

VAT reduction and tax incidence: Evidence from a Finnish VAT reform on restaurant services

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ABSTRACT

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VAT REDUCTION AND TAX INCIDENCE: EVIDENCE FROM A FINNISH VAT REFORM ON RESTAURANT SERVICES

Relative to the comprehensive theoretical literature on tax incidence, the empirical research on the subject is still sparse. The purpose of this thesis is to complement the research on tax incidence by studying a tax reform on restaurant services in Finland in 2010. The case study concentrates on defining the consumer price effects of a value-added tax (VAT) reduction of nine percentage points. In addition to the case study, an overview of the existing theoretical and empirical literature on positive and normative aspects of commodity taxation is provided.

The study utilizes the difference-in-differences method with fixed effects specification to reveal the causal effect of tax reduction on consumer price. An EU level directive change facilitated a tax change exogenous to the economic conditions in the Finnish restaurant industry. The counterfactual price development is controlled by the price development in Estonian restaurants. The DID OLS with fixed effects is used to derive an average of the consumer price reduction based on the number of restaurants. The Weighted Least Squares method is applied to provide a sales-based average of the change in the consumer price and thus to reflect the change in the restaurant expenses of an average consumer.

The study found undershifting of tax change to consumer prices. The price reduction of 2,3 percent translates into a pass-through rate of 31 percent. The chain restaurants and the restaurants belonging to the labor market organization and lobbyist MaRa demonstrate a higher-than-average reduction in the consumer price, being 4,6 percent and 4,1 percent, respectively. The sales-weighted average of the pass-through rate is higher than the average based on the number of restaurants, revealing the higher tendency of high-sales restaurants to shift tax reduction to their prices. The sales-weighted average of the price effects ranges from 5,3 to 6,5 percent, corresponding to a 71 to 88 percent pass-through rate of tax change, depending on the definition of weights.

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ARVONLISÄVERON VÄHENNYS JA VERON KOHTAANTO: TUTKIMUS SUOMEN RAVINTOLA-ALAN VEROUDISTUKSEN SEURAUKSISTA

Tämän tutkielman tavoitteena on täydentää veron kohtaannosta tehtyä empiiristä tutkimusta hyödyntäen Suomessa vuonna 2010 toteutettua verouudistusta, jossa ravintolapalveluiden arvonlisäveroa laskettiin yhteensä yhdeksän prosenttiyksikön verran. Aiheesta julkaistuun teoreettiseen kirjallisuuteen verrattuna veron kohtaantoa on tutkittu empiirisesti vasta vähän. Tutkimus pyrkii selvittämään arvonlisäveron alennuksen vaikutuksen kuluttajahintaan. Lisäksi tutkielma luo katsauksen kulutusverotuksen teoreettiseen ja empiiriseen kirjallisuuteen sekä positiivisesta että normatiivisesta näkökulmasta.

Tutkimuksessa hyödynnetään difference-in-differences (DID) –menetelmää veronalennuksen kausaalisen kuluttajahintavaikutuksen selvittämiseksi. EU-tason direktiivimuutos mahdollisti veromuutoksen, joka oli riippumaton Suomen ravintolasektorin taloudellisesta tilanteesta. Veronalennuksen hintavaikutus pyritään erottamaan muista kuluttajahintaan vaikuttavista tekijöistä käyttämällä Viron ravintolahintojen kehitystä vaihtoehtoisen hintakehityksen kontrolloimiseen. Hintamuutoksen ravintoloiden määrään perustuva keskiarvo määritetään DID – menetelmällä käyttäen kiinteiden vaikutusten (fixed effects) mallia ravintolakohtaisten ajassa muuttumattomien tekijöiden huomioimiseksi. Myynnillä painotettu hintamuutoskeskiarvo saadaan Weighted Least Square -menetelmää hyödyntäen. Jälkimmäinen estimaatti kuvaa paremmin keskimääräisen kuluttajan ravintolapalveluihin kuluttaman summan muutosta.

Tutkimustulokset osoittavat kuluttajahintojen laskeneen veronalennuksen seurauksena keskimäärin 2,3 prosenttia. Veronalennus siirtyi siten 31-prosenttisesti kuluttajahintoihin. Hinnanalennus oli keskimääräistä suurempi ketjuravintoloissa sekä alan edunvalvojajärjestö MaRaan kuuluvissa ravintoloissa. Edellisissä hinnan alennus oli 4,6 prosenttia, kun taas jälkimmäisissä kuluttajahinnat laskivat keskimäärin 4,1 prosenttia. Liikevaihdolla painotettu keskiarvo osoittaa hinnan laskeneen keskimääräistä enemmän myös sellaisissa ravintoloissa, joissa on suhteellisesti paljon myyntiä. Liikevaihdolla painotettu hintavaikutuskeskiarvo on 5,3-6,5 prosenttia riippuen painojen määrittelytavasta. Tällä mittarilla mitattuna veronalennus siirtyi 71-88-prosenttisesti hintoihin.

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1. Introduction

1.1. Motivation and background

Value-added tax (VAT) has become an important source of tax income in modern economies (OECD 2006). It is the most common form of commodity taxation, and it is applied generally in nearly all OECD countries with the exception of the United States. Its contribution to the total tax income has increased in Finland during the last 15 years, being the only source of tax income of the kind (Statistics Finland 2010). The increasing use of the tax instrument emphasizes the significance of appropriate VAT rates and system design. In the past, variation in tax rates has risen from the needs of public finance. Also unemployment, environmental issues and varying health concerns have been addressed by either raising or decreasing the VAT rates. Recently, many developed economies have had to revise the VAT system to answer to the future challenges of globalization, environmental threats and aging population (Mirrlees et al 2011, Ministry of Finance 2010b). This thesis will focus on studying tax incidence, i.e. the distribution of tax burden between producer and consumer; a subject studied disproportionately little compared to its relevance regarding the success of tax policies.

The tax reforms are many times targeted to influence demand or to build up employment in the sector in question (e.g. EUR-Lex 1999). When a reform is discussed, it is often assumed that the whole tax change is reflected in consumer price, which then induces the desired effects on demand and sector employment. The assumption is not limited to political debate; also, many applied studies on commodity taxation, e.g. studies on environmental taxation (Fullerton and Kim (2008), West and Williams (2004), Bento, Goulder, Jacobsen and van Haefen (2009) etc.), disregard the considerations of tax incidence, i.e. whether the consumer actually bears the whole burden of taxes. The subject has not been studied extensively, and the existing theoretical and empirical research seems to suggest that the full pass-through of tax to consumer prices might only be a special case. As the price responses define the potential extent of the indirect consequences of a tax reform, the tax incidence deserves to be studied in more depth.

Studying tax incidence algebraically in the partial equilibrium framework indicates that the price responses depend largely on demand and supply characteristics. When supply is a lot

more elastic than demand, as is assumed in the long-run case of perfect competition, the model predicts nearly complete shifting of taxes to consumer prices. The application of partial equilibrium framework, however, implies a number of restrictions on market behavior. Considering tax incidence with supply inelasticities or in imperfectly competitive markets shows that full shifting is rather an exception. These supply inelasticities may be short-run, or spur from permanent market characteristics, such as barriers in market entry. Marginal costs, the level of competition and demand characteristics define the amount of pass-through in the case of imperfect competition, concavity of demand resulting in tax undershifting. Full consumer price response follows only in the case of Bertrand competition. (Myles 1995.)

For defining the relation of theoretical predictions and the reality, empirical research is crucial. Although the number of the studies on the subject is increasing, research applying scientific methods is still limited to a few research papers and the results remain mixed. Evidence of full pass-through and over- and undershifting have all been found by researchers. Poterba (1996) studied tax incidence in three commodity groups with a city-specific consumer price index data from the United States. Full shifting of taxes was found during the 1947-1977 period while the estimates from the earlier data set from the Depression period indicated undershifting of taxes to consumer prices. Alm, Sennoga and Skidmore (2009) found instant and full shifting of gasoline taxes to consumer prices studying a monthly data set from 50 U.S. states. The urban, more competitive states exhibited slightly higher pass-through rates than the rural ones.

Besley and Rosen (1999) discovered differing results from an 8-year quarterly U.S. data set on consumer prices of well-specified commodities. For more than half of the goods studied, the pass-through estimates indicated overshifting of taxes while for the rest complete shifting cannot be statistically rejected. As opposed to Besley and Rosen, Doyle and Samphantharak (2008) found undershifting of excise taxes to gasoline prices in the context of tax suspensions. Following tax reinstatements, taxes were passed on by 80-100 percent. The research was conducted on daily U.S. data set using price development in the neighboring states to control for counterfactual price development.

In Finland, Peltoniemi and Varjonen (2010) examined a tax reform on groceries. The tax reduction resulted in a sharp decrease in consumer prices. The price reduction translated into a 121 percent pass-through rate when the goods experiencing high seasonal variation were excluded from the examination. Kosonen (2010) studied tax incidence on hairdressing

services in the context of a tax reduction of 14 percentage points. A difference-in-differences set-up was used to disentangle the causal price effect of the tax reform from other price-affecting factors. Kosonen estimated a pass-through rate of tax of around 60 percent. Additionally, Kosonen found variation in consumer price responses across firm types, the large corporations exhibiting the highest pass-through rates.

The mixed results reflect the lack of consensus of the implications of the tax changes. The differences in the results may partly be attributed to market power. Also, the variation across studies might result from differences in the specification of the goods examined, the reasoning behind executing a tax policy or the methods applied for controlling other price-affecting variation. Above all, the contradicting results stress the necessity for further examination of tax incidence. This thesis aims to contribute to the understudied field of tax incidence by analyzing a short-term consumer price change in the context of a Finnish VAT reform on restaurant services in 2010.

1.2. Objective, methodology and findings

The principal research problems of the thesis could be formulated as *What consequences does setting or changing the value added tax induce? What determines the potential extent of the effects of a tax reduction?* For a comprehensive view, these questions are addressed first by providing an overview of the tax incidence theory and the predicted impacts of the tax changes. Second, a normative analysis of commodity taxation is presented. The normative theories investigate how an optimal commodity tax system should be organized. Approaching commodity taxation from a normative aspect provides insight on effective taxation and the use of differentiated tax rates. Then, a review of empirical literature on tax incidence enlightens the link between tax incidence theory and the reality and goes over the existing evidence of the pass-through rates. Finally, a case study of tax incidence on Finnish restaurant industry is performed to further illustrate the subject.

The case study concentrates on estimating the consumer price change originated by the tax reform in the Finnish restaurant industry in 2010. An EU-level directive change provided an exogenous source of state-level variation in the tax policy and facilitated the application of natural experiment design for studying the causal consumer price reactions. The causality of price development to the tax reform is taken notice of by using a control group of Estonian restaurants to distinguish the effect of the tax reform from other factors contributing to the price development. A micro-level data set, collected from a randomized sample of restaurants

before and after the tax reform, allowed the derivation of exact pass-through estimates. The method applied in our study is the difference-in-differences (DID) technique with fixed effects specification. To reflect the extent in which the tax change affects the restaurant expenses of an average consumer, a sales-weighted average is estimated in addition to the average based on the number of the restaurants.

Independent on whether a number-based or a sales-based average of the consumer price reduction is observed, the estimates indicate undershifting of the tax change. The estimate for the average causal effect of the tax reduction on consumer prices is -2,3 percent, corresponding to a 31 percent pass-through rate. The chain restaurants and the restaurants belonging to the labor market organization and lobbyist MaRa demonstrated a higher-than-average reduction in consumer price, being 4,6 percent and 4,1 percent, respectively. The estimate of the sales-weighted average of the price reduction varies between -5 - 6,5 percent, depending on the highly arbitrary choice of weight. This translates into a 71 - 88 percent pass-through rate.

Our results are supported by two other studies examining the Finnish 2010 VAT reform by Peltoniemi and Varjonen (2011) and Harju and Kosonen (2010). Our data set, collected by the Government Institute for Economic Research, was utilized also in the latter research paper. Additionally, the method applied is the same. As for Peltoniemi and Varjonen (2010), the researchers used a distinct method and data set. Both studies found evidence of undershifting of tax reduction to consumer prices as a consequence of the reform. Although this result contradicts some of the earlier research, it is in line with the principal reference studies by Doyle & Samphantharak (2008) and Kosonen (2010), whose methods also incorporate considerations on policy endogeneity and counterfactual price development. Correspondingly, these studies found undershifting as a response to tax reductions.

1.3. Structure of the thesis

The thesis consists of nine chapters. In the second chapter, the general properties of VAT and the EU and Finnish level legislation governing VAT collection are introduced. Chapter 3 presents the predictions of the economic theory regarding the tax incidence both in competitive and imperfectly competitive markets. Then, in Chapter 4, a limited analysis of the normative aspects of commodity taxation is provided. Chapter 5 represents the empirical research on tax incidence. Background, methods and the data set are introduced in Chapter 6,

and in Chapter 7 the empirical analysis is carried out. Chapter 8 discusses the outcomes of the empirical analysis, and Chapter 9 concludes.

2. VAT in general

2.1. General properties of VAT

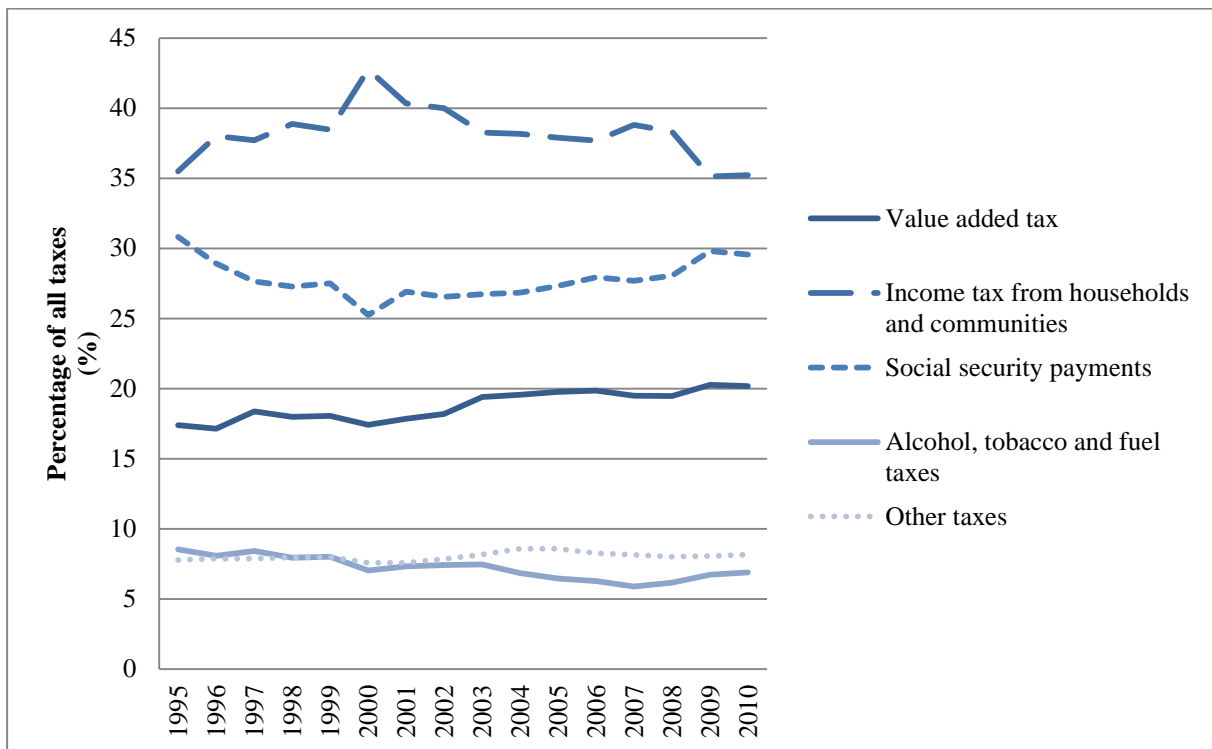
Value added tax is a general, broad-based consumption tax, assessed on a sale of good as a percentage of the good's value. VAT is charged at the time of selling, and it is remitted to the tax authorities by the seller. The amount of tax is calculated as a percentage of the producer price. The consumer price thus consists of two components: the producer price and the VAT. The seller remits the tax forward, deducted by the amount of tax that has been charged as a part of the input prices. This property of VAT ensures that the tax only falls on the value added in the production, so that taxes do not overlap.

The most common forms of commodity taxation are an *ad valorem* tax and a specific, or a unit tax. *Ad valorem* translates from Latin to 'according to value': the amount of tax is based on the value of the good rather than the number of units produced or sold. VAT, being proportional to the value of the good, is an *ad valorem* tax.

Whereas the amount of VAT is based on the value of a good, the unit tax is often a given sum per one unit sold. Excise tax is a tax set on the production of the good for sale within a country. These taxes are typically unit taxes. Examples of goods subject to excise taxes are alcohol beverages, tobacco and gasoline. The amount of alcohol tax, for instance, is typically determined by the product's concentration of ethyl alcohol in volume units.

The value added tax was introduced in Finland in 1994 (FINLEX 1993) when the former sales tax was substituted and the tax system was reformed to comply with the EU directives. The VAT becoming more general has been a typical development in industrialized countries: over the last decades, nearly all OECD countries except for the United States have adopted the use of VAT (OECD 2006). The US sales tax system forms the most significant exception to the VAT adoption pattern globally. In Finland, around 15 billion euros of tax revenue are collected through VAT every year (Statistics Finland 2010). It accounts for roughly 20 percent of the total tax income. As demonstrated in Exhibit 1, VAT has been the only type of tax with a constant or growing share of the total tax revenue over the last fifteen years.

Exhibit 1. Sources of tax revenue in Finland.



Source: Statistics Finland (2010).

VAT possesses certain useful characteristics. As the seller can deduct the taxes included in the input prices from the tax bill, no taxes are levied on intermediate goods. This property fits the Diamond-Mirrlees production efficiency result (1971a) which, given a set of assumptions, supports no taxes on intermediate goods for ensuring production efficiency; even though distortions in consumption are inevitable for collecting tax income, distortions in production should not be allowed. Though the assumptions by Diamond and Mirrlees are many times not met in reality, the production efficiency result provides an important guideline for commodity taxation and is a weighty argument in the favor of VAT.

The fractional nature is another favorable property of VAT. VAT is collected at each stage of the production chain, and thus remitted forward to tax authorities in smaller disbursements. The VAT paid at the sale of the good to the final consumer indeed accounts for the whole amount of value added in the production process. However, the final seller only remits to the tax authorities this tax deducted by the input taxes – the input taxes have been remitted forward earlier in the production chain. Thus, the loss associated with possible tax evasions in the production chain is smaller than with e.g. a retail sales tax. Moreover, the benefit of tax evasion being smaller, also the incentive for tax evasion is lower with VAT. (Mirrlees et al 2011.)

Internationally the most general way to organize VAT in cross-border trade is the *destination principle*. In the trade between different countries, it is applied for equitable treatment of imports and domestically supplied goods. According to the principle, taxation takes place where the goods are consumed. Thus, exports are left untaxed and imports are taxed at the domestic rates. The destination principle sets the imported and domestically supplied goods in the same position; both face the same VAT rate. (Mirrlees et al 2011.)

As a drawback of the destination principle, the fractional nature of VAT is lost in cross-border trade. As the exports are zero rated, there are no deductions to claim by the importer. At the sale, importer then collects VAT for the total value of the product. The net VAT liabilities become large, and problems with compliance arise. The *Missing Trader Intra-Community (MTIC)* fraud occurs when importer disappears without remitting the tax forward to the Government. Carousel fraud is a form of MTIC fraud with a chain of defrauder companies involved. The costs from MTIC frauds are substantial, and rethinking the destination principle in such a way that these frauds could be avoided remains a future challenge. (Mirrlees et al 2011, Chapter 7.)

2.2. VAT legislation at the EU level

Finland, as a member state of the European Union, must comply with the Union's VAT Directives. The harmonized VAT legislation for the Union countries has been developed to promote efficient functioning of the union-wide inner market. Value-added tax must be paid on goods that are consumed in the Union area. Thus, sales to be consumed outside of the Union area are typically tax free. (European Commission Taxation and Customs Union A.)

The aim of the Union-wide system is to tax goods and services in the country of consumption. The system is origin-based for a single consumer: the VAT rate applied to a consumer's purchases is determined by the legislation of the country of purchase, with the exception of consumers outside European Union. However, the destination principle, explained in the previous section, is applied to the trade between taxable persons¹. (European Commission Taxation and Customs Union A.)

VAT legislation in the Union is to a large extent based on the Directive 2006/112/EC. In most cases, the consumption goods are subject to a general VAT rate of at least 15%. In addition, the directive allows the application of one or two reduced rates. Both these rates must be

¹ "For VAT purposes, a taxable person is any individual, partnership, company or whatever which supplies taxable goods and services in the course of business." (European Commission Taxation and Customs Union)

equal or above 5%, and they can only be applied to goods and services determined in the VAT Directives. EU legislation sets a minimum to the rates, not exact rates to be applied. Also, supplies of certain goods are exempt from VAT. For example education and certain financial services belong to this group. In addition to these simple rules, the VAT system is complicated by the numerous derogations granted to the member states. Some member states are allowed to apply zero rates on certain groups of goods and services due to their country-specific circumstances. (European Commission Taxation and Customs Union B.)

Labor-intensive services are subject to special treatment in the EU VAT legislation. In 1999, European Union adopted a directive that allowed the application of reduced VAT rates on certain labor intensive services (EUR-Lex 1999). The directive was enacted to explore the effects of reduced VAT rates on employment and the size of the black economy on an experimental basis. The services specified included hairdressing and repairs of bicycles, shoes and leather goods, among others. The reduced rates were extended several times until, in 2009, Directive 2009/47/EC was enacted. The directive allowed the application of reduced VAT rates on a permanent basis and included restaurant services within their scope. The enforcement of the reduced rates was set voluntary. The directive came into force in June 2009. (EUR-Lex 2009.)

2.3. VAT legislation at the Finnish level

The Finnish VAT legislation corresponds to the EU VAT directives and also defines the exact rates applied in the Finnish taxation. Åland forms an exception, as the group of islands was negotiated a special status and left outside the taxation union when Finland joined the group of Union countries in 1995 (Tax Administration).

In Finland, the general VAT rate is set at 23%. It was raised by one percentage point from 22% in 2010. The reduced rates are 9% for e.g. medicine, transportation, books, accommodation services, subscriptions for newspapers and tickets to cultural events, and 13% for food, non-alcoholic beverages, restaurant services and feed. The sale of a large watercraft not used for amusement purposes is zero-rated. (Ministry of Finance 2010a, FINLEX 2011.)

In 2006, Finland joined the group of countries experimenting with labor-intensive services (FINLEX 2006). Reduced VAT rates were applied to hairdressing and small repairing services of bicycles, shoes and leather goods, clothing and linen. The tax rate of 22 percent

was decreased to 8 percent from the beginning of 2007. The originally three-year experiment was extended in 2010 to last for an additional year (FINLEX 2010).

In 2009, the VAT for groceries was reduced to 12 percent, the lower of the reduced rates at the time (FINLEX 2008). As a consequence of the reduction, the gap between the VAT rates in food from grocery stores and restaurants increased to ten percentage points. Take away food and meals eaten in a restaurant were treated differently in taxation, sales of the take away food benefiting from the lower rate. The unequal taxation of the two led to growing pressure to decrease VAT rates for the restaurant services as well (Taloussanommat 2009b, Elonon et al 2009 etc.).

After Directive 2009/47/EC allowed the application of reduced VAT rates on restaurant services, France and Belgium were the first countries to put the tax reduction in action (Peltoniemi & Varjonen 2011). Finland followed in July 2010 by decreasing the VAT rate on restaurant services by eight percentage points from 22 to 13 percent (FINLEX 2009a). The policy change was made possible by the directive change at the Union level, and as described in the previous section, the directive embodied other labor intensive services as well. The preceding facts give a credible reason to believe that the Finnish tax change was exogenous of the specific economic conditions on the Finnish restaurant industry. Thus, the setting is usable for studying the incidence of tax reduction on labor-intensive services.

