

# Do honest hairdressers get a haircut?

On tax rate and tax evasion\*

Jarkko Harju, Tuomas Kosonen and Olli Ropponen

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## Abstract

This paper studies the effect of consumption tax rate on tax evasion by firms. We utilize a natural field experiment that varies the probability of an audit together with a VAT reform increasing VAT rate from 9 % to 23% for hairdressers and not affecting a similar control group. We observe the effects of these two treatments from a very detailed tax records. The results indicate that firms respond to the letters by reporting more VAT relative to the control group. Higher VAT rate increases VAT evasion. We decompose the total effect into evasion and real responses. Two thirds of the decline in reported turnover seems to have resulted from an increase in tax evasion and the remaining one third from real responses.

Government Institute for Economic Research (VATT)

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# 1 Introduction

Consumption tax rates vary from around 20 per cent in many European and Latin American countries to less than 10 per cent in the USA. One important reason for low consumption tax rates in some countries is the fear of tax evasion (Slemrod and Gillitzer 2013). Moreover, the main motivation for the EU to allow certain labor intensive services to have reduced VAT rate is to try to limit tax evasion. However, the effect of tax rate on the extent of tax evasion remains largely unknown. This paper asks what is the effect of consumption tax rate on consumption tax evasion, and what is the role of VAT evasion compared to real outcomes. Furthermore, we are interested in how effective tax enforcement is in deterring value added tax evasion. We utilize a variation in audit probability coming from a natural field experiment at the same time with a consumption tax reform for labor intensive services to answer this question.

The impact of audit probability together with VAT rate on labor intensive industries is of particular importance. First, tax evasion is unobserved in administrative data, and thus challenging to analyze. However, tax reports are observed, and variation in audit probability is known to affect tax evasion, which in turn affects tax reports (Allingham and Sandmo 1972). Thus, by comparing the reported VAT of groups in the natural field experiment that have exogenously different audit probabilities is informative about VAT evasion. The differences are also informative about the effectiveness of threat-of-audit letters on tax evasion by firms.

Second, the reported sales may change when VAT rate increases because firms trade less (real effects) or because they evade more taxes (tax evasion). However, the causal impact of VAT rates on reported is unknown without exogenous variation in tax rates. For example, VAT rate could be low for endogenous reason, like tax evasion. The VAT reform provides the exogenous variation needed. Firms in hairdressing industry were affected by the VAT rate change and firms in other similar service industries were not affected by it. Comparing these different industries before and after the VAT change gives us the total impact of VAT rate on real and evasion responses combined.

Third, the impact of VAT rate on VAT evasion is particularly difficult to observe. The advantage in this study is that we have exogenous variation in both, VAT rate and audit probability, affecting the reported sales of the same firms. This allows us to estimate the share of tax evasion from the total response to VAT rate change. This in turn is informative about the impact of VAT rate on VAT evasion.

Fourth, labor intensive services are perfect industry to study these relationships, since labor intensive firms have more potential to engage in tax evasion than other firms. They use relatively often cash trade, which is easy to conceal from tax authorities.

The natural field experiment consists of 1800 threat-of-audit letters that the Finnish Tax Authority sent to small labor intensive businesses. Half of the letters stated that the tax authority will audit<sup>1</sup> the VAT reports of firms with a 33% (high) probability and half of the letters stated a 5% (low) probability for the audit. We also randomized a control group from tax records receiving no letter. Later the audits were carried out according to the numbers stated in the letters.

The VAT reform ended a reduced VAT period for hairdressing services and certain other labor intensive services. The quasi-experimental setting comes from the fact that according to EU directives only some labor intensive services were eligible for the reduced VAT rates. As a result, from the beginning of 2012 the VAT rate for hairdressing services in Finland increased from 9% to 23%, while VAT rate did not change for other beauty and well being services. In the experiment we randomized over half of the high and low probability letters to hairdressers and under half to other services.

We monitor the results from very detailed tax register data provided by Finnish Tax Administration. The data include monthly level VAT reports for each firm liable to taxation in Finland. We are able to follow firms over time according to their treatment status in the reform and field experiment. Moreover, we observe the tax reports of each firm and see if the changes are associated with receiving a letter or experiencing a change in VAT rate. We

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<sup>1</sup>The audit in question is an intensified desk audit, where firms were asked to send documents to the tax authority backing up their VAT reports.

also have price data from a survey to hairdressers and beauty salons. These data include the prices of single services over the reform in these sectors.

The results indicate that those who received the letter reported more VAT to the tax authority than the control group. A graph shows that the effect is clearly visible in average statistics and fairly stable. The group that responded most to the experiment are hairdressers who received high probability letter. They reported 4.8% more turnover after receiving the letter relative to the control group. Low probability letter and letter to other services had a negligible impact on VAT reports. Thus it seems that the tax authorities can induce firms to report more VAT by enforcing the tax system with higher intensity strategies. However, this may be costly, since low intensity enforcement did not induce the firms to report more VAT.

We also study the overall tax incidence. The value of reported sales did not change significantly (measured in producer prices) in the group not affected by the VAT rate or audit probability changes in the observation period. The value of sales of hairdressers, that were subject to an increase in VAT rate from 9% to 23%, declined by 7% relative to the control group (absent the threat-of-audit letters). This total effect includes both tax evasion and real responses. Furthermore, we observe that tax incidence to consumer prices is 10%. The full pass-through would have been 12.7%. Thus, the net-of-tax price (producer price) received by firms declined on average by 2.5%.

We decompose the total 7% decline into tax evasion and real responses. To that end we show a theoretical decomposition of different effects. It indicates that the difference in reported sales between the joint VAT rate and audit probability treatments and the sole VAT rate treatment is tax evasion. We need to assume that the audit probability does not have an effect on the true output, only on tax evasion. In numbers, from the 7% estimate more than 4 percentage points is coming from tax evasion.

An additional support for this decomposition comes from the price incidence result. It shows that the total value of net-of-tax sales decline by 2.5% because the firms did not shift the VAT rate increase fully to prices. Summing the impacts on tax reports together coming from tax evasion, found in the audit probability treatment, and the reduction in net-of-tax prices,

estimated from consumer prices, coincidentally equals the total impact of tax reform. Furthermore the decomposition results suggests that there is a negligible role for the effect of VAT rate on the true quantities of services traded. The latter fact is consistent with Kosonen (2013).

This study contributes to the literature on tax evasion and compliance. Earlier Slemrod *et al.* (2001) found that audit probability in threat of audit letters increases income tax reports, especially those of self employed. Kleven *et al.* (2011) utilized similar methodology and found, among other things, that tax evasion is negatively associated with third party reporting. Also Fellner *et al.* (2013) find that increased detection risk prompts more tax payments. Our study contributes to this literature by focusing on VAT reported by firms rather than income reported by individuals. Pomeranz (2013) analyzes the effect of a large scale threat of audit experiment on VAT evasion in Chile. She focuses more on the effect of chain feature of VAT, while the current study focuses on the effect of VAT rate.

