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Jarkko Harju
Tuomas Kosonen
Joel Slemrod

VATT INSTITUTE FOR ECONOMIC RESEARCH

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Jarkko Harju, VATT Institute for Economic Research, jarkko.harju@vatt.fi

Tuomas Kosonen, Labour Institute for Economic Research,
tuomas.kosonen@labour.fi

Joel Slemrod, University of Michigan, jslemrod@umich.edu

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Valtion taloudellinen tutkimuskeskus
VATT Institute for Economic Research
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Jarkko Harju – Tuomas Kosonen – Joel Slemrod

Abstract

We study a tax evasion response to car taxes in Finland, where used car importers overstate the mileage to reduce tax liability. First, we develop a tax evasion measure by comparing reported mileage upon import with subsequent information from vehicle inspections, and find that a decline in mileage — "missing miles" — occurs frequently. Second, we analyze a tax rate increase, and observe a reduction in the number of imported used cars, but only among non-evaders. Finally, we analyze an RCT informing some potential importers about a program of inspections that uncover true odometer readings, and the results suggest that third-party reporting reduces evasion.

Key words: car tax, tax evasion, enforcement measures

JEL classes: H21, H23, H26, C93

1 Introduction

Car taxes are part of many countries' environmental policies (Sallee 2011), but these policies may create unintended behavioral responses. For example, car manufacturers have been found to (legally) alter the tax-relevant characteristics of cars without materially changing the actual functioning of the cars (Klier and Linn 2010, 2012, Sallee and Slemrod 2012 and Reynaert and Sallee 2016) and some companies, notably Volkswagen, have been caught cheating on emission tests. In this paper we analyze Finnish data to explore a previously unexamined response to car taxes. Importers of used cars may evade some of the car tax by overstating the vehicle's mileage[1], reducing the tax base and the tax due. We can provide a high-quality estimate of the magnitude of tax evasion by comparing the stated mileage upon import to the mileage collected in mandatory car inspections carried out at the same time or soon after. Observing that reported mileage upon import is higher than the mileage from the inspections is a nearly foolproof trace of car import tax evasion—"missing miles." We provide evidence that plain-vanilla odometer fraud is not "driving" our main results.

Some previous papers have analyzed the impact of tax rates on probability of evasion (Fisman and Wei 2004 and Marion and Muehlegger 2008). We are able to estimate not only how tax rates affect the probability of tax evasion and the decision to import a car, but also estimate how exogenous variation in tax rates affects evaders and non-evaders separately. To accomplish this, we focus on a Finnish car import tax reform in April 2012 that significantly increased tax rates on cars with high CO2 emissions, while leaving tax rates on cars with median or low CO2 emissions either unchanged or only slightly increased. We separate used car importers into evaders and non-evaders using our missing-miles trace measure of evasion described above.

Finally, we estimate the evasion and real responses to changes in the strictness of tax enforcement, in particular the usage of third-party information in tax enforcement. We begin by examining the effects of a change in the enforcement regime in 2013, where third-party information became more extensively used in enforcement. Because this evidence is not compellingly causal due to the lack of a control group that did not face the change in an enforcement regime, we follow up by analyzing a randomized controlled trial designed in collaboration with the Finnish Customs that varied the salience of tax enforcement for car importers in the latter half of 2014. Although previous literature has considered both sending letters increasing the subjective probability of being audited and having third-party information in general (e.g. Kleven et al. 2011 and Pomeranz 2015), we contribute to this literature by considering exogenous variation related to using third-

[1]In this paper we use the word "mileage" to refer to the total number of miles a vehicle has been driven, or a report on that figure, rather than its alternative meaning as the average distance a vehicle can travel on a specified quantity of fuel; we will use the term "fuel efficiency" to refer to the latter concept.

party information in tax enforcement.

Our results show systematic evidence of missing-miles evasion. We find that approximately 10% of used cars imported to Finland between 2008 and 2015 exhibit a compelling trace of at least some tax evasion; most of this evasion is observed at the registration inspection conducted either before, about at the same time or soon after the car import tax declaration. We show that tax evasion occurs to some extent from all kinds of used imported cars, but most prominently among slightly older cars that have lower average fuel economy.

We present one of our main results by utilizing the tax reform in April 2012 which shows that on average used car imports decline after the reform. We divide imported used cars into a high CO2 group, for which tax rates increased by 6.5% on average, and low CO2 group, for which tax rates increased by only 1.5% on average. We also divide all imported used cars into different groups further using our missing-miles measure for tax evasion, resulting in four groups that we follow over the reform. We find that the decline in the number of imported used cars occurred primarily in the high CO2 group for which taxes have not been evaded. Otherwise, imports among the four groups follow each other reasonably well before the reform and continue on these trends after the reform. We do detect some decline in the high CO2 group that evaded taxes, but this decline is not statistically significant. These data patterns suggest that car import decisions do depend on tax rates, but very weakly among tax evaders, consistent with statutory tax rates mattering less among those who do not comply with these rates. Thus, the reform increased the overall extent of evasion because it reduced the base of cars from which taxes have not been evaded. We also estimate the elasticity of the number of imported used cars separately for evaders and non-evaders and find an elasticity of -1.6 for non-evaders, and a statistically not significant elasticity for evaders. The elasticity estimate takes the continuous tax variation into account and thus captures the full response to tax incentives better than the differences-in-differences estimate.

Having established that missing-miles tax evasion responds only weakly to variation in the tax rate, a natural follow-up inquiry concerns what it does respond to. Evidence derived from a change in the enforcement regime in 2013 strongly suggests that stricter enforcement does reduce tax evasion: as soon as the tax authority began extensive usage of third-party information, the number of cars on which taxes were evaded began to decline sharply, and the drop continued for many years. The decline in tax evasion occurred similarly among cars to which high or low tax rates are applied. In this way the combination of the differential timing of tax reform and the change in enforcement regimes allows us to identify how tax rates and enforcement separately influence car import and tax evasion decisions.

Finally, we analyze an RCT to provide causal evidence of the impact of tax enforcement on tax evasion. In 2014, in cooperation with the Finnish customs authority, we

implemented an RCT that informed some likely car importers of the use of the third-party information that began to be collected in 2013. One treatment in the experiment increased the salience of the public disclosure of reported mileage, which makes "missing miles" visible to potential buyers of the car. The results from this experiment, which are intention-to-treat effects, suggest that these enforcement treatments reduced the prevalence of missing-miles evasion, supporting the view that this type of tax evasion responds more clearly to tax enforcement than to variation in tax rates. Notably, though, we do not find any effect of the enforcement-related treatments on the number of imported used cars, which is consistent with the earlier analysis.

One potential challenge with our method of measuring tax evasion with missing miles is that odometer fraud could also explain declining apparent mileage over time: sellers of used cars might try to get a higher price for the car by fraudulently reducing the mileage shown on the car odometer. However, we show that most of the tax evasion we detect is observed at the time of the initial registration inspection, which usually occurs within a couple of weeks of the car import tax declaration. We argue that this cannot be odometer fraud because, if one is willing to alter the odometer, the incentives are to align the odometer reading, i.e. to increase the odometer mileage at the time of the registration inspection to equal the mileage in the import car tax declaration so as to avoid getting detected evading taxes. Plain-vanilla odometer fraud would entail much lower risk of detection if it were done after the registration inspection. We show that our main results regarding the effect of 2012 tax reform and 2013 tax enforcement reform hold even when confining the analysis to the tax evasion observed very soon after the registration inspections.

This paper explores a formerly unstudied variety of tax evasion, using methods that have been utilized in the recent explosion of academic interest in this area.[2] One broad finding in accordance with our results is that individuals and firms do respond to information about expanded enforcement, at least in the short run, by reducing tax evasion (see, e.g., Slemrod, Blumenthal, and Christian 2001, Pomeranz 2015 and Meiselman 2018), especially in settings where third-party information had not been extensively utilized in tax enforcement (see, e.g., Kleven et al. 2011 and Naritomi 2019). The reduction in total tax evasion might be offset through increases in evasion from other variables affecting the tax base, as in Carrillo et al. (2017). In our case there is no visible offsetting effect through elsewhere in tax base, and thus the total tax revenue increases when tax evasion through inflated mileage is reduced, possibly because there are no obvious alternative methods to evade taxes. Since these kinds of institutional features might have an effect on total tax evasion, it is interesting to study tax evasion in different contexts.

Our finding that non-evaders respond to statutory tax rate changes more than evaders

[2]For a more comprehensive surveys of the burgeoning recent literature of the empirical analysis of tax evasion, see Slemrod (2017).

do has not been heretofore demonstrated. According to this mechanism, the extent of tax evasion might respond to tax rates even when tax evaders themselves do not change their behavior. This phenomenon is more likely to occur in situations where extensive margin responses are common (such as when economic agents are importing goods). For example, the result by Fisman and Wei (2004), showing that a higher tax rate is associated with more tariff evasion, could be partly explained through this mechanism. Overall, our results suggest that being able to distinguish real behavior and tax evasion is important to better understand what underlies the aggregate responses to policies.

