creates an incentive to regulate taxi markets to decrease the excess market power of service providers.

From the viewpoint of optimal tax administration and tax evasion prevention, the new Act included measures that reduce the possibilities to obtain third-party information from taxi company revenues, even though third-party information has been found to one of the most effective ways to prevent tax evasion. It is not optimal to prevent all tax evasion, but it seems that the new Act makes prevention more costly, which may increase the level of optimal tax avoidance that is allowed. This cannot be classified as a good thing. Usage of third-party information also decreases the need for high audit probabilities and other inspections. The new Act no longer includes obligation to use taxi meters that before deregulation were mandatory, which reduces reliable third-party information sources. To achieve the same level of tax enforcement, taxi company revenues should now be inspected otherwise. Compared to automatic taxi meter based information, firm-level inspections and audits in turn are much more costly and labor-intensive to implement.

On the other hand, a very large part of taxi market service suppliers consists of small enterprises or self-employed workers. In many countries it has been detected that open market entry also leads to less skilled or educated workers, in terms of language skills for example, to start operating as taxi drivers. Tax compliance is costly for the workers when the income is self-reported, but declaring income correctly according to the law also requires some information and understanding of taxation practises. Especially difficulties with language could possibly create some skill-based barriers that result in tax avoidance. Avoiding these problems again requires labor-intensive actions and inspections from tax authorities.

The results of this study clearly require more research. The shortcomings of the study are the lack of actual data of demand and information form taximeter records. To asses the new Act's effects on tax compliance more precisely, more data on realized rides and prices of the rides is required. Nonetheless, the results of this study already suggest that there has been a change in the functioning of taxi markets, and the change has not been positive. It is possible that the reform has caused some changes in demand that would be visible in kilometer records that would partially or entirely explain the drop in taxi markets' revenue, but this would also give a reason to assess the success of the reform more precisely. In addition, even though the underlying reason for decreasing VAT-payments and revenue would be tax evasion, the real magnitude of black market in the industry is very hard to estimate.

Conceptual framework and empirical results, including the observed increase in prices, suggest that taxi markets are not perfectly competitive and may thus succeed better under some regulative measures. There is a large consensus in the earlier literature that the underlying reasons for problems emerging after reforms are precisely unlimited entry and free pricing. The limits for entry, for example, do not necessarily have to be numerical, if for example quality requirements create some de facto entry barriers that restrict oversupply. Regulation of prices may require some numerical limits, if it applied. The obligation to use taximeters in turn would clearly be a cost-effective way to prevent tax evasion, as it could be classified as a sort of third-party information source. There does not seem to be an obvious reason how the removal of this obligation would have eased market entry, as the cost of the meter is measured in a couple of hundred euros, not thousands.

The theories of optimal taxation enhance the importance and effectiveness of third-party information usage in tax evasion prevention, and thus returning the obligation of taximeters to the Act would seem to be justified. More research on the reasons behind decreasing turnover rates is needed, and identifying explanations for diminishing tax revenues requires even more detailed data on taxi rides and fares. If the market experiences informalisation due to too stringent market conditions, returning market entry regulation could be beneficial.

The relative amount of tax revenues from taxi industry is not very large, but if the cost of preventing tax evasion is not very high and there are obvious loopholes in the legislation that give incentives to tax evasion, it would be sensible to improve legislation to tackle these shortcomings. Taxi markets may also serve as an example of a deregulation process in a market that is not perfectly competitive, and give valuable information of possible problems that may emerge.

The results form taxi markets also raise the question of reform objective and tool design. Increasing competition should not be regarded as an objective if it does not provide desired results. Competition should be assessed as a tool of producing more efficient markets, not an independent target variable. However, quite often reinforcing competition has become an intrinsic value in the politics. This perplexity also raises some questions of the responsibilities in reform design and implementation. Politicians are responsible for producing reasonable objectives for reforms and determining the desired outcomes. The responsibility of implementation is also on authorities. Hence, whether an objective is defined as the target variable or as a possible tool to reach other outcomes may have an effect on public discussion. Political objectives also are the key of defining the possible tools of the authorities, and unreasonable objectives leave authorities with only bad options. Furthermore, the markets should always be assessed as an entity, and promoting single objectives should not overstep fostering a healthy market functioning as a whole. Increasing competition and lowering prices may be very justified and reasonable targets in some cases, but legislators should also take a note on market operators prospects to conduct sustainable business without the incentives to engage in black market transactions.