3. Theory of tax incidence

When a tax is set, is it the consumer price that increases or the producer price that decreases more? How is the burden of a tax distributed between the market parties? Tax incidence theory aims to answer these questions on a general level. For analyzing the empirical results provided later in Chapter 7, a theory framework on tax incidence is necessary. The impact of levying a tax upon the prices and the utilities of economic agents are of concern here. In imperfectly competitive markets, the profits of the producer are also a topic of interest.

Tax incidence is essential when considering the consequences of a given policy. Job creation and fighting the informal economy were stated as the primary reasons for European Commission to introduce reduced VAT rates on labor-intensive services, among them restaurant services (EC Taxation and Customs Union C). Reaching these policy objectives involves a series of effects. For labor demand to increase there must be a need for additional supply of services. Thus, tax reduction must induce additional demand, and lower consumer prices are essential in achieving this. How consumer prices react as a consequence of a tax reduction is a subject of tax incidence theory and also the topic of our research.

This chapter is divided into sections to study tax incidence under different intensities of competition. First, tax incidence under perfect competition is presented. Then, an illustration of tax incidence in a monopoly is provided, with restricting assumptions of linear demand and constant marginal costs. These restrictions are loosened in Section 3.3., where a more general model of tax incidence in imperfectly competitive markets is examined.

3.1. Tax incidence under perfect competition

3.1.1. Partial equilibrium model

In this section, tax incidence is studied in the partial equilibrium framework under the assumptions of perfect competition. The partial equilibrium framework focuses on the effects of the tax in the market in question and ignores the interactions between markets, e.g. the effect of the tax on labor demand. This framework is useful in identifying the primary impacts of taxation. It might also be a relatively realistic description of the reality in the case that the markets of the taxed good are small relative to the whole economy (Tuomala 2009, 166).

In the absence of tax, consumer price and producer price, i.e. what producer earns per one unit sold, are equal. Denote q = consumer price and p = producer price. The market equilibrium is

defined by demand and supply, $D(q) = D(p) = S(p)$. When an ad valorem tax is imposed, consumer price differs from the producer price by the amount of tax. Let the tax rate be denoted by t , and the consumer price by $q = (1 + t)p$. The difference between consumer and producer prices is now given by tp .

The impact of imposing a tax can be derived from the market clearing condition

$$D((1 + t)p) = S \quad (1)$$

The derivation yields

$$\frac{\partial \log p}{\partial t} = -\frac{\varepsilon_D}{\varepsilon_D + \varepsilon_S} \quad (2)$$

for the effect of tax on the producer price (Appendix 2). ε_D denotes the price elasticity of demand and ε_S the price elasticity of supply. Correspondingly, the tax's effect on consumer price becomes

$$\frac{\partial \log q}{\partial t} = \frac{\varepsilon_S}{\varepsilon_S + \varepsilon_D} \quad (3)$$

(Appendix 3). The effect on the demand for the good is given by

$$-\frac{\partial \log D}{\partial t} = \varepsilon_D \frac{\partial \log q}{\partial t} = \frac{\varepsilon_D \varepsilon_S}{\varepsilon_S + \varepsilon_D} \quad (4)$$

With the new price $q = (1 + t)p$, the consumer is likely to consume less of the good. At the new market equilibrium, the amount exchanged is smaller, the consumer price is higher and the producer price is lower.

The formula 3 above indicates that the effect of the tax on consumer price is likely to be between zero and the size of the tax, with the infrequent exception of the Giffen good. Note that when the demand is not inelastic, consumers adjust their behavior and decrease the consumption of the good in question. If the supply was perfectly elastic, the amount exchanged in the market would decrease but the producer price would not, as the firms in the perfectly competitive markets would price at their marginal costs. Perfectly elastic supply is, however, not what we usually expect when inspecting the short-term impacts on the market equilibrium.

The preceding formulas indicate that the tax burden is divided between the market parties based on the elasticities of supply and demand. The tax burden falls more heavily on the producer as a lower producer price if the demand is relatively more elastic. Correspondingly, the consumer ends up bearing the majority of the tax burden if the supply is more elastic than demand. As a rule of thumb, the tax falls more heavily on the less elastic side of the market. The decrease in the quantity exchanged in the market is the greater the more elastic supply and demand are. It should be noted that the tax is shifted forward to the consumer price by its whole amount only if the supply is much more elastic than the demand, $\varepsilon_S \gg \varepsilon_D$.

As was shown above, the price responses follow from demand and supply characteristics. In the framework of perfect competition, there are no barriers of entry or exit, and elastic supply is thus assumed in the long run. As the elasticity of supply increases, the effect of the tax on consumer price becomes

$$\frac{\partial \log q}{\partial t} = \lim_{\varepsilon_S \rightarrow \infty} \frac{\varepsilon_S}{\varepsilon_S + \varepsilon_D} = \lim_{\varepsilon_S \rightarrow \infty} \frac{1}{1 + \frac{\varepsilon_D}{\varepsilon_S}} = \frac{1}{1 + 0} = 1 \quad (5)$$

Thus, in the context of perfectly elastic supply, the consumer price increases by the amount of the tax in the long run. Firms price at their marginal costs, and there are no pure profits. If a tax is introduced, the effect is equal to an upward shift in the marginal costs. Vice versa, if a tax is removed, the short-run profits disappear when new competitors enter the market.

3.1.2. General equilibrium model

By far, tax incidence has been studied in the partial equilibrium framework. In the partial equilibrium model, effects on the price level and other markets in the economy are not taken into account. Nor does the analysis include considerations of the use of the tax revenue or the effect of the increased tax rate on the income level. The Harberger model (1962) is often used to model these effects. Even though aiming to a more sophisticated description, it cannot still capture all relevant characteristics of the real world. Only infinitesimal taxes can be studied, having a zero-tax situation as a starting point.

The Harberger model assumes a closed two-good economy with two inputs, capital and labor. The inputs are mobile across sectors. The production technology exhibits constant returns to scale. Demand is a function of relative prices and total production only; identical and homothetic preferences are assumed.

The starting point is an economy without taxes. The cost functions are proportional of production level, i.e. marginal costs are constant. The demand equals supply, the prices equal marginal costs and the total income in the economy equals the sum of factor incomes and GDP. This leads to a system of equations. When taxes are introduced, the system can be used to study their effects on the prices and quantities exchanged. It is used as a basis for *computable general equilibrium* (CGE) models and various analyses of existing tax systems. (Salanié 2003.)

The model reveals the interactions between markets. When a value added tax is introduced in the commodity markets, it has an impact on the factor market equilibrium through the *volume effect*. A tax leads to an increase in the after tax price of the good. This decreases demand of the good. In the factor market, labor demand decreases consequently if the sector in question is relatively labor intensive. This, in turn, reduces the relative labor income. (Salanié 2003.)

The Harberger model provides a basis for outlining the job creation argument by the European Commission. A tax decrease on labor-intensive services is expected to induce the following volume effect: prices decrease, demand for restaurant services shifts upwards and labor demand increases. Alongside, this is likely to boost wages and employment.

There is another supportive argument for the success of the policy objectives that is related to the labor-intensity of the sector. Typically, labor is more flexibly adjusted than capital, and thus supply in the labor-intensive sectors can be assumed more elastic than in the capital-intensive ones. In the restaurant industry, both supply and demand can thus be reckoned relatively elastic. Based on the suggestive partial equilibrium formulas 2-4, the theory thereby predicts large demand effects in the industry.

Analyzing tax incidence under perfect competition provides a framework for considering the impacts of imposing a tax. However, many factors are known to contradict the assumptions of perfect competition, and imperfect competition is often considered as a more realistic representation of reality. In the next section, tax incidence under market power is studied.

3.2. Tax incidence in monopoly

Tax incidence becomes more complex when relaxing the assumption of perfect competition. Firms do not set prices at the level of marginal costs, but above. The firms make non-zero profits, and these profits will also be influenced by taxation.

For a monopoly, the price setting behavior differs from that of a firm in perfectly competitive markets. The monopoly producer has to consider the effect of the pricing decision on consumers' behavior. The monopolist faces decreasing marginal revenue curve arising from the adjustments of consumption by consumers in the association with price changes. The monopolist maximizes

$$\pi = pD(q) - C(D(q)) = \frac{q}{1+t} D(q) - C(D(q)) \quad (6)$$

, where $D(q)$ is a decreasing function in price.

By assuming linear demand $D(q) = a - q$ and constant marginal costs $MC = c$, profit maximization yields the effects of the tax change

$$\frac{\partial \log q}{\partial t} = \frac{c}{a+c} \quad (7)$$

(Appendix 4). As a is naturally above zero, this is always smaller than one and thus indicates a pass-through rate of *less* than 100%. This is, however, a formula developed as a result of many restrictive assumptions.

With linear demand, theory predicts an increase in the price less than the amount of tax. However, when restricting the assumptions, taxes can also shift to prices more than completely; this is the case when the marginal cost curve for the monopolist slopes downwards, which is a theoretical and unlikely case, accompanied with sufficient concavity in the demand for monopolist's product (Bishop 1968).

The little illustrative example with linear demand function was derived to demonstrate how the tax incidence in a monopoly differs from that in perfect competition, when all market power is possessed by only one market actor. The analysis in the next section allows for varying levels of competition and a more general form of the demand function.

3.3. Tax incidence in oligopoly

The analysis of tax incidence under imperfect competition follows that of Myles (1995). Myles introduces a general equilibrium economy model, where part of the economy is imperfectly competitive. The representation provides a general framework for considering tax incidence for varying intensities of competition. To simplify the analysis, the results are derived for a specific, i.e. unit, tax.

Assume we have an industry with a fixed number m_i of firms, with identical cost functions and the same expectations of other firms' behavior. The equality of firms in these respects implies the existence of equilibrium, with all firms producing the same amount of output. Labor is the only input used in the production, and labor markets are competitive, with constant returns to scale. The inverse demand function for the industry is denoted by

$$q_i = \phi_i \left(\sum_{j=1}^{m_i} x_i^j, q_k \right) \quad (8)$$

, where q_i is the consumer price of good i , x_i^j the output of firm j and q_k some representative other price, reflecting that the demand is also affected by the prices of other goods. Firms maximize profit, taking into account the impact of their production decisions on the price q_i . The profit function for firm i is

$$\pi_i^j = x_i^j \phi_i \left(x_i^j + \sum_{\substack{j'=1 \\ j' \neq j}}^{m_i} x_i^{j'}, q_k \right) - t_i x_i^j - C(x_i^j) \quad (9)$$

The cost function $C(x_i^j)$ is the same for all firms in the industry.

Then, assume that each firm holds an expectation, i.e. a conjecture, of how the other firms will react on its choice of production level. The conjecture can be defined as

$$\lambda = \frac{\partial \left(x_i^j + \sum_{\substack{j'=1 \\ j' \neq j}}^{m_i} x_i^{j'} \right)}{\partial x_i^j} \quad (10)$$

, i.e. how the firm's production decision changes the decisions of others. As the profit maximizing condition becomes

$$\frac{\partial \pi_i^j}{\partial x_i^j} \equiv q_i - t_i + x_i^j \lambda \frac{\partial \phi_i}{\partial X_i} - \frac{\partial C}{\partial x_i^j} = 0 \quad (11)$$

, we are able to interpret λ . $\lambda = m_i$ reflects the situation where the set of firms would behave together like a monopoly and maximize the *sum* of profits. $\lambda = 1$ represents Cournot behavior, i.e. firms maximize their profits given the reaction functions of other firms in the market.

When $\lambda=0$, the producer price equals the marginal costs². This situation arises as a result of Bertrand price competition.

The total derivative of the consumer price q_i with respect to tax rate t_i can be used to assess the effect of imposing a tax on the consumer price, or, in other words, the *degree of forward shifting*. It is given by

$$\frac{dq_i}{dt_i} = \frac{m_i \frac{\partial \phi_i}{\partial X_i}}{[m_i + \lambda] \frac{\partial \phi_i}{\partial X_i} + x_i m_i \lambda \frac{\partial^2 \phi_i}{\partial X_1^2}}. \quad (12)$$

To derive this, marginal costs are assumed to be constant, $MC = c$.

The result above proves that a full pass-through of taxes is in most cases inadequate assumption under imperfect competition. The degree of forward shifting, given by the formula, only equals one, or 100%, when $\lambda = 0$, as is the case with Bertrand competition. The degree of forward shifting depends on demand curvature. In the case of *overshifting*, the prices shift by more than the change in the tax is and $\frac{dq_i}{dt_i} > 1$. The condition for overshifting can be written as

$$\frac{\partial \phi_i}{\partial X_i} > -x_i m_i \frac{\partial^2 \phi_i}{\partial X_i^2}. \quad (13)$$

The tax is overshifted, when the slope of the inverse demand curve, $\frac{\partial \phi_i}{\partial X_i}$, is positive and there is sufficient convexity in the inverse demand function. *Undershifting*, prices increasing by less than the increase in the tax, occurs when demand is concave. The tendency for either over- or undershifting holds both for monopoly and oligopoly – only with Bertrand competition, $\lambda = 0$, the pass-through rate is 100%.

The precise effect on profits can be derived by differentiating the profit with respect to t_i . The profit can be written as

$$\pi_i^j(t_i) = x_i(t_i)[q_i(t_i) - t_i] - C(x_i(t_i)) \quad (14)$$

, and derivating with respect to t_i and reformulating yields

² Because $x_i^j \lambda \frac{\partial \phi_i}{\partial X_i} = 0$ and $\frac{\partial C}{\partial x_i^j} = q_i - t_i$.

$$\frac{d\pi_i^j}{dt_i} = \frac{-\left[2x_i \frac{\partial \phi_i}{\partial X_i} + x_i^2 m_i \lambda \frac{\partial^2 \phi_i}{\partial X_i^2}\right]}{[m_i + \lambda] \frac{\partial \phi_i}{\partial X_i} + x_i m_i \lambda \frac{\partial^2 \phi_i}{\partial X_i^2}} \quad (15)$$

Surprisingly, following a tax increase, firms' profits may even increase; the denominator can take both a positive or a negative sign. The decrease in production levels of firms as a consequence of tax might move the oligopoly equilibrium towards the joint profit maximization situation, the collusive outcome, naturally without implying actual collusive actions.

The general equilibrium model of Myles also considers the effect of a tax on prices of the goods from other sectors. Levying a tax on some other commodity k induces a change in commodity i 's price and in the profit of the producer of good i . Since the indirect demand of good i can be written as

$$q_i = \phi_i \left(\sum_{j=1}^{m_i} x_i^j, p_k + t_k \right) \quad (16)$$

, differentiating with respect to t_k yields

$$\frac{dq_i}{dq_k} = \frac{\lambda \left[\frac{\partial \phi_i}{\partial q_k} \left[\frac{\partial \phi_i}{\partial X_i} + x_i m_i \frac{\partial^2 \phi_i}{\partial X_i^2} \right] - x_i m_i \frac{\partial \phi_i}{\partial X_i} \frac{\partial^2 \phi_i}{\partial X_i \partial q_k} \right]}{[m_i + \lambda] \frac{\partial \phi_i}{\partial X_i} + x_i m_i \lambda \frac{\partial^2 \phi_i}{\partial X_i^2}}. \quad (17)$$

The change in the price of good i might be of either sign and thus, the price of good i may either decrease or increase following a tax change for good k . The direction of the effect depends on the rate of complementarity between the goods.

Imperfect competition also brings up the different impacts of specific and ad valorem taxation on consumer price, tax revenue and profits. Whereas these two forms of commodity taxation are found equivalent with respect to incidence and distribution of welfare in perfect competition, the equivalence does not hold under market power (Salanié 2003, pp. 21-22). Delipalla and Keen (1992) examine two models of oligopoly with homogenous products, one with free entry and another with a fixed number of firms. They find that overshifting is less likely to occur with *ad valorem* taxes than specific taxes – *ad valorem* taxation is associated with a lower consumer price. A lower consumer price implies less distortion in consumer

behavior and thus higher tax revenue. As was pointed above, taxation can in fact increase producer's surplus in the context of market power. In the model with deterred entry, Delipalla and Keen show that these socially undesirable profits to firms are relatively lower with *ad valorem* taxes.

Anderson, de Palma and Kreider (2001a) demonstrate that the results on profits and price effects can be generalized to an oligopoly with differentiated products and Bertrand competition: consumer prices are lower and the profits to firms smaller with *ad valorem* taxes. However, in another paper from 2001 Anderson et al. (2001b) call into question the superiority of *ad valorem* taxes to unit taxes with respect to their welfare effects in Bertrand oligopoly with product differentiation.

To conclude, on the contrary to what is often assumed, imposing a tax might increase the good's price by more or less than the amount of tax. The less-than-complete pass-through of taxes to consumer prices might be associated to perfect competition with relatively inelastic supply, or alternatively, to market power. In the latter case, the degree of forward shifting, or whether the tax is over- or undershifted, depends on the curvature of the demand curve. The pass-through rate equals one only in the case of Bertrand competition. Imposing a tax in one sector also affects the prices on other sectors due to the induced effects of the tax. Surprisingly, a tax increase might actually boost the profits of the firms as the equilibrium moves closer to the monopoly equilibrium. The differences in tax incidence between the *ad valorem* and specific taxes also become relevant in association with market power.

4. Literature on optimal commodity taxation

Taxing commodities is an important source of tax revenue. Nevertheless, taxation causes a welfare loss in the economy. Setting a tax results in a higher consumer price and lower demand. The decrease in demand consists of two distinct effects. First, the *income effect* is a consequence of diminishing purchasing power. When the consumer price increases, the net wealth after consumption decreases. Second, the *substitution effect* arises from the change in the relative prices of goods. The consumer is likely to replace consumption of the taxed good with consumption of another, now relatively cheaper commodity. The substitution effect is the source of distortions and leads to a deadweight loss in the economy, as this part of welfare is not shifted between the market parties involved but disappears as a result of taxation. (Tuomala 2009.)

There are numerous theories on the optimal tax rates of the commodities. The models represented here have done important contributions regarding the rules for defining the optimal tax rates for each good. The normative theories on commodity taxation often combine the revenue raising target of taxation with the minimization of economic distortions. Frank Ramsey (1927) aimed in his analysis on optimal commodity taxation to determine a tax system that simply maximizes economic efficiency. Diamond and Mirrlees (1971b) revised his results by adding different marginal utilities of money and social welfare weights to different types of consumers. Myles (1989) relaxed the assumption of perfect competition present in the preceding two models and derived optimal commodity tax rules for monopoly and oligopoly. Corlett and Hague (1953) provided a contribution to the theories of optimal commodity taxation by considering the optimal relations between tax rates on various types of goods. These theories provide a normative framework for considering optimal commodity taxation.

The theories by Ramsey, Diamond and Mirrlees and Myles all approach optimal commodity taxation from a common angle. The distortions and welfare loss of taxation are minimized under varying sets of assumptions, given that the tax revenue collection target is fulfilled. Corlett and Hague have a different perspective. They define a three-good system and inspect the relations between the tax rates of the goods in the presence of income taxes.

The main model in the Corlett-Hague analysis concludes that if leisure cannot be taxed, the goods complementary to leisure should be taxed more heavily. Thus, leisure-associated

consumption could be used as a tool to encourage working. As the consumption in restaurant services per person stands at 1093 euro a year in Finland, being a modest amount of 3,6 percent of the total per person consumption (Statistics Finland 2009), even radical changes in the prices of the services might not affect labor participation. Additionally, if the restaurant services were taxed more heavily, the effect on working would be ambivalent; whereas leisure can be complementary with dining, having lunch may be complementary with working. Thus, Corlett-Hague analysis will be left without further consideration, as the other above-mentioned theories might provide more helpful tools for analyzing the optimal design of commodity taxes in the context of restaurant services.

To simplify the notation, most of the analysis in this chapter is derived for a specific tax, not for ad valorem tax. The qualitative implications of the results, however, apply to value-based taxes as well.

4.1. The first-best solution: Lump-sum taxes

Several sources consider lump-sum taxes as the most efficient way of organizing commodity taxation (Mirrlees et al 2011, Myles 1995, Tuomala 2009 etc.). However, most sources also exclude this tax system from the set of available tax instruments. The theoretically appealing system will be described here, and the obstacles in implementing such a system in practice will be presented.

Consider the second fundamental theorem of welfare economics. Suppose that in a two-person economy, there is a consumption array $[\{x^h\}, \{y^j\}]$ with two goods x and y , forming a Pareto optimum such that at least one household is not satiated. Then, given convex preferences and production sets, continuous preferences and that x^h is interior to the consumption set of h , there exists a set of prices $p' \neq 0$ such that $[\{p', x^h, y^j\}]$ is a competitive equilibrium. In other words, any competitive, Pareto optimal equilibrium in the economy can be reached and sustained by redistributing the initial allocations and then allowing markets to work. (Myles 1995.)

The theorem states that any Pareto-optimal outcome preferred by the policy maker can be reached by lump-sum redistributions of endowments. The redistributive methods could be taxation or income transfers. In this setting, consumers would not be able to affect the level of taxation by adjusting their behavior and thus there would be no efficiency costs in association with lump-sum taxation.

To illustrate this, take taxes on consumption. When a tax is levied on a good, consumer will be paying more of this commodity and thus her disposable income after consumption will decrease. This is the income effect. However, as consumption of the commodity is more expensive now, the consumer will be buying less of the good and possibly more of another, substitutable good. This is the substitution effect. Thus, the consumer's welfare decreases as she has to substitute from the initial consumption set to a less preferable one. But also the tax revenue collected by the government decreases as the consumer changes her behavior as a response to the tax increase. This distortive effect is not present in the context of lump-sum taxes: if all consumers face the same amount of lump-sum taxes independent on how they behave, there will be no substitution effect from one good to another. By not being distortive, the lump-sum taxes would be the most efficient tax instrument available.

In practice, the future labor supply represents the endowment of the consumer. Thus, the lump-sum transfers should, in the light of the theory, redistribute the future labor supply. As the earnings capacity differs across individuals, the optimal lump-sum taxes should be based on relevant economic characteristics, e.g. expected future income. The earnings potential is, however, unobservable, and the individuals are again likely to adjust their behavior or not to reveal truthfully their characteristics to tax authorities to avoid tax payments. Thus, levying a lump-sum tax related to these characteristics may not be feasible. If not based on ability to pay or earnings capacity, lump-sum taxes raise a question of social equity. In most societies, lump-sum taxes have been excluded from the set of applicable tax instruments due to equity and implementation problems.

4.2. Efficiency in commodity taxation

As the first-best solution for organizing commodity taxation does not provide an applicable option, the contributions on the field of optimal commodity taxation have continued. In his work of 1927, Ramsey aimed to answer the following question: When government needs a certain amount of tax revenue to finance its expenses, how the tax rates on different commodities should be determined to minimize the deadweight loss associated with the collection of taxes. Ramsey leaves out equity considerations arising from differences in marginal utility of money. There are n consumption goods that are consumed in quantities x_1, \dots, x_n . There is no international trade, and all commodities are either consumed or saved. Labor is the only input in the model. $U = V(q_1, \dots, q_n, w, I)$ denotes the indirect utility of the consumer; there is only a single consumer or, alternatively, a population of identical

consumers. $q_i = p_i + t_i$ is the consumer price of commodity i , p_i denotes the producer price. Tax rates are denoted by t_1, \dots, t_n . w is the wage earned from working, and I is the nonlabor income, which is assumed to equal zero in the model. The derivations are done for a unit tax instead of an *ad valorem* tax here. The results are, however, qualitatively applicable to an *ad valorem* tax as well.