The paper proceeds as follows: Section 2 describes the Finnish car import tax system and related enforcement details, Section 3 presents the data and our indicator of tax evasion. Section 4 offers evidence on what factors affect tax evasion, shows evidence of the "missing miles," and discusses the results of the RCT. Section 5 offers concluding remarks.

2 Car Import Practices and Car Taxes in Finland

2.1 Car Import Practices

Figure 1 shows the number of new and used cars imported into Finland between 2008 and 2014. On average, more than 100,000 new cars are imported annually. Used car imports comprise over 15% of the yearly addition to the Finnish car fleet. Most of the used car importers are private individuals as opposed to firms. As we discuss below, there is a declining trend in the number of used cars imported after 2010, with no similar trend appearing for new cars. While there are no sharp changes in the time trends, we observe a small decrease in car imports after the 2012 reform that increased the average car tax rate.

When importing a used car to Finland, one needs to report the transaction by filing a form with Customs and then, within five days, filing a car tax declaration, also to Customs. This declaration specifies the vehicle identification number, make, model, age, CO2 emission value (g/km), weight, special equipment, and other information about the condition of the car. We have all this information in our data and, crucially to our study, the information relating to the condition of the car includes the mileage reported at the time of import.

Usually at the same time as the car tax declaration, one starts the process of registering the car, the first step of which is to take the car to a registration inspection that records the vehicle identification number, make and model, and also checks that the car fulfills the requirements for cars driven in Finland (such as having a rear fog light). Registration must be done within four months of filing the car tax declaration, but most people start the registration process simultaneously, or even before, filing the car import tax

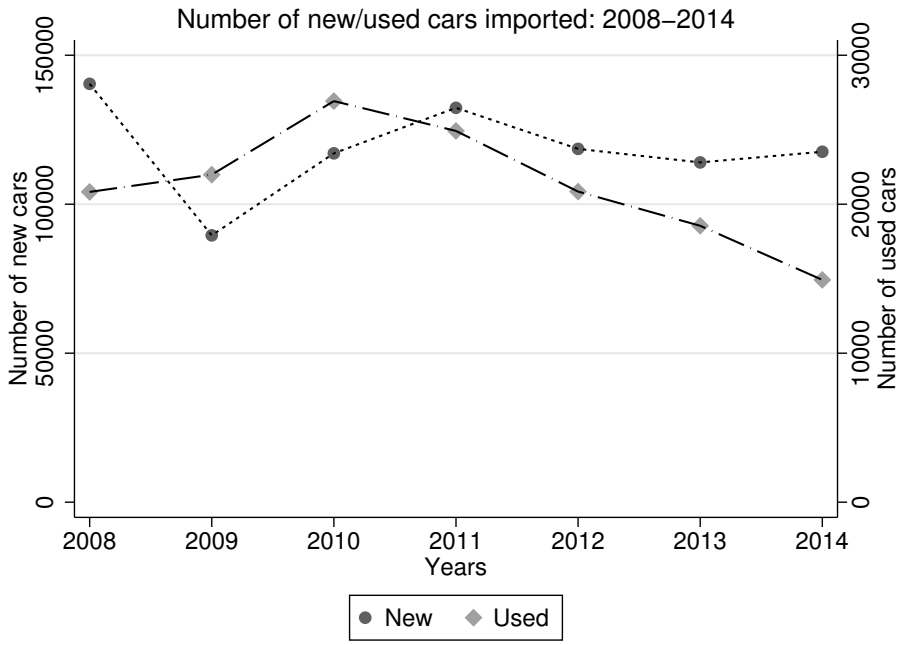

Figure 1: Number of new and used cars imported to Finland over time

declaration. Figure 21 in Appendix F presents the distribution of the number of days between filing the tax declaration and the registration inspection. The distribution is visibly centered at zero and most of the mass is within 30 days of filing the taxes, and it seems to be rather common also to file the tax form before registration, as illustrated by the mass on the left-hand side of zero.

2.2 Car Taxes

Almost all cars driven in Finland are imported.[3] Finland levies a tax on all vehicles[4] imported into or newly registered in Finland, regardless of whether the vehicle is new or used. We will refer to this as the car tax.[5] This tax must be remitted before a vehicle's introduction to, or first registration, in Finland, and is collected by Finnish Customs. The person entered in the register as the owner of the vehicle is liable for remitting the car tax, unless the vehicle is imported by a business that Customs has authorized as a

[3]For example, in 2011, the mid-year of Figure 1, only 2,540 new cars were manufactured in Finland as the total number of new imported cars to Finland was 126,123.

[4]This includes passenger cars, vans, buses, motorcycles, and other vehicles.

[5]In addition to the car tax, an annual vehicle tax is collected on all registered cars in Finland. This tax contains two parts. The first part is the so-called "basic" tax that depends on the CO2 emission value or, for older cars, the mass of the vehicle. An additional part applies only to cars that use other than petrol as a motive power, e.g. diesel, so that the annual vehicle tax is higher for these cars. Note that vehicle tax liability does not depend on the value or other characteristics of cars, and amounts for a typical car to between 100 and 400 euros.

registered agent, in which case the agent must remit the tax.[6]

Car tax is based on the value of the car, V. A small deduction is made from this value to determine the taxable value. The rate of tax applied depends on the CO2 values according to a schedule stated in the law. The CO2 values are assigned according to international standards for new cars, and the same value applies to all cars of a particular make, model and engine size regardless of the actual CO2 emissions of an individual car.[7] Car taxes are derived simply by multiplying the taxable value of a car by the car tax rate so that tax due is $T = V * \tau(CO2)$.

Customs estimates the value for used cars based on the price of similar cars sold in Finnish retail markets, depending on the technical characteristics of a car, such as the make, model, and age of the car as well as its overall condition. One important input to this estimation procedure is the car's mileage, m; ceteris paribus, higher mileage reduces the estimated taxable value. If reported mileage m^r is higher than the true mileage m^*, also the estimated value $V(m^r) < V(m^*)$ and thus car taxes are lower: $T^r = V(m^r) * \tau(CO2) < T^* = V(m^*) * \tau(CO2)$. This constitutes the incentive to evade taxes by means of overstating mileage when filing the car tax return.

In this paper we first examine the impact of the reform of April 1, 2012[8], which raised the gradient of the tax schedule with respect to CO2 emissions. Figure 2 depicts the tax schedules before and after the 2012 reform by CO2 values (right y-axis), and shows that the reform made the tax schedule more steeply dependent on CO2 values and that the tax rate increased for virtually all used cars, declining only in the very low end of the CO2 distribution when comparing the tax schedule that took effect in April 2012 to the tax schedule before that, which had been applied after 2009. Figure 2 adds the distribution of imported used cars by CO2 values, with densities on the left y-axis. The vertical dashed line corresponds to a division of imported cars into two groups that we will use in the analysis of the impact of the 2012 reform.

2.3 Car Tax Enforcement

Missing-miles evasion consists of reporting a falsely high mileage when filing the car tax return, perhaps while also overstating the reading on the odometer. Misstating the odometer reading would be detected if Customs were to inspect the odometer, but the Customs authorities do not regularly check the odometers. If one also alters the odometer, the evasion would not be caught even in the case of an inspection. The two standard

[6] If the tax cannot be collected from the registered agent, the person entered in the register as the vehicle's owner is liable for the tax, unless he or she can demonstrate having remitted to the registered agent or their representative an amount expected to be the tax liability.

[7] In case the official CO2 value is not available, the mass of the car is used instead with an associated tax schedule.

[8] Finlex 57/2011. The purpose of the reform was to increase tax revenue and to improve the environmental impact of the import car tax policy.

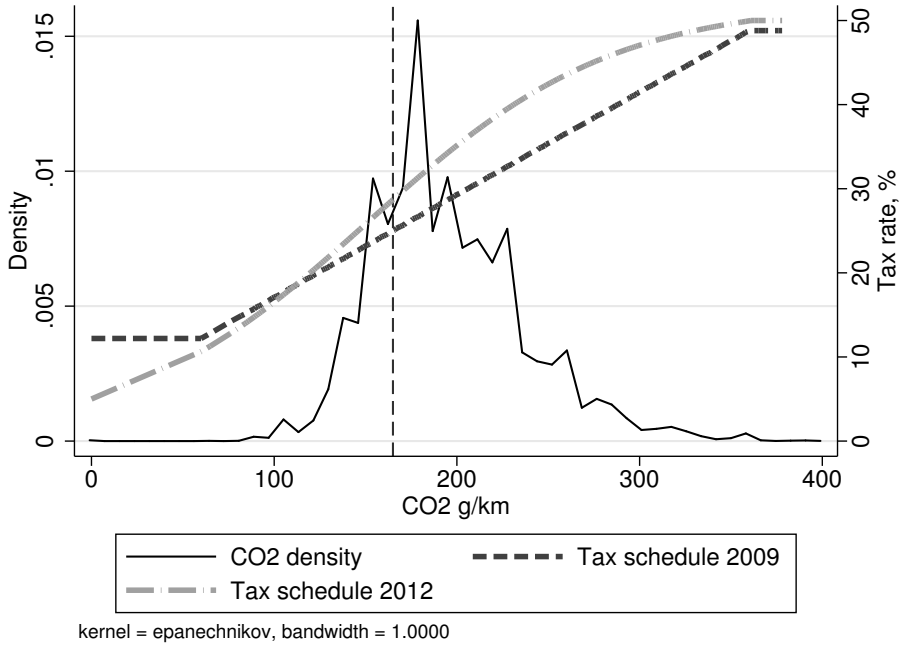

Figure 2: The CO2 distribution of imported used cars around the 2012 reform and the tax schedule change

methods to alter an odometer reading are to buy a dedicated device for the purpose, which costs a few hundred euros, or to buy odometer changing as a service from a company.