It should also be critically assessed, whether the underlying problems of the market are correctly indentified and do the chosen actions correspond to them. One of the main challenges of Finnish taxi markets is that service supply in rural areas is rapidly decreasing. This problem may not arise from taxi market itself but be a reflection of increasing trend of urbanization. The supply of taxis is diminishing in rural areas because the demand is not sufficient and population decreases. If the objective is to guarantee taxi services of good quality in the whole country, the question is how to keep non-urban areas populated enough. Instead of looking at the smaller picture of one market segment, the attention should also be turned into wider issues like whether or not the non-urban areas should stay populated. If the objective is to maintain private sector services also in non-urban areas, the focus should be on improving overall business conditions outside main cities. If politics aim at promoting urbanization, it may be impossible to produce market-driven services in low-demand areas. If it was not possible, the provision of those services should maybe be public.

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A Appendix A

Table 1: Summary statistics for taxi companies of different legal form, months 01/2016-12/2018

		Revenue	VAT-payments	Net-VAT -payments	Variable costs	Payroll	Employer's social security payments
Natural person							
	Mean	8 630,514	864,19	194,40	2 790,81	2 051,31	28,74
	Std Dev	6 539,26	866,85	1 193,92	6 200,81	2 618,15	35,15
	N	102 913	102 913	102 913	102 913	66 616	65 638
General partnership							
	Mean	12 762,35	1 274,73	-96,07	5 711,67	3 747,85	52,20
	Std Dev	12 096,58	1 411,78	1 741,55	8 934,26	4 186,99	63, 10
	N	3 006	3 006	3 006	3 006	1 885	1 860
Limited partnership							
	Mean	11 837,56	1 204,30	208,68	4 148,42	3 493,69	48,49
	Std Dev	11 119,99	1 376,80	1 671,24	8 614,23	4 267,75	65,36
	N	6 281	6 281	6 281	6 281	4 819	4 782
Ltd							
	Mean	27 324,66	2 945,90	42,29	12 098,39	9 239,30	124,33
	Std Dev	79 585,92	9 470, 27	6 538,67	44 665,87	20 513,77	285,88
	N	30 883	30 883	30 883	30 883	27 368	27 308
Other form							
	Mean	5 783, 21	836,01	209,14	2 611,97	4 021,52	55,82
	Std Dev	22 911,62	3 483,09	1 881,16	13 255,07	11 687,50	160,08
	N	7 557	7 557	7 557	7 557	2 280	2 206

Notes: This table shows summary statistics for taxi companies of different legal forms from 01/2016 to 12/2018.

Table 1 presents summary statistics for financial variables for taxi companies grouped by legal form. The table shows that the mostpart of taxi companies are natural persons of their legal form, over 102 000 of altogether slightly over 150 000 taxi companies. The second largest group is Ltd companies with approximately 31 000 observations for 36 months. On average, Ltd companies also have the highest mean turnover of different legal forms, followed by general partnership companies. However, sizable turnover does not seem to directly indicate large net-VAT -payments, as Ltd and general partnership companies on average have relatively high tax deductions and variable costs. Natural person, limited partnership and other, indeterminate legal form companies on average have higher net-VAT payments. For general partnership companies the average of net-VAT payments is actually negative.

Table 2: Summary statistics for taxi companies of different legal forms, one-year period 07/2017-06/2018