Another strand of literature focuses on how tax rates affect tax compliance (see e.g. Slemrod and Yitzhaki 2002). We contribute to this literature by first presenting a theory model on the issue, which is a modification of Slemrod (2001). We then test the findings of this model in our empirical setting. Earlier Fisman and Wei (2004) found that in the border trade between mainland China and Hong Kong larger fraction of goods disappear from categories that have higher wage rate. Marion and Muehlegger (2008) found that dyeing diesel fuel, which allows for easier tax enforcement, led to significant reduction in demand for non-taxed substitute. The effect seems to be larger in the states with higher diesel taxes. Kopczuk *et al.* (2013) find that seemingly associated with tax evasion, tax incidence depends on which part of the production chain needs to remit the tax. We contribute to these studies by analyzing variation in VAT rate. Furthermore, we study service sectors, which often are suspect of especially large VAT evasion.

This paper proceeds by explaining the prevailing institutions and experimental design in section 2. Section 3 presents our theory model. Section 4 explains the empirical methods and section 5 describes the data set. Section 6 presents the results and section 7 concludes the study.

## 2 Institutions and experimental design

### Institutions

The European Union (EU) sets directives for consumption tax system, which is value added tax (VAT). Each Member State has possibility to have three VAT bases with limitations for the VAT rates. A normal base has to be 15 % or more, and the two other bases can be below 15 %. The EU controls strictly which goods and services can be on the lower VAT bases.

Specifically, the EU allows for barber and hairdressing services to have a reduced VAT rate. Instead, beauty salons, masseurs and physiotherapists are not allowed to have reduced VAT rates. The distinction between these different services may be very arbitrary. For example, a treatment for hair is a hairdressing service, but a treatment for an eyebrow is not.

The VAT bases are service specific, rather than firm specific. As a result a hairdressing shop can perform beauty salon services and also sell shampooing products for which the reduced rate does not apply. We observe how much each firm remitted VAT at each rate. We describe this in section 5.

Businesses subject to VAT remit their taxes to tax authority separately for different VAT bases using either electronic system or manual sheet. In this system there is a record from every action a firm takes. Typically firms need to remit their VAT on monthly basis, but some smaller firms only need to remit their VAT on quarterly basis. Firms self report their taxes and tax authority can later audit the reports. Tax authority easily observes if the tax reports appear to be in disorder, but it is more challenging to detect selling products without reporting any VAT from the sales, since then there are no visible records to evaluate.

### Value added tax reform

Finland experimented with reducing the VAT rate for barber and hairdressing services<sup>2</sup> from the beginning of 2007 (Kosonen 2013). This experiment ended in the end of 2011, which meant that VAT rate increased for these services

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<sup>2</sup>We refer barbers to represent both barbers and hairdressers.

from 9 % to 23 %. Since the EU rules do not allow for it, beauty salons and other labor intensive services were not subject to this experiment. Therefore VAT rate for these other services were already at the main base of 23 %, and there was no change in their VAT rates.

The VAT rate increase from 9% to 23% leads to 12.8% increase in consumer prices, if the tax hike is passed on to consumer prices in full. This can be calculated simply by noting that the pre tax price, the producer price, stays constant. Denote  $P = p * (1 + \tau)$ , where  $P$  is the consumer price,  $p$  producer price and  $\tau$  the VAT rate. The full pass-through to prices is:

$$FullPass = \frac{p1.23 - p1.09}{p1.09} * 100\% \approx 12.8\%$$

By observing the change in consumer prices and knowing the VAT rates we can also deduct the changes in producer prices. For example, suppose the consumer prices increase by 10%. The per cent change in producer prices is given by

$$= \frac{1.1P/1.23 - P/1.09}{P/1.09} * 100\% \approx -2.5\%$$

### **Experiment design**

The experiment consists of two parts. In the first part we designed a letter informing an audit with certain probability. The two possible probabilities were 5 % and 33 %. The thread of audit letter explained in simple and easy to understand words that the firm in question was selected to a group where the x share of firms would be audited. Further, the letter specified that the audit would be about the periodic tax reports for the VAT from the first part of the year 2012.

We randomly selected 1000 firms from the tax records to the 5 % group and 1000 firms to the 33 % group. Half of each group consisted of those service sector firms that also experienced the VAT reform explained above and half did not experience a VAT reform. The letters were sent out in the end of January 2012. There were plenty of time for firms to react to this letter,

since they needed to report their taxes regarding January in mid-March if they need to report once a month, or in mid-May if they need to report quarterly. We also randomized a control group from the same industries that did not receive any letter from the tax authority. Table 1 summarizes the number of firms randomized to each letter and VAT change group.

Table 1: Number of firms randomized to each group

N=4800		VAT change	No VAT change
Letter prob.	5%	500	400
	33%	500	400
Control	-	2000	1000

A possible threat to this kind of experiment is contamination. In this case contamination would be that firms complain about the letters openly in public. This would lead other firms in the control group to know about the increased audit probability. Luckily for the experiment, we did not observe any discussion of the experiment in the public. Furthermore, there were not many contacts to the help phone number provided by the tax authority. This also indicates that the firms in the treatment groups quietly accepted that they would be audited with some probability. Despite of this, the possible contamination would give us a lower bound of the tax evasion effect. Contamination would have affected the control group in the same way as the treatment group narrowing the potential treatment effect, the difference between the groups.

The second part of the experiment fulfilled the threat of audit. This was done by the tax authority and it occurred on top of their normal audit activity. This means that we can compare the treatment and control groups by being confident that the only difference between them is the treatment. We also randomized a group to the audit scheme from the firms that had not received any threat of audit letter. The audits took place well after the letters were sent. Majority of them took place in April - June 2012. This time difference allows firms to first react to the letter and then possibly have a separate reaction to the audit.

In the audit the firms were asked about any discrepancies in their tax records. For example, if they had requested to be credited for too high amount of VAT being paid from inputs, explanation was asked for. Almost all the firms that asked to be credited any significant amount of input were asked to send receipts from these to the tax authority. Also they were asked to show the accounts from concerning the beginning of year period.

### 3 Potential mechanisms explained

The literature on tax evasion has largely followed the model of Allingham and Sandmo (1972). They model tax evasion as a risky choice, which depends on payoffs when caught and when not caught. In the literature modeling tax evasion as a risky choice, there has been two findings of interest in this study. First is that increasing the exogenous detection probability reduces tax evasion and the second is that tax rate has an ambiguous effect on tax evasion (Slemrod and Yitzhaki 2002). A higher tax rate may reduce tax evasion when income effects dominate payoff effects.