The fines for falsely reporting mileage are defined loosely in the law, and are thus largely at the discretion of Customs. They depend on the severity of the misreporting, and at a minimum the owed taxes must be paid plus a small fine. In the event of multiple offenses, a criminal case may be opened against the car importer, with the possibility of imprisonment.

We describe next how the car tax enforcement changed in the 2013 reform and the utilization of third-party information.

2.4 Measuring Missing Miles and the 2013 Enforcement Reform

We can assess car tax evasion through over-reported mileage upon import because we have access to a novel source of comparison information about cars' true mileage that originates from annual car inspections that are mandatory for all cars registered for use on public roads in Finland. The data from the Finnish Transport Safety Agency (FTSA) contain mileage information from annual inspections (in later years, cars under five years old need to be inspected biannually). In addition, we have access to another data source that contains mileage information from a sample of about 40% of car inspections from 2008–2012.[9] Using this chain of links, we can follow the same car from the day it was

[9]The data in the 40% sample come from one car inspection company that recorded odometer readings during this period. Thus, this is not a random sample and is not necessarily representative of the universe

imported to Finland, through its annual inspections, until it is removed from the FTSA registers when it is scrapped or exported. Comparing the reported mileage upon import inspection to the mileage at the inspection provides insight regarding missing miles. The Customs data also allows us to see how frequently the same individuals or firms import cars to Finland.

In 2013 the Finnish authorities began exchanging vehicle-related information across different agencies for the purposes of more efficient tax enforcement. The FTSA mandated that the inspection stations performing the inspections to systematically record the odometer reading from all cars. This information is gathered into registers and is also available to Customs.[10] Customs then have reliable comparison information about the mileage with only a few months delay, which they can utilize in their tax enforcement. The Customs began to run systematic checks on cars that had a suspiciously high discrepancy between reported mileage and this new comparison information. Notably, though, the Customs did not publicly advertise the existence of this information. Moreover, it used only the mileage from the first registration inspection that takes place at the same time, soon after, or before the car tax declaration is filed. It is thus possible to keep the inflated reading on the odometer during this first inspection, and later reduce it. Then the lower mileage would still be visible to a researcher at a later inspection.

Figure 3 shows the number of used cars imported to Finland over all, the number of these that are ever observed in the inspection data and the number of these that are observed soon after in the registration inspection. We observe most cars in the inspection data and, of those that we observe, almost all also from the registration inspection (and in subsequent inspections as well). We define "soon after" to refer to inspection information that we observe within four months of the car import tax filing. We define the time period between tax filing and inspection information to be rather long so that we have as many tax filing observations with the comparison information as possible, especially because the inspection data before 2013 is only a 40% sample of all inspections.[11] Notably, Figure 3 shows that the share of imported cars for which we have inspection data, and were inspected soon after tax filing, did not change markedly over time. Thus, we think that observing a car in the inspection data does not produce any spurious changes over time

of car inspections.

[10]The exchange of information between car inspection stations, FTSA and Finnish Customs was passed into law in January 2013, but did not come into effect until the beginning of 2014 (Finlex 144/2012). However, in practice, car inspection stations started to collect mileage information in January 2013, some already by October 2012. We also have auxiliary data source about mileage in car inspections from one major inspection company beginning in 2008. Therefore, we have some information about inspection from 2008, and comprehensive comparison information about the mileage of cars from 2013 onwards.

[11]We perform robustness checks using a shorter definition of the time period between tax filing and inspection information, especially when we study the effects of the RCT on missing miles. Note also that it is possible to bring an imported car to inspection before tax filing, as is visible from Figure 21 in the Appendix. Most of the inspections in our data are observed very close to the tax filing dates; approximately 65% of comparison information is observed within two weeks of the tax filing date.

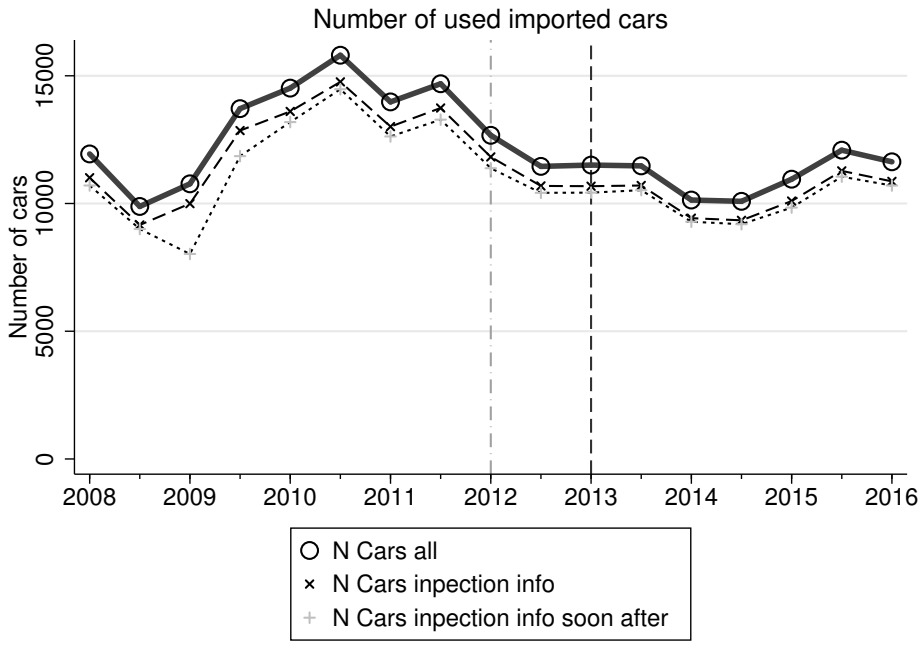

Figure 3: Number of used cars imported to Finland by their status in the inspection data, 2008-2016

in the tax evasion measures that we analyze below.

3 The volume and nature of missing miles

We describe here tax evasion among imported used cars using the FTSA and additional 40% inspection data combined with Customs data. The institutional setting described above where all cars are mandated to regular inspections allow us to analyze this comprehensively.

3.1 The Frequency of Tax Evasion

Figure 4 depicts the frequency of missing miles, measured as the difference between the mileage reported upon import and observed in inspection for used cars, for which overstating mileage upon import can reduce tax liability. The left panel refers to those cars for which car tax filing and inspection mileage are observed within four months of each other; we will refer to such inspections as happening "immediately" or "soon after" as the car import tax filing. The right panel shows the mileage difference for the remaining cases between 2008 and 2015, i.e., those for which the inspection was observed more than four months after import and import tax filing. In the right panel, unsurprisingly there are many observed positive changes in observed mileage as time passes. Strikingly, though, there is also substantial mass at *negative* values that expands to more than -

200,000 kilometers. The mileage of such cars at inspection is thus *below* the mileage reported upon import.

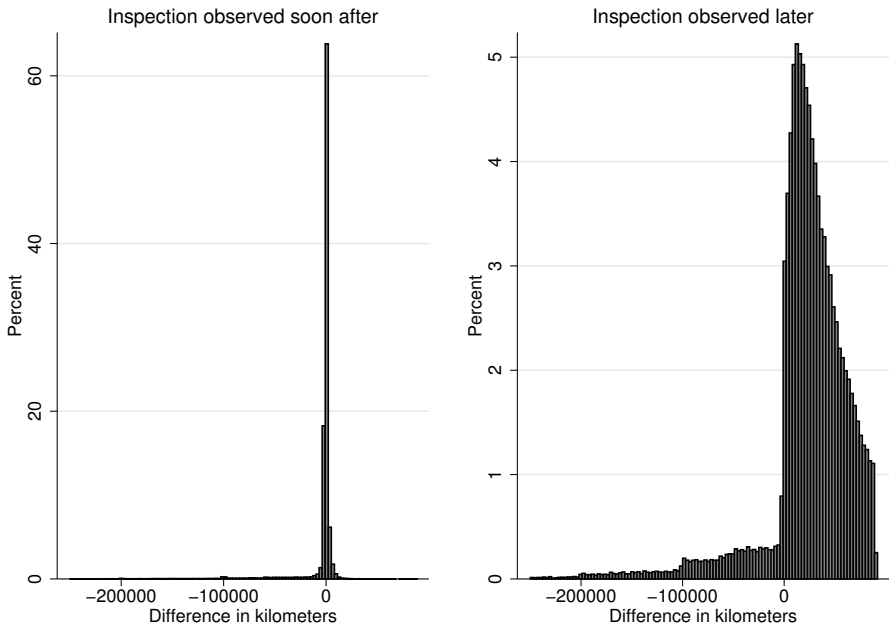

Figure 4: Distribution of mileage reported at inspection minus mileage reported upon import