Ramsey first deals with perfectly general utility function. The tax rates t_i are differentiated across goods so that, given the tax revenue $R = \sum_{i=1}^n t_i x_i$, the utility V is maximized. When $R \rightarrow 0$, the utility-maximizing solution is found to be tending to point P : the competitive equilibrium point also maximizing utility V in the absence of taxation. When t 's and R can be regarded as infinitesimals, the optimal solution is reached when

$$\frac{dx_1}{x_1} = \dots = \frac{dx_n}{x_n} = -\theta \quad (18)$$

, where $-\theta = \frac{R}{\sum \sum x_r x_s \frac{\partial t_r}{\partial x_s}}$. The changes in the quantity demanded are thus equal for each commodity.

For proceeding further in the analysis, Ramsey makes an assumption of non-homogenous, quadratic utility function. This implies linearity of t 's – thus, lump-sum taxes are excluded and taxation is necessarily distortive. Now, the preceding result applies not just to infinitesimal tax revenues, but to any tax revenue raised: the compensated demand should decrease in the same proportion for each commodity compared to the pre-tax equilibrium. Put differently,

$$\frac{\partial V}{\partial t_k} = -\lambda \left[x_k + \sum_{i=1}^n t_i \frac{\partial x_i}{\partial q_k} \right] \quad (19)$$

where λ is the Lagrangean coefficient; for all goods k , the utility cost of raising the tax rate should be the same in the proportion to the marginal revenue raised by the tax increase.

For more intuition on what his results imply, Ramsey includes in his analysis certain specific cases, e.g. the case of independent goods. If the compensated cross-elasticities between the goods are $\frac{\partial x_i}{\partial q_k} = 0, i \neq k$, there is no substitution effect from one good to another in the context of price changes, and the goods are said to be independent. Thus, an increase in the tax on a commodity only affects other goods through the income effect. Now, ignoring the

interactions between markets, the general equilibrium model turns into a partial equilibrium one. This assumption allows further manipulation of the Ramsey rule of equal changes in compensated demand. The conditions on the optimal amount of tax can be rewritten as the *inverse elasticity rule*,

$$\frac{t_k}{p_k + t_k} = \left[\frac{\alpha - \lambda}{\lambda} \right] \frac{1}{\varepsilon_k^d} \quad (20)$$

, where α denotes the marginal utility of income. The optimal tax rate for a good is in an inverse relation to the commodity's price elasticity of demand.

The main intake from the Ramsey analysis is that taxation should decrease the compensated demand for each commodity in the same proportion. Thus, according to Ramsey's analysis, commodities with a demand of lower sensibility to price changes should be taxed more heavily. Should be noted, however, that only in the special case of no cross-elasticities the linkage between the own price elasticity and tax rate is this straightforward. In other contexts, the interrelationships between the demands need to be taken into account.

Ramsey theory is a theory of the second best: given that lump-sum taxes are not used and thus distortions cannot be avoided, it demonstrates the tax system which under these circumstances *minimizes* the distortions. As Ramsey uses the utility of a single consumer as the objective function, the analysis pays no attention to the questions of equity. By the Ramsey rule, goods with low elasticity of demand should be taxed more heavily than goods with high responsiveness to price changes; thus, the application of the theory suggests a low tax rate on restaurant services. The commodities with inelastic demand, however, are often necessities and consumed disproportionately by poor, and applying Ramsey rule in practice would lead to a highly regressive taxation. In many societies, this kind of tax system is considered unacceptable. Other researchers have extended Ramsey's work by deriving the tax rule in context of multiple, non-identical household. The use of social welfare function for many households instead of a utility function for a single consumer allows the introduction of equity considerations in the analysis.

4.3. Introduction of social welfare

Ramsey's analysis was later generalized for many consumers with differing preferences by Diamond and Mirrlees (1971b). The use of social welfare function of many households introduces different weights for different types of consumers in the system. Here, we continue

to assume simply that labor is the only input used in the production, though the result was also generalized by Diamond and Mirrlees for other production technologies. The indirect utility of a household h is $U_h = V_h(q_1, \dots, q_n, w, I^h)$, q_i being the consumer price and I^h the nonlabor income. These indirect utility functions vary across households. The revenue constraint remains $R = \sum_{i=1}^n \sum_{h=1}^H t_i x_i^h$. Social welfare function is defined as $W = W(V^1(\cdot), \dots, V^H(\cdot))$. The maximization problem, W as the objective function, yields the tax rule

$$\frac{\sum_{i=1}^n \sum_{h=1}^H t_i S_{ki}^h}{\sum_{h=1}^H x_k^h} = \frac{1}{\lambda} \frac{\sum_{h=1}^H \beta^h x_k^h}{\sum_{h=1}^H x_k^h} - 1 + \frac{\sum_{h=1}^H \left[\sum_{i=1}^n t_i \frac{\partial x_i^h}{\partial I^h} \right] x_k^h}{\sum_{h=1}^H x_k^h}. \quad (21)$$

$$\beta^h = \alpha^h \frac{\partial W}{\partial V^h} \quad (22)$$

is the social marginal utility of income for household h , reflecting both the society's values, or social welfare weight of the household, $\frac{\partial W}{\partial V^h}$, as well as the household's marginal utility of income, α^h . Here, the left-hand side approximately corresponds to the proportional change in the compensated demand for good k . Once again, this is equal for all consumption goods. If the tax results in a decrease in demand, which generally is the case, the left hand side is negative.

The right hand side indicates that the demand changes should be smaller for goods consumed extensively by households with high β^h and for the goods consumed in larger amounts by those whose tax payments are sensitive to changes in income. The former term reflects equity and the latter efficiency in the model. A high value of β^h stands for high marginal utility of income and high social welfare weight of the household. If the welfare function of the society is concave, i.e. the changes in social welfare are higher with low income levels, the social welfare weight is higher for a poor household. Correspondingly, under the Diamond-Mirrlees optimal commodity tax rule, the decrease in demand is allowed to be greater for the goods consumed by households with 1) low social marginal utility of income and 2) small decreases in tax payments in the context of decreases in income.

Diamond (1975) represents two cases in which the above tax rule reduces to the Ramsey rule: first, if the households are not given differing social valuations or, second, if the tax system cannot discriminate between the households. The latter occurs when consumption patterns are

similar in low-income and high-income households: both types consume the same amounts of each good relative to their income, i.e. the preferences are homothetic. When the tax rates cannot be chosen for redistribution, only efficiency aspects can be considered.

4.4. Introduction of imperfect competition

The Ramsey rule presented the least distortive commodity tax system, when lump-sum taxes were excluded. Diamond and Mirrlees developed Ramsey's analysis further by adding considerations on equity. These two baseline theories are, however, based on the assumption of perfect competition. Myles (1989) relaxes this assumption and aims to define the optimal commodity tax system in imperfectly competitive markets. In this context, commodity taxation may also have a counter-distortive effect by reducing the welfare loss associated with production decisions under market power.

In perfectly competitive markets, imposing a tax necessarily creates distortions. Imperfect competition, however, causes welfare loss to begin with. Myles (1987) first provides an example on how taxation can be used to minimize the distortions arising from imperfect competition. Myles presents a single-consumer economy with no revenue-raising requirement for taxes. There are two commodities, both produced using only labor. The consumer price of good i is again denoted by q_i .

We have a competitive and an imperfectly competitive market. The consumer price of the good produced in the competitive market is $q_1 = p_1 + t_1$. The price of good 2, produced in the imperfectly competitive industry, depends on the production decisions of the firms in the market and on the price of good 1, q_1 . In the general equilibrium model of Myles, profits are assumed to be taxed at a rate of 100%. The preferences of the society are represented with an indirect utility function. As the revenue raising target here is zero, one of the taxes will be negative and the other positive. If both markets were perfectly competitive, in order to avoid distortions the tax rates would be set at $dt_1 = dt_2 = 0$.

The maximization of social welfare function V yields that if

$$X_1 \left[1 - \frac{dq_2}{dt_2} \right] + X_2 \frac{dq_2}{dt_1} < 0 \quad (23)$$

, then dt_2 should be negative. As the initial situation involved no taxes on either commodity, the result implies a negative tax, i.e. subsidy, on the product from the imperfectly competitive

industry. A situation of this kind arises when 1) $\frac{dq_2}{dt_2}$ is large, meaning that taxes are over-shifted, or 2) $\frac{dq_2}{dt_1}$ is negative, i.e. commodities 1 and 2 are complements. Overshifting implies that a subsidy to a good with $\frac{dq_2}{dt_2} > 1$ is reflected in a price decrease exceeding the amount of the subsidy. Our setting here requires that the tax rate for perfectly competitive good should be positive. As the outcome of the policy, however, the overall price level decreases. Thus, the subsidy can be seen as an efficient means of improving welfare.

Myles (1989) also extends the analysis and provides optimal commodity tax rules for imperfect competition. He first derives a single-consumer rule, which he later expands to cover many consumers. The general equilibrium economy consists of two sectors; the competitive and imperfectly competitive. In the model, the price changes as a response to the tax changes are not linear, interconnections between price levels of goods in different sectors are allowed and the taxation also impacts profits.

Profits in the competitive markets equal zero. In the imperfectly competitive market, each firm makes its output choice considering three factors; its cost structure, the shape of the demand function and the output choices of other firms. As the model in question is a general equilibrium model, the demand for a good is dependent on the prices of other goods as well. Thus, a tax change is followed by two effects. The direct effect of the tax alters the cost structure of the firm and thereby changes the price of the good in question, whether supplied in competitive or imperfectly competitive markets. The induced effect is the impact of taxing other goods on the demand and the price of the good in question.

Myles defines each price in the imperfectly competitive market as a function of the tax rate and the prices of other goods. Then, in the single consumer economy, the utility of the consumer is maximized with respect to the tax rates, so that the revenue collection objective of the government is fulfilled and the prices and profit functions are defined as explained above.

The maximization problem yields tax rules resembling the Ramsey tax rule. However, the rule for competitive market goods now includes a term that captures the induced effects of a tax change on profits and prices of other goods. For imperfectly competitive markets, the variation in the degree of forward shifting also affects the optimal tax rate. Naturally, two goods only differing in the degree of forward shifting of taxes should be taxed so that the one

whose price is more responsive to tax change is subject to a lower rate. This also recurs when optimal tax rule is generalized for a many-consumer economy.

Myles' work stresses the importance of considering the whole series of actions following a tax change. The assumptions of perfect competition, present in the earlier studies in the field, are fairly restrictive, and Myles is the first to provide a general equilibrium framework for imperfectly competitive markets. Myles also brings the question of tax incidence to the scope of the debate on optimal commodity tax system. In the earlier studies, the perfect competition assumption implies complete pass-through of taxes.

4.5. General remarks on optimal commodity taxation

The preceding theories present tax rules for defining the optimal tax rates for commodities. In all these systems, the optimal tax rates are differentiated. In practice, such a differentiated system also has certain drawbacks. First, setting a tax rate for each good based on its demand characteristics would require an enormous proportion of information. Given the product variety of the modern economies, gathering such information would be extremely costly, if not impossible. Second, differentiated tax structure contradicts horizontal equality. The choices between goods are distorted, and otherwise similar consumers are punished or rewarded based on the types of goods they consume. Third, the administrative and compliance costs for maintaining a differentiated system are substantial (Tuomala 2009, Mirrlees et al 2011, Copenhagen Economics 2007). Differing tax treatment of goods is a source of legal conflicts in cases where the classification of the good in a certain commodity group is not straightforward. Additionally, it makes the tax policy susceptible to lobbying (Mirrlees et al 2011, Chapter 6). These reasons, among others, have led eminent quarters, such as Mirrlees et al (2011), consisting of top-rated economists, to prefer the use of uniform rates with certain well-defined exceptions³. The Finnish tax committee, set up by the Ministry of Finance, also recommended moving towards a more harmonized VAT system (Ministry of Finance 2010b). As Mirrlees Review puts it, *“There are some quite subtle and theoretical arguments here, but, in general, the case for differentiated rates looks weak and that for a broader, more uniform, structure looks strong”* (Mirrlees et al 2011, Chapter 6, pp.6).

Even when there are gains to achieve from a differentiated system, it is not settled whether these gains outweigh above-mentioned costs. In most societies, a well-developed social security system and direct taxation may be better instruments for e.g. distributing income. As

³ These include tax exemption on childcare (Mirrlees Review, Chapter 6, pp.15) and environmental and sin taxes.

the pure efficiency-based Ramsey result demonstrated, efficiency and equity aspects are often contradictory in commodity taxation. Thus, a commodity tax system which balances between these two requirements may be a less effective means of carrying out the egalitarian objectives than direct income payments would be. This emphasizes the necessity to design these two as an ensemble.

Also, consumption taxation fails, when the tax changes, targeted to achieving economic or social gains, are not remitted to demand or consumer prices. Empirical research on tax incidence provides essential information on the effects of tax changes and is the subject of the next Chapter.

5. Research on tax incidence

The empirical evidence to back up the theories on tax incidence is growing, but still sparse, and the results remain mixed. Full pass-through as well as over- and under-shifting have been found by researchers, applying varying methods for deriving the causal estimates of the price and demand effects of the tax reforms. In this chapter, the above theory is complemented with a review of empirical contributions to this understudied field of public economics. The research in the international scale is first summarized, followed by an overview of the studies carried out in the Finnish context. The second part of the chapter discusses the results.

5.1. Overview of the previous research

Complete pass-through of taxes to consumer price was found by Poterba (1996) and later, applying different research methods, by Alm, Sennoga and Skidmore (2009). Being one of the earliest recognized studies on the subject, Poterba (1996) studied sales tax incidence with two large data sets from the U.S. The primary data set is a city-specific consumer price index data for men's and women's clothes and personal care items from 1947-1977. Another dataset is constructed for the Depression period of 1925-1939, consisting of less accurate half-yearly price index data for a commodity group defined broadly as "clothing". The national price level over the period is used as a control proxy for cost development.

The point estimates for the period of 1947-1977 indicate overshifting for women's clothing and personal care items; however, null hypothesis of one-for-one pass-through of tax cannot still be rejected. For the Depression period, undershifting of taxes is found; the point estimate

for the pass-through is 0,62, reflecting less-than-complete shifting of taxes to prices. Here, the null hypothesis of full pass-through is rejected.

Alm et al's paper from 2009 studies the excise taxes on gasoline using a monthly panel data set from 50 U.S states in the period of 1984-1999, acquired from U.S. Energy Information Administration. Alm et al study not only tax incidence, but also the asymmetry of price responses to tax changes in different directions and the level of pass-through under different intensities of competition. They also estimate how rapidly prices adjust to the tax changes.

Using within-group estimation model including fixed state and time effects, Alm et al find complete or nearly complete (99 %) shifting of taxes to consumer prices. Spatial analysis reveals that especially urban, more competitive states exhibit patterns of complete pass-through, whereas in rural states slight undershifting may occur. The coefficient for the lagged tax rate is insignificant; thus, the price responses seem to occur within one month of tax change. The responses are found homogenous to whether the tax is increased or decreased.

In the contrast to studies by Poterba (1996) and Alm et al (2009), Besley and Rosen (1999) and Doyle and Samphantharak (2008) find different-than-complete tax forward shifting in their studies. Besley and Rosen (1999) examine the incidence of sales taxes with U.S. data set from 1982 to 1990. They explain prices of selected, well-specified commodities with the variation in tax rates, controlling for costs and time effects. The panel data consists of quarterly dataset over eight years and 155 U.S. cities for 12 goods.

The estimates on the degree of forward shifting differ between commodities. More than half of the twelve goods exhibit price changes exceeding the size of the tax change. For the rest, one-per-one increase in prices cannot be rejected. The level of overshifting is notably high; 5 of the 12 goods studied actually exhibit a pass-through of more than 200 %. The findings are essentially confirmed by an alternative specification with lags. Correspondingly to Alm et al, Besley and Rosen find the price responses occurring shortly after the tax changes; within the scale of 0,3 - 1,3 quarters.

Doyle and Samphantharak (2008) examine pass-through of sales taxes on gasoline by comparing daily price development in Illinois and Indiana to that of their neighboring states in the same period, applying the difference-in-differences method. In Illinois and Indiana, the sales tax was first suspended and, after a period of 120 days in Indiana and 6 months in Illinois, raised back to its original level. As legislation in both states regulates the maximum

length of the tax suspensions, the changes in taxes were known by the market parties to be temporary. The researchers observe daily prices in gas stations in Illinois and Indiana and five neighboring states. They control for wholesale prices and neighborhood characteristics, such as median household income, age and race, in the analysis. Also the number of gas stations in a particular area is observed to provide a measure of local competition.

The researchers find undershifting in the context of tax suspensions. The observed cut in retail prices is about 70 percent, after controlling for changes in wholesale prices and demographic characteristics of the neighborhood. The full shifting to prices is rejected. The reinstatements, for their sake, are followed by 80-100 percent pass-through. In contrast to the findings by Alm et al, these point estimates might reflect asymmetric reactions to tax changes; i.e. the dependence of the price responses on whether the tax rate is increased or decreased. However, equality of responses cannot be statistically rejected. Areas with lower brand concentration exhibit lower pass-through rates; this corresponds to the findings of Alm et al regarding the slightly smaller pass-through rates in the rural areas. However, a word of caution is necessary here; as the tax suspensions were known to be temporary, the results cannot be generalized to apply in a situation of permanent tax reform without discretion.

Empirical research on tax incidence in Finnish context consists of only a few research papers, among them studies on VAT reduction on groceries by Peltoniemi & Varjonen (2010) and on hairdressing and small repair services by Kosonen (2010). Peltoniemi & Varjonen (2010) examined a VAT reform on groceries, executed in Finland starting from October 2009. The VAT was decreased by 5 percentage points from 17 % to 12 %, decreasing the traditionally high Finnish price level on groceries being the objective of the tax change. The research studies the effects of the tax reduction on prices in a mid-length period. The prices from well-specified 171 groceries and 22 non-food products are collected 7 times during a two years period from supermarkets and grocery stores across Finland. The changes in transport and heating costs are considered by observing the variation in prices for a set of non-food products.

While full-shifting of the tax change would imply a 4,3 percent price reduction, the researchers find a 5,7 percent decrease in grocery prices as a result of the reform when vegetables are included and a 5,2 percent decrease when left out. The change is calculated over one month's period over the reform in October 2010. The decrease translates into a 133 percent pass-through of the tax change with vegetables and to one of 121 percent without. The

variance regarding the inclusion of vegetables results from their seasonal price patterns, showing a decreasing price trend also in the international scale. No price changes on non-food products are found over the period of inspection; thus, the price change is not considered a consequence of changes in costs. The limited location-based analysis included in the study reveals heterogeneity of price changes, varying from 4,8 to 6,1 percent over space; the more sparsely populated areas representing the smallest pass-through rates.

Kosonen (2010) studies tax incidence in the context of a tax reform from 2007 where value added tax on hairdressing was decreased by 14 percentage points. As the beauty salons, day spas and masseurs, representing similar trend behavior to hairdressers, were left out of the scope of the reform, the application of natural experiment design is facilitated. The data utilized consists of a 7-year monthly tax data set from the tax administrator and two types of survey price data. The monthly Consumer Price Index data covers in total 7 years before and after the reform. The Finnish Consumer Agency price data has observations from two periods, one before and one after the reform.

The estimates derived from a difference-in-differences set-up indicate a pass-through of tax of around 60 percent, being significantly different from full pass-through. Responses across firm types are found heterogeneous, corporations exhibiting the largest pass-through rates and sole proprietors and partnerships adjusting their prices the least. Almost half of the firms are found not adjusting their prices downwards even slightly as a response to the tax reduction. For the firms that lowered their prices, a price change equal to the tax reduction is not typical; only slightly over 10 percent of the firms indicated a pass-through of more than 71 percent.

In addition to the price effects, Kosonen studies the demand effects of the tax reduction. A slight decrease in firm turnover is found following the reform; this reduction, however, also includes the direct effect of possible price reduction on turnover. The instrumented turnover estimation, clearing the results from the direct effect of the price reduction on turnover, yields no significant estimates for price changes' effect on turnover. The lack of demand effects is supported by the stable input demand by the hairdressers across the period of inspection; regarding this, it is not very likely that output increased either. No evidence of changes in the wage sum is found, suggesting that the level of employment remained unchanged also after the reform.

5.2. Discussion and shortcomings of the previous research

The above studies derive varying conclusions on tax incidence. Undershifting is found by Doyle & Samphantharak (2008) and Kosonen (2010). Complete pass-through follows in the studies by Poterba (1996) and Alm et al (2009), and the results by Besley & Rosen (1999) and Peltoniemi & Varjonen (2010) suggest overshifting.

The degree of forward-shifting in the studies seems to evolve according to the elasticity of demand. In the partial equilibrium model the pass-through rate was discovered inversely related to the elasticity of demand. The studies seem to confirm this pattern of higher pass-through rates for goods with less elastic demand, suggested by the examination of the partial equilibrium framework. The tax reductions on gasoline, having inelastic demand, result generally in nearly complete pass through, as does the reform on groceries, with reported elasticity in Finland being 0,36 (Peltoniemi & Varjonen 2010). On the contrary, the more elastic hairdressing services exhibit less-than-perfect shifting of taxes.

Several studies also found that the brand concentration or the differences in the level of local competition resulted in differences between studies. The areas with lower brand concentration were generally found to exhibit lower level of pass-through. Even though this might be evidence that the level of competition affects the incidence of taxes, the possibility of lower pass-through being a result of less elastic supply in these areas cannot be excluded.

What might attribute to the differences in the pass-through results could also be the level of competition. The theories presented in Chapter 3 indeed suggest that, instead of full-shifting deterministically following from tax changes, the degree of forward-shifting of tax is dependent on the number of firms in the market, the marginal costs and the shape of the demand. Also, in the context of perfect competition relative inelasticity in supply might result in undershifting. Besley & Rosen (1999) argue that the overshifting found might result from the exercise of market power in retailing, and a reference is made to Delipalla and Keen (1992) to make sense of the results. The undershifting in gas stations, observed by Doyle & Samphantharak, might result from either imperfect competition or competitive markets with inelastic supply. The demand in the gasoline market being known as inelastic, the latter might provide a plausible interpretation. The observed overshifting by Peltoniemi & Varjonen could be caused by the high level of concentration in the Finnish grocery retail sector. However, some of the above-mentioned studies possess certain shortcomings. Thus, the observed

differences in results might follow from biases in estimation, resulting from other underlying price-affecting factors.

The first problem, primarily present in the study of Poterba (1996), has to do with the specification of goods observed over a given period. The data of Poterba is very aggregated; the classification of goods is made under broad categories of 'women's clothing', 'men's clothing' and 'personal care items'. A problem for causality arises from the use of broadly defined commodities; examining prices of more narrowly categorized items would facilitate a more accurate analysis. The further studies generally avoid this shortcoming using less aggregated micro data; the goods are homogenous over space and time, as gasoline, or the categories subject to inspection are well specified, such as 'Big Mac' by Besley & Rosen (1999) or 'a haircut, 30 minutes' by Kosonen (2010). This provides a solid basis for a *ceteris paribus* examination of the tax changes' effects. As a result of a lot of noise in the research, the standard errors for point estimates are large in Poterba's study, and thus it does not provide unambiguous results of the forward shifting of taxes. The point estimates are not to consider; if anything, this study might provide information of the direction of the change.

The development towards more accurate data also concerns the frequency of observations. Whereas the studies by Poterba (1996) and Besley & Rosen (1999) handle quarterly data, the monthly data by Alm et al (2009) is likely to provide more exact estimates for example of the time of response of prices. The data of Kosonen (2010) consists for essential parts of monthly observations; Doyle & Samprahantak (2008) use daily data.

Additionally, some of the above studies suffer from inadequate examination of policy endogeneity. The use of price indices for long time periods fails to shed light on the motives for the tax changes – the tax decreases may, for example, have been utilized as a tool for counter-cyclical policy, whereupon the identification of the source of the price change may not be clear. The policy reasons for the tax changes are not controlled for, thus leaving out the concern of industry-specific factors driving the tax changes. This aspect is not touched in the studies of Poterba (1996) and Alm et al (2009). In Besley & Rosen (1999), the issue of policy endogeneity is left unconsidered as well; on the run of six years studied, no evidence is provided that the tax changes are not endogeneous of conditions in the industry in question. As possibly not providing unbiased estimates, their results can be seen as not conclusive, but indicative, and to suggest evidence against the traditional view of the full pass-through of taxes.