We follow below the approach taken by Slemrod (2001). This model does not focus on modeling how risk attitudes affect tax evasion, it could be considered a risk constant model. Instead, the model focuses more on substitution effects created by taxation. Thus a higher tax rate potentially increases tax evasion.

#### Elements of the model and their link to observables in data

Let us start with what we can actually observe in data normally, and in our data in particular. We observe three key variables, based on which we can disentangle to certain degree which margins responded to the reform. The measures we can observe are:

$$\frac{d(xq)}{dt} = m\%$$

$$\frac{d(qx)}{dtdp} = \frac{d(q(y - e))}{dtdp} \sim \frac{d(qy)}{dt} - \frac{d(qe)}{dtdp}$$

Each of the above variables are explained below.  $q$  is the producer price, which is the consumer price less the VAT. We also observe the tax reports  $xqt$  for each month or quarter, from which we can deduce  $qx$  and  $x$  ( $t$  and  $q$  are known).  $x$  refers here to the average volume of reported sales. The tax liability is based on tax exclusive value of sales  $qx$ . The tax evasion  $e$  is the difference between true sales  $y$  and reported sales  $x$ ,  $e = y - x$ .

We are interested in the effects of VAT reform and the threat-of-audit letter treatments. The first equation above notify that we observe the extent to which the average reported sales change when VAT rate changes.

The second equation above gives the change in the value of reported sales when both VAT rate and audit probability change. The equation shows how we attempt to decompose the reported change into change in the true sales  $y$  and tax evasion  $e$ . The idea in the last relationship is that the change in audit probability do not have an effect on true sales. Thus the difference in the change of reported sales between those firms that experienced the VAT reform and those that experienced both the reform and the experiment can be attributed to changes in tax evasion. We denote the last equation by approximation mark, since in principle the experiment could have an effect on the value of true output, for example through prices.

### **Joint production and tax evasion choice of an entrepreneur**

We next investigate how the choices of an entrepreneur depend on the tax rate and tax enforcement. Consider a utility maximizing entrepreneur. She derives income  $Z$  by producing in her firm  $y$ . There is exogenous demand, the entrepreneur sells the product with a producer price  $q$ . The entrepreneur needs to pay taxes  $t$  according to  $tqx$ , which she reports to the tax authority. The difference between the true production  $qy$  and report  $qx$  is tax evasion  $qe$ . We denote the difference of true tax liability and evasion as  $q(y - e)$ .

There is a tax authority, which receives the tax reports and has a tax enforcement policy. The enforcement policy leads to cost from tax evasion  $p(e; \theta)$ .  $\theta$  is an exogenous shift parameter that captures the tightening of tax enforcement, like increasing the audit rate.

These considerations are written in to a budget constraint for an entrepreneur.

$$Z = qy - tq(y - e) - p(e; \theta)$$

The utility maximization problem of an entrepreneur is:

$$\begin{aligned} \max_{e,y} EU &= U(Z, y) \\ &s.t \\ Z &= qy - tq(y - e) - p(e; \theta) \end{aligned}$$

Next we parametrize the model to get a simple version of the result. Assume utility takes the following form:  $U(z, y) = z - \frac{1}{1+\varepsilon}y^{1+\varepsilon}$ , where  $\varepsilon > 0$ . Note that this formulation rules out income effects. The cost function  $p(e; \theta)$  is parametrized as  $p(e; \theta) = \frac{1}{1+\beta} (e\theta)^{1+\beta}$ , where  $\beta > 0$ .

$$\max_{e,y} qy - tq(y - e) + \frac{1}{1+\beta} (e\theta)^{1+\beta} - \frac{1}{1+\varepsilon}y^{1+\varepsilon}$$

Taking the first order conditions lead to optimal solutions for production  $y$  and tax evasion  $e$ :

$$y^* = (q(1-t))^{\frac{1}{\varepsilon}}$$

$$e^* = \frac{1}{\theta} (tq)^{\frac{1}{\beta}}$$

Consider what happens to these equilibrium values, when the tax rate  $t$  is increased

$$\frac{\partial y^*}{\partial t} = \frac{-q}{\varepsilon} (q(1-t))^{\frac{1}{\varepsilon}-1} < 0$$

$$\frac{\partial e^*}{\partial t} = \frac{q}{\beta\theta} (tq)^{\frac{1}{\beta}-1} > 0$$

Moreover, if the parameter governing the effectiveness of tax enforcement,  $\theta$ , is increased

$$\frac{\partial e^*}{\partial \theta} = -\frac{1}{\theta^2} (tq)^{\frac{1}{\beta}} < 0$$

The parametrized model reveals that increasing the tax rate reduces pro-

duction  $y$  and increases tax evasion  $e$ . The size of these effects are different in absolute value. Which one is greater in absolute value, depends on the shape of utility and cost of evasion functions, in parametrized version on  $\varepsilon$  and  $\beta$ .  $1/\varepsilon$  could be interpreted as elasticity of true income with respect to taxation and  $1/\beta$  as responsiveness of tax evasion on tax enforcement. If  $1/\varepsilon < 1/\beta$  (both are positive), the tax rate hike reduces true income less than it increases tax evasion.

Increasing the cost of tax evasion  $\theta$  reduces tax evasion  $e$ . Since we assumed no direct link between production and tax evasion, it does not affect the true production  $y$ . Higher tax rate leads to greater reduction in tax evasion when cost function is shifted up.

## 4 Empirical methods

This study is interested in estimating the causal effect of VAT rate change on tax evasion, true output of firms and on their profit margins. We apply natural experimental methods, where treatment groups faces certain type of letter and / or VAT reform. We take a close control group to represent the counterfactual state. In the experiment the control group are those who are randomized into not receiving the treatment. In the VAT reform the treatment group are hairdressers and control group are firms in close industries; beauty salons, masseurs and other well being services.

We estimate the following kind of equations:

$$\ln y_{ft} = \beta_1 DD_{ft} + firm_f + time_t + \gamma X_{ft} + \nu_{ft} \quad (1)$$

where  $\ln y_{ft}$  represents the logarithmic outcome for firm  $f$  at time  $t$  and  $DD_{ft}$  a binary differences-in-differences indicator, having value one for all the after treatment observations for the treatment group and zero otherwise.  $firm_f$  is an unobserved firm-specific factor and  $time_t$  is a possibly flexible time trend for all firms,  $X_{ft}$  is a vector of control variables and  $\nu_{ft}$  is the residual error term. The outcomes of interest are prices and turnover evaluated at producer prices.