Revenue	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	33226	8877,764	6537,549	42739557,51
	General partnership	964	13416,337	12785,954	163480644,4
	Limited partnership	2035	11971,847	11332,828	128433002,4
	Ltd	10245	28298,566	80908,467	6546180187
	Other	2163	6413,836	24736,86	611912242,5
VAT	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	33226	885,140	841,975	708922,514
	General partnership	964	1353,076	1508,493	2275552,051
	Limited partnership	2035	1210,865	1385,135	1918599,845
	Ltd	10245	3117,005	10189,095	103817665,6
	Other	2163	917,542	3704,007	13719673,4
Net-VAT	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	33226	199,158	1213,251	1471978,141
	General partnership	964	-73,254	1773,516	3145359,812
	Limited partnership	2035	210,763	1579,316	2494239,104
	Ltd	10245	36,164	6354,743	40382770,31
	Other	2163	167,601	2017,327	4069610,745
Tax deductions	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	33226	685,982	1524,152	2323040,548
	General partnership	964	1426,330	2253,331	5077503,145
	Limited partnership	2035	1000,101	1935,635	3746683,63
	Ltd	10245	3080,841	11289,917	127462238
	Other	2163	749,941	3636,549	13224493,41
Payroll	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	20686	2223,051	3313,551	10979626,62
	General partnership	586	4214,002	4574,625	20927201,98
	Limited partnership	1521	3552,182	4603,497	21192191,94
	Ltd	8817	9822,302	22254,439	495260086,4
	Other	478	6205,843	14532,213	211185238,6
Social security payments	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	20686	21,638	23,289	542,418
	General partnership	586	41,222	45,277	2050,035
	Limited partnership	1521	34,300	46,659	2177,086
	Ltd	8817	94,838	212,597	45197,730
	Other	478	59,964	141,582	20045,716
All taxi companies	Company form	No of obs.	Mean	Stdev	Variance
	Turnover	48633	13078,786	38817,591	1506805372
	VAT	48633	1379,650	4888,935	23901690,63
	Net-VAT	48633	158,504	3140,857	9864988,102
	Tax deductions	48633	1221,145	5497,116	30218295,16
	Payroll	32088	4469,831	12605,150	158889807,6
	Social security payments	32088	43,280	119,360	14246,821

Notes: This table shows the monthly evolution of variables for taxi companies of different legal forms, from 07/2017 to 06/2018.

Table 3: Summary statistics for bus companies of different legal forms, one-year period 07/2017-06/2018

Revenue	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	371	9532,828	15051,505	226547810,5
	General partnership	82	23655,621	40617,330	1649767529
	Limited partnership	387	22930,731	32118,573	1031602765
	Ltd	1650	99840,491	308918,786	95430816491
	Other	216	94155,767	342753,980	1,174E+11
VAT	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	371	996,686	1570,866	2467623,086
	General partnership	82	2184,083	3593,898	12916109,64
	Limited partnership	387	2298,888	3409,215	11622753,62
	Ltd	1650	9781,502	30407,793	924633886,6
	Other	216	9564,904	32966,830	1086811946
Net-VAT	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	371	-99,232	1932,730	3735446,454
	General partnership	82	242,328	2106,709	4438224,236
	Limited partnership	387	-473,973	3964,853	15720062,61
	Ltd	1650	-2040,522	19313,325	373004532,1
	Other	216	1677,344	15406,631	237364294,3
Tax deductions	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	371	1095,919	2522,900	6365025,135
	General partnership	82	1941,755	3173,082	10068450,7
	Limited partnership	387	2772,861	5653,297	31959768,27
	Ltd	1650	11822,025	40812,508	1665660809
	Other	216	7887,560	29613,858	876980628,9
Payroll	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	128	4143,822	5351,231	28635679,06
	General partnership	52	9003,552	12879,576	165883502
	Limited partnership	255	8247,735	11400,188	129964307,4
	Ltd	1524	32872,214	128415,624	16490572577
	Other	69	126638,106	242568,125	58839295269
Social security payments	Company form	No of obs.	Mean	Stdev	Variance
	Natural person	128	39,103	51,997	2703,711
	General partnership	52	85,775	128,712	16566,940
	Limited partnership	255	80,105	114,811	13181,571
	Ltd	1524	312,677	1184,615	1403314,34
	Other	69	1246,634	2401,191	5765720,694
All bus companies	Variable	No of obs.	Mean	Stdev	Variance
	Turnover	2706	73697,372	263060,073	69200602494
	VAT	2706	7259,436	25815,078	666418275,1
	Net-VAT	2706	-1184,378	15828,386	250537812,8
	Tax deductions	2706	8443,814	33333,430	1111117594
	Payroll	2028	30540,951	121750,9978	14823305470
	Social security payments	2028	292,125	1136,737	1292172,401

Notes: This table shows the monthly evolution of variables for bus companies of different legal forms, from 07/2017 to 06/2018.