In one sense, the mileage observed during an inspection carried out about at the same time as the car is imported provides our best measure of mileage inflation due to tax evasion, because this measure is not obscured by the fact that the actual mileage of cars naturally increases over time as they are driven. To more clearly observe the shape of this distribution, Figure 5 reproduces the left panel of Figure 4 without the approximately 70% of observations close to zero – excluding differences that are less than 5,000 kilometers. The figure depicts the distinguishable misreporting of mileage and shows a clear spike at -100,000 kilometers, along with another smaller one at -200,000 kilometers. These spikes are consistent with round-number mileage inflation: for a car with less than 100k on the odometer, a tax evader decides to put a number one (or two!) in front of the true mileage when filling in the car tax declaration form. In some cases they could do the same for the odometer, but those cases would not be observed in this figure, because then the odometer mileage that comes from the registration inspection would be altered to a higher figure to match the reported mileage.

We next describe the frequency of missing-miles tax evasion over time. Figure 6 shows the number of imported used cars over time for which we have the mileage comparison information from inspection, and adds two time series for apparent tax evaders. The first series shows the number of used cars for which we observe tax evasion with our missing miles measure and the second shows the number of cars for which the evasion is

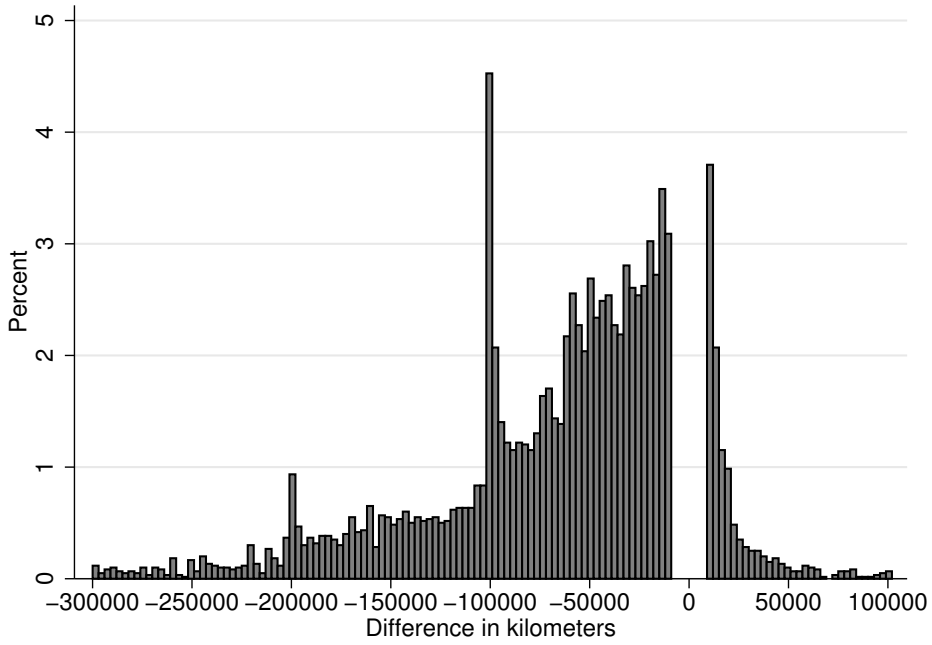

Figure 5: Distribution of mileage reported at inspection minus mileage reported upon import of cars inspected soon after import, excluding observations smaller than 5,000 kilometers

detected using mileage from the registration inspection conducted soon after the car tax declaration. The graph confirms that a trace of evasion is present in about 10% of all imported cars for which we have the evasion measure. Importantly, the figure shows that almost all of the evasion we detect is through the registration inspections as opposed to post-registration inspections, and that this do not change much over time.

Thus far, we have provided evidence strongly suggesting that some used car importers inflated the reported mileage for tax evasion purposes. To understand more precisely how common this is, and how the inflated mileage relates to the tax system, in Table 1 we present some statistics related to car taxes and mileage.[12] The first two columns of the table present information about car taxes and mileage for all used cars, and the next six columns show data for those cars likely evading: those that exhibit declining mileage of more than 5,000 kilometers between import and the lowest mileage value in inspections immediately after car tax filing or later. These statistics are shown for CO2 quintiles of cars and, at the bottom of the table, as a total for all used cars. For each cell, the average is provided with the number of observations below.

Given that, after the tax reform in 2008, the rate of car tax increased with CO2 emissions, it is meaningful that the average tax increases with the CO2 quintile. The "km" column shows the average number of kilometers (in thousands) reported to have

[12]Appendix A gives the information on how we relate the amount of missing miles to tax evasion in euros.

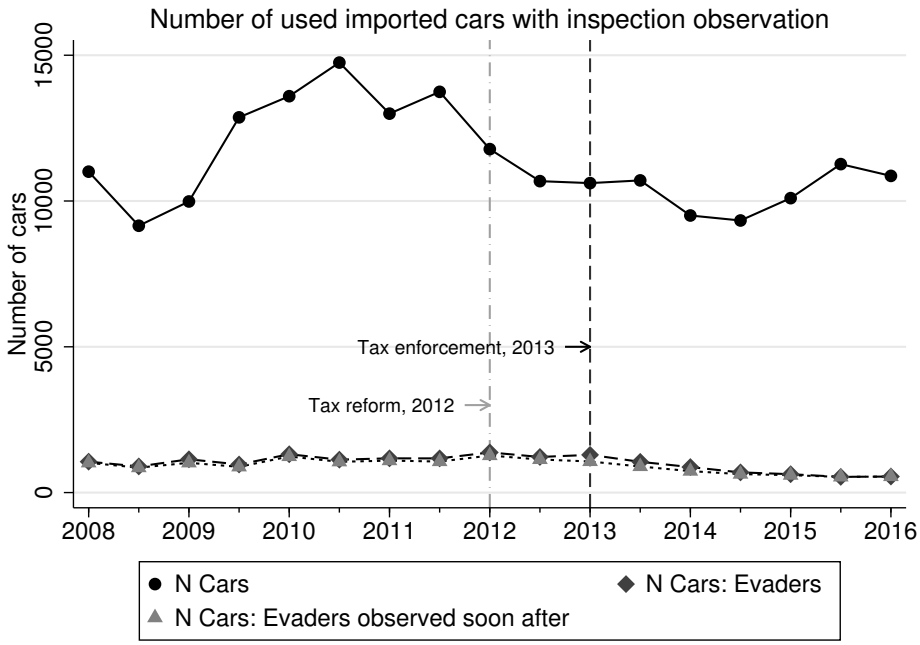

Figure 6: The total number of imported used cars, "evader" cars and those observed soon after the registration inspection in inspection data over time

been driven before import to Finland. On average, cars in all CO2 quintiles are driven more than 100,000 kilometers, with the highest number in the middle CO2 quintile.

In each CO2 quintile, the car tax remitted by the apparent evaders is substantially lower than the overall average, and the reported mileage is substantially higher. Of course, the lower amount of car taxes could reflect that these cars have a true lower value, that they have evaded taxes to arrive at the lower amount, or some of both. To better understand this issue, the "km_ev" column shows the amount of mileage corrected for tax evasion, which is the average amount of mileage inflation in car import tax filings calculated by adding to the mileage the observed negative difference between the comparison information and the car tax report. It is clear that, conditional on evading, the average amount of mileage inflated (km_ev) is a large fraction of the reported mileage (km), and the corrected mileage is actually lower for the evading cars–they are below-average-mileage cars masquerading as above-average-mileage cars.

The last three columns in Table 1 show the fraction of cars having at least 5,000 kilometers of inflated mileage in their import tax filing, separately according to whether we observe the inspection immediately or later. Note that the relative number of observations in Column 6 implies that we observe about 94% of evasion immediately. Column 8 shows the same statistics using the shorter time interval of one month. This examination supports the view that a very high fraction of the comparison information is observed within one month after tax filing (87%) and that the average statistics are very similar

to those using our preferred definition in Column 6.[13] The results confirm that having some discrepancy between the reported and comparison mileage is by no means a rare phenomenon. The frequency of apparent tax evasion increases with the CO2 quintile (and therefore the tax rate), with the highest frequency observed in the fifth quintile of the final column: 13% of the highest CO2 quintile cars are imported as used when observed immediately, and 19% when observed later. Note that when we observe the inspection mileage later, the share evading is consistently higher than when we observe the inspection immediately, and for this (small) group of observations we cannot rule out that some of the decline in mileage occurs due to odometer fraud rather than import tax evasion. We take this issue up in the next section.