The important assumption is that the treatments are exogenous to the outcomes of firms. The letters were randomized to firms not conditioning their outcomes (other than that they existed). Thus, conditional on being in certain industry, the behavior of firms does not influence their treatment status. Moreover, since the letters were sent by tax authority without the firms knowing about them before they were sent, the firms could not opt out from receiving a letter. The VAT reform applied to hairdressers because of EU level rules and not because there would have been something peculiar about Finnish barbers at the time of implementing. This guarantees the exogeneity of the treatment in the VAT reform.

The development of treatment and control groups should resemble each other in the absence of the treatment. In the case of the experiment this assumption should be satisfied because of the randomization. In the case of the VAT reform, we need to be sure to compare similar firms with each other. Beauty salons and hairdressers are very similar services, both are labor intensive jobs carried out by a single person to a single client at a time. Both services are also in the business of providing services for the well being of clients. We still need to check from the data that the pre reform time trends of treatment and control group firms resemble each other, though. Moreover, there could be fluctuation in the time trends. To provide cleaner results, we control for flexible time trends.

When investigating the effect of the threat of audit letters on turnover, we pool time observations for each firm into before the letter and after the letter observations. Since the experiment was randomized, we could in principle look at the simple difference in outcomes across the two groups. However, the firms are so heterogeneous in the size and volatile in their over time behavior, that we deem it plausible that the groups may differ somewhat even in the absence of the experiment. Thus we follow the differences-in-differences procedure outlined above, but with the pooled data. Effectively, we control for firm level fixed effects, which takes into account the pre-reform difference between the treatment and control groups.

To study the joint effect of the experiment and the VAT reform, we run triple difference regressions. There the estimation equation takes the follow-

ing form.

$$\ln y_{ftrl} = \beta_1 DDD_{ftrl} + firm_f + time_t + reform_r + letter_l + \gamma X_{ftrl} + \nu_{ftrl}. \quad (2)$$

where  $\ln y_{ftrl}$  is an outcome variable and  $DDD_{ftrl}$  a dummy variable, which gets value 1 if firm  $f$  has experienced the VAT reform and received a letter of type  $l$  at time  $t$ , and zero otherwise.  $X_{ftrl}$  includes control variables of the firm as well as 2nd order interaction terms between the time, reform status and letter status.  $\beta_1$  is identified with the variation across time-reform-letter cells.

## 5 Data description

We have access to very detailed tax record data from the Finnish Tax Administration. These data include by date the monthly VAT remittances by VAT base. The other variables include VAT credited against purchases (inputs) and monthly wage sums of the firms. We observe by date every entry made by an entrepreneur, including corrections to previous entries. We link these data to a richer set of annual level information also coming from tax records. These include accounting information about the annual tax declaration of the firm, as well as demographic information about the location and the legal form of the company. These tax data contain every firm liable to taxation in Finland.

We link survey data with the register based data. One survey data are recorded by the tax authority during the audits featuring the observations of auditor during the audits. The other survey data is a sample of prices before and after the VAT reform from both barber and beauty salon services.

The threat of audit letters were sent to firms from 5 different industries defined by 5 digit industrial classification. All these industries are small labor intensive services. Hairdressers are the largest group, and the group facing the VAT reform. In the end of 2011 there were about 8700 unincorporated hairdressers in Finland and 7500 unincorporated firms in the other selected industries.

In the threat of audit letter experiment 1000 hairdressers were randomized to receiving one of the letters and 2000 to the control group not receiving a letter. From the other industries, which did not face the VAT reform, the largest group are formed by beauty salons. There are 500 beauty salons randomized into receiving one of the letters and 600 randomized into not receiving a letter. The remaining industries consist of masseurs, physiotherapists and other small services, from which 300 firms received a letter and 400 were randomized into not receiving a letter.

Table 2 describes the data. The table is divided into 6 exclusive columns according to the letter treatment and the VAT reform status. The first three columns are for hairdressers, which faced the VAT reform, and the latter three columns are for other services, which did not face the VAT reform. The columns for both groups are for those firms that receive 33% probability letter, 5% probability letter and no letter, respectively. The descriptive statistics, which we observe at monthly level are the producer value of output (turnover), wage sums, and VAT credited against purchases (inputs). The annual descriptive statistics from accounting data are rents (paid typically from renting a business property), assets and income from firm (profits). The table also shows the number of quarterly observations pooled for 2010 to May 2013 and number of firms in the end of 2011.

Table 2 shows that the different groups within the VAT reform status are remarkably similar. Hairdressers are on average slightly larger than the other services, although firms in both groups are small on average, they have under 4000 euros monthly turnover. Moreover, neither of the firms pay very low wage sums to employees indicating that they on average have no employees.

Table 3 presents the balancing tests for the relevant statistics in table 2. The table tests prior the treatment difference between a letter group and the control group receiving no letter. The outcome variable, turnover, is not statistically differing across the groups at the time of the randomization. There are weakly statistically significant differences in other statistics, which is likely in the noisy firm level data and relatively small sample size. We take any prior treatment difference into account by utilizing differences-in-differences approach.

Table 2: Descriptive statistics divided by treatment and VAT reform status

	Hairdressers			Other services		
	33%	5%	contr.	33%	5%	contr.
Turnover <sup>a</sup>	3488 (2477)	3410 (2705)	3417 (2712)	2809 (3131)	2869 (3504)	2688 (3668)
Wage sums <sup>b</sup>	21 (312)	17 (249)	22 (368)	26 (351)	16 (222)	38 (502)
Inputs	1100 (1179)	1116 (1340)	1109 (1367)	1140 (1934)	1200 (1952)	1064 (2275)
Rents <sup>^</sup>	2649 (4849)	2532 (4342)	2790 (4721)	1990 (3983)	1892 (3847)	2179 (4241)
Assets <sup>^</sup>	4955 (12814)	5327 (14448)	4739 (14436)	5283 (15404)	5166 (14793)	6119 (17970)
Profits <sup>^</sup>	10564 (14941)	9537 (12352)	10080 (12557)	7209 (12551)	7075 (11763)	8799 (15739)
N	25511	26147	104404	17481	17933	36680
N of firms	496	495	1981	392	388	936