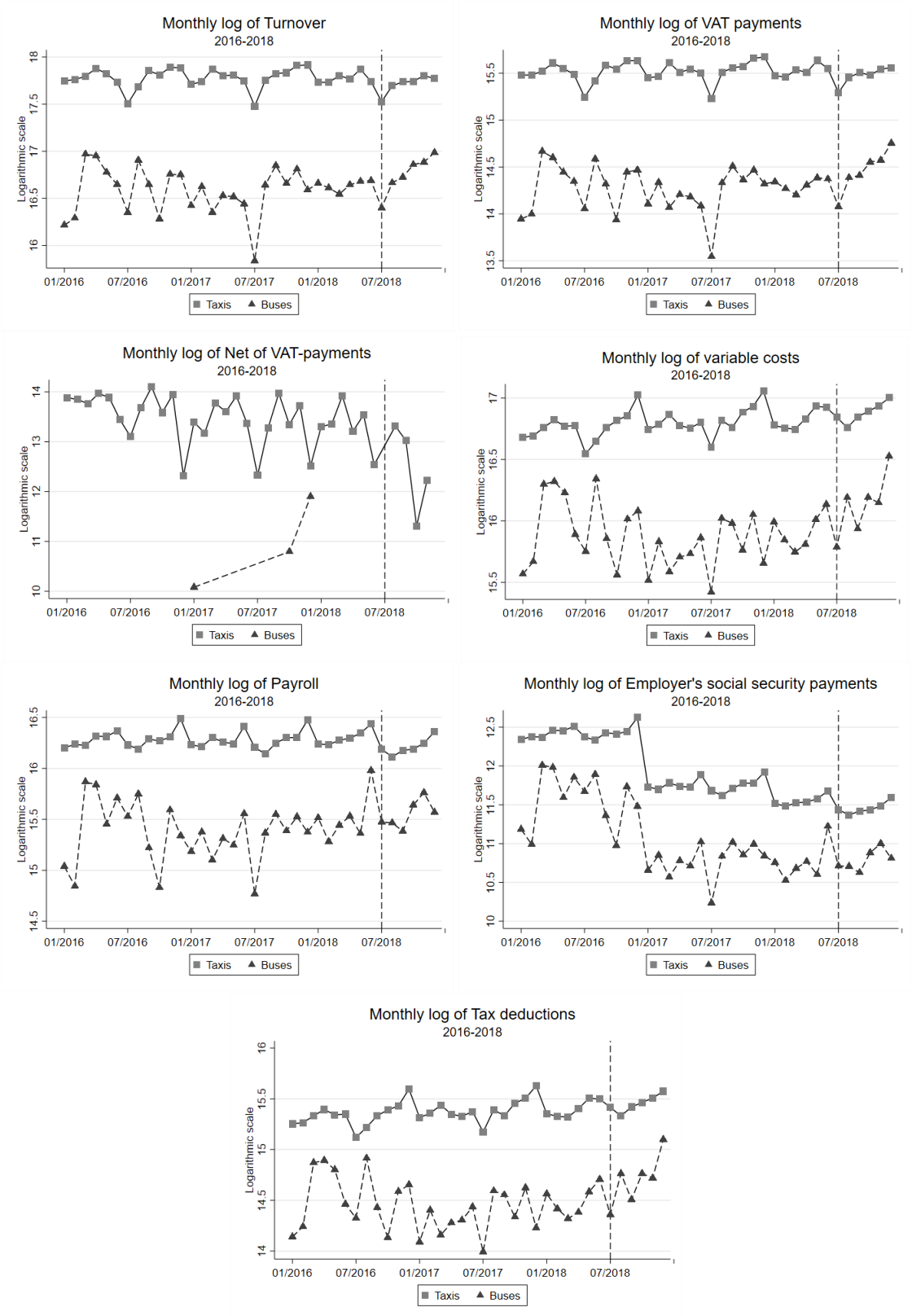

Figure 1: Monthly evolution of financial variables aggregate levels, years 2016-2018

Notes: This figure plots monthly evolution of financial variables, measured on logarithmic scale. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