As opposite to the above-mentioned studies, Doyle & Samphantharak's study (2008) is the first to incorporate analysis on policy endogeneity issue. The populist policies of an election year are found as the principal motive behind the temporary tax suspensions in the two US states. In the paper by Kosonen (2010), policy endogeneity is also considered, and the experiment is found to be lacking industry-specific reasoning behind the tax reduction.

The handling of costs appears problematic in multiple studies. For Poterba (1996), the national price index is used as a control for changes in general price level. However, industry-specific price factors, such as material or employment costs or quality changes, are not accounted for. The study of Besley and Rosen (1999) also suffers from the lack of appropriate cost data. The proxies for production costs are price indices for chosen inputs; two-room apartment rent, the minimum charge for a laundry machine repairer and the price of one gallon of unleaded gasoline; and another choice of cost factors could thus have yielded deviating results. In contrast, the data of Alm et al (2009) is well comprehensive; the wholesale price is the dominant retail-price affecting cost factor in the gasoline retail market, but also other cost factors, like retail wage costs and a proxy for transport costs are included.

Instead of trying to incorporate multiple price indices to control for cost changes, there is a trend towards less cumbersome techniques. The most recent research (Doyle & Samphantharak 2008, Kosonen 2010) takes advantage of natural experiments with proper methods; the difference-in-difference method with a valid control group saves the trouble of controlling for the wide-ranging unobserved cost factors with at times inaccurate proxies. The key underlying assumption of parallel trends between the treatment and the control groups seems fulfilled in the two studies mentioned. The lack of an appropriate control group is well demonstrated in Peltoniemi & Varjonen (2010): even though non-food product prices are used to control for the development of prices for some cost factors, it still does not succeed in capturing the natural seasonal fluctuation in food prices. Based on the downward price trend from the last few months preceding the reform, the researchers suspect that the food prices would have been decreasing anyway. If the counterfactual price trend continued being downward sloping, the estimates derived exaggerate the causal effect of the reform on prices.

The lack of consensus and corresponding results on the area emphasizes the need for further research on the subject. In the next chapter, the VAT reduction on the restaurant services in Finland is studied.

6. Empirical analysis

6.1. Background and hypotheses

This thesis utilizes the Finnish tax reform on restaurant industry to estimate the tax incidence on labor-intensive services. The main estimate of interest is the average change in the consumer price of a restaurant meal. Heterogeneity of responses over restaurant type is also examined. To better reflect the consumer viewpoint, a weighted average of the price change is calculated, the weights being based on the sales of the restaurants. The sales serves as the proxy for the number of servings sold in each restaurant. The results are then reflected against the framework of theoretical models of tax incidence under different intensities of competition. Whether the estimates correspond to those derived in the earlier empirical work on tax incidence will also be discussed.

As was noted in Chapter 3, the level of pass-through is related to the form of competition in the market. Monopolistic competition could be an appropriate model for describing the restaurant industry. Restaurants differ in non-price characteristics such as atmosphere, location, serving sizes and the quality of food. The products are substitutes, but not homogenous as in perfect competition. In the short run, firms in the monopolistically competitive market behave like monopolies. An individual firm can freely choose prices, without the need to engage in strategic competition. However, the entry in the market is easy, and in the long run, the competition is expected to tighten up within the product groups and the market structure to become more similar to that of perfect competition. As the consumption of the services is not very mobile across space, the competition is also local. The maturity of the local market is thus likely to define the amount of market power possessed by the restaurants.

Among the restaurants operating in the monopolistically competitive markets, there are a handful of very large firms such Restel and S-group, the latter possessing a market share of 19,3 % of the Finnish restaurant industry in 2010 (SOK Corporation Annual Report 2010). The lunch restaurant subsector is dominated by Amica, Sodexho, Palmia and Antell-Catering. These large corporations undoubtedly possess undetermined level of market power, and thus their behavior is expected differ from the behavior of their smaller counterparts.

The main hypothesis here is that the tax change is reflected in lower consumer prices. A difference in pass-through rates is expected between a representative small restaurant and a

large chain restaurant, arising from differences in market power. The data includes an indicator of whether or not the restaurant belongs to MaRa, the labor market organization and lobbyist operating on the industry. Following the Parliament's decision to decrease the VAT rate, MaRa decided to recommend full price reduction to its member restaurants (MaRa 2009). Thus these restaurants might also exhibit responses that differ from the average.

Under- or complete shifting of tax was likely in the case of perfect competition. As the supply side of the market hardly is inelastic and the production capacity is likely to be adjusted quite easily, complete shifting would be the more plausible option in the context of restaurant services. Under- or overshifting is predicted under market power, depending on the demand characteristics and the number of firms. As the demand characteristics are unknown, hypotheses are not provided of the level of pass-through. Also, the public pressure might be reflected in pricing decisions of the large companies (Taloussanomat 2009a, Taloussanomat 2010a, Helsingin Sanomat 2010 etc.).

The effects on factor demand, considered in the general equilibrium model, are left outside the scope of this thesis as the main focus is in deriving estimates on the reform's effect on consumer price. When evaluating the reform's effect on the economy on the whole, these effects should be considered.

The VAT rate was decreased from 22 to 13, and thus complete shifting of tax to prices would induce a price change of 7,4 percent, derived from

$$\frac{1,13p - 1,22p}{1,22p} * 100\% = -7,38\%.$$

This serves as a benchmark for calculating the degree of pass-through.

6.2. Methodology

For estimating the change in the consumer prices caused by the tax change, its effect must be distinguished from other price-affecting factors' effect. An upward shift in input prices; food, for example; could cause restaurant prices to rise, and ignoring that effect would yield biased estimates of the causal effect of the reform. The counterfactual development of prices in the absence of the reform must be controlled for.

The approach taken here differs e.g. from that of Poterba (1996) and Besley & Rosen (1999), who attempted to control for the price development by using proxies of different cost factors.

A less complicated and potentially more accurate way to proceed is to follow the practice by Doyle & Samphantharak (2009) and Kosonen (2010) and use the *Difference-in-Differences (DID)* method⁴.

The DID method uses a *control group* that captures the counterfactual behavior of prices in the absence of the reform. The *treatment group* is the group subject to the measure of interest, in this case the tax reform. The method requires panel data. The aggregate-level differences between the groups are controlled in the model. When the control group is observed over time and the group-level differences subtracted away, the unobserved time effect, common for both the treatment and the control group, is captured.

Denote the price in restaurant i belonging to group g at time t as

$$y_{git} = \gamma_g + \lambda_t + \delta D_{gt} + \varepsilon_{git} . \quad (24)$$

Here,

g = group indicator; T = treatment group, C = control group

γ_g = group-specific price affecting factors, constant over time

λ_t = common time effect

D_{gt} = dummy; 1 = treatment group & treatment period⁵

δ = the causal effect of the treatment on price

ε_{git} = residual, $E(\varepsilon_{git} | g, t) = 0$

For the control group, the expected change in prices between the time periods becomes

$$\begin{aligned} E(Y_{git} | g = C, t = \textit{after the reform}) - E(Y_{git} | g = C, t = \textit{before the reform}) &= \gamma_C + \\ &\lambda_a + \delta D_{Ca} + \varepsilon_{Cia} - (\gamma_C + \lambda_b + \delta D_{Cb} + \varepsilon_{Cib}) \\ &= \lambda_a - \lambda_b \end{aligned} \quad (25)$$

, where $a = \textit{after}$, $b = \textit{before}$, as $D_{Ca} = D_{Cb} = 0$ and $E(\varepsilon_{Cia}) = E(\varepsilon_{Cib}) = 0$. The expected difference in the treatment group between the time periods is

⁴ The derivation of DID functions follows the representation of Angrist and Pischke (2009).

⁵ Here, the dummy refers to the restaurants subject to tax reform when the reform is in force.

$$\begin{aligned} E(Y_{git}|g = T, t = after) - E(Y_{git}|g = T, t = before) \\ = \lambda_a - \lambda_b + \delta \end{aligned} \quad (26)$$

, because $D_{Ta} = 1$ now. The difference-in-differences between the groups is

$$\begin{aligned} [E(Y_{git}|g = T, t = after) - E(Y_{git}|g = T, t = before)] \\ - [E(Y_{git}|g = C, t = after) \\ - E(Y_{git}|g = C, t = before)] \\ = \delta. \end{aligned} \quad (27)$$

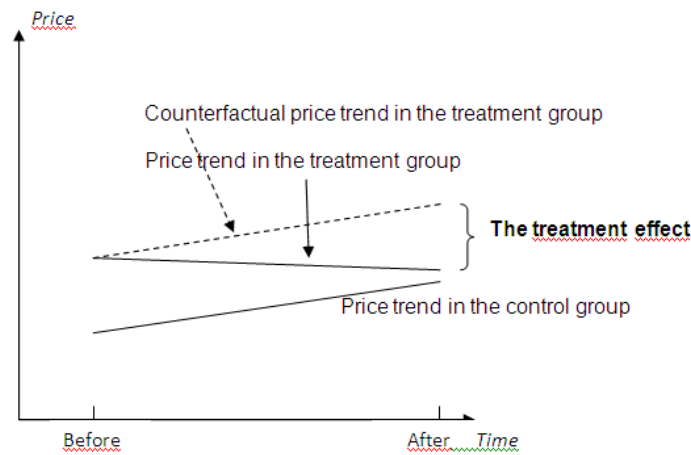
Thus, the causal effect can be estimated by calculating these differences between the groups' means. The causal impact, or the *average treatment effect*, is the difference between the observed outcome and the counterfactual outcome in the absence of the treatment in the group subject to the program.

The application of the difference-in-differences method does not demand similarity between the groups in all other dimensions than tax policy. γ_g term is used to control for the aggregate level unobserved differences between groups, when these differences remain constant over time. In this sense, DID method acts like the fixed effects estimation (explained in more depth in Section 6.2.3), but at a more aggregate level. The key identifying assumption is, however, that without the treatment the groups indeed would behave in a similar manner – i.e., that the trends between the groups are similar, and

$$E(Y_a^C|g = T) - E(Y_b^C|g = T) = E(Y_a^C|g = C) - E(Y_b^C|g = C). \quad (28)$$

Then, the treatment is a deviation from this trend. Exhibit 2 illustrates the situation graphically.

Exhibit 2. The DID set-up.



6.2.1. Selection of the control groups

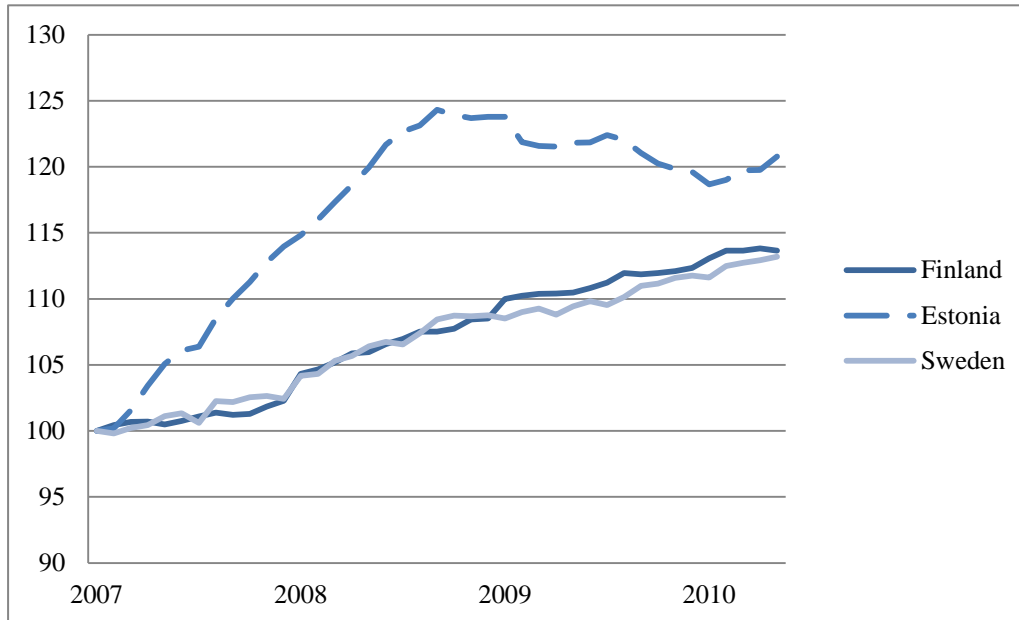
The treatment group consists of Finnish restaurants serving food and non-alcoholic beverages. For utilizing the DID method, a valid control group is needed, a similar time trend between the groups being the requisite. Thus, the control group should share the same time-varying characteristics as the treatment group. The ideal experiment would randomize the tax reduction between Finnish locations, making a natural division into control and treatment groups. While this consideration obviously is hypothetical, it provides a benchmark for defining the nearest equivalent for the control group.

The factors that affect the development in Finnish restaurant prices include variation in general price level and in particular input prices, the costs of labor and food. Of those, food prices are indirectly affected by the transportation costs. The holiday season is a cause for demand shocks; in lunch restaurants, a negative demand shock may occur, whereas having other meals in a restaurant may be complementary to leisure and thus occur increasingly during the holidays. Given these facts, the restaurants in such a neighboring country that experiences no tax reform and experiences the same holiday season provide a well-grounded choice for a comparison group. Here, Estonian restaurant prices are used.

As similar price trends were the prerequisite for the use of the method, differences in the past inflation rates may contradict the choice made. Historically, the price development in the Finnish and Estonian restaurants has not been quite similar, as is shown in Exhibit 3. Price development in Sweden corresponds more with that of Finland. However, the availability of

data defined the choice here; Estonian restaurants provided the nearest equivalent with the data available.

Exhibit 3. Restaurant and hotel price indices for Finland, Estonia and Sweden.



Sources: Statistics Estonia (2011), Statistics Finland (2011), Statistics Sweden (2011).

Regardless of the long-term dissimilarity between the prices, parallel development is expected over the period of observation because of the short duration of the period and the above-mentioned seasonality reasons. In addition, the effects of the potentially diverging time trends are discussed in Chapter 8.

The Estonian data contains a large number of observations, and is thus fit for deriving significant estimates. Other control groups are used to contrast the results derived from the Estonian primary control group. Similarity between estimates from the use of different control groups would provide support for the primary results derived. Our data set allowed for the examination of the price change against Finnish hotel prices. The group shares the same seasonal pattern with the restaurant services sprung from tourism. The design of the tax reform also offers a natural control group, as alcoholic beverages are not subject to tax reduction. These prices are also included in the data set. The number of the observations is too small for deriving reliable regression estimates; however, they are used as a reference when describing the price change in the treatment group.

6.2.2. Basic regression DID model⁶

As described in subsection 6.2.1., there will be three control groups used. The primary control group is Estonian restaurants. The primary method used for modeling the price in restaurant i in group g at time t (groups being Finnish and Estonian restaurants) is a difference-in-differences with OLS estimation

$$\ln(\text{combined price})_{igt} = \alpha + \gamma \text{Finland}_g + \lambda D_t + \delta(\text{Finland}_g \cdot D_t) + \beta X'_{igt} + \varepsilon_{ist} \quad (29)$$

where

$\ln(\text{combined price})_{igt}$ = the logarithm of the average price in restaurant i in group g at time t

Finland_g = dummy; 1 = Finland, 0 = Estonia

D_t = time dummy; 1 = after the reform

$\text{Finland}_g \cdot D_t$ = dummy for treatment; 1 = (Finland = 1 & after = 1)⁷

X'_{igt} = group- and restaurant-level characteristics

ε_{ist} = residual for restaurant i in group g at time t

Data were collected from various servings in each restaurant to examine whether price changes were symmetric across different portions (explained in more depth in Section 6.4). To capture the average price effect in each restaurant, the mean of different servings is calculated and used as a dependent variable. Taking a logarithm from the prices of varying scale in absolute numbers removes the bias resulting from very large prices in the sample. Using a semi-logarithmic form allows for straightforward interpretation of result; now, the coefficients can be interpreted as an approximation of the percentage changes in prices resulting from the explanatory variable.

Coefficient of the treatment group and period interaction dummy, δ , is the causal effect of interest. Recall from Section 6.2 that it measures

⁶ Follows the representation of Angrist & Pischke (2009).

⁷ Corresponds to D_{gt} in Equation 24.

$$\delta = [E(Y_{git}|g = Finland, t = after) - E(Y_{git}|g = Finland, t = before)] - [E(Y_{git}|g = Estonia, t = after) - E(Y_{git}|g = Estonia, t = before)]. \quad (30)$$

6.2.3. Regression DID model with fixed effects

To derive more accurate estimates, a *fixed effects* model is put to use. The DID estimation controlled for the aggregate level differences between the control and the treatment group. The fixed effects estimation takes into account the individual-level unobserved differences across restaurants. The method can be used when there are observations from two or more time periods for each individual. The key underlying assumption here also requires that unobserved characteristics stay constant over time. The sample used is a heterogeneous group of restaurants with price-affecting unobserved characteristics such as managerial ability and location. Thus, the model is also applicable in our study. (Angrist & Pischke 2009.) Because fixed effects estimation allows correlation between the unobserved factors and the explanatory variables, fixed effects model is preferred to random effects (Wooldridge 2003). The case of such correlation cannot be excluded.

The fixed effects method can be interpreted as adding a dummy for each restaurant and thus calculating a specific coefficient for all of them in the regression. The dummy's coefficient then captures the effect of all unobserved individual-specific factors that are constant in time. The setting is equivalent to giving an individual intercept for each restaurant in the regression model. The statistical software packages used for running a fixed-effects regression often exploit some simplifications that are similar to the above-mentioned specification. The techniques include calculating differences from means, a method that corresponds algebraically to adding individual dummies. As for two time periods, there is no difference between time-demeaning; i.e. calculating differences from mean, and taking first differences over time, either. The programs also adjust the standard errors for the right degree of freedom after calculating the additional means. (Stock & Watson 2007.)

The fixed effects regression model becomes

$$\ln(\text{combined price})_{igt} = a_i + \gamma \text{Finland}_g + \lambda D_t + \delta(\text{Finland}_g \cdot D_t) + \beta X'_{igt} + \varepsilon_{ist} \quad (31)$$

Note here that a_i appears with the individual subscript i . a_i is specific to each restaurant; it includes the intercept common to the whole sample *and* the individual intercept, i.e. the

dummy and the dummy coefficient for the individual. The individual averages for the time-demeaning technique become

$$\overline{\ln(\text{combined price})}_{ig} = \alpha_i + \gamma \text{Finland} + \lambda \bar{D} + \delta(\text{Finland}_g \cdot \bar{D}) + \beta \bar{X}'_{ig} + \bar{\varepsilon}_{is} \quad (32)$$

and the subtraction yields

$$\ln(\text{combined price})_{igt} - \overline{\ln(\text{combined price})}_{ig} = \lambda(D_t - \bar{D}) + \delta \text{Finland}(D_t - \bar{D}) + \beta(X'_{igt} - \bar{X}'_{ig}) + (\varepsilon_{ist} - \bar{\varepsilon}_{is}) \quad (33)$$

As demonstrated above, using time-demeaning estimation removes the time-invariant variables, including the group effects, in the estimation. This holds also for first-difference approach. Thus, all explanatory variables used must change over time. Although some information is lost there, the use of the method facilitates consistent estimates of the effect of interest. In the differences-of-means technique, the standard errors are potentially serially correlated. (Angrist & Pischke 2009.) With two time periods, the distance from mean is equal for both observations on individual. The serial correlation is thus removed in the within estimation, and the use of clustered standard errors is not necessary in our case. Robust standard errors, consistent with error term heteroskedasticity, will, however, be used.

6.3. Causality considerations

The above-described methods all aim to provide consistent estimates on the causal effect of the tax reform on the restaurant prices. There are, however, three factors that need special consideration when the causal relationship between the price change and the tax reduction is examined. Broadly speaking, causality refers to the phenomenon of an action directly causing an outcome. Stock & Watson (2007, pp. 9) define causal effect as “the effect on an outcome of a given action or treatment, as measured in an ideal randomized controlled experiment”.

6.3.1. Anticipation

The law change was announced half a year before it was actually enforced (FINLEX 2009a). If the restaurants had anticipated the tax reduction by raising the prices preceding the reform and decreased them after, the short-term price effect would differ from that of long-term. The issue was considered by Harju and Kosonen (2010). The inspection of Finnish restaurant price

index against the Swedish one shows no signs of anticipation effects for the six months period preceding the tax reform. Thus, there seems to be no anticipation effects to bias the estimates.

6.3.2. Policy endogeneity

When exploiting variation in policies in the design of empirical experiments, the intentions behind policy-making must be considered. If the policies are enacted as a response to an industry's economic or political conditions e.g. as expansionary measures, biased estimates on the policy's causal effect may arise.

The issue of policy endogeneity in the context of this study was considered earlier in Section 2.3. The timing of the law change was largely affected by the Union level legislation, and there were public demands for lowering the VAT rate for restaurants to the level of food sold in grocery stores. Thus, the law change is unlikely to have been carried out due to the conditions specific to Finnish restaurant industry.

6.3.3. Demand effects

Also a change in consumption, e.g. increasing demand just after the tax reduction, could bias the estimates of the tax incidence. An upward shift in demand as a consequence of tax reduction would create upward pressure in prices, and ignoring the effect would result in smaller-than-actual estimates on price change. The turnover of the company would, controlling for other factors, provide an estimate of changes in demand. However, demand effects will be left outside the scope of this thesis. Because the period of data collection only continues one and a half months after the beginning of the reform, we assume here that the possible demand effects are not yet reflected in prices.

6.4. Data description

The analysis is performed with a micro-level panel dataset collected during the summer 2010 for the Government Institute for Economic Research. The sample restaurants were randomly chosen from the official business information system. Randomization is a necessary condition for a representative sample of the whole restaurant industry in Estonia and Finland. The restaurants selected in the sample were followed before and after the tax reform of July 2010. Each restaurant was observed twice; data was recorded on restaurant prices and the characteristics of the restaurant. At the first round of data collection, the serving name was recorded. Thus, prices for these specified servings could be recorded also on the second price collection round. The primary method of data collection was internet collection. If the prices

could not be found on the web sites or no existing web sites were found, the restaurant was contacted by phone. For each restaurant, data were collected for various servings under different categories, such as lunch, a vegetarian meal, non-alcoholic beverage or an appetizer (see Table 3 for variable description). Information on restaurant characteristics was also recorded.

The sample includes 1357 restaurants in total, of those 958 being Finnish and 399 Estonian. In addition, data on 274 hotels are included. The composition of groups stayed essentially the same across time; attrition was small, with only 26 restaurants dropping out of the sample in the second round of price collection. As this accounts for only 2 percent of the total number of restaurants, attrition is not considered a problem in the research.

Most of the analyses are made using a logarithmic combined price variable. The variable is a combination of seven prices that represent different serving categories: meal1, meal2, vegetarian meal, pizza, appetizer, dessert and lunch. The use of combination price reflects the size of average price change over the whole variety of servings; if the restaurant keepers would differentiate the price change across different meal categories, only assessing a price change on one meal type would give a biased result of the average effect of the tax reform on the price level. The logarithmic conversion is used to calculate the relative changes in prices.

In the raw data set, Estonian prices were announced in Estonian kroons, the currency of the nation at the time. The kroon's rate was fixed at EUR 1 = EEK 15.6466 since 2004 (European Central Bank 2004), and this rate is used in converting Estonian restaurant prices to correspond with the euro ones.