Note: <sup>^</sup>Annual level variables

<sup>a</sup>Net of tax turnover

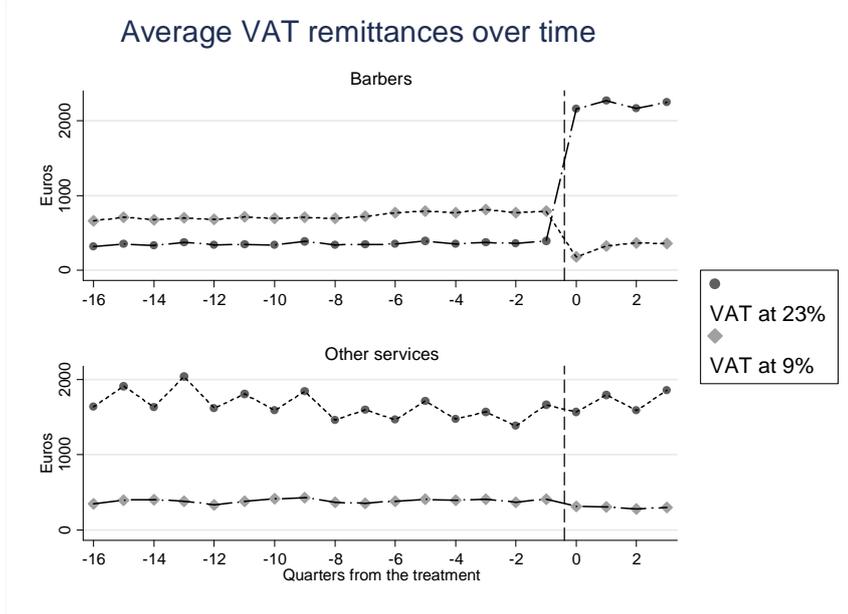
<sup>b</sup>Wage sums paid to employees

Table 3: Balancing tests

	Hairdressers		Other services	
	33 vs. control	5 vs. control	33 vs. control	5 vs. control
Turnover	108.6 (89.62)	72.25 (92.13)	140.3 (154.0)	146.5 (157.1)
Wages	6.348 (12.96)	-10.22 (12.27)	-17.25 (19.35)	-43.16* (18.19)
Inputs	11.95 (44.08)	83.39 (46.35)	30.05 (92.67)	77.54 (92.65)
Rents	-284.0 (167.2)	-378.1* (166.9)	45.93 (169.7)	140.5 (170.0)
Assets	395.6 (552.2)	948.0 (554.3)	-364.0 (732.2)	-153.2 (745.7)
Profits	530.1 (373.1)	-1019.2** (372.3)	-1632.0** (601.5)	-1645.1** (604.4)
N	6493	6490	3531	3492

Figure 1 shows how VAT remittances at the main rate (23%) and the reduced rate (9%) develop over time for hairdressers and other services. The VAT reform from the beginning of 2012 is evident in the statistics for hairdressers. The figure shows that firms within certain industry offer different services, some of which are at different VAT rates. Before the reform most hairdressers provided services on the reduced rate. Nevertheless there were nontrivial fraction of services on the main rate already before the reform. As a result of the reform, the reduced rate no longer applied for hairdressing services. The effect of the reform on VAT reports by firms is immediate in the figure. After the reform there are virtually no reports to the reduced rate and there is an increase in the reports to the main VAT rate. The total VAT receipts of the tax administration increased due to the reform. Other services offer virtually no services at the reduced rate prior to the reform, and thus there is no visible changes in their VAT reports due to the reform.

Figure 1: Description of VAT remittances over time in different services



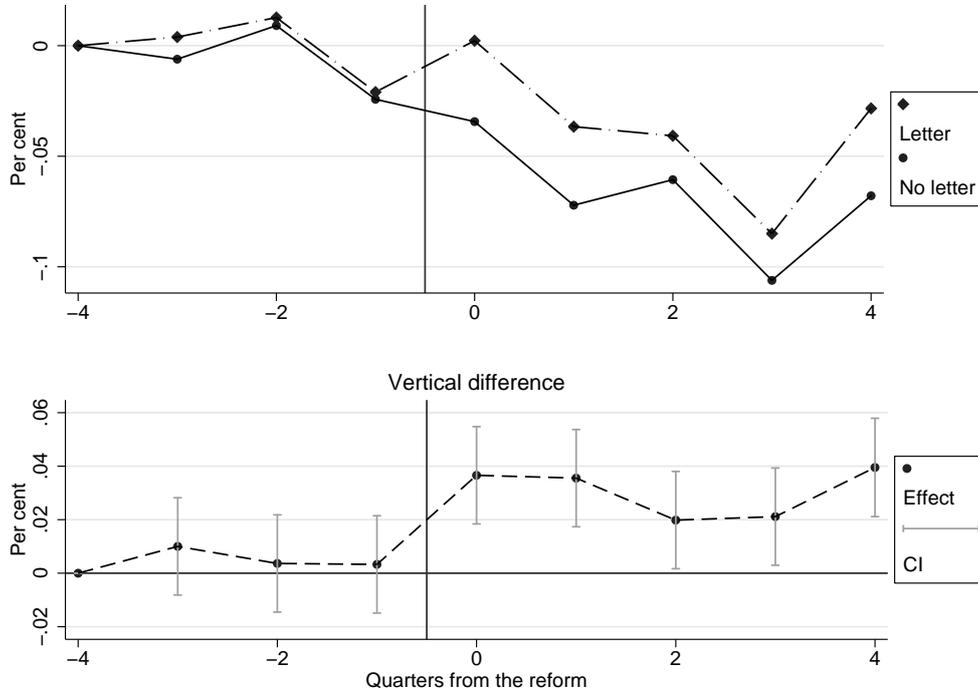
## 6 Results

### 6.1 Graphical evidence

We first present the results in graphs that show how the log of producer price turnover develops over time in various treatment and control groups. We focus on producer price turnover, since it captures the total remittances in VAT by the firms. Furthermore, this measure is not affected by changes in VAT bases, if there are no behavioral responses. We present below two graphs comparing a group that received a letter and a control group receiving no letter. Again the horizontal axis indicates months from January 2012 when both the letter experiment and VAT reform took place, indicated with a vertical line.

The time series for producer price turnover in the top panel is drawn from residuals of a regression that takes out monthly variation in the pre reform data. The graphs also include a bottom panel that presents the vertical difference between the groups and a confidence interval for it. The latter difference is drawn from a fixed effects regression for the log of producer

Figure 2: Hairdressers: turnover in letter vs. control



price regressed on the interactions of a group indicator and indicators for each month.

Figure 2 presents the log of producer price over time for barbers (VAT reform group) who received a 33% probability threat letter and a control group (also barbers) that did not receive a letter. Note how the randomization works in that the two lines follow each other over time in the upper panel. There is a small difference between the groups, which seems to be more or less the same over time.