In Appendix B we provide the details of a procedure that uses these exercises to estimate the total amount of missing-miles tax evasion. We conclude that 15% of the tax that should have been remitted was not.

3.2 Could Odometer Fraud Explain Missing Miles?

Central to our analysis is the argument that, because inspection always occurs at the same time or soon after import, mileage reported upon inspection that is *less* than what is stated for tax purposes upon import is a strong trace of tax evasion. The only possible alternative explanation, other than unsystematic data errors, is downward odometer fraud after import to increase the car's resale value. But it is highly unlikely that odometer fraud could explain our measure of tax evasion for those cars for which the comparison information from inspections is observed soon after the car tax declaration. This is because, when the registration inspection takes place, the immediate incentive is to *increase* the odometer reading to match the car tax declaration to avoid getting caught from import car tax evasion. The risk of getting detected by the authorities of odometer fraud reduces significantly after the registration car inspection.[14] Odometer fraud by *reducing* the odometer reading becomes potentially attractive before re-selling a car, but we would observe this as declined mileage no sooner than in the inspection subsequent to the registration inspection, at least one year later. But recall that we already showed in Figure 6 that most of tax evasion we detect comes from registration car inspection. Thus, the bulk of our trace measure of tax evasion is almost certainly not due to odometer fraud.

Nevertheless, it is interesting to evaluate the extent of odometer fraud in our data,

[13] Although we acknowledge that four months time difference between tax filing and inspection information might not strike all readers as "immediately", we have two main reasons to argue that this definition is suitable in this context: 1) A car importer is allowed to drive three months before registration inspection with a temporary license that allows at least that amount of time to visit an inspections station, and 2) we want to include all credible comparison observations in our analysis so that we can offer as precise results as possible.

[14] Most registration inspection take place within 30 days of filing the tax declaration as shown in Figure 21 in Appendix F.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All		Evaders					
CO2-quintiles	Car tax	km	Car tax	km	km_ev	D<-5k Immed.	D<-5k Later	D<-5k <1 mo.
1	3,609	103	1,979	158	75	.054	.084	.052
	35,202	35,202	1,989	1,989	1,989	32,630	2,572	30,037
2	4,268	127	2,586	198	105	.061	.10	.059
	41,224	41,224	2,591	2,591	2,591	39,164	2,060	36,423
3	4,553	141	2,746	215	115	.088	.17	.085
	34,435	34,435	3,209	3,209	3,209	32,372	2,063	29,731
4	4,695	147	3,001	204	111	.099	.17	.095
	38,983	38,983	3,993	3,993	3,993	36,961	2,022	33,996
5	6,089	137	3,940	188	97	.13	.19	.13
	36,479	36,479	4,880	4,880	4,880	34,187	2,292	31,297
Total	4,642	131	3,040	195	102	.086	.14	.083
	186,323	186,323	16,662	16,662	16,662	175,314	11,009	161,484

Table 1: Descriptive statistics of car taxes and mileage for all cars and evading cars, years 2008–2015.

Note: Evaders are defined here as having more than 5,000 kilometers of misreported mileage in tax filing. CO2 quintiles are calculated by dividing data according to car-level CO2 emissions as new. Car tax shows the amount of average car taxes paid by different quintiles, km shows the average thousands of kilometers reported in tax filing, km_ev depicts the difference between tax filing and comparison information, D<-5k refers to having less than -5,000 kilometers difference between reported and observed mileage, Immed. refers to observations for which the tax evasion measure is observed soon after, Later refers to observing tax evasion from later inspections than soon after and <1 mo. refers to observing tax evasion from inspections within one month from the tax filing.

given that it is regarded as a problem worldwide (European Commission 2014 and U.S. Department of Transportation 2002). We investigate whether, in the absence of tax incentives, downward changes in mileage are a common phenomenon. Figure 7 shows the share of cars having ever observed at least 5,000 kilometer decline in mileage from one inspection to another, and thus does not include reported mileage upon import. The cars are recorded according to the year we first observe them in our data. The figure shows that suspected odometer fraud is quite a common phenomenon, at times more than 15% for cars imported as used and almost 10% for cars imported as new. Conveniently for us, the probability of odometer fraud does not seem to have drastic changes over time, especially around the reforms we utilize in the analysis below. For both groups there is a downward trend, but that is expected as the cars we first observe later have had less time to have been observed with a negative change in the odometer mileage.

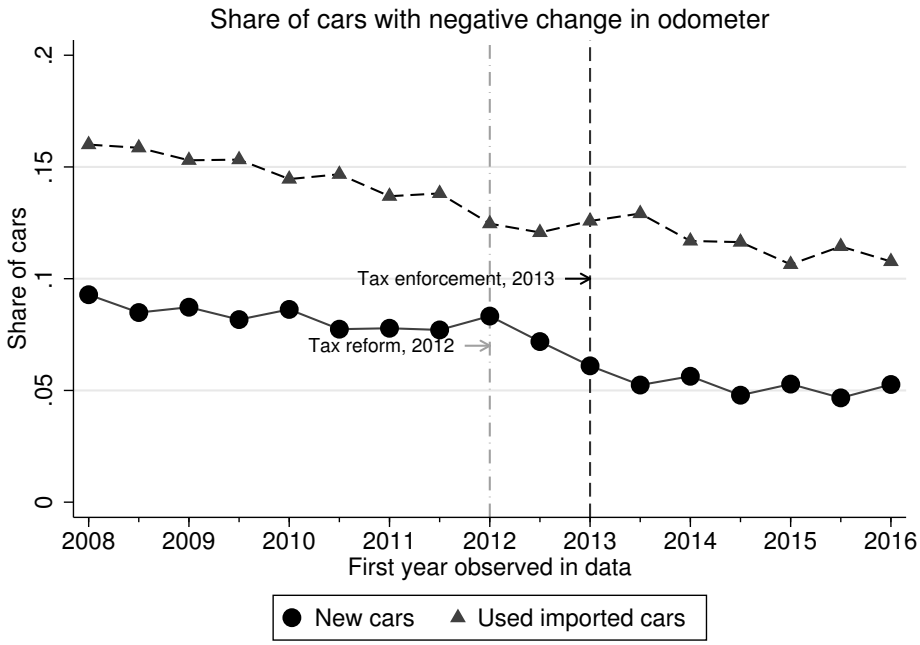

Figure 7: Suspected odometer fraud over time for cars imported as new and used

4 What Affects Tax Evasion?

4.1 The Impact of Tax Rates on Missing-Miles Tax Evasion

In this section, we analyze how car tax rates affect the extent of missing-miles tax evasion. We first focus on examining the impact of tax rates on the probability that an imported used car has an inflated mileage report, and then investigate the effect of car tax rates on the amount of imported cars with and without tax evasion. In order to provide causal evidence, we examine the 2012 reform described in Section 2.2.

Figure 2 in Section 2 shows the pre- and post-reform tax schedules and the distribution of imported used cars by CO2 values, with densities on the left y-axis. In order to provide graphical evidence on the impact of the change in tax rates, we divide the imported used cars into two groups; those with CO2 emissions under 165 g/km and those above that threshold. The dividing line between the groups is marked as the vertical dashed line, with each group having a fair number of cars imported but a clear difference in the tax changes faced. Below we also present estimates of the impact of tax rates on evasion using continuous variation in tax rate changes.

Table 2 provides descriptive statistics for the two groups measured one year before and after the April 2012 reform. The table shows that, in the lower CO2 group, the average tax rate increased from about 23% prior to the reform to 24.5% after, while for the high CO2 group it rose from about 30% to 36%; thus the increase was approximately four times larger than for the high CO2 set of cars. The last column shows that 6% of the

low CO2 group cars exhibit traces of tax evasion (at least 5,000 kilometers more reported in the car tax filing compared to car inspection information), while the comparable figure is 10% for the high CO2 group.

CO2 group	Stat	Car tax %, pre	Car tax %, post	Ind. tax evasion
Low CO2	Mean	22.91	24.45	0.06
	Sd	*2.23*	*3.43*	*0.24*
	N	9262	11854	9262
High CO2	Mean	29.92	36.20	0.10
	Sd	*6.37*	*6.09*	*0.31*
	N	31935	26238	31935

Table 2: Descriptive statistics for imported used cars prior and post to the 2012 reform
Note: Table shows car tax rates before and after the reform and the share of cars having tax evasion in low and high CO2 value groups. Low CO2 group is defined to have less than 165 g/km of CO2 and high CO2 group refers to cars equal or above 165 g/km.

In Figure 8, we show the number of imported cars over time for cars with and without evasion in groups that faced high versus low tax increases. Consistent with the descriptive analysis in Section 3, the number of cars on which taxes were not evaded is substantially larger than evading cars in both tax-change groups. At the time of the 2012 reform, marked with the darker vertical dashed line, we see that the number of cars with no tax evasion declined in the high CO2 emission group, for which tax rates increased, by about 6 percentage points on average. In sharp contrast, the number of imported used cars in the low-tax-increase group rose after 2012.