Table 1 summarizes the characteristics of the sample restaurants. The observations from Finland outnumber those from Estonia. *Tax_22* is tax data for the taxes paid by the Finnish sample restaurants, and it is later used as a proxy for the relative sales of the restaurants. Table 1 also demonstrates that most of the data was collected from the restaurants' web sites. Roughly 25 percent of the sample restaurants were contacted by phone and 2,6 percent were paid a visit. Table 2 represents the restaurant characteristics by country. The proportion of MaRa member restaurants is naturally zero in Estonia; in the Finnish sample, they present a share of 33,5 %. In Finland, S-group restaurants are well represented in the sample, being a portion of nearly 14 percent.

Table 1. Characteristics of the restaurants over the whole sample.

Variable	Description	n	Mean	Std. Dev.	Min	Max
<i>MaRa</i>	dummy; 1 = Belongs to the Finnish Hospitality Association	2772	0.238	0.426	0	1
<i>Chain restaurant</i>	dummy; 1 = Chain restaurant.	2622	0.275	0.447	0	1
<i>S-ryhmä</i>	dummy; 1 = Belongs to S-group	1634	0.069	0.253	0	1
<i>Tax_22</i>	taxes paid at the rate of 22%, information available only for Finnish restaurants	2106	402 057	1 665 435	-85.58	14 500 000
<i>Method of price collection</i>	0 = internet; 1 = phone call; 2 = visit	2643	0.305	0.514	0	2
	Internet	1906	72.10 %			
	Phone call	668	25.30 %			
	Visit	69	2.60 %			
<i>Country</i>	"Finland" / "Estonia"					
	Finland	1859	70.30 %			
	Estonia	787	29.70 %			

Table 2. Restaurant characteristics by country.

<i>Restaurant classification</i>	Estonia (%)	Finland (%)
Fast food restaurant	12	32.1
A la carte	49.6	33.6
Café	20.6	14.5
Lunch restaurant	17.7	19.7
Total	100 %	100 %
n	800	1,895
<i>S-group</i>		
Belongs to S-group	0	13.8
Other	100	86.2
Total	100 %	100 %
n	800	871
<i>MaRa restaurants</i>		
MaRa restaurant	0	33.5
Other	100	66.5
Total	100 %	100 %
n	800	1972
<i>Chain restaurants</i>		
Chain	15.3	32.8
Other	84.7	67.2
Total	100 %	100 %
n	784	1838

The composition of the restaurant industry differs between Estonia and Finland. Fast food and chain restaurants appear in a much higher proportion in Finland. Cafes and a la carte restaurants are more often found in Estonian restaurant industry. The classifications of restaurant type are suggestive and are likely to depend on the data collector (for the classification by restaurant type, see Appendix 6).

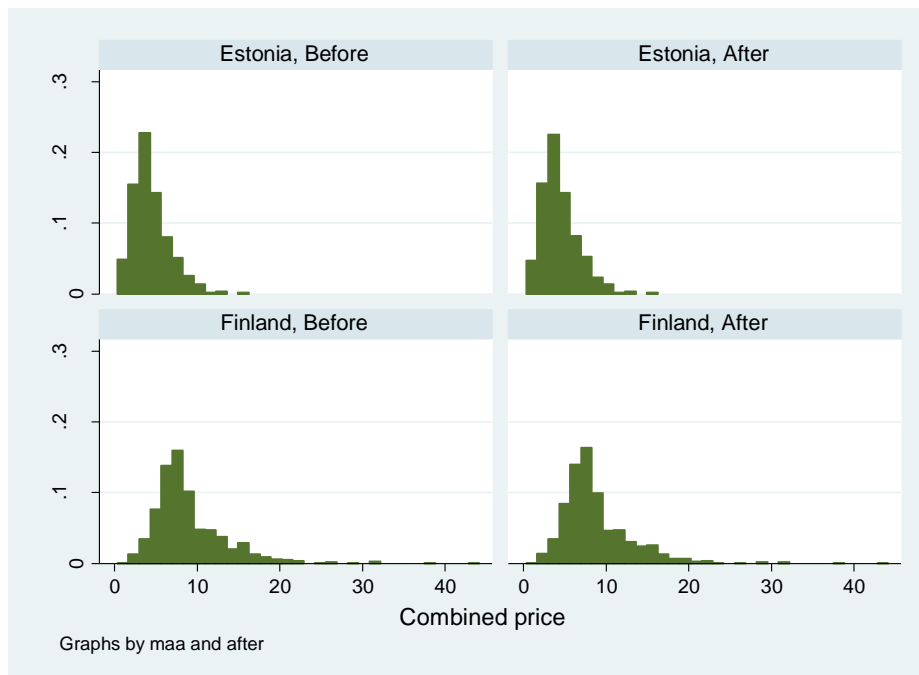
Table 3 summarizes and describes the price variables used. *Combined price* is the row mean for the seven price variables; the average change in the restaurant price level can be calculated as the difference in the combined price variable between two time periods for each restaurant. In Exhibit 4, the distributions of Finnish and Estonian prices are represented before and after the tax reform. The distributions are of same shape; in both groups, the distribution is skewed to the right, and excess kurtosis is observed. Thus, the majority of prices are small, while the long right tail represents relatively few, large values. The prices in the Finnish restaurants are generally higher, and the longer right tail indicates that there are more restaurants with high price level relative to the bulk of the values. Not surprisingly, the normality tests strictly reject the null hypothesis of no kurtosis or skewness. The tests confirm higher kurtosis in the Finnish data; the Finnish price distribution is also found more skewed than the Estonian one.

The logarithmic transformations smooth the distributions. The distributions are still not normal, but the distributions follow more closely the QQ-plot of a normal distribution. Additionally, skewness is no longer found for the Finnish price distribution.

Table 3. Variable description over the whole sample.

Variable	Description	n	Mean	Std. Dev.	Min	Max
<i>Meal1</i>	price for a popular meal; a beef, a sushi assortment, kebab with fries, Big Mac etc. depending on the restaurant type	2268	9.79	6.93	0.29	55
<i>Meal2</i>	price for a popular meal; chicken, fish etc. depending on the restaurant type	1710	8.98	5.86	0.24	59
<i>Vegetarian meal</i>	price for a vegetarian meal or a less popular meal	1602	6.94	4.68	0.32	65
<i>Pizza</i>	price for a pizza	578	7.85	2.87	0.45	15
<i>Appetizer</i>	price for an appetizer	1144	4.91	2.76	0.32	20.45
<i>Dessert</i>	price for a dessert	998	3.02	2.17	0.32	19.17
<i>Non-alcoholic beverage</i>	price for a soft drink or another non-alcoholic beverage	960	1.83	0.78	0.38	6.35
<i>Lunch</i>	price for lunch	1180	7.00	3.27	0.89	29
<i>Lunch soup</i>	price for lunch soup	320	4.69	2.18	0.89	12.5
<i>Beer</i>	price for a beer	712	3.16	1.26	0.89	6.2
<i>Wine</i>	price for house wine; a glass of 12cl, or if not found, a bottle	454	6.29	9.37	1	90
<i>Coffee</i>	price for a cup of coffee	234	1.27	0.49	0.26	3
<i>Latte</i>	price for a special coffee; a latte, cappuccino etc.	144	2.03	0.79	0.64	4.2
<i>Combined price</i>	a mean of seven variables; <i>Meal1</i> , <i>Meal2</i> , <i>Vegetarian meal</i> , <i>Pizza</i> , <i>Appetizer</i> , <i>Dessert</i> and <i>Lunch</i> ; calculated by restaurants and time period	2458	7.47	4.37	0.32	44.13

Exhibit 4. The distribution of combined consumer price by period and country.



7. Results

The representation of the results begins with a mostly visual overview of the price change. The Finnish price development is compared to that of Estonia. The alternative control groups are then used to contrast the results. The price change is examined over meal categories and in different subgroups; the chain restaurants, members of the Finnish Hospitality Association MaRa and the S-group restaurants are inspected with particular care.

The rest of the chapter is devoted to the regression results. A difference-in-differences estimation is first run with a simple OLS model without and with control variables. The fixed effects estimation is then used to derive more precise regression coefficients. Last, a weighted average of the price change is estimated, using the sales of the company as a proxy for the number of servings sold.

7.1. Description of the price change

For estimating the relative change in prices, i.e. the change in percentages, the price data is converted to natural logarithm form. For small changes, the difference in logs approximates the percentage change of a variable. It is important to note that the price changes presented here are still not estimates of the causal effect of the reform, as they have not been controlled for the counterfactual price development.

Exhibit 5 shows the distribution of the logarithmic combined price change in Finland and Estonia. The vertical dashed line stands for the benchmark value of -7,4%, the amount of full pass-through of tax. The distribution for Finnish prices has two peaks; one at the full pass-through and another at no price effect. The Finnish restaurants thus show an ambivalent reaction pattern to the tax reform: most restaurants have either passed the tax fully to the prices, or not reacted to the tax change at all. Appendix 8 shows the distribution of the price change for each meal category. The pattern present in Exhibit 5 with two high-frequency points seems to recur across meal categories. Only dessert and appetizer categories show diverging behavior; no peak is observed at the point of full pass-through.

When comparing the distributions of the Finnish price change and the price change in the control group, the control group shows nearly no variation in prices. The shape of the Finnish price change distribution seems to be driven by the tax change, not other price-affecting factors. The observation is supported whether the Finnish change is contrasted against Estonian prices or the alternative control groups, prices for alcoholic drinks and hotel prices (Exhibit 6, Appendix 9). The distribution of the price change in the three control groups is of similar shape, with the highest frequency at zero change benchmark. The range of the price change, however, varies. Detailed numbers of the price change in Finnish and Estonian restaurants is provided in Appendix 7. Exhibit 7 shows a visual representation of the price change in different meal and drink categories. Note that wine and beer were not subject to tax reduction, as alcoholic beverages were excluded from the scope of the reform.

Exhibit 5. Change in the combined price by country.

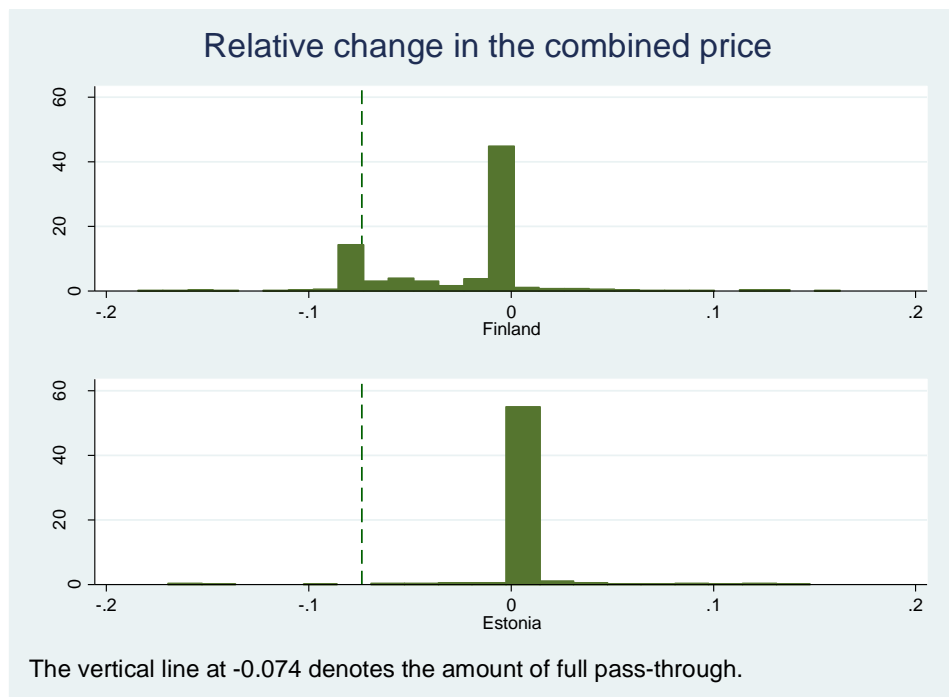


Exhibit 6. Consumer price change against Finnish hotels.

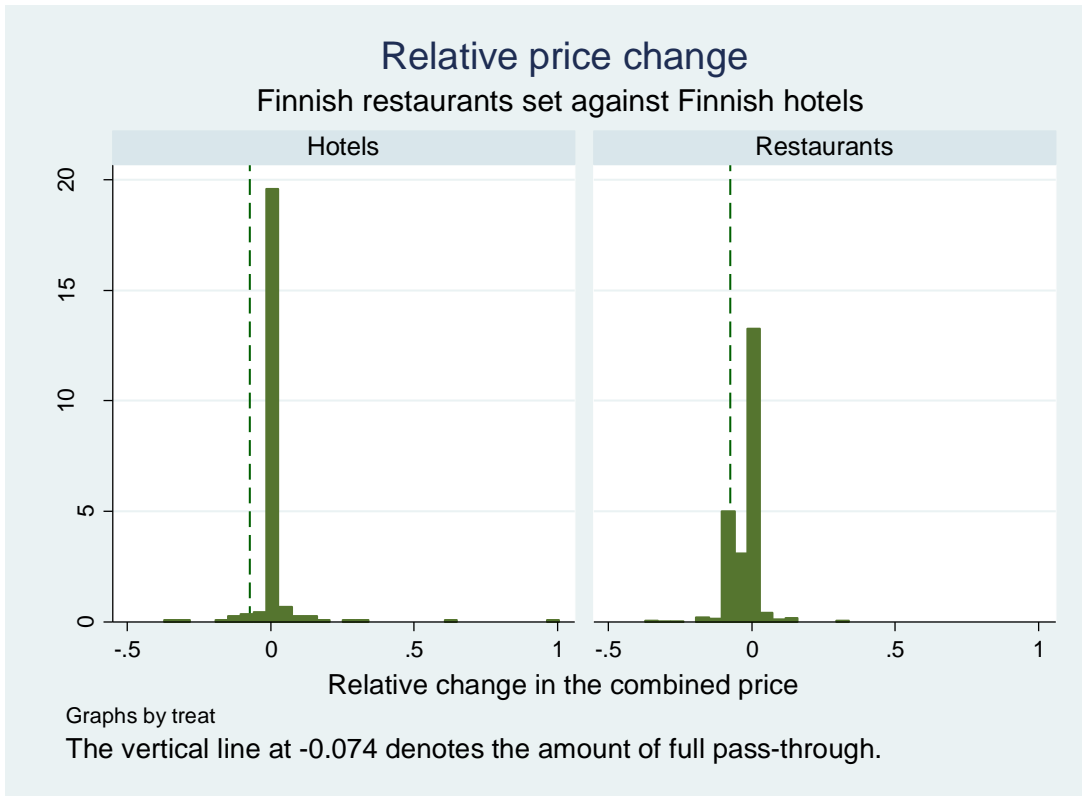
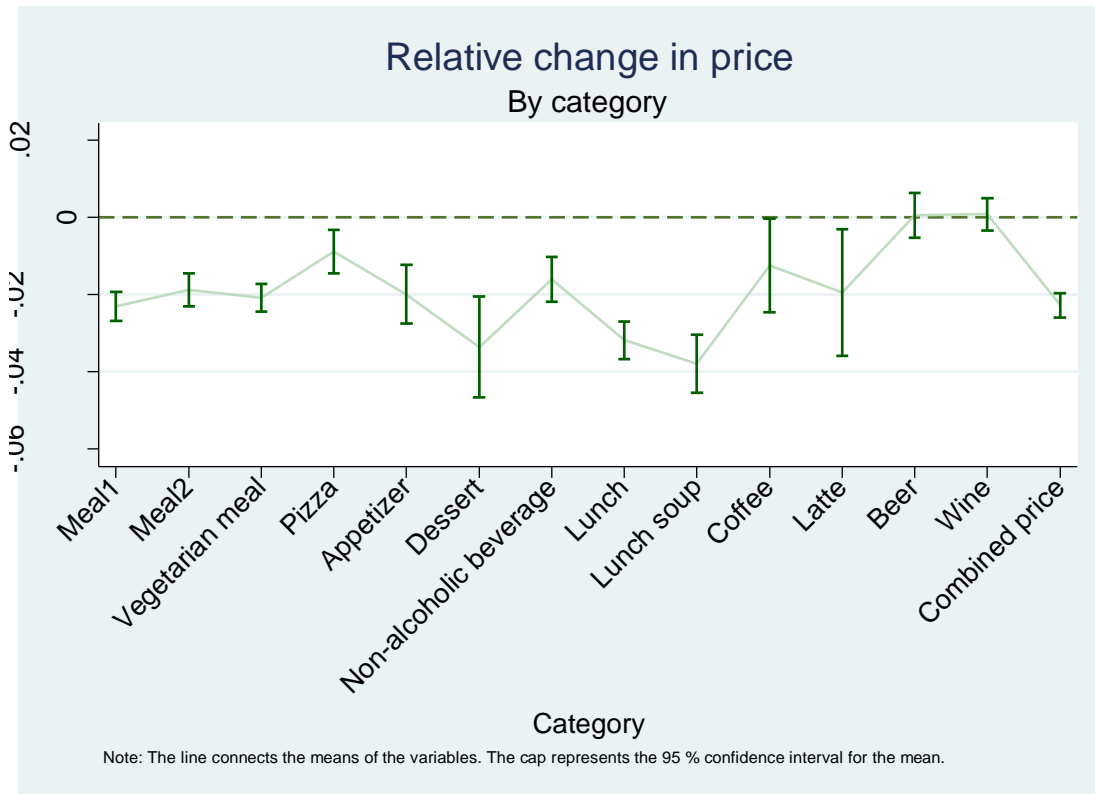
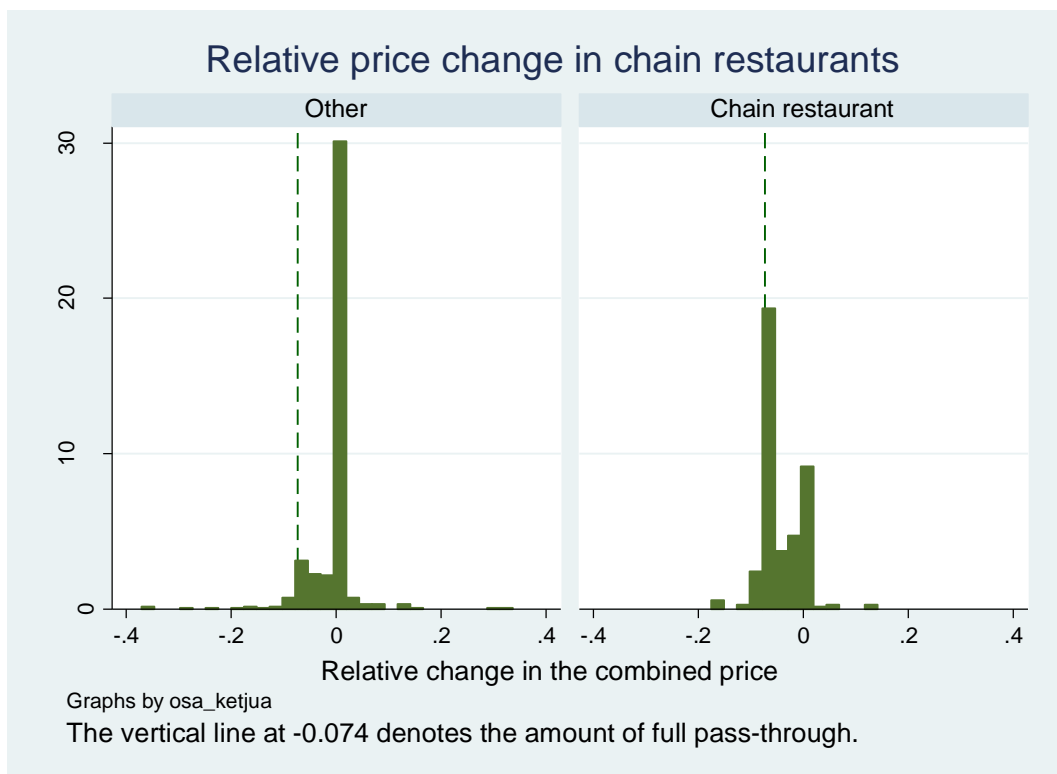


Exhibit 7. Consumer price change in different meal categories.



The rest of the section will focus on analyzing how the price change was divided between Finnish restaurants. Exhibit 8 shows the price change in chain restaurants versus other restaurants. Chain restaurants are of particular interest, as they differ from the sole restaurants in the degree of market power. There are small and large chains under the category, and thus the level of market power among the subgroup varies substantially. Thus, a straightforward analysis of the effects of the market power cannot be carried out on this basis.

Exhibit 8. Consumer price change in chain restaurants.

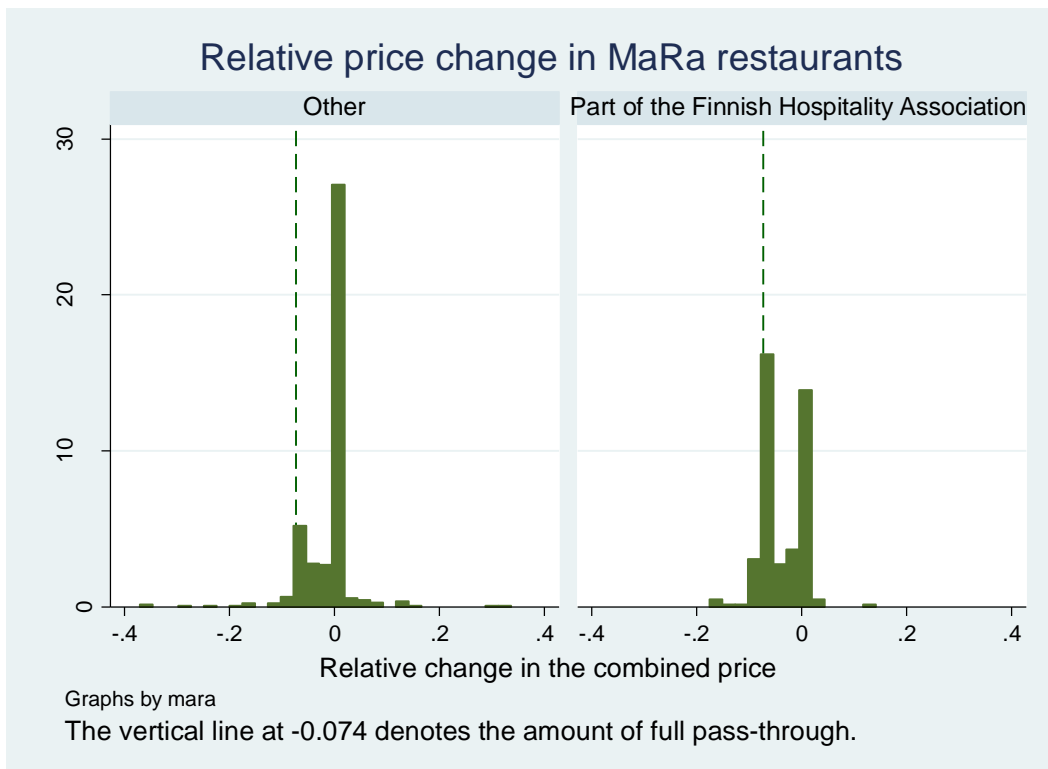


The chain restaurants certainly differ from the stand-alone restaurants in their price adjustment behavior. Whereas the point of highest frequency in the change distribution is zero for stand-alone restaurants, chain restaurants exhibit a higher tendency to reduce prices for the size of the tax than not to change prices at all. This might suggest that the average price change is largely driven by the chain restaurants.

The level of organization of a restaurant could also affect its response to the reform. The association for the Finnish restaurant keepers is MaRa, the Finnish Hospitality Association. The reform was lobbied by MaRa, and it campaigned for a price reduction in its member

restaurants before the tax reform (Nuutinen 2010). The reactions in these restaurants are also of particular interest because MaRa member restaurants cover 20-25 percent of the industry in the number of restaurants and 80-90 percent in the share of sales (Nuutinen 2010). The MaRa restaurants are graphed against non-MaRa restaurants in Exhibit 9. The graph illustrates that the changes are heterogeneous between MaRa and non-MaRa restaurants. The MaRa restaurants were more likely to reduce the price level by the size of the tax reduction. Also, this behavior seems to be more probable in the group than leaving the prices unchanged. This also suggests that as the majority of the sales in the industry is generated by MaRa restaurants, the price change observed by the consumers is likely to be larger than the change calculated as the average based on the number of restaurants.