On top of these general trends for both groups, figure 2 displays a difference between the letter and no letter barbers. The producer price decreased more among those who did not receive a letter. This suggests that receiving a letter induced barbers to evade less taxes. Since both groups were exposed to the reform and the only difference between them is receiving the letter, any difference in their behavior after receiving the letter must be caused by

Figure 3: Other services: turnover in letter vs. control

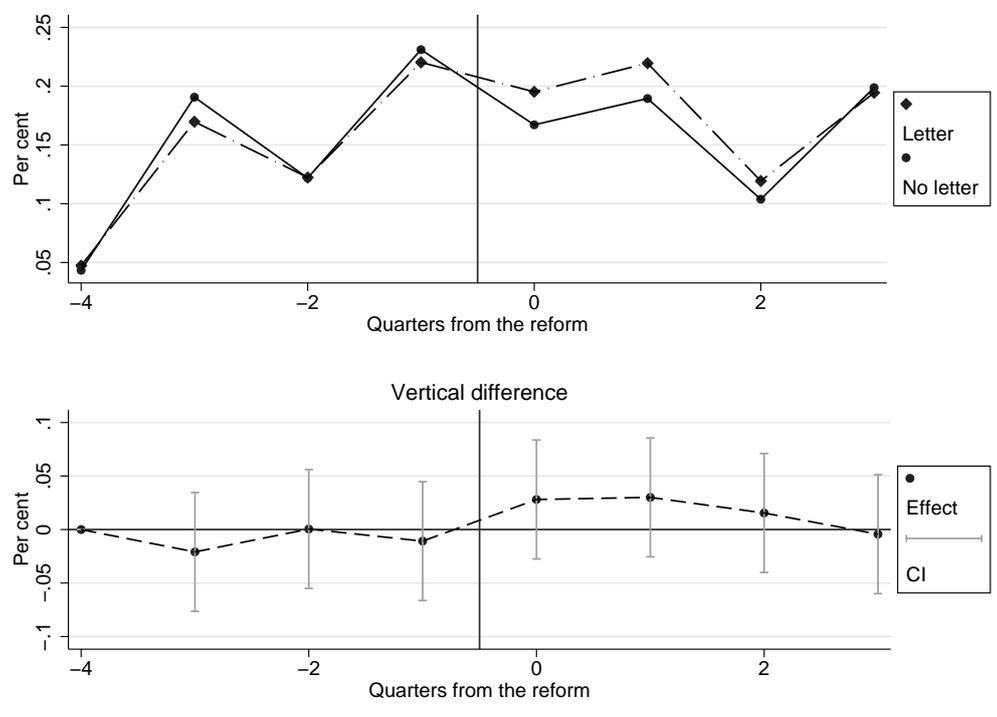


Table 4: DD results on the log of producer price turnover

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	Barbers	Other s.	Barbers	Barbers	Other s.	Other s.
	vs. c.	vs. c.	vs c.	33% vs. c.	5% vs. c.	33% vs. c.	5% vs. c.
dd	0.044*** (0.015)	0.036** (0.015)	0.020 (0.032)				
dd33				0.048** (0.018)	0.024 (0.020)		
dd5						0.022 (0.038)	0.019 (0.040)
N	9,196	5,887	3,308	4,902	4,906	2,571	2,558
$R^2$	0.002	0.019	0.012	0.021	0.022	0.010	0.010
N of firms	4,713	2,997	1,718	2,494	2,497	1,336	1,332

Note: Fixed effects DD regressions on the log of producer price turnover. Table compares treatment and control groups before and after the beginning of 2012. Columns (1) - (3) includes all the firms who received a letter into the treatment group. Columns (4) to (7) divide between 5 % probability letter and 33% probability letter and compare these separately with the control group. Robust standard errors in parentheses: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

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## 6.2 Regression results on tax evasion

It was evident from the figures 2 - 3 that the two groups, randomized into treatment and control, did not have exactly the same averages in producer price turnover even before the treatment. Since firms' turnover is very heterogeneously distributed (compared to individuals' income) and the group size is not terribly large, it is very difficult to randomize perfectly. However, any difference between the groups seem to keep constant over time. Therefore we estimate a differences-in-differences (DD) models that take group level and over time fixed differences into account. We further estimate firm level fixed effects, since these reduce the heterogeneity across the firms. We are interested in how firms respond, how their behavior changes over time, when they are approached with a letter threatening with an audit with some probability. A DD model comparing two randomized groups before and af-

ter receiving the letter is ideal for this. We code as before period July to November 2011 and as after period January to May 2012.

Table 4 collects the regression results. The table is organized as follows: column (1) compares all firms that received a letter to all firm randomized into control group before and after receiving the letter. Column (2) does the same only for barbers and column (3) only for other services. Column (4) compares barbers that received a 33% probability letter with barbers in the control group, similar to figure 2. Column (5) compares barbers receiving 5% probability letter with the control group. Columns (6) and (7) perform similar estimates for the firms in the other services.

The results indicate that on average firms reported 4.4% more turnover when they received a letter indicating a threat of audit. This result seems to be largely driven by barbers receiving the 33% probability letter. From the other letter groups none of the estimates are significant. This result tells the same story as the figures above, the only significant response was from a group that simultaneously were exposed to a VAT increase and received a high probability threat of audit.

To check that it was indeed hairdressers who received a letter who responded of all firms, table 5 presents triple difference results. The DDD variable takes value 1 for hairdressers who received a letter after the reform. Other services and those that did not receive a letter are in the control group. The results coincide with the DD results above. The model behind the triple difference results does not include all the second stage interactions, since there are not enough observations to identify them all with fixed effects regressions. It includes interaction with hairdressers and after the reform indicators.

Although there is not enough observations to have a statistically significant difference across the different letter groups, this result is remarkable. It is possible that when there is that large hike in VAT, it becomes more costly to pay taxes. Even if the firm would shift the higher VAT fully to consumer prices, it could face reduced demand for its services because of this. This increases the incentive to evade taxes. However, the result does not quite follow the standard intuition from Allingham and Sandmo's (1972) model.

Table 5: Triple difference results

	(1)	(2)
	All	High prob letter
DDD	0.035** (0.015)	0.048*** (0.018)
Hairdr*after	-0.135*** (0.019)	-0.132*** (0.021)
After	0.072*** (0.016)	0.069*** (0.019)
N	9,196	7,473
$R^2$	0.015	0.015
N of firms	4,713	3,828

Note: Fixed effects triple DD regressions on the log of producer price turnover. Table compares hairdressers that received a letter with other services and those who did not receive a letter before and after the beginning of 2012. Treated firms in column (1) are all the firms who received a letter and in column (2) those who received the high probability letter. Robust standard errors in parentheses: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

According to that model we should have seen more effect from other services that received the high probability letter. Since this did not happen, it seems that the interaction of the reform and higher subjective probability of getting caught is necessary to induce the behavioral response seen in column (4) of table 4.

One further worry is that there is something specific about the turn of the years. We could not choose the timing of the VAT reform (from the beginning of 2012), but we can check whether the results look different if we pretend the reform and experiment happened one year earlier than they actually did. Table 6 presents these placebo estimates, that are otherwise similar to the main estimation results in table 4. It is evident that none of the placebo DD coefficients are significant. Furthermore, most of the coefficients are negative, unlike the actual DD results in main estimates. This result gives more confidence that the significant estimates in the main estimation results were actually caused by receiving the letter.