We examine more closely the changes in number of imported cars in different groups in Figure 9. The figure shows the changes in log numbers of cars imported in different groups, with all groups centered at zero in the half year prior to the reform in 2012 in order to make comparison across groups easier. The graph shows that car imports were increasing and following nearly parallel trends in all groups prior to the reform. The seasonal pattern is somewhat different between evaders and non-evaders, but not to a great extent.

At the time of the reform a significant gap appears among non-evaders between the high-tax-change and low-tax-change groups. The higher tax rate seems to have led to lower car imports in the non-evading group. Even with this closer examination we do not see any deviation in the low-tax-change group from previous trend. A smaller gap also appears between the two tax-change groups among evaders, but not as large or displaying a clearly different pattern from pre-trends as among non-evaders. Tax evaders seem to follow their pre-reform trend also in the year after the reform, before the 2013 tax enforcement reform kicks in. In sum, by examining all four groups, it seems that the reform reduced the number of imported cars in the high-tax-change group who did not

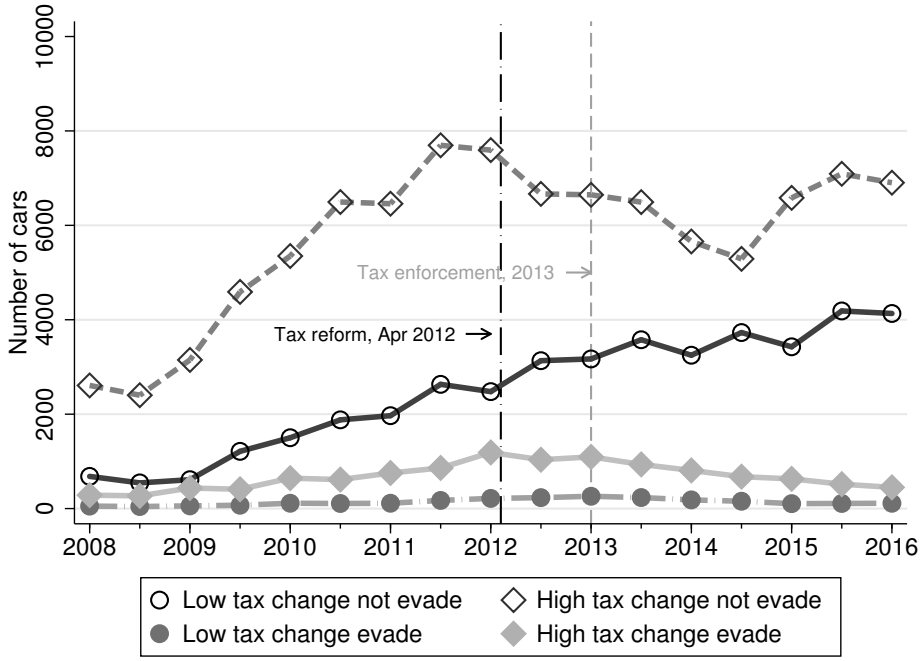

Figure 8: Number of imported used cars by missing-miles evasion and CO2 class

evade taxes.

To quantify this finding, we next estimate a differences-in-differences specification where we compare the groups before and after the reform presented in Figure 9. We estimate the following equation:

$$N_{gt} = \beta_0 + \beta_2 1(treat_g) + \beta_3 DD_{gt} + \mu_t + \beta_4 X_{gt} + \varepsilon_{gt} \tag{1}$$

where N_{gt} is the log of the number of cars imported in group g and half-year t. The variable DD_{gt} is an indicator term that is derived by interacting the variable $1(after_t)$, an indicator taking the value of 1 after the reform in April 2012 and 0 before it, and the variable $1(treat_g)$, an indicator taking the value of 1 if the group of cars belongs to the high tax change group and 0 otherwise. The value of β_3 is the coefficient of interest, measuring the effect of the tax reform on high-tax-change cars relative to low-tax-change cars. We include flexible time trends, indicated by μ_t in the equation. The variable X_{gt} is a control vector that includes a car make classification, 40 CO2 cells and eight car age cells as well as the group level average car weight. We estimate this equation separately for cars for which we infer that car import taxes have been evaded, and for cars for which we infer that taxes have not been evaded. The standard errors are clustered at group level, and together with clustering this reduces the problems arising from serial correlation.

Table 3 shows the results of estimating specification (1). The data are aggregated to these cells by the number of imported cars within each half year. Columns (1) and (2) are

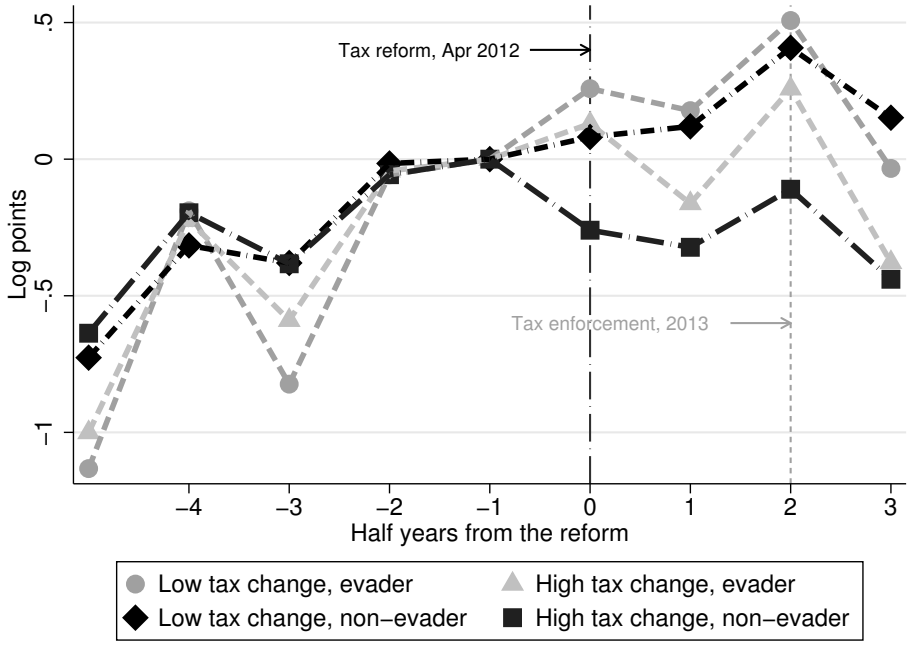

Figure 9: Relative change in the number of imported cars around the 2012 reform, by tax change and missing-miles evasion

for non-evaders, columns (3) and (4) for evaders and column (5) combines both groups and shows an interaction term with the effect of the tax reform. The results indicate that for non-evaders the reform led to a statistically significant reduction in the number of imported cars. Columns (3) and (4) show that, although the sign of the effect is negative among evaders, it is much smaller in absolute value and not statistically significantly different from zero. When we combine non-evaders and evaders in the same analysis in column (5), we see that the point estimate for the interaction term is positive, going in the opposite direction than the main effect of the reform, but is not statistically significant. The lack of statistical precision for evaders could arise due to their small numbers, or else reflect a small but imprecise effect. We conclude from this analysis that there is a relatively stronger and clearer effect of a higher tax rate reducing the importing of used cars for non-evaders than for evaders.

Column (6) in the table shows a car-level regression, where the outcome is a dummy variable for whether or not taxes had been evaded from the car. Otherwise, the estimation presented in this column follows the differences-in-differences setting where the tax reform creates two groups by the tax change status, but now the focus is on the impact of the tax reform on the likelihood of finding missing-miles evasion from an individual car imported as used. The result indicates that the likelihood of tax evasion slightly increased after the reform. This is consistent with the other results in the table and suggests again that the likelihood increased because less cars were imported without evasion after the reform than before the reform and relative to the cars with evasion.

Vars	(1) Non-evaders	(2) Non-evaders	(3) Evaders	(4) Evaders	(5) Interact	(6) Evasion
Data grouping	Make, 40 CO2 cells and 8 Age cells					Car
DD tax	-0.104***	-0.115***	-0.021	-0.014	-0.110***	0.013***
	(0.034)	(0.027)	(0.030)	(0.030)	(0.027)	(0.005)
DD tax * Evade					0.053	
					(0.064)	
Treat tax	0.148***	0.413***	0.184***	0.030	0.330***	-0.007
	(0.019)	(0.126)	(0.024)	(0.107)	(0.120)	(0.027)
Evade					-0.617***	
					(0.065)	
N of cells /cars	16,958	16,958	4,806	4,806	18,134	79,169
R^2	0.005	0.381	0.026	0.212	0.395	0.100
Controls	No	Yes	No	Yes	Yes	Yes

Table 3: The impact of tax increase on number of imported cars among evaders and non-evaders

Note: Table shows differences-in-differences results on data aggregated to number of cars in each sell imported during a half-year. Columns (1) and (2) are for non-evaders, columns (3) and (4) for evaders and column (5) shows an interaction term between evaders and non-evaders. In columns (2), (4) and (5) we include coarse make, CO2 and car age class dummies as well as weight of a car as controls. Column (6) presents car-level analysis on probability of tax evasion on a dependent variable taking value 1 when tax evasion is observed and 0 when tax evasion is not observed. *** p<0.01, ** p<0.05, * p<0.1.