Exhibit 9. Consumer price change in Mara and non-Mara restaurants.



For analysis of the amount of the price change in the Finnish restaurants, the price change is divided into different categories based on whether price increased, stayed the same or decreased. Additionally, price reduction is divided into three categories based on whether the price decreased less, equal to or more than the amount of tax. Table 4 below shows the relative frequencies of each price category, first cross-tabulated over country. The Finnish

price change is then inspected in particular over chain and S-group restaurants and different restaurant types.

The table delivers essentially the same message as the graphs above did. The inspection of the price change by restaurant type shows that the price change was most likely to be equal to the tax change in lunch restaurants. For all other restaurant types, more than half of the restaurants are classified in the 'No effect' category. The peculiarity that 7 percent of the cafes seem to have decreased prices by more than the amount of tax is due to the small sample size of those restaurants, individual observations thus standing out. From S-group restaurants, an impressive majority of 80 percent of the group's restaurants have reduced prices by the amount of tax.

The 'Reduction equal to the tax change' category includes the price changes within one percentage point scale in both directions. A stricter definition of equality (from -7 to -7,8 percent) reveals that 140 of the sample restaurants decreased prices exactly by the amount of the tax. The price change that this accurately corresponds to the size of tax reduction might be rather a result from strategic behavior than a consequence of new market equilibrium.

Table 4. The density by the amount of the price changes.

	The change in the consumer price by category					Total
	Price increase	No effect	Reduction below tax change	Reduction equal to tax change	Reduction above tax change	
Country						
Estonia	4.9 %	91.4 %	2.6 %	0 %	1 %	100 %
Finland	5.8 %	52.9 %	18.5 %	19.8 %	3.1 %	100 %
All	5.5 %	64.9 %	13.5 %	13.6 %	2.4 %	100 %
N	68	798	166	167	30	1,229
Finland						
<i>Chain restaurant</i>						
Chain restaurant	3.1 %	20.3 %	26.2 %	46.2 %	4.2 %	100 %
Other	7.3 %	70.1 %	14.3 %	5.8 %	2.5 %	100 %
All	5.9 %	53 %	18.4 %	19.6 %	3.1 %	100 %
N	49	444	154	164	26	837
<i>By restaurant type</i>						
Fast food	8.1 %	56.8 %	18.2 %	13.7 %	3.2 %	100 %
A la carte	6 %	54.2 %	17.3 %	19.9 %	2.7 %	100 %
Cafe	6 %	57.1 %	13.1 %	16.7 %	7.1 %	100 %
Lunch restaurant	1.7 %	42.3 %	23.4 %	30.9 %	1.7 %	100 %
All	5.8 %	52.9 %	18.5 %	19.8 %	3.1 %	100 %
N	49	447	156	167	26	845
<i>S-group</i>						
Belongs to S-group	1.8 %	3.6 %	14.5 %	80 %	0 %	100 %
Other	6.1 %	53.9 %	20.9 %	15.1 %	4.1 %	100 %
All	5.5 %	47 %	20 %	24 %	3.5 %	100 %
N	22	188	80	96	14	400

7.2. Analysis of the average price effect

As noted in the beginning of the preceding section, the price change does still not necessarily account for the causal effect of the tax reduction on prices. To estimate the causal price responses to the reform, the regressions here take advantage of the methods described in Section 6.2. First, the average change for a representative restaurant is derived. Then, the sales-weighted regression is run to reflect the average price change from the consumer perspective.

The ordinary least squares (OLS) regression with no weights derives the causal effect of the price change for a representative restaurant. OLS does not take into account whether the restaurants have large or small numbers of customers. The estimator is simply derived as a

result from the minimization of the squared prediction error, i.e. squared residuals, and for a large number of observations it approaches the population average. As the sample in question is a random sample of the registered Finnish restaurants, the average is simply based on the number of firms. The matter is emphasized here to provide a basis for understanding the weighted regression in the section 7.3.

7.2.1. Simple DID model

Recall from Subsection 6.2.2 that the regression is of form

$$\ln(\text{combined price})_{igt} = \alpha + \gamma \text{Finland}_g + \lambda D_t + \delta(\text{Finland}_g \cdot D_t) + \beta X'_{igt} + \varepsilon_{ist} \quad (29)$$

, where X'_i is the vector of possible control variables used. The regression is first run without control variables. Then, dummies for S-group, MaRa and chain restaurants are included. The Breusch-Pagan test for heteroskedasticity rejects the null hypothesis of constant variance, and thus heteroskedasticity-robust standard errors are used to correct the standard errors.

The regression results are exhibited in Table 5. The first column shows the regression results for the DID OLS regression. Note that the estimate of interest, δ , is the coefficient for DD. The estimate gives a value of -0.023, which in a semi-logarithmic regression corresponds to a -2,3 percent change in the prices and thus a 31 percent pass-through rate of the tax reduction. This is the effect on price resulting from belonging to the treatment group at the time of the treatment. However, the estimates suffer from large standard errors, and the coefficient is not statistically significant. The only estimate with significance is γ , the coefficient for belonging to the treatment group. It indicates that prices in restaurants in Finland are 72 percent higher than in Estonia.

Column 2 reports the regression results when the model is controlled with MaRa, S-group and chain restaurant variables. Restaurants belonging to MaRa or S-group are likely to have higher price level than other restaurants, and belonging to a chain is likely to decrease prices. The downward effect of belonging to a chain on the price level might be driven by the many fast food restaurants and cafes operating within chains. Again, no significant estimates of the price change due to the tax reduction can be derived. Note here that the number of observations decreases from the first column. This is due to a lack of S-group indicator for a big number of observations. While the reason behind the missing indicators remains unclear, it does not challenge our analysis. Based on the examination of the restaurant characteristics,

the selection of restaurants with missing information does not seem to follow a certain pattern, but seems to be rather arbitrary. Thus, the group still subject to the analysis is smaller but representative of the whole sample, and an unbiased analysis can be carried out.

7.2.2. DID model with fixed effects

DID OLS regression fails to derive significant coefficients, as there is a lot variation in the explained variable, the combination price; that is left unexplained by the model. An attempt to correct for this is made by using the fixed effects model. In the model, each restaurant is allowed its own intercept. Thus, the unobserved restaurant-specific factors are controlled for.

Column 3 represents the results for the fixed effects estimation. The DD coefficient value implies a price reduction of 2,3 percent due to the tax change. This corresponds to a 31 percent level of pass-through. The value of the coefficient is equal to its value in the first column; the estimates from the OLS regression are unbiased. This is natural as the fixed effects estimation only affects the individual intercepts. What is different, however, is the level of statistical significance. The DD coefficient is now significant at the 1 % level while the same estimate from the OLS estimation was not found statistically significant at all. This is due to the smaller standard errors resulting from the better explanatory power of the model. Note that the constant reported at the bottom of the column is the average of the fixed effects parameter (StataCorp. 2009, pp. 447).

The value of R^2 , however, is in contrast with the claim of the better explanatory power. Stata utilizes the time-demeaning technique explained in subsection 6.2.3 in calculating the fixed-effects estimates. Thus, no dummies are actually calculated, and within R^2 is calculated from the mean-deviated regression. When it comes to the fixed effects parameters that are added in the model, the within R^2 makes no attempt to measure their effect on the overall fit of the model (StataCorp. 2009, pp. 463). Thus, the overall R^2 results in lower than in the OLS model. However, the F-statistics indicate joint significance of the estimates.

Although the fixed effects model does not allow including time-invariant variables, those can be interacted with variables that change over time (Wooldridge 2009). Thus, while belonging to MaRa or being a part of a chain is not likely to change over the short period of inspection, interacting MaRa and chain indicators with the treatment group and –period term DD enables the estimation of the effects of the tax reform for these groups separately. The inspection of the graphs in the beginning of the section suggested that the effect of the reform in MaRa and

chain groups differs from the average change pattern. Column 4 reports the regression results for the fixed effects estimation with MaRaDD interaction term. The average treatment effect for restaurants that are not MaRa members is now -1,5 percent which corresponds to a pass-through of 20 percent. For MaRa restaurants, the treatment effect is the sum of the -1.5 percent effect and the MaRa “premium” -2,6 percent. Thus, the average effect of tax reduction observed in MaRa restaurants was a 4.1 percent reduction in prices, which translates to a 55 percent pass-through of tax. This is in line with the price change graphs. The increased R^2 also indicates that the explanatory power of the model increased when the interaction variable for MaRa was added.

In column 5, the regression results imply an average of one percent decrease in prices in stand-alone restaurants, whereas chain restaurants exhibit a 4,6 percent price reduction. Since the DD estimate for a stand-alone restaurant is below and for a chain restaurant above the overall average DD estimate of 2,3 percent (column 3), it seems that the price reduction was to a large extent driven by chain restaurants. Based on the value of R^2 , this model seems to be so far the most effective in explaining the variation in the combined price.

A DID regression with fixed effects is estimated to hotels control group to analyze the similarity between the results derived from using different control groups. The estimation results are shown in column 6. The causal effect of interest is now -3,0 percent, while the regression gave -2,3 percent for the same coefficient when using Estonian restaurants as a control group. However, the null hypothesis of the equality of estimates cannot be rejected. The consistency of results across alternative control groups is supportive of the validity of the results.

Table 5. Regression results.

VARIABLES	(1) OLS, DID	(2) OLS, DID with additional controls	(3) DID, FE	(4) DID, FE, MaRa included	(5) DID, FE, Chain included	(6) DID, FE, hotels
treat	0.718*** (0.0297)	0.641*** (0.0368)				
after	0.000318 (0.0360)	0.000318 (0.0359)	0.000318 (0.000988)	0.000318 (0.000988)	0.000318 (0.000988)	0.007214 (0.005333)
DD	-0.0229 (0.0420)	-0.0272 (0.0475)	-0.0229*** (0.00189)	-0.0147*** (0.00224)	-0.0105*** (0.00220)	-0.0298*** (0.00557)
MaRa		0.175*** (0.0361)				
Chain		-0.158*** (0.0312)				
S-group		0.279*** (0.0371)				
MaraDD				-0.0258*** (0.00308)		
ChainDD					-0.0359*** (0.00301)	
Constant	1.374*** (0.0254)	1.398*** (0.0258)	1.869*** (0.000576)	1.869*** (0.000558)	1.866*** (0.000542)	2.728*** (0.000883)
Observations	2,450	1,544	2,450	2,450	2,434	2,218
R-squared	0.333	0.376	0.178	0.229	0.276	0.230
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Number of ytunnus			1,225	1,225	1,217	1,109

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: within R-squared reported for the fixed effects estimation.

7.3. Analysis of the weighted price effect

So far, the estimates are derived for an average firm. The definition of an average firm is based on the number of firms. However, what is also of interest is how much the price decreased from the consumer perspective; if the majority of servings sold is eaten in a certain restaurant, then the price change in that restaurant can by some criteria be considered more important than in a restaurant with only one serving sold per day. Thus, by this criterion, the restaurants selling a larger proportion of the servings should receive a larger weight in the estimation. The weighted average of the reform effect differs from the average effect only if the effect in large restaurants is different from the effect in the smaller ones.

The Weighted Least Squares (WLS) model is often used to deal with heteroskedastic residuals. In such cases, a larger weight is assigned to observations with large variance to downweight their squared errors in the least squares estimation. Thus, the effect of those observations on the estimate derived becomes larger. (Stock & Watson 2007, pp. 691-696.) Here, the weights are based on the importance of the larger restaurants. There might be a relatively small number of large firms, but their proportion of the industry sales is large. The mechanism of weighting, however, is analogous as in the situation described above; the weight assigned to an individual is in inverse relation to the variance of an observation.

First, the weights need to be assigned to the restaurants. As the number of servings sold is not centralizedly recorded by any quarter, the sales data are used as a proxy for the number of servings sold. We have tax data for the restaurants available for year 2009. Main branch indicator for each restaurant is also recorded in the data. By the business ID, the data can be linked to the right restaurant in the price data. The restaurant services were subject to the VAT rate of 22 % in the year 2009 data. As the relative weights are similar whether the data is converted to sales amounts or not, the data set is handled in the tax form.

While the mean of the restaurant-specific taxes stands at 402 057, the median is only 3468,4 euros. This suggests that there are huge outliers in the data. This is confirmed by the examination of the distribution of taxes (Appendix 12). These observations would get a disproportionately high significance in the estimation if the raw tax data was assigned to the firm weights. This would be well-founded if such large players would indeed to such extent dominate the Finnish restaurant industry. However, the inspection of the large values reveals that this is not the case here. Some of the restaurants with large sales are listed under a main branch other than restaurant industry. This suggests that the sales consist primarily of other business activity than restaurant business. Others are chains, with all chain's restaurants listed under the same business ID.

The proportion of the actual restaurant business is hard to solve. Attempts could be made to gather information on the conglomerates' restaurant activity from the businesses' financial statements. However, this information is not available for all firms. Additionally, for properly allocating the taxes paid by each sample restaurant, information would be needed on the number of restaurants operating within a chain. Otherwise, the individual restaurant that operates within a chain would be allocated the total amount of the chain's sales. Because these actions would cause unnecessarily inconvenience and even at their best result in

defective tax estimates, the approach taken here is to limit the upper-level sales (taxes) by a partially arbitrary procedure. Thus, the results derived are only suggestive in nature and must be interpreted with caution.

First, from the restaurants that were listed under main branch other than restaurant branch, the weight for those who paid more than 100 000 euros of taxes in 2009 was limited. From those restaurants that were left with more than 100 000 euros of taxes paid, all were chain restaurants. Thus, their weights were divided by ten. Then, the Estonian restaurants, with no tax information at hand, were each allocated a weight of the size of the mean weight of Finnish restaurants. The modified distribution is found in Appendix 13. Note that the frequency at the location of mean is disproportionately high due to the mean weight being allocated to all Estonian restaurants.

Table 6 exhibits the results of the fixed effects estimation with weights. In the first column, the estimates from a regression, where the tax distribution was not limited, are reported. The estimate implies an effect of -6,5 percent on the consumer price. However, setting limitations to the highest weights essentially changes the results; the coefficient for DD is now almost one percentage point lower. The estimates for the regression, when applying the limited weights on restaurants, are shown in column 2. It seems that the price change estimates are not robust for the largest restaurants; there is asymmetry between the treatment effects in large and small restaurants. Thus, how the weights are defined substantially affect the estimates derived of the causal effect of the tax reduction. This is confirmed also by the results in column 3, where the upper limit for the tax-based weights is capped to 100 000 euros; the effect of interest decreases by 4 per Milles.

However, conclusions can be drawn of the direction of the effect of weighting the restaurants by the proxy for amount of servings sold. The large restaurants showed a larger tendency to pass the tax forward to consumer prices in the context of the tax reform. The sales-weighted average of the causal effect of the tax change on prices ranges between -5,3 and -6,5 percent; these correspond to a 71-88 percent pass-through of tax. Note, however, that the upper limit to the estimate is based on distorted weights, as other-than-restaurant business operations add to the significance of the largest firms. The other results are also very sensitive to the choice of weights, and thus very suggestive.

Table 6. Weighted regression results.

VARIABLES	(1) FE, WLS with unlimited distribution of taxes	(2) FE, WLS with limited distribution of taxes	(3) FE, WLS with a more limited distribution of taxes
after	0.000315 (0.000977)	0.000315 (0.000977)	0.000315 (0.000977)
DD	-0.0646*** (0.00373)	-0.0565*** (0.00248)	-0.0525*** (0.00256)
Constant	2.013*** (0.00132)	1.907*** (0.000777)	1.893*** (0.00076)
Observations	2,226	2,226	2,226
R-squared	0.807	0.690	0.621
Prob > F	0.000	0.000	0.000
Number of ytunnus	1,113	1,113	1,113

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: within R-squared reported for the fixed effects estimation.

8. Discussion

Based on the inspection of the price change using both graphs and summary statistics, it seems that the tax change translated into lower prices. The regression analysis with the OLS DID model supports the interpretation; the estimates derived of the causal effect of the tax reduction imply a price change of -2,3 percent. However, the results are not statistically significant. The use of fixed effects estimation decreases the amount of unexplained variation for each observation and thus provides more efficient estimates. The significant estimates show a 2,3 percent price reduction as a response to the tax change. The pass-through rate of tax is then 31 percent.

The tax reduction is, on average, undershifted. This does not imply any definitive conclusions about the competitive model in the market; with all forms of competition, undershifting is possible under certain assumptions. The examination of partial equilibrium model for perfectly competitive markets suggests that undershifting could be related to the demand being relatively more elastic than supply. The Finnish-level estimates of the demand elasticity by Soppi (2006) are derived from Almost Ideal Demand System (AIDS), and suggest that the elasticity of demand for restaurant services be -0,84. Edgerton et al (1996) apply the same system and derive a value of 1,02 for the Finnish price elasticity. Both elasticity estimates indicate high demand responses to price changes and could thus suggest *relatively* inelastic supply. In Subsection 3.1.2., the supply characteristics in the industry were shortly discussed. It was claimed that labor-intensive services exhibit relatively high supply elasticity, as labor input can be easily adjusted and entry to the market is facilitated. More information on the supply characteristics would be needed to draw conclusions of the sources of undershifting.

In the models including market power, undershifting is related to the demand characteristics. The price responses are below the size of the tax when the demand is concave. Concave demand would induce large demand changes for small price reductions on high price levels and small ones for large reductions on the lower price levels. This option cannot be excluded given the information available.

Another characteristic of the results is the asymmetry of price responses in different subgroups. The price reduction was higher for the chain and MaRa restaurants. The chain restaurants, with supposedly larger amount of market power than the stand-alone ones, show a differing response compared to the estimate derived for a representative restaurant from the

basic fixed effects OLS model. In large proportion of chain restaurants, the tax reduction is passed fully on to consumer prices (Exhibit 8, Table 4). The same pattern is observed in the MaRa restaurants, although the proportion of restaurants with complete pass-through is smaller.

Exhibit 7 demonstrated that the price reduction was largest for lunch prices. In the beginning of July 2010, the value of the luncheon voucher, a popular Finnish fringe benefit, decreased from 9,50 to 8,80 euros (Taloussanomat 2010b). This corresponds to -7,4 percent, the computational value of the tax reduction. Luottokunta, the issuer of the luncheon voucher, reports that 90 000 meals a day are paid using the luncheon voucher (Luottokunta). This number cannot be considered negligible; the decrease in luncheon voucher value might even induce an effect in market pricing. Thus, the luncheon voucher factor might contribute to the exceptionally large drop in the lunch prices.

An element also present in Kosonen's (2010) study is the dependence of the level of pass-through on the form of business. Kosonen found that the large corporations exhibited the largest and the sole proprietors the smallest pass-through rates in the context of a tax reform on hairdressing. Correspondingly, our study presents highest pass-through rates to chains and the largest restaurants, measured by the sales. For example, the S-group corporation with a 20 percent market share (SOK Corporation Annual Report 2010) exhibits full pass-through in 80 percent of its restaurants. This might seem surprising, as in theory full pass-through was only found to reflect perfect competition or Bertrand competition outcome. Belonging to a chain is not necessarily a sign of significant market power, but the degree of market power is certainly higher than for an average stand-alone restaurant. A full pass-through in chain restaurants, observed in the market immediately following the tax change, is then likely to reflect something else than competitive market behavior; the reasons for the producer to pass the tax reductions fully to the consumer price might be strategic, or they may follow from public pressure.

As explained in Section 6.1, the tax reduction was followed closely in the Finnish media both before and after the tax change. A web site www.alv13.fi⁸ was founded to publish a black list of restaurants that did not pass the tax on to prices (Helsingin Sanomat 2010). The large restaurants with higher customer levels might have found the public attention more oppressive than the smaller ones. The inquiries of the price reduction might be more frequent in these

⁸ The web site is no longer operating.

restaurants, and in the absence of reduction the large chain restaurants might attract a lot of negative attention. Partially, this is field of behavioral economics. Additionally, the big restaurants can simply have afforded to decrease prices; larger market power is likely to translate to higher mark-ups. Large chain restaurants may also benefit from increasing returns to scale in their operations.

Inspection of MaRa restaurants reveals that the association consists of restaurants with high customer levels. Although only 20-25 percent of Finnish restaurants belong to the association, they cover 80 to 90 percent of the sales of the industry (Nuutinen 2010). Thus, the right interpretation of the higher pass-through estimates for the subgroup is not necessarily that belonging to MaRa would be driving the result; i.e. that the estimate would be causal. This would actually be quite improbable; although MaRa campaigned for the pass-through of tax reduction, it does not have command over the pricing policies of its member restaurants. The restaurants belonging to the association could just possess certain characteristics that affect the outcome. The inspection of MaRa restaurants reveals that a slight majority of these restaurants operate within a chain. That fact, accompanied by the above-mentioned information of the disparity between the amount of members and the amount of sales by the member restaurants, illustrates that MaRa is an association of large restaurants. Thus, the differing results for MaRa could be driven by the selection of the restaurants in the association.

The fit of the above models, as measured by R^2 , is below 50 percent. However, this is not found problematic, as the aim of the study was to provide estimates on the tax change's average effect on prices, not to model the phenomenon.

The sales-weighted pass-through estimates in Section 7.3 were above those for a representative restaurant. A 71-88 percent level of pass-through was found, depending on the definition of weights. There was no clear-cut way in defining the weights, though; more specific information would have been needed on the sales per restaurant. However, a positive relationship is observed between the level of pass-through and the sales of the restaurant. Thus, the price change observed in the consumption of the restaurant services by an average consumer is larger than the estimates from the unweighted regressions suggest.

In most restaurants, the absolute changes in prices were small (Appendix 14). The mean for the change in absolute values ranged from -0,02 euros for coffee to -0,27 euros for lunch. If the demand characteristics are such that consumers do not react to such small price changes,

i.e. the demand is inelastic for small scale price variations, no demand effect is generated. Thus, to analyze the materialization of the policy objectives, information is needed on the demand effects of the reform. What can be concluded from our study is that the reform was partly ineffective in inducing demand effects, as the full pass-through of taxes to prices was not realized.

A cautionary word was given in Subsection 6.2.1 of the potentially differing trend behavior of the primary control group. The past development in restaurant prices has, on average, been more rapid in the Estonian restaurants. Therefore, the distribution of the change in Estonian prices was compared to those of the alternative control group. Those were found to greatly resemble each other (Appendix 10). Also, the average change in the combined price in Estonia was not significantly different from zero. If the pattern of more rapid growth in Estonia would have continued across the study period, Finnish restaurants should have experienced a period of negative price growth. This has not been typical of Finland in the past (Exhibit 3). The Estonian price development is thus considered as a plausible counterfactual for the Finnish price development. However, if the Estonian control group had actually exaggerated the level of counterfactual price development, the real pass-through estimates would have been smaller than derived in Chapter 7. If the Finnish counterfactual price growth would have exceeded that of Estonia, the real estimates of the level of pass-through would have been larger.

The pass-through estimates derived here are in line with the previous research on tax reduction. Though tax reduction in particular has not been studied extensively, there are a few references to contrast our results with. Doyle & Samphantharak (2008) studied sales tax incidence in the gasoline market. They find undershifting of taxes in the context of tax suspensions. The short-run pass-through estimate is 70 percent. Kosonen (2010) found a 60 percent pass-through in a Finnish tax reform from 2009, where a tax reduction was targeted at hairdressing and small repair services. These treatment effects correspond to the weighted estimates of Section 7.3; however, the unweighted estimates of average pass-through are notably smaller.