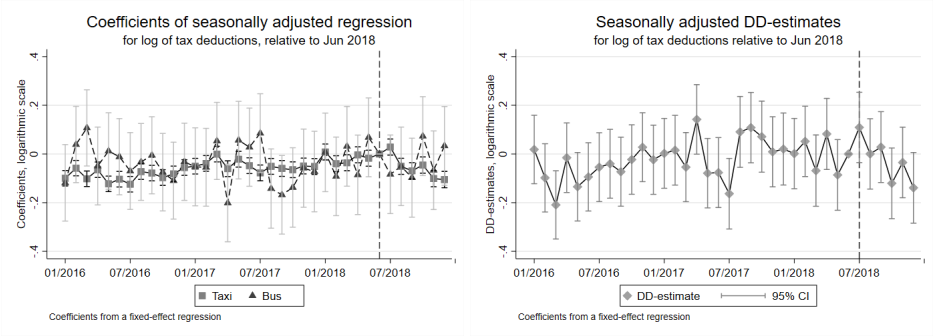

Figure 2: Coefficients of a seasonally adjusted regression and seasonally adjusted DD-estimates for tax deductions

Notes: This figure plot the seasonally adjusted regression coefficients and DD-estimates compared to June 2018. Taxi market deregulation applies from the beginning of Jul 2018, Jun 2018 serves as a reference point and the time of political change is marked with the dashed line.

Table 4: Difference-in difference estimates for taxi companies compared to buses, tax deductions

Tax deductions		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term	δ	-0,021	(0,040)	-0,508	0,611	-0,100	0,059
Industry dummy	γ	0,130	(0,103)	1,260	0,208	-0,072	0,333
Pre-post dummy	ρ	-0,077	(0,042)	-1,837	0,066	-0,159	0,005
Constant	α	-0,067	(0,099)	-0,678	0,498	-0,261	0,127

Notes: This table shows the estimates of seasonally adjusted fixed-effects difference-in-difference analysis with firm-clustered standard errors. The estimates are based on formula (64).

Table 5: Difference-in difference estimates for taxi companies of different legal forms compared to buses, tax deductions

Tax deductions		Coef	Std. Err	T-val	p-val	95% Ci low	95% Ci up
Interaction term 1	δ_1	-0,015	(0,041)	-0,375	0,708	-0,096	0,065
Interaction term 2	δ_2	0,051	(0,053)	0,964	0,335	-0,053	0,156
Interaction term 3	δ_3	-0,050	(0,046)	-1,081	0,280	-0,141	0,041
Interaction term 4	δ_4	-0,120	(0,108)	-1,109	0,267	-0,332	0,092
Legal form dummy 1 : natural person taxi	γ_1	0,093	(0,117)	0,794	0,427	-0,137	0,323
Legal form dummy 2: Partnership taxi	γ_2	-0,224	(0,236)	-0,950	0,342	-0,686	0,238
Legal form dummy 3 : Ltd taxi	γ_3	0,429	(0,203)	2,119	0,034	0,032	0,827
Legal form dummy 4 : other company form taxi	γ_4	0,021	(0,176)	0,119	0,905	-0,325	0,367
Pre-post dummy	ρ	-0,077	(0,042)	-1,812	0,070	-0,160	0,006
Constant	α	-0,079	(0,097)	-0,809	0,418	-0,270	0,112

Notes: This table shows the estimates of seasonally adjusted fixed-effects difference-in-difference analysis with firm-clustered standard errors.

B Optimal tax administration in the context of optimal tax framework

Slemrod (2014) presents a model of optimal income taxation, in which the taxpayer chooses the levels of earned income y and the income that is sheltered, marked with s. Representative taxpayer's tax liability T(y,s,θ) depends on income y, sheltered income s and an n-dimensional vector θ, which represents different tax instruments. The instruments can be continuous with a domain of $\theta \in [0,\infty[$ or they can be binary with a domain of $\theta \in \{0,1\}$. Income sheltering, in other words tax evasion, incurs monetary costs for taxpayers, marked with κ(y,s,θ), and in addition they face compliance costs that have a fixed component for every tax instrument. In most cases the model supposes that the derivative of compliance costs m(θ) is positive, meaning that raising the level of a tax or adding a new instrument increases compliance costs. However, there is a possibility for the derivative being negative, if removing tax shelters decreases or eliminates the incentives to take part in obscure businesses. (Slemrod 2014, 115.)