The fact that adding fixed effects of car characteristics does not greatly change the results, evident for example by comparing columns (1) and (2) in the table, reduces the worry that the changes in the average numbers after the reform arise from compositional changes. Including the fixed effects renders the analysis to within cells of quite tightly specified make, age and CO2 groups of cars. Thus, the changes occur within groups that are similar on observational characteristics before and after the reform, and especially have similar predicted values because these characteristics are important predictors of the value of a car. In principle, there could be different kinds of individuals buying the cars but, given that the cars are similar, the compositional change of individuals is a less likely explanation for the result.

Another potential confounder to the validity of our DiD setting is that a general equilibrium effect coming through prices in the used car markets would bias the direct effect of the tax reform. To show some evidence on prices, Figure 15 in Appendix D plots the price indices for used and new cars in Finland to show that the 2012 tax reform did not induce any large changes in these prices as the indices do not show deviations from their own trend after the reform. Although this does not capture all the general equilibrium effects, we think it shows robustness against such effects.

In order to more precisely analyze the relationship between the tax rates, the number

of imported used cars, and tax evasion, we next estimate the elasticity of the number of imported used cars with respect to the tax price for different sub-samples. We calculate the tax price as one plus the car tax rates described in Table 2 above. Then, we calculate the logarithm of the number of used cars in cells defined by different classifications of cars. We base the elasticities on the following regression equation.

$$\triangle \log Ncar_{ct} = \alpha + \beta_1 \triangle \log(1 + MTR)_{ct} + \zeta_1 X + \epsilon_{ct}, \tag{2}$$

where the dependent variable is the difference in the log number of cars from the two years before the reform and two years after the reform in each cell, and the independent variable is the difference in the log tax price for the cars in that cell. Thus, we aggregate the data to before and after observations in order to reduce the problems associated with serial correlation of observations. The other covariates in control vector X are the CO2 dummies and dummies for car age. We calculate this for all used cars imported around the 2012 reform for which we observe the comparison mileage, and divide this into those for which we presume that import taxes have been evaded and those for which we observe that taxes have not been evaded. Note also that differencing the outcome already invokes car cell fixed effects, meaning that we examine the change in the tax rate of specific car type on imports of those cars, and do not include effects arising from changes into importing different types of cars.

Table 4 shows the estimates of the elasticity of the number of imported used cars with respect to the tax price. Columns (1) through (3) show a simple regression without control variables for which the cells over which the data is aggregated are based on 40 CO2 classes, eight car age classes and make of a car similarly as the regressions in Table 3. Columns (4) through (6) include as controls the make of a car and age class indicators as well as the average weight of a car within the cell. Columns (1) and (4) include all observed cars for which we have comparison mileage information around the 2012 reform, columns (2) and (5) include only cars for which we observe a trace of tax evasion, and columns (3) and (6) include only cars for which we do not observe any trace of tax evasion.

Strikingly, the estimated elasticity attracts a different sign for the tax-evasion and no-tax-evasion cars. Among the no-evasion cars, a lower tax-inclusive price (i.e., a lower tax rate) is associated with higher demand, as would normally be expected. The elasticity with respect to the tax price is estimated to be about -1.6, and is statistically significant in column (6). In contrast, and corroborating the intuition derived from Figure 8, demand for those cars for which we observe tax evasion does not respond to the changes in statutory tax rates in a statistically significant way, and the point estimates are even positive. This result is consistent with the idea that the possibility of evasion mitigates what would otherwise be the demand-reducing impact of a tax increase.

We also analyze the elasticity of tax evasion in monetary terms in Appendix D. After

VARS	(1) All	(2) Evasion	(3) No evasion	(4) All	(5) Evasion	(6) No evasion
Elasticity	-1.467***	0.354	-1.878***	-1.138**	0.395	-1.579***
	(0.554)	(0.557)	(0.595)	(0.568)	(0.673)	(0.607)
Constant	-0.044*	-0.015	-0.023	0.008	-0.056	0.194***
	(0.026)	(0.038)	(0.027)	(0.165)	(0.242)	(0.016)
N cells	2,464	585	2,263	2,464	585	15,917
N cars	18,647	1,634	16,275	18,647	1,634	16,275
R^2	0.005	0.000	0.007	0.056	0.073	0.041
Controls	No	No	No	Yes	Yes	Yes

Table 4: Elasticity of number of imported used cars with respect to the price plus tax

Note: Table shows the regression results on the number of imported used cars with respect to (1+car tax rate). We aggregate the data to 40 CO2 classes, eight car age classes and make of a car, and before and after observations. Columns (1) and (4) include all observed cars for which we have comparison mileage information around the 2012 reform, columns (2) and (5) include only cars for which we observe a trace of tax evasion, and columns (3) and (6) include only cars for which we do not observe any trace of tax evasion. Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

controlling for the extensive margin response of whether or not a car is imported with evasion, and other characteristics of a car, the elasticity of tax evasion in the intensive margin is statistically and economically zero, as shown in Appendix Table 10. Given the above result, this is an expected result. Table 10 also shows in column (7) that tax rates still affect the amount of taxes remitted with a small positive elasticity.

In sum, in this section we uncover evidence that higher car tax rates do not affect the number of cars imported with tax evasion, or the euro amount of tax evasion. In fact, the analysis shows that the amount of tax evasion is quite insensitive to variation in tax rates. In contrast, we showed that used car imports among non-evaders responds to tax rates. This was evident both in the differences-in-differences analysis utilizing dichotomous tax variation and in the elasticity analysis utilizing continuous tax variation. Thus, when examining the impacts of tax rates, it seems crucial to account for tax evasion as the results can be drastically different depending on possibilities for tax evasion.

4.2 The Impact of Enforcement on Missing-Miles Evasion

In this section we analyze the impact of the introduction of a new enforcement scheme under which mileage information was systematically collected from car inspections and compared to the reported tax filings by the Customs. This change in the enforcement regime took place beginning in 2013, a year in which there were no car tax base or rate changes.

Figure 10 depicts the number of imported used cars, dividing the data into two CO2

groups, but restricting the sample to those for which we observe our trace of missing-miles tax evasion. Recall that the car tax rate increased in 2012 for the high CO2 group by approximately 6 percentage points on average, while the tax increase was on average 1.5 percentage points for the low CO2 group. As shown before, we do not observe any break in the trend for evaders around the tax rate changes of 2012. What is clear, though, is a dramatic decline in estimated tax evasion in both tax-change groups starting in the latter half of 2013 that levels out only in the latter half of 2015. The clear break in the trend starts precisely at the same time that the Customs began to employ the new enforcement regime using third-party information from car inspections. We surmise that car importers learned about this new regime gradually over time and, as they become aware of it, many concluded that the chance of getting caught with missing miles had non-trivially increased and now made tax evasion an unattractive gamble.

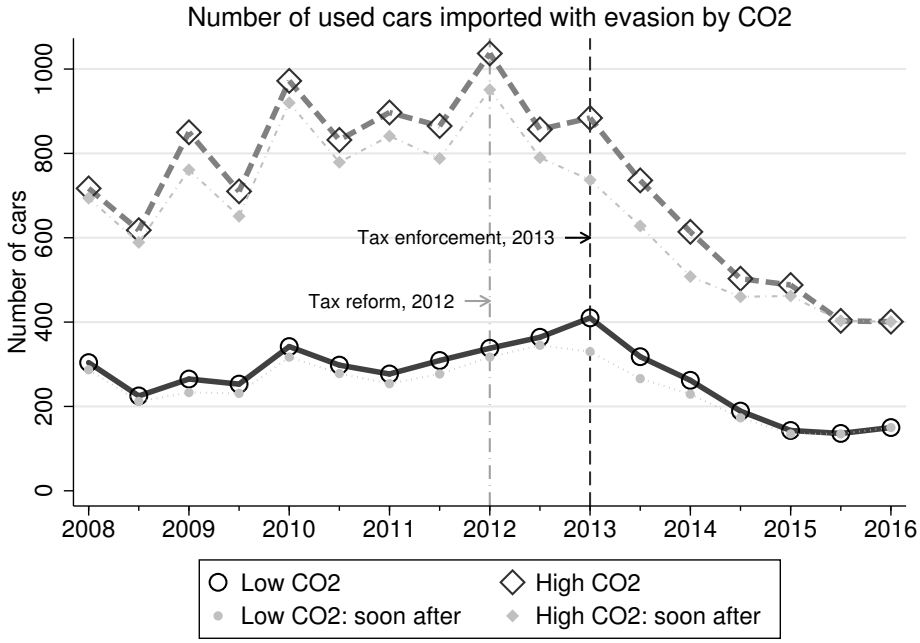

Figure 10: Trends among imported used cars with observed evasion, divided into high and low CO2 groups

To summarize, we find evidence of an intriguing, previously unexplored behavioral mechanism. The results in Section 4.1 suggest that while non-evaders respond to the tax rate increases by decreasing the number of imported used cars, evaders do not respond nearly as strongly to tax rate changes. This section shows that stricter enforcement measure seem to reduce the amount of tax evasion through reducing the number of imported used cars from which taxes have been evaded. Therefore, the real margin responses (number of imported cars) and evasion responses (missing miles) depend on different but related factors in a coherent way. To learn more about the effects of enforcement on tax evasion, the next section provides evidence from an RCT in which we varied salient

details about the use of third-party information in tax collection.