The Finnish tax reduction on restaurant services was also subject to other studies. The results by Peltoniemi and Varjonen (2011) are derived using a different method and sample. The average effect is counted by weighting the changes for different restaurant types by the CPI-based consumption shares of those types. By the method, the price reduction is 4,4 percent on

average, driven by large and MaRa restaurants. The non-organized restaurants exhibit a price reduction of 1,8 percent. The results correspond to the results derived in Chapter 7. The deviation of the average effect from our estimates is likely to result from different approach to weighting. The treatment effect for non-organized restaurants, however, is similar to our estimate of 1,5 percent (Table 5, column 4). The estimates from our study are also consistent with those of Harju and Kosonen (2010), derived from the use of the same data set and method.

9. Conclusions

The aim of the thesis has been to study the normative aspects of differentiated tax rates and the positive aspects of tax changes and to complement the theory with an overview of the empirical research on the subject. Additionally, a case study of a VAT reform on Finnish restaurant industry was included to contribute to the still understudied field of tax incidence. The motivation for the research spurred from the lack of consensus among researchers on the implications of tax changes. The increasing application of VAT as a tax instrument highlights the need of practical information on its effects on the sectors involved and the economy on the whole and on the fulfillment of the aimed targets.

The tax reforms have been subject to a limited amount of research. In the majority of these studies, the price changes following the tax changes have been the effect of interest. However, the results on the forward-shifting of taxes remain ambiguous. Also, few comprehensive studies on tax changes' impacts on the economy on the whole have been conducted. This thesis contributes to the research by utilizing a natural experiment design and applying the difference-in-differences method to derive the causal effect of an exogenous change in tax policy in the Finnish restaurant industry in 2010. The method used corresponds to that used by Doyle & Samphantharak (2008) in studying the consequences of tax suspensions and, later, reinstatements. The analysis aims to determine the tax reform's effects on consumer price. We concentrate on deriving two principal estimates of interest. The first one is the simple average of the causal effect of tax change on consumer prices based on the number of restaurants. The second one is a sales-weighted average of the reform's effect; an estimate that aims to better reflect how the tax changes affected the consumers' spending on these services. We find that prices decrease following the tax change, but not to the whole extent of tax reduction. The sales-weighted average of price decrease exhibits a higher pass-through rate than the simple

count-based average, revealing a higher tendency of price reduction in more popular restaurants.

The lack of estimates on supply and demand characteristics challenges the interpretation of the results. Undershifting could result from relatively inelastic supply in a competitive industry or, alternatively, from the exercise of market power. We rest more on the latter alternative, as the supply should be relatively easily adjusted in the labor-intensive industry in question, especially as the Finnish economy did not exhibit full employment in 2010. Our results correspond with Doyle & Samphantharak (2008), who found less-than-full shifting of taxes in the context of tax reduction, and Kosonen (2010), finding evidence of undershifting of tax reduction on hairdressing.

The individual pass-through rates of the firm seem to be linked to the size of the firm, the largest ones exhibiting highest pass-through rates. Also restaurants that belong to a chain are found to respond more intensely to tax reduction. This could be attributed to a potentially more elastic supply in the larger companies; also, it could be a result of engaging to Bertrand competition. The suggestive analysis provided here emphasizes the need for further research, encompassing also the demand and employment effects of the VAT reforms. Also, the analysis needs to be industry-specific, as the outcomes seem to be essentially tied to the particular demand and supply characteristics of the industry. As these characteristics differ across industries, the results from one sector may not be directly generalized to others.

Studying VAT incidence is important not only to contribute to the research on tax incidence in general, but also to provide practical information about the tax reform in particular. The restaurant services are often characterized as luxury goods. Based on the research by Varjonen & Aalto (2010, pp. 40), the highest income quintile spends nearly two and a half times more money on “outsourcing” meal services than the lowest quintile. The number, although also including the expenses on the convenience food, suggests that if the tax reform did not achieve its objectives of increasing demand and employment, it became merely a subvention to the highest income groups. Although further information on demand and supply characteristics and employment effects would be necessary to evaluate the reform’s success on the whole, the consumer price change alone provides valuable information on the extent of the potential demand effects.

Previous studies on tax incidence by Doyle & Samphantharak (2008) and Alm et al (2009) have incorporated spatial analysis in their work. Alm et al compare responses in prices

between the urban and rural areas. Spatial analysis on the effects of the tax reduction would be engrossing in our study too; comparing otherwise similar restaurants in areas with differing restaurants-to-inhabitants density would allow exploring the asymmetry of responses based on the level of competition. The demand effects could be studied by comparing the development in restaurants' sales levels in Finland and Estonia. As the objectives of the European Commission also included the reduction of the size of the informal sector of the economy, the development of the grey economy should also be examined.

To conclude, the varying results of the effects of commodity tax changes further emphasize the need for case-specific consideration of tax reforms. Our study adds to the findings by Doyle & Samphantharak (2008), Kosonen (2010) and Besley & Rosen (1999) and demonstrates that the full pass-through is not a self-evident outcome of a tax change, but rather a special case. Comprehensive research incorporating also demand and employment effects is still crucial to complement the field of research of tax incidence.

References

- Alm, J - Sennoga, E. – Skidmore, M. (2009): *Perfect Competition, Urbanization, and Tax Incidence in the Retail Gasoline Market*. *Economic Inquiry*, Vol. 47, No. 1, pp. 118-134.
- Anderson, S.P - de Palma, A. – Kreider, B. (2001a): *Tax incidence in differentiated product oligopoly*. *Journal of Public Economics*, vol. 81, pp. 173-192.
- Anderson, S.P - de Palma, A. – Kreider, B. (2001b): *The efficiency of indirect taxes under imperfect competition*. *Journal of Public Economics*, vol. 81, pp. 231-251.
- Angrist, J.D. – Pischke, J. (2009): *Mostly Harmless Econometrics. An Empiricist's Companion*. Princeton University Press 2009.
- Atkinson, A.B. – Stiglitz, K.E. (1976): *The design of tax structure: Direct versus indirect taxation*. *Journal of Public Economics*, vol. 6, pp. 55-75.
- Bento, A.M. – Goulder, L.H. – Jacobsen, M.R. – von Haefen, R.H. (2009): *Distributional and efficiency impacts of increased U.S. gasoline taxes*. *American Economic Review*, Vol. 99, Iss. 3, pp. 667–699.
- Besley, T.J. – Case, A. (1994): *Unnatural experiments? Estimating the incidence of endogenous policies*. Working Paper Series No. 4956, National Bureau of Economic Research (NBER).
- Besley, T.J. – Rosen, H.S. (1999): *Sales Taxes and Prices: An Empirical Analysis*. *National Tax Journal*, vol. 52, No. 2, pp. 157-178.
- Bishop, Robert L. (1968): *The effects of specific and ad valorem taxes*. *Quarterly Journal of Economics*, vol. 82, no. 2, pp. 198-218.
- Commission of the European Communities (2003): *Report from the Commission to the Council and the European Parliament. Experimental application of a reduced rate of VAT to certain labour-intensive services*. SEC(2003) 622.
- Copenhagen Economics (2007): *Study on Reduced VAT Applied to Goods and Services in the Member States of the European Union*. Publications. Available at <http://www.copenhageneconomics.com/Publications/>. Visited 31.10.2011.
- Corlett, W.J. – Hague, D.C. (1953): *Complementarity and the Excess Burden of Taxation*. *The Review of Economic Studies*, Vol. 21, No. 1, pp. 21-30.
- Delipalla, S – Keen, M. (1992): *The comparison between ad valorem and specific taxation under imperfect competition*. *Journal of Public Economics*, Vol. 49, pp. 351-367.

Diamond, P.A. – Mirrlees, J.A. (1971a): *Optimal Taxation and Public Production I: Production Efficiency*. The American Economic Review, Vol. 61, Iss. 1, pp. 8-27.

Diamond, P.A. – Mirrlees, J.A. (1971b): *Optimal Taxation and Public Production II: Tax rules*. The American Economic Review, Vol. 61, No. 3, Part 1, pp. 261-278.

Diamond, P.A. (1975): *A Many-Person Ramsey Tax Rule*. Journal of Public Economics, Vol. 4, pp. 335-342.

Doyle, J.J. - Samphantharak, K. (2008): *\$2.00 Gas! Studying the Effects of a Gas Tax Moratorium*. Journal of Public Economics, vol. 92, pp. 869-884.

Duflo, E. – Glennerster, R. – Kremer, M. (2006): *Using randomization in development economics research: A toolkit*. Discussion Paper Series No. 6059, Center for Economic and Policy Research (CEPR).

Edgerton, D.L. ed. (1996): *The Econometrics of Demand Systems: With Applications to Food Demand in the Nordic Countries*. Kluwer Academic Publishers.

Elonen, P. – Laitinen, J. – Mölsä, J. – Vuoristo, P. (2009): *Jyrki Katainen ajaa sovittua pienempää arvonlisäveron alennusta ruualle*. Helsingin Sanomat 18.8.2009.

EUR-Lex (1999): *Council Directive 1999/85/EC*. Official Journal of the European Communities. Published 28.10.1999. Available at <http://eur-lex.europa.eu/>. Visited 20.1.2012.

EUR-Lex (2009): *Council Directive 2009/47/EC*. Official Journal of the European Union. Published 9.5.2009. <http://eur-lex.europa.eu/>. Visited 20.1.2012.

European Central Bank (2004): *Estonian kroon included in the Exchange Rate Mechanism II (ERM II)*. 27.6.2004. Available at http://www.ecb.int/press/pr/date/2004/html/pr040627_2.en.html. Visited 10.6.2011.

European Commission Taxation and Customs Union (2011): *VAT Rates Applied in the Member States of the European Union. Situation at 1st July 2011*. Available at http://ec.europa.eu/taxation_customs/. Data retrieved on 20th January 2012.

European Commission Taxation and Customs Union A. *General overview*. Available at http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/index_en.htm. Visited 31.10.2011.

European Commission Taxation and Customs Union B. *VAT Rates*. Available at http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/rates/index_en.htm. Visited 31.10.2011.

European Commission Taxation and Customs Union C. *VAT on Labour Intensive Services*. Available at http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/labour_intensive_services/. Visited 20.1.2012.

FINLEX (1993). *Arvonlisäverolaki 30.12.1993/1501*. Available at <http://www.finlex.fi/fi/laki/ajantasa/1993/19931501>.

FINLEX (2006). *Laki arvonlisäverolain 85 a §:n väliaikaisesta muuttamisesta (1060/2006)*. Available at <http://www.finlex.fi/fi/laki/alkup/2006/20061060>.

FINLEX (2008). *Laki arvonlisäverolain 85 §:n muuttamisesta (785/2008)*. Available at <http://www.finlex.fi/fi/laki/alkup/2008/20080785>.

FINLEX (2009a). *Laki arvonlisäverolain muuttamisesta (1780/2009)*. Available at <http://www.finlex.fi/fi/laki/alkup/2009/20091780>.

FINLEX (2009b). *HE 137/2009*. Available at <http://www.finlex.fi/fi/esitykset/he/2009/20090137>.

FINLEX (2010). *Laki arvonlisäverolain 85 a §:n väliaikaisesta muuttamisesta annetun lain voimaantulosäännöksen muuttamisesta (904/2011)*. Available at <http://www.finlex.fi/fi/laki/alkup/2010/20100904>.

FINLEX (2011). *Laki arvonlisäverolain muuttamisesta (1202/2011)*. Available at <http://www.finlex.fi/fi/laki/alkup/2011/20111202>.

Fullerton, D. – Kim, S.-R. (2008): *Environmental investment and policy with distortionary taxes, and endogenous growth*. Journal of Environmental Economics and Management, Vol. 56, No. 2, pp. 141-154.

Harberger, A.C. (1962): *The Incidence of the Corporation Income Tax*. The Journal of Political Economy, Vol. 70, No. 3, pp. 215-240.

Harju, J. – Kosonen, T. (2010): *Ravintoloiden arvonlisäveroalennuksen hintavaikutukset*. Muistiot 10, Valtion taloudellinen tutkimuskeskus (VATT).

Helsingin Sanomat (2010): *Moni ravintola pistää arvonlisäveron alennuksen omaan pussiinsa*.

Helsingin Sanomat 2.7.2010. [online] Available at <http://www.hs.fi/talous/artikkeli/Moni+ravintola+pist%C3%A4%C3%A4+arvonlis%C3%A4veron+alennuksen+omaan+pussiinsa/1135258309597>. Visited 20.1.2012.

Kosonen, T. (2010): *What was actually cut in the barbers' VAT cut?* Working Papers, October 2010, No. 18.

Lipsey, R.G. – Lancaster, K. (1956): *The General Theory of Second Best*. The Review of Economic Studies, Vol. 24, No. 1, pp. 11-32.

Luottokunta. *Tietoa Lounassetelistä*. [online] Available at http://www.luottokunta.fi/fi/kortit_ja_setelit/lounasseteli/tietoa_lounassetelista. Visited 20.1.2012.

Matkailu- ja Ravintolapalvelut Mara (2009): *Eduskunta hyväksyi ravintolaruoan arvonlisäveron alentamisen*. 18.11.2009. Available at <http://www.mara.fi/?file=755>. Visited 31.10.2011.

Ministry of Finance (2010a): *Arvonlisäverokannat Suomessa 1.7.2010 alkaen, %*. 1.7.2010. Available at http://www.vm.fi/vm/fi/10_verotus/. Visited 31.10.2011.

Ministry of Finance (2010b): *Verotuksen kehittämistyöryhmän loppuraportti*. Valtiovarainministeriön julkaisuja 51/2010.

Mirrlees, J. - Adam, S. - Besley, T. - Blundell, R. - Bond, S. - Chote, R. - Gammie, M. - Johnson, P. – Myles, G. and Poterba, J. (2011): *Tax by Design: The Mirrlees Review*. Oxford University Press: September 2011.

Myles, G.D. (1987): *Tax Design in the Presence of Imperfect Competition: An Example*. Journal of Public Economics, Vol. 34, pp. 367-378.

Myles, G.D. (1989): *Ramsey Tax Rules for Economies with Imperfect Competition*. Journal of Public Economics, Vol. 38, pp. 95-115.

Myles, G.D. (1995): *Public Economics*. University Press, Cambridge 1995.

Nuutinen, V. (2010): *Ravintolalounaan pitäisi halventua 70 senttiä*. Helsingin Sanomat 8.6.2010.

OECD (2006): *International VAT/GST Guidelines*. Available at <http://www.oecd.org/dataoecd/>. Visited 31.10.2011.

Peltoniemi, A. – Varjonen, J. (2010): *Elintarvikkeiden alv-alennus ja hintakehitys. Hintaseurannan tulokset ja katsaus kuluttajahintaa määrittäviin tekijöihin*. Julkaisuja 1/2010, Kuluttajatutkimuskeskus.

Peltoniemi, A. – Varjonen, J. (2011): *Ravintoloiden ruokapalveluiden alv-alennus ja hintakehitys vuonna 2010*. Julkaisuja 1/2011, Kuluttajatutkimuskeskus.

Poterba, J.M. (1996): *Retail Price Reactions to Changes in State and Local Sales Taxes*. National Tax Journal, Vol. 49, No. 2, pp. 165-176.

Ramsey, F.P. (1927): *A Contribution to the Theory of Taxation*. The Economic Journal, Vol. 37, No. 145, pp. 47-61.

- Salanié, B. (2003): *The Economics of Taxation*. MIT Press 2003.
- Seade, J. (1985): *Profitable cost increases and the shifting of taxation: Equilibrium responses of markets in oligopoly*. Warwick Economic Research Papers. Department of Economics, The University of Warwick.
- SOK Corporation Annual Report (2010). Available at <http://www.s-kanava.fi/>. Visited 31.10.2011.
- Soppi, P. (2006): *Elintarvikkeiden ja ravintolapalveluiden kysyntä Suomessa*. Working papers 84, Pellervon Taloudellinen Tutkimuskeskus.
- StataCorp. (2009): *Stata: Release 11*. Statistical Software. College Station, TX: StataCorp LP.
- Statistics Estonia (2011): *Consumer Price Index*. Available at http://pub.stat.ee/px-web.2001/I_Databas/Economy/24PRICES/24PRICES.asp. Visited 31.10.2011.
- Statistics Finland (2009): *Kulutustutkimus 2006. Käyttäjän käsikirja*. Käsikirjoja 26. Helsinki.
- Statistics Finland (2010): *Verot ja veronluonteiset maksut*. Available at http://pxweb2.stat.fi/database/statfin/jul/vermak/vermak_fi.asp. Visited 31.10.2011.
- Statistics Finland (2011): *Consumer Price Index*. Available at http://www.stat.fi/til/khi/tau_en.html. Visited 31.10.2011.
- Statistics Sweden (2011): *Consumer Price Index*. Available at <http://www.ssd.scb.se/databaser/makro/> . Visited 31.10.2011.
- Stock, J. H. - Watson, M. W. (2007): *Introduction to Econometrics*. Addison-Wesley 2007.
- Swedish Tax Office (2011): *Halverad moms på restaurang- och cateringtjänster*. 17.03.2011. Available at <http://www.skattebetalarna.se/Skattebetalarna/smid/12460/ArticleID/3758>. Visited 31.10.2011.
- Taloussanomat (2009a). *MaRa: Veroalennus vietävä kokonaan hintoihin*. 10.3.2009. [online] Available at http://www.taloussanomat.fi/kauppa/2009/03/10/mara-veroalennus-vietava-kokonaan-hintoihin/20096575/12?ref=lk_ts_yr_1. Visited 31.10.2011.
- Taloussanomat (2009b). *Alv-alennuksen arvostelu kiihtyy*. 2.8.2009. [online] Available at <http://www.taloussanomat.fi/politiikka/2009/08/02/alv-alennuksen-arvostelu-kiihtyy/200917460/12>. Visited 31.10.2011.

Taloussanomat (2010a). *Ravintolat lupaavat laskea hintojaan*. 7.6.2010. [online] Available at <http://www.taloussanomat.fi/yrittaja/2010/06/07/ravintolat-lupaavat-laskea-hintojaan/20108076/137>. Visited 31.10.2011.

Taloussanomat (2010b). *Lounassetelien arvo laskee*. 21.6.2010.[online] Available at <http://www.taloussanomat.fi/raha/2010/06/21/lounassetelien-arvo-laskee/20108758/139>. Visited 20.1.2012.

Tax administration. Available at <http://www.vero.fi/>

Tuomala, M. (2009): *Julkistalous*. Gaudeamus Helsinki University Press 2009.

Varjonen, J. – Aalto, K. (2010): *Kotitalouksien palkaton tuotanto ja ostopalvelujen käyttö*. Julkaisuja 2/2010, Kuluttajatutkimuskeskus.

West, S.E. – Williams III, R.C. (2004): *Estimates from a consumer demand system: Implications for the incidence of environmental taxes*. Journal of Environmental Economics and Management, Vol. 47, pp. 535–58.

Wooldridge, J. M. (2003) : *Introductory econometrics: a modern approach*. 2nd edn. South-Western 2003.

Appendices

Appendix 1. VAT rates applicable in EU member countries.

I. LIST OF VAT RATES APPLIED IN THE MEMBER STATES

Member States	Code	Super Reduced Rate	Reduced Rate	Standard Rate	Parking Rate
Belgium	BE	-	6 / 12	21	12
Bulgaria	BG		9	20	-
Czech Republic	CZ	-	10	20	-
Denmark	DK	-	-	25	-
Germany	DE	-	7	19	-
Estonia	EE	-	9	20	-
Greece	EL	-	6,5/13	23	-
Spain	ES	4	8	18	-
France	FR	2,1	5,5	19,6	-
Ireland	IE	4,8	9 / 13,5	21	13,5
Italy	IT	4	10	20	-
Cyprus	CY	-	5 / 8	15	-
Latvia	LV	-	12	22	-
Lithuania	LT	-	5 / 9	21	-
Luxembourg	LU	3	6 / 12	15	12
Hungary	HU	-	5 / 18	25	-
Malta	MT	-	5 / 7	18	-
Netherlands	NL	-	6	19	-
Austria	AT	-	10	20	12
Poland	PL		5 / 8	23	-
Portugal	PT	-	6 / 13	23	13
Romania	RO		5 / 9	24	-
Slovenia	SI	-	8,5	20	-
Slovakia	SK	-	10	20	-
Finland	FI	-	9 / 13	23	-
Sweden	SE	-	6 / 12	25	-
United Kingdom	UK	-	5	20	-

N.B.:Exemptions with a refund of tax paid at preceding stages (zero rates) are not included above (see section V)

Source: European Commission Taxation and Customs Union 2011.

Appendix 2. Partial equilibrium: Perfect competition. The impact of imposing an *ad valorem* tax t on producer price p .

$$D(q) = S(p)$$

$$D((1+t)p) = S(p)$$

$$D((1+t)p) - S(p) = 0$$

Total derivative:

$$[D'((1+t)p)(1+t) - S'(p)]dp + D'((1+t)p)pdt = 0$$

$$\frac{dp}{dt} = -\frac{D'((1+t)p)p}{D'((1+t)p)(1+t) - S'(p)}$$

Assume $t=0$ initially:

$$\frac{dp}{dt} = -\frac{D'(p)p}{D'(p) - S'(p)}$$

$$\frac{dp}{dt} \frac{1}{p} = -\frac{\frac{p}{x}D'(p)}{\frac{p}{x}D'(p) - \frac{p}{x}S'(p)}$$

From the definition of elasticity of demand: $\varepsilon_D = -D'(p)\frac{p}{x}$

From the definition of elasticity of supply: $\varepsilon_S = S'(p)\frac{p}{x}$

$$\frac{dp}{dt} \frac{1}{p} = -\frac{\varepsilon_D}{\varepsilon_D + \varepsilon_S}$$

$$\frac{\partial \log p}{\partial t} = -\frac{\varepsilon_D}{\varepsilon_D + \varepsilon_S}$$

Appendix 3. Partial equilibrium: Perfect competition. The impact of imposing an *ad valorem* tax t on consumer price q .

$$D(q) = S(p)$$

$$D(q) = S\left(\frac{q}{1+t}\right)$$

$$D(q) - S\left(\frac{q}{1+t}\right) = 0$$

Total derivative:

$$\left[D'(q) - S'\left(\frac{q}{1+t}\right)\left(\frac{1}{1+t}\right) \right] dq - \left[S'\left(\frac{q}{1+t}\right)\left(-\frac{q}{(1+t)^2}\right) \right] dt = 0$$

$$\frac{dq}{dt} = \frac{\left[S'\left(\frac{q}{1+t}\right)\left(-\frac{q}{(1+t)^2}\right) \right]}{\left[D'(q) - S'\left(\frac{q}{1+t}\right)\left(\frac{1}{1+t}\right) \right]}$$

Assume $t=0$ initially:

$$\frac{dq}{dt} = \frac{S'(q)(-q)}{D'(q) - S'(q)}$$

$$\frac{dq}{dt} \frac{1}{q} = -\frac{S'(q)}{D'(q) - S'(q)}$$

$$\frac{dq}{dt} \frac{1}{q} = \frac{\frac{q}{x} S'(q)}{\frac{q}{x} S'(q) - \frac{q}{x} D'(q)}$$

From the definition of elasticity of demand: $\varepsilon_D = -D'(p) \frac{p}{x}$

From the definition of elasticity of supply: $\varepsilon_S = S'(p) \frac{p}{x}$

$$\frac{dq}{dt} \frac{1}{q} = \frac{\varepsilon_S}{\varepsilon_S + \varepsilon_D}$$

$$\frac{\partial \log q}{\partial t} = \frac{\varepsilon_S}{\varepsilon_S + \varepsilon_D}$$

Appendix 4. Partial equilibrium: Monopoly facing linear demand. The impact of imposing an ad valorem tax t on consumer price q .

$$\max_q \pi = pD(q) - C(D(q)) = \frac{q}{1+t}D(q) - C(D(q))$$

foc:

$$\frac{q}{1+t}D'(q) + D(q)\frac{1}{1+t} - C'(D(q))D'(q) = 0$$

$$\frac{q}{1+t}\left(D'(q) + \frac{D(q)}{q}\right) = C'(D(q))D'(q)$$

$$\frac{q}{1+t} = \frac{C'(D(q))D'(q)}{D'(q)\left(1 + \frac{D(q)}{D'(q)q}\right)}$$

$$\frac{q}{1+t} = \frac{C'(D(q))}{1 + \frac{D(q)}{D'(q)q}}$$

From the definition of elasticity of demand: $\varepsilon_D = -D'(q)\frac{q}{D(q)}$

$$\frac{q}{1+t} = \frac{C'(D(q))}{1 - \frac{1}{\varepsilon_D}}$$

Assume linear demand: $D(q)=a-q$ and constant marginal costs $C'(D(q))=c$:

$$\varepsilon_D(q) = \frac{q}{a-q}$$

Substituting to the profit maximization condition:

$$\frac{q}{1+t} = \frac{qc}{q - (a-q)}$$

$$\frac{1}{1+t} = \frac{c}{2q - a}$$

$$q = \frac{1}{2}[(1+t)c + a]$$

$$\log q = \log \left[\frac{1}{2}(a + (1+t)c) \right]$$

A derivative with respect to t :

$$\frac{\partial \log q}{\partial t} = \frac{c}{(a + (1 + t)c)}$$

For an infinitesimal tax this yields

$$\frac{\partial \log q}{\partial t} = \frac{c}{a + c}$$

Appendix 5. Consumer prices by country.