The objective in social planning is to maximize taxpayer's utility u(c,y) that depends on consumption and income such that society's budget constrain is met. The budget constraint takes the form

$$T((y,s,\theta) = D(\theta) + G, \tag{1}$$

where D(θ) is the function of administrative costs that depend on tax policy applied, and G is an exogenous term, representing public costs and thus tax revenue requirement. Marginal utility of consumption, in other words the first derivative of u(c, y) is positive, but the second derivative is negative, because earning income requires giving up on leisure to increase labor supply. The derivative of D(θ) is also expected to be positive in most cases, indicating that adding or increasing the level of tax instruments is usually costly. However, in some cases it may be that the derivative is actually negative, if it decreases the complicacy of the tax system. The budget constraint for the taxpayer equals consumption to earned income minus cost of compliance and sheltering and the tax liability itself. (Slemrod 2014, 116)

The taxpayer maximizes utility so that the solutions to the problem are

$$[\partial y]\, u_1[(1-T_y) - \kappa_y] + u_2 = 0 \tag{2}$$

$$[\partial s]T_s + \kappa_s = 0 \tag{3}$$

The Lagrangian for the social planning problem is

$$L = \nu(\theta) + \lambda[T(y(\theta), s(\theta), \theta) - D(\theta) - G] \tag{4}$$

in which $\nu(\theta)$ is the indirect utility function of the taxpayer. If θ_i is continuous and the first-order condition is not a corner solution, it can be expressed in the form

$$[\partial \theta_i]\, u_1[T_{\theta_i} + \kappa_{\theta_i} + m_{\theta_i}] = \lambda[T_y \frac{\partial y}{\partial \theta_i} + T_s \frac{\partial s}{\partial \theta_i} + T_{\theta_i} - D_{\theta_i}] \tag{5}$$

in which the term after λ in the right side of the equation represents the marginal revenue that is raised by tax instrument θ_i and the term after u_1 in the left side is the marginal cost of θ_i to the taxpayer. The ratio of marginal cost and marginal revenue of a tax instrument is the marginal efficiency cost of funds for the tax instrument in question. (Slemrod 2014, 116)

Even though it would be possible to prevent all tax evasion, it almost never is optimal. Slemrod (2014, 129) argues

that the habit of determining optimal audit probability by equating marginal audit revenue and marginal administrative costs of audits leads to unduly high audit probabilities. Higher audit probabilities raise the marginal social cost of tax revenue. Thus, marginal revenue of tighter tax enforcement should be higher than just marginal administrative costs. If marginal revenue is instead equated with marginal administrative costs of raising extra tax revenue, it implies that there is no net revenue to be obtained, but the marginal social costs still exist. Instead, audit probability should be defined so that the marginal social cost of audits equals marginal reduction in the excess burden of the taxpayer. (Slemrod 2014, 129.)

One of the problems that effect optimal tax enforcement level is the difficulty to observe individuals' income. The heterogenous taxpayers, whose income depends on personal characteristics, maximize utility that depends on consumption and income. Slemrod (2014, 147-149) analyze the optimal level of income observability in case of linear income tax. Because the authorities cannot observe the precise income level of an individual and instead observe the income level accompanied with exogenous variation term, tax liability becomes uncertain for the taxpayers. The error term is supposed to have certain expected value and variance, and the variance can be reduced by increasing administrative costs. Administrative costs are a function of variance in observed income, and its derivative is negative. This means that when variance rises, administrative costs decrease, and inversely reducing variance requires higher administrative costs. Insecurity of after-tax income in turn reduces the welfare of a taxpayer. (Slemrod 2014, 146-147.)

Slemrod (2014, 147-148) shows that the higher is the marginal change in administrative costs due to a marginal change in observability, the lower is the level of optimal observability and the less resources should be dedicated to make income recording more accurate. In addition, the effect of marginal improvement of observability on earned income should be taken into account. The larger positive the effect is, the greater is the optimal level of observability. (Slemrod 2014, 147-148.)