Table 6: Placebo DD results on the log of producer price turnover

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	Barbers	Other s.	Barbers	Barbers	Other s.	Other s.
	vs. c.	vs. c.	vs c.	33% vs. c.	5% vs. c.	33% vs. c.	5% vs. c.
dd	-0.004 (0.015)	-0.012 (0.012)	-0.012 (0.036)				
dd33				-0.026 (0.017)	-0.011 (0.049)		
dd5						0.002 (0.015)	-0.014 (0.041)
N	8,407	5,514	2,893	4,603	2,222	4,609	2,231
$R^2$	0.013	0.011	0.021	0.010	0.021	0.013	0.024
N of firms	4,418	2,845	1,573	2,375	1,211	2,374	1,213

Note: Fixed effects placebo DD regressions on the log of producer price turnover. Table compares treatment and control groups before and after the beginning of 2011. Columns (1) - (3) includes all the firms who received a letter into the treatment group. Columns (4) to (7) divide between 5 % probability letter and 33% probability letter and compare these separately with the control group. Robust standard errors in parentheses: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

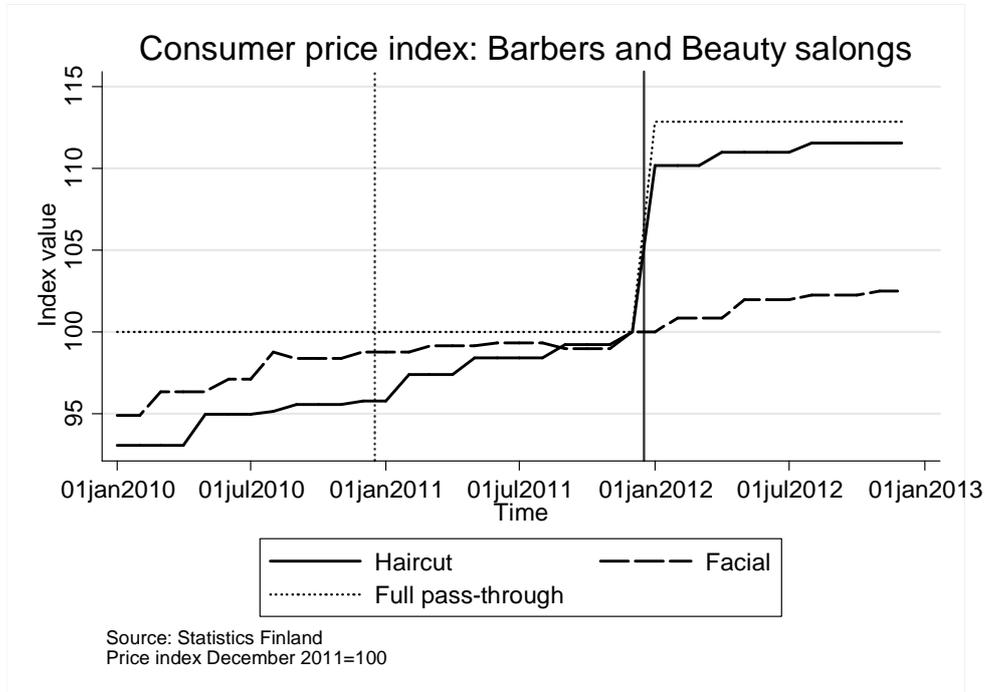
### 6.3 Tax incidence analysis

We analyze in this section the tax incidence induced by the VAT reform for barber services. We first gauge at the price incidence using a price index for the treated industries from Statistics Finland. We then analyze output incidence by presenting how micro level data on turnover behaves around the reform.

The first question is the tax incidence on prices. The VAT rate was increased from 9% to 23% indicating that full forward shifting would lead prices to increase by 12.8%. At the same time beauty salon services continued at the 23% rate all along. Therefore we get a meaningful image of the pass-through on prices by comparing the prices indices of the barber and beauty salon services. Graph 4 presents these added with a visual presentation of the full pass-through line.

From the graph it is evident that barber service prices increased as a consequence of the VAT increase. At the same time there were no significant changes in the beauty salon prices. Furthermore, it seems that although the

Figure 4: Price indices



barber prices increase significantly, the pass through is less than full.

We estimate the effect of a VAT reform on prices utilizing our price survey data. The estimation procedure is differences-in-differences and controls for service fixed effects. Effectively we follow each service over the VAT reform and observe how their prices change. The VAT reform applies only to part of the sample. Thus we can control for simple time variation in services with this sample and method.

Table 7 presents the result. The dependent variable is log price. Thus the result can be interpreted as per cent change in prices as a response to change in the VAT rate. The standard errors are block bootstrapped on 21 area times treatment status blocks. The result indicates that prices increased by 10 % as a response to the reform. The implied full pass through was 12.8 %. Our point estimate is statistically different from that according to a linear Wald test.

This result implies that the producer prices declined by 2.5% and with the producer price also the profit margin from each service sold declined.

Table 7: DD results on the log consumer prices

Hairdressers vs. other services	
DD	0.099*** (0.006)
After	0.004 (0.003)
N	956

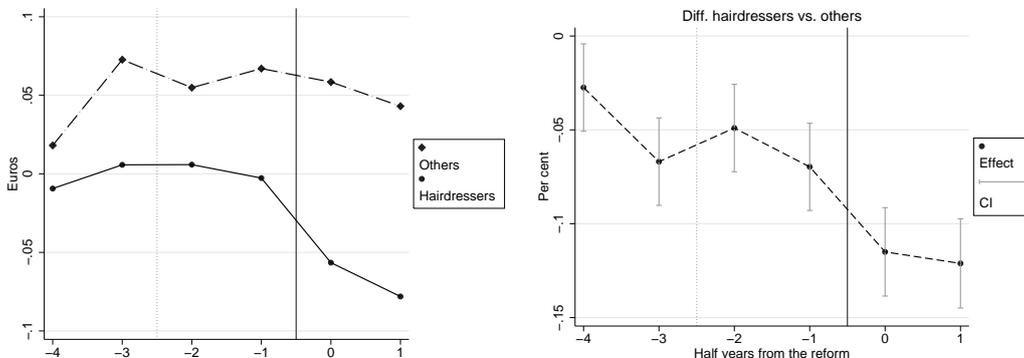
Note: Fixed effects regression on the log prices of hairdressers and other services. Standard errors are based on block bootstrap using as blocks the 6 provinces in Finland interacted with treatment indicator: s: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Based on this evidence we expect that the output measured at producer prices falls. The change in output of firms is combined effect of changes in producer prices, quantity of services sold and tax evasion. We assume that the quantity of services or tax evasion do not *increase* due to increase in VAT rate (a normal good assumption).