Estonia					
	Obs	Mean	Std. Dev.	Min	Max
Meal 1	706	6.52	4.03	0.29	25.25
Meal 2	656	6.42	3.78	0.24	24.29
Vegetarian meal	676	3.71	2.02	0.32	14.70
Pizza	92	3.80	1.92	0.45	8.95
Appetizer	510	3.89	2.35	0.32	20.45
Dessert	716	2.44	1.47	0.32	19.17
Non-alcoholic beverage	448	1.24	0.47	0.38	4.79
Lunch	366	4.16	2.67	0.89	15.34
Lunch soup	130	2.42	1.00	0.89	5.75
Beer	414	2.28	0.72	0.89	4.79
Wine	222	3.95	6.61	1.02	62.31
Coffee	118	1.03	0.43	0.26	2.24
Latte	88	1.62	0.54	0.64	3.45
Combined price	768	4.41	2.24	0.32	16.19
Finland					
	Obs	Mean	Std. Dev.	Min	Max
Meal 1	1562	11.27	7.44	1.00	55.00
Meal 2	1054	10.57	6.34	0.60	59.00
Vegetarian meal	926	9.30	4.67	2.10	65.00
Pizza	486	8.62	2.33	3.00	15.00
Appetizer	634	5.74	2.79	1.00	19.00
Dessert	282	4.50	2.87	0.80	14.00
Non-alcoholic beverage	512	2.34	0.62	1.10	6.35
Lunch	814	8.27	2.66	2.80	29.00
Lunch soup	190	6.24	1.15	3.00	12.50
Beer	298	4.38	0.73	2.50	6.20
Wine	288	7.40	10.10	1.00	90.00
Coffee	116	1.51	0.41	0.60	3.00
Latte	56	2.68	0.66	1.90	4.20
Combined price	1690	8.87	4.40	1.50	44.13

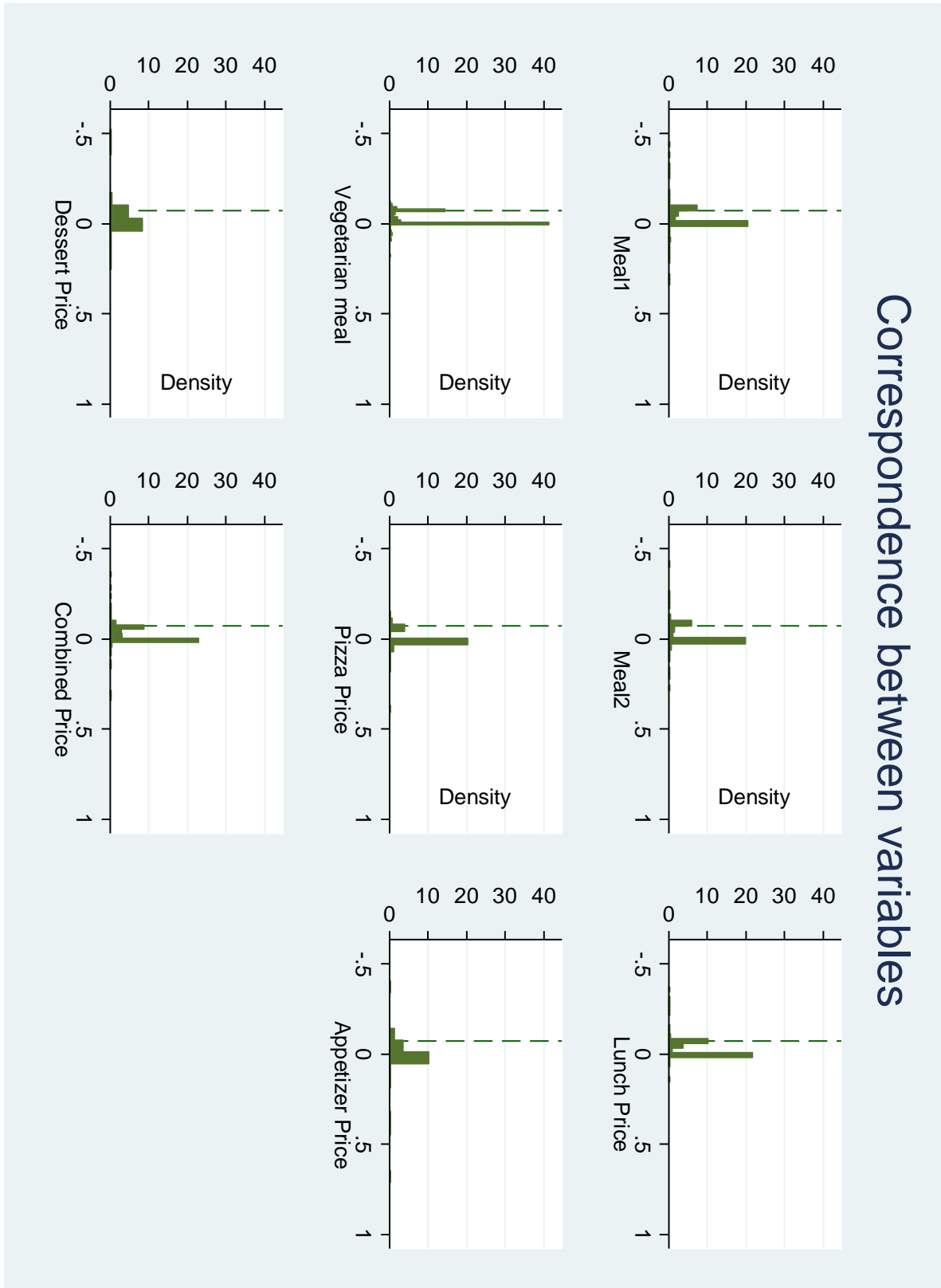
Appendix 6. Distribution of restaurant types in Finland and Estonia.

<i>Restaurant type</i>	Estonia	Finland
Spanish	0.3	0.3
Fine dining	19.3	8.3
Italian	4.3	16.1
Cafe	17.4	12.9
Chinese, Indian, Thai or Japanese	4.5	6.2
Other ethnic	13.1	1.0
Tex mex	0.5	1.4
Turkish	0.5	3.8
General restaurant	16.8	27.1
Gas station		3.1
Staff or student restaurant		4.4
Other	23.5	15.5
Total	100 %	100 %
n	800	1,903

Appendix 7. Consumer price changes by country and meal category.

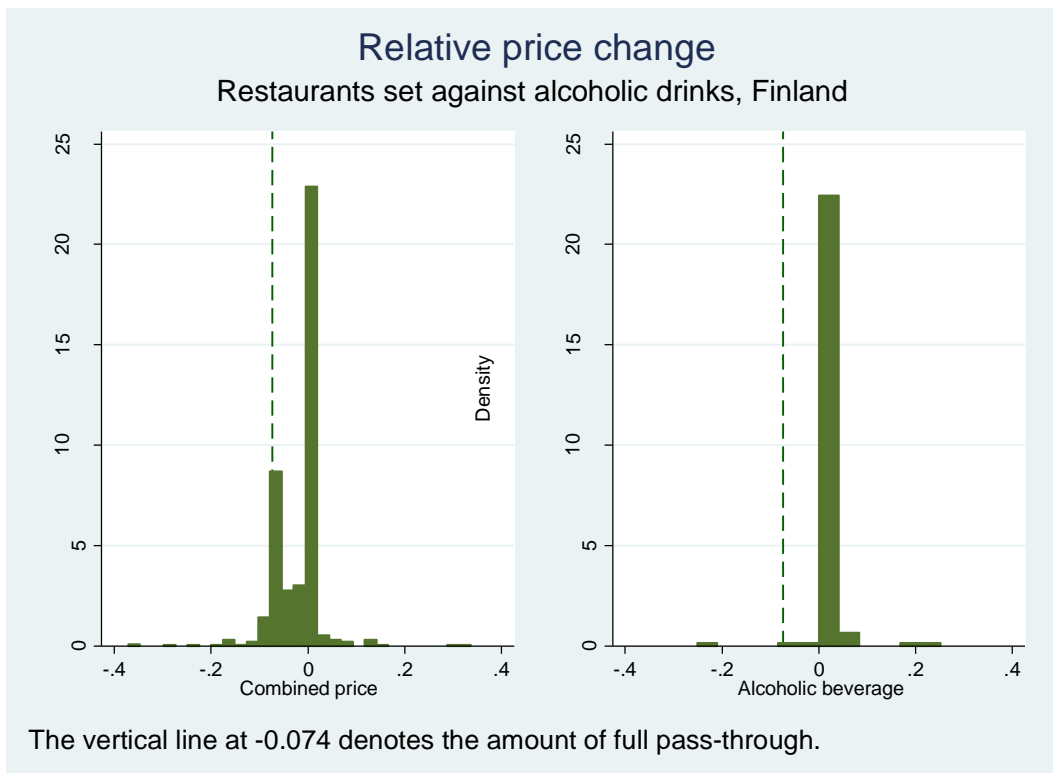
Estonia					
	Obs	Mean	Std. Dev.	Min	Max
Meal 1	353	0.003013	0.040174	-0.11778	0.682218
Meal 2	328	-0.00171	0.045835	-0.76136	0.167054
Vegetarian meal	338	0.000677	0.056698	-0.8473	0.336472
Pizza	46	0.001856	0.012586	0	0.08536
Appetizer	255	-0.00092	0.034123	-0.33647	0.37949
Dessert	358	0.003309	0.053523	-0.28768	0.628609
Non-alcoholic beverage	224	0.00047	0.00704	0	0.105361
Lunch	183	-0.00356	0.087328	-1.00145	0.435318
Lunch soup	65	-0.00114	0.021681	-0.15415	0.080043
Beer	207	-0.00038	0.005419	-0.07796	0
Wine	111	0.000614	0.019116	-0.15415	0.074108
Coffee	59	0	0	0	0
Latte	44	0	0	0	0
Combined price	384	0.000511	0.022739	-0.16946	0.147761
Finland					
	Obs	Mean	Std. Dev.	Min	Max
Meal 1	781	-0.02304	0.05398	-0.45495	0.336472
Meal 2	527	-0.01871	0.049915	-0.43078	0.287682
Vegetarian meal	463	-0.02074	0.039299	-0.12516	0.182322
Pizza	243	-0.00881	0.045219	-0.15415	0.405465
Appetizer	317	-0.01991	0.069152	-0.40547	0.710242
Dessert	141	-0.03355	0.079266	-0.52452	0.251315
Non-alcoholic beverage	256	-0.01598	0.047258	-0.40547	0.154151
Lunch	407	-0.03179	0.05071	-0.37118	0.14994
Lunch soup	95	-0.03788	0.037454	-0.11488	0.04919
Beer	149	0.003999	0.035988	-0.25131	0.251315
Wine	116	0.000857	0.022863	-0.12921	0.068993
Coffee	58	-0.01238	0.047012	-0.24512	0.127833
Latte	28	-0.01941	0.044117	-0.1431	0
Combined price	845	-0.02276	0.04742	-0.37118	0.336472

Appendix 8. Consumer price change by meal category.

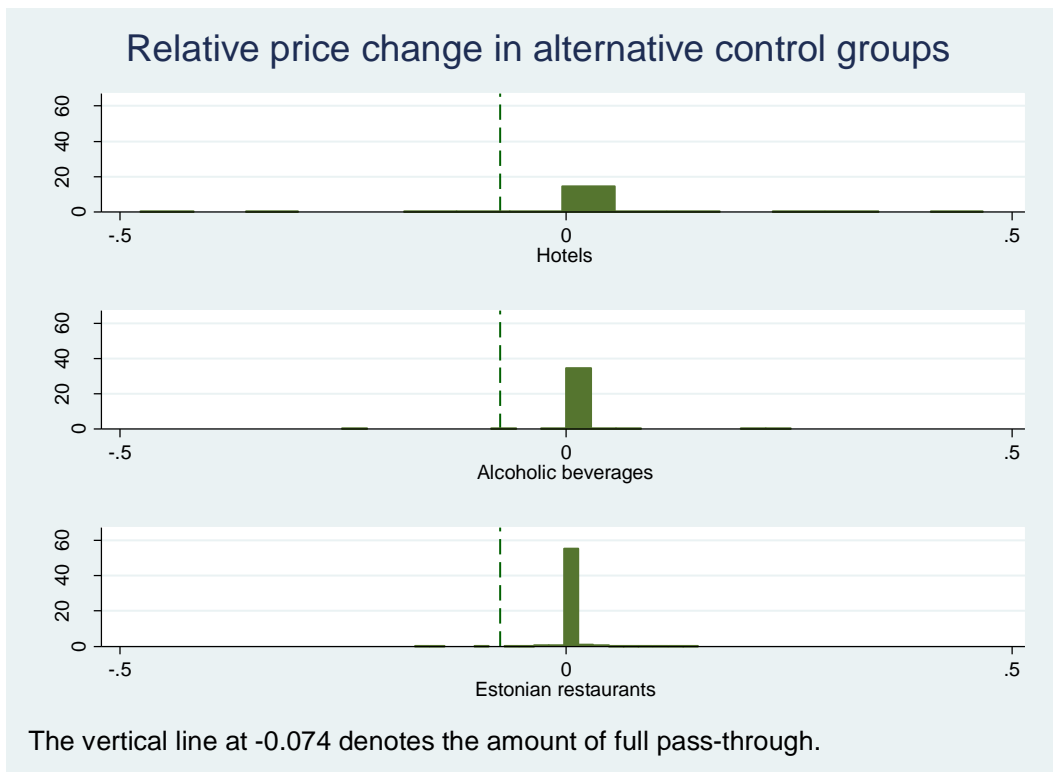


Correspondence between variables

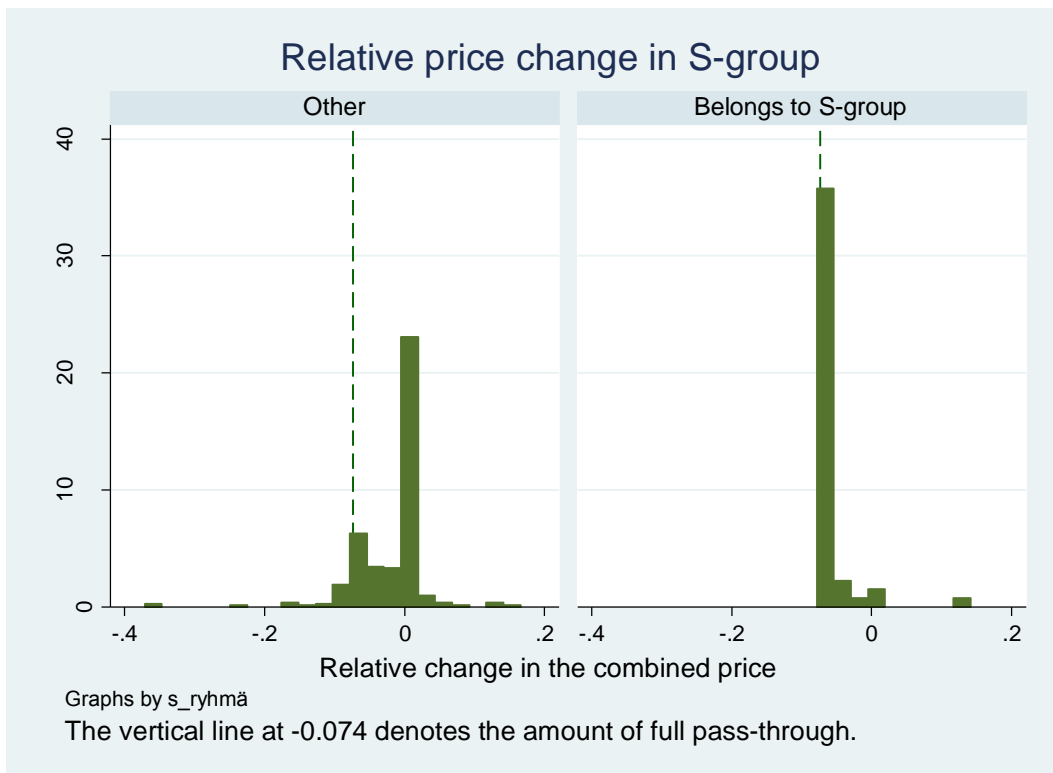
Appendix 9. Consumer price change versus the alternative control group of alcoholic beverages.



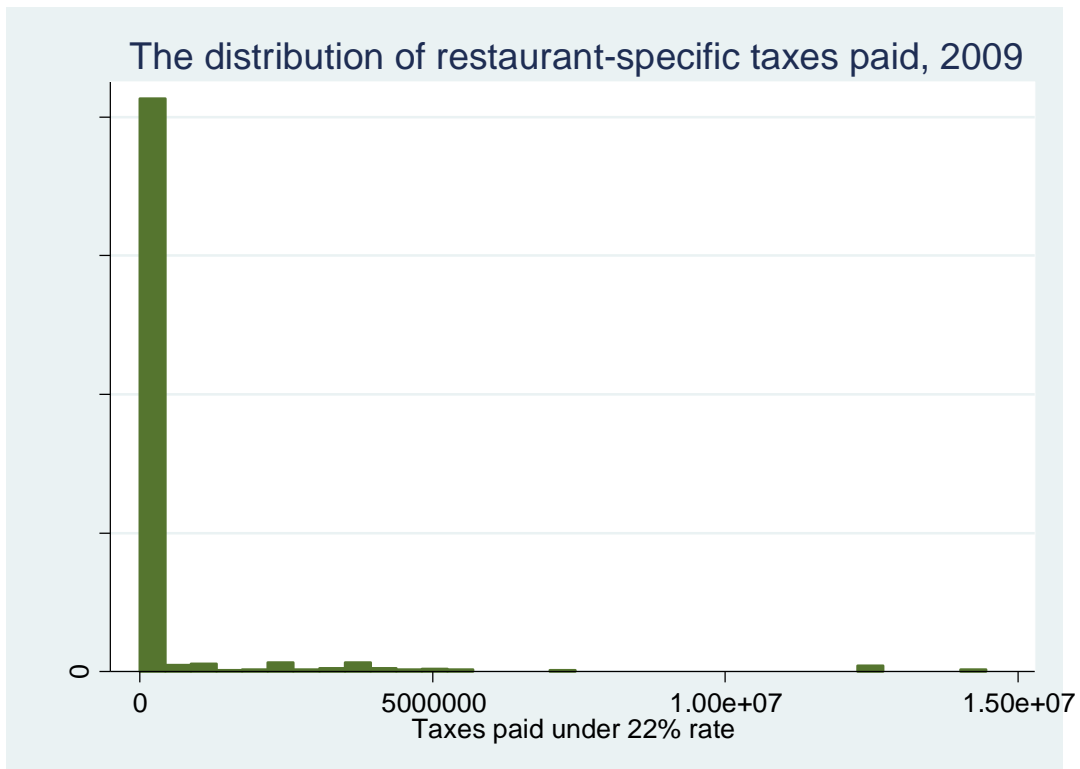
Appendix 10. Distribution of consumer price change in the alternative control groups.



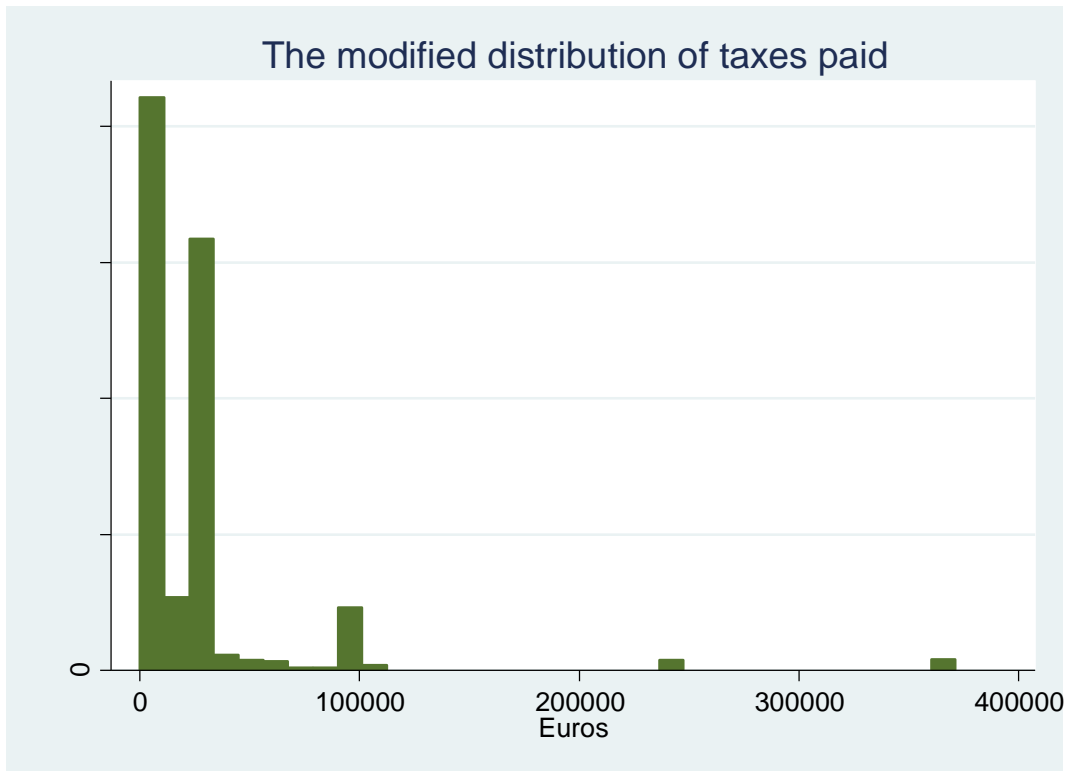
Appendix 11. Consumer price change in S-group.



Appendix 12. The distribution of value added taxes paid (22%), Finnish restaurants.



Appendix 13. The modified distribution of value added taxes paid (22%), Finnish restaurants.



Appendix 14. The absolute change in consumer prices in Finland (in euros).

Variable	Obs	Mean	Std. Dev.	Min	Max
Meal 1	781	-0.26	0.61	-5.30	5.40
Meal 2	527	-0.20	0.60	-4.20	6.00
Vegetarian meal	463	-0.19	0.40	-2.00	2.00
Pizza	243	-0.08	0.39	-1.00	3.00
Appetizer	317	-0.10	0.35	-2.50	3.00
Dessert	141	-0.10	0.33	-2.00	2.00
Non-alcoholic beverage	256	-0.04	0.12	-1.00	0.50
Lunch	407	-0.27	0.45	-4.00	1.10
Lunch soup	95	-0.23	0.24	-0.70	0.60
Beer	149	0.02	0.15	-1.00	1.00
Wine	116	-0.01	0.43	-4.00	2.00
Coffee	58	-0.02	0.09	-0.50	0.30
Latte	28	-0.06	0.13	-0.40	0.00