We turn to the turnover analysis to reveal the effect of the VAT reform in the absence of the natural field experiment. We measure the turnover in net of tax (producer price) value. Thus we expect this value to decline due to the reform in absence of tax evasion or demand effects, since the producer prices declined. The left panel of graph 5 presents the development of turnover for barbers (treatment) and other services (control). On horizontal axis 0 indicates the first half year of 2012, when the increased tax rates for hairdressers were first applied. The right panel shows the average difference between the groups in each half year. The figure shows that the turnover of hairdressers declines after the VAT increase more than in other similar services. The gap between these groups reveals the incidence of visible turnover due to VAT rate increase.

To estimate the tax incidence on output measured at producer prices we estimate equation (1) for turnover, a standard DD model. We compare hairdressers with beauty salons before and after the reform. There are significant differences in cyclicity of the turnover between the groups, visible in graph 5, but the overall time trend between the groups follow each other. We take

Figure 5: Output of firms in producer prices in the two groups



this into account by including flexible controls for cyclical and diverging time trends in the regressions.

Table 8 describes the regression results on tax incidence for turnover. The dependent variable is the log of turnover. Column (1) presents the main DD result. It compares barbers that did not receive a letter in the field experiment before and after the beginning of 2012 with beauty salons that did not receive a letter. The result implies that the turnover of hairdressers decreased by 7% as a result of the tax rate increase. Column (2) presents the placebo test by comparing the same groups before and after the beginning of 2010, two years before the actual VAT reform. We have more confidence in comparing these industries, since the placebo estimate produces zero.

## 6.4 Policy implications

We combine all policy relevant outcomes here. The first aggregate figure of interest is how much tax revenue the VAT rate increase collected. The total amount of VAT in a half year about 10,000 targeted firms paid was 28.2 M euros. After the reform, in a half year period, the comparable figure was 53.7 M euros, almost a double. Since this total estimate includes all behavioral responses (that typically reduce the tax revenue when tax rates increase), it shows that from the tax revenue perspective tax evasion or other responses are not enough to cancel the consumption tax rate hike.

With our estimates from the previous section we can assert a rough es-

Table 8: DD results on the log of turnover

	DD		Placebo	
	All	No corp.	All	No corp.
Effect	-0.071*** (0.013)	-0.071*** (0.013)	-0.007 (0.013)	-0.008 (0.013)
After	-0.018 (0.014)	-0.018 (0.014)	0.041*** (0.014)	0.041*** (0.014)
N	48,688	48,677	52,678	52,654
R <sup>2</sup>	0.093	0.093	0.071	0.071
N of firms	8,152	8,147	7,598	7,591

Note: Fixed effects regressions on the log of turnover. DD results compare hairdressers with other services before and after the VAT reform. Placebo results compare the same industries before and after 2010. Robust standard errors in parentheses: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

timate on how much different behavioral responses reduced the total tax revenue. The total effect of VAT rate increase induced 7% decline in reported turnover, which is 17 M euros in turnover and implies 3.7 M euros in paid VAT. Since the total impact is under 10% from the increase in tax revenue meaning that the total equilibrium quantity is not that sensitive to increases in consumption taxes, this suggests in Ramsey (1927) framework that VAT rate was efficient.

Tax evasion response was over 4 %, which is 9.7 M euros in turnover and 2.1 M euros in paid VAT. This low figure highlights that the tax evasion responses are not high enough to suggest lower VAT rates. However, this tax evasion estimate corresponds to the impact of VAT reform. The total tax evasion could be more widespread in these industries. Thus, from policy perspective, it could be advisable to investigate whether the tax system could be better enforced to deter tax evasion better.

## 7 Conclusions

We presented results on to what extent consumption tax rate affects consumption tax evasion by firms. A value added tax (VAT) reform took place at the same time with a natural field experiment. In the natural field ex-

periment the Finnish Tax Administration sent letters to firms stating either low or high probability of auditing the firm's VAT reports. In the reform the VAT rate for hairdressers in Finland increased from 9% to 23%, while other similar services were unaffected. These simultaneous treatments provided an opportunity to investigate the extent service sector firms changed their tax evasion decisions as a consequence of the VAT rate increase. We also estimated the role of profit margin and demand responses in the VAT reform.

The results indicated that the threat-of-audit letters had an effect on the VAT reports of hairdressers (VAT reform treatment group). Those hairdressers that received a high (33%) probability threat of audit letter increased their tax reports by 4.8% of turnover value relative to control group. Receiving a high probability threat of audit letter without the VAT reform or receiving a low probability threat (5%) of audit letter did not produce statistically significant results.

The VAT rate increase led to 10% increase in consumer prices. This is by 2.8 percentage points less than a full pass through. It implies that the profit margin measured as the producer price declined by 2.5%. Moreover, the value of output (at producer prices) declined by 7% as a response to the reform. We analyzed whether the true output of firms decreased, or whether the 7% decline in reported output value is a combination of increased tax evasion and declined profits. By combining three different results, 1) decline in producer price, 2) decline in tax reports and 3) the effect of the experiment on tax reports, we find that the true output seem not to have responded to the reform. Thus one thirds of the response resulted from a decline in profits and two thirds from an increase in tax evasion.

Our theory model is consistent with our empirical results. The model predicted that a higher tax rate decreases the effort of an entrepreneur and increases tax evasion. The latter effect could be stronger if income elasticity is low compared to tax evasion elasticity.

Our results showed that VAT evasion indeed responds to the VAT rate. Earlier empirical results are seen in a new light if two thirds of total response could come from tax evasion, as found here. This suggests that the tax

evasion margin should be taken into account when setting the optimal consumption tax rate. However, the 4.8% less reported turnover for tax evasion reasons is not sufficient to prevent increasing the VAT rate for the fear of tax evasion.

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## A Exhibit for the audit letter

# Announcement

(date)

## Dear entrepreneur

Tax Administration intensifies measures against the shadow economy. Your firm has been selected into a group, where one out of three (1/3) firms will be audited. We randomly selected firms into this group, and this selection has nothing to do with your previous announcements to Tax Administration.

As a part of the intensified measures, Tax Administration will audit periodic tax reports from the beginning of 2012. In case of a check, we will compare the tax reports to the other information we have about you. If deemed necessary, we will ask for further declarations. The audit period will start in March 2012 and will end in June 2012.

Please try to fill in your periodic tax return as carefully as possible.

If you have anything to ask about tax audits, you may contact Tax Administration.

(Contact information)



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VEROH 0124/w 8.2004

Figure 6: Threat of audit letter