4.3 An RCT Analysis of Enforcement Policy

To examine more closely the role of enforcement on missing miles and more generally to provide causal evidence of the effect of tax enforcement on tax evasion, we next present the results of a randomized controlled trial (RCT) in this section. In August 2014, in association with the Finnish Customs authority, we initiated an RCT to assess the efficacy of different enforcement efforts stated in information letters. Customs sent out letters to randomly chosen groups among a set of likely future importers of cars, providing different information about different enforcement measures to randomized groups.

The target population for the experiment was individuals (not firms) who were judged to be likely to import a used vehicle to Finland in the near future. Because the population considering importing a vehicle is not directly observable, the experiment targeted those who had imported a car in the recent past, up to three and half years prior to the experiment (January 2011 - February 2014). In the data, about 40% of individuals who bring at least one used car to Finland subsequently import another car within four years' time.

The letters were sent to recipients who were randomly chosen from this baseline population, and therefore any results are based on comparison of whether or not receiving a letter or comparisons of the effects among different letter groups. In principle, the treatments could affect either the intensive margin of tax evasion conditional on importing a car and the extensive margin decision of whether or not to import a car, and we analyze both margins below.

There were four different letters: a baseline (control/neutral) letter and three main treatment letters, comprising about 5,000 letters in each group, for a total of about 20,000 letters.[15] The results of the RCT must be interpreted in the context described in Figure 10 that showed that tax evasion in 2014 had significantly declined from previous years. It is highly likely that at least some of the previous tax evaders already were aware of the new enforcement measures, the salience of which the RCT attempts to increase.[16]

The first treatment is a control letter, included to gauge how receiving an anodyne informational letter from the Customs affects potential car importers. This letter explains how imported used vehicles are taxed and the consequences of non-compliance in general terms.

The second treatment is designed to test the impact of the public disclosure of information. The letter informs potential car importers that the Customs authority operates

[15]The letter wording is provided in Appendix E.

[16]Figure 20 in the Appendix E shows power calculations for the RCT by plotting the relationship of sample size and alternative mean for the probability of car tax evasion and mileage difference between car tax declaration and inspection.

a website where anyone can search for information about vehicles imported to Finland in the past. By entering the vehicle identifying number (serial number), the user can learn the mileage reported upon import and other characteristics about the car. The letter specifies that the site can be used as a tool to approximate the (taxable) value of used cars. In principle, if the mileage of the car upon import was significantly larger than its current odometer reading, this suspicious mileage history could reduce the perceived value of the car. The letter also mentions that the web service will likely be improved in the future to make it even more informative about imported used vehicles.

We hypothesize that receiving this information reduces the willingness of an individual to over-report the mileage of a car upon import while possibly planning to later deflate the odometer reading for resale. The chances of getting away with this behavior are reduced under public disclosure because the reported mileage upon import is publicly available information and could be compared with the mileage reported when the car is later put up for sale – e.g., adding 100,000 kilometers upon import that later disappears looks suspicious to a potential buyer. Once it is clear that successful evasion is less likely, we expect to see less inflation of mileage upon import.

The third treatment letter indicates that Customs will check the information provided by a car importer against other administrative information, such as the mileage of the vehicle recorded in the regular car inspection. The letter specifies that car tax declarations where the reported mileage is at least 10% higher than the comparison mileage will be audited. This is a probability notch design, where the notch is relative to the actual mileage.[17] This information may or may not be available to the general public, but the most important message imparted is that it is available to Customs for enforcing the car tax. The information is provided to the Customs by the Finnish Transport Safety Agency. This cross-check presumably increases the probability of getting caught from tax evasion, and in theory this would reduce the willingness to over-report the mileage. As noted above, the effectiveness of this treatment letter depends on the extent to which the information is new for prospective importers, and it might have not been new information for all importers.

The fourth treatment combines the second and third treatments by including in the same letter statements about the public disclosure system and the existence of the third-party information. This treatment is included to learn about the combined effect of the probability of detection and the effect of the public disclosure system on the future value of the car.

All the letters specify that the time period to which the treatments apply is one year from the time of receipt (from August 2014 to July 2015). This is the time period for which the Finnish Customs committed to examine the differences in reported and

[17] Our analysis of the data does not show any evidence of bunching at this 10% threshold either before or after the treatment in different groups.

Letter group	**Pre-reform**			**Post-reform**		
P (Δkm<-5000)	mean	s.e. mean	N	mean	s.e. mean	N
0	.100	.003	13181	.093	.008	1450
1	.103	.004	5374	.076	.011	620
2	.108	.004	5409	.106	.012	631
3	.096	.004	5333	.067	.011	564
4	.099	.004	5401	.068	.010	601
Δkm |	**Pre-reform**			**Post-reform**		
Δkm<-5000	mean	s.e. mean	N	mean	s.e. mean	N
0	-69634	1566	1321	-59508	4441	135
1	-64414	2339	553	-72445	10703	47
2	-69646	2433	583	-54171	6670	67
3	-72007	2598	513	-48644	7976	38
4	-70805	2640	532	-51997	6960	41

Table 5: Pre- and post-reform differences in reported and inspected mileage and probability of this difference exceeding 5,000 kilometers by cars in treatment groups

Note: Table shows the balancing statistics of difference in kilometer between reported kilometers in tax filing and comparison information and the probability of tax evasion – larger than 5,000 kilometer misreporting – before the RCT by treatment group.

inspected mileages of imported used cars for these treatment groups. The effects of different letters can be disentangled by their potential differential impact on the car tax mileage statements. Table 5 provides some statistics on the balance across the groups to check that the randomization was successful and to help interpret the estimates. Table 5 shows the average share of the cars with mileage differences that exceed 5,000 kilometers and the average pre-treatment mileage differences for those that have evaded. The table shows that the probability of having more than a 5,000 kilometers negative difference (missing miles) per imported car is approximately 10% across the groups. The mileage difference between the import report and comparison inspection information hovers between 64,000 and 72,000 kilometers across groups for evaders. The groups seem to be well-balanced according to both statistics.[18] Finally, there are around 5,400 imported used cars for which we observe the mileage comparison information before the treatment in each letter group.

We use a standard difference-in-difference strategy to estimate the effects of different information treatments. The main outcomes are mileage difference in the imported cars and the number of cars each person imports. The latter analyses captures the extensive margin responses, that is, if some individuals no longer importing a used car after receiving one of the letters. We compare different randomized groups before and after the

[18]Table 13 in Appendix F shows the balancing test results comparing treatment groups to the control group for the difference in reported and inspected mileage in kilometers, the likelihood of misreporting more than 5,000 kilometers and the number of days between reported mileage and car inspection. The table shows that the groups are statistically very similar before treatment period.

treatment. We estimate the following DD regression:

$$Y_{it} = \beta_0 + \beta_1 1(after_t) + \beta_2 1(treat_i) + \beta_3 DD_{it} + \beta_4 X_{it} + \varepsilon_{it} \quad (3)$$

where Y is the outcome variable, either $(R-C)_{it}$, the mileage difference of used imported cars between the reported mileage R and comparison information from car inspections C for cars i in time t, or N_{it}, the number of imported used cars per person i within a time-period t. The variable $1(after_t)$ takes the value of 1 after the treatment letter were sent out and 0 otherwise, $1(treat_i)$ is an indicator taking the value of 1 for individuals that received one of the letters and 0 for the control group, and DD_{it} is the interaction variable of the latter two terms. The coefficient β_3 identifies the average change in an outcome in the treatment group relative to the control group before and after the treatment. In order to offer more precise estimates, we include a vector of control variables X_{it} in the model that includes the time lapse between the reported mileage upon import and the car inspection information in days, the CO2 emission level of an imported cars and five-year car age cluster dummies for imported cars. We estimate using a difference-in-differences method the effects of the treatments on the extent to which reported mileage upon subsequent import differs from the lowest mileage upon inspection and on the number of cars imported to Finland.

The results of the regression analyses with the mileage outcome difference are shown in Table 6. A positive estimated coefficient on the DD variable indicates that mileage reported upon import has been decreased in the treatment group relative to the control group after receiving the treatment, and thus that tax evasion has been reduced due to the treatment.

Column (1) shows the estimated overall treatment effect of receiving any one of the treatment letters (letters number 2, 3 or 4) against receiving letter 1 (the neutral letter). The DD coefficient indicates that the reported mileage upon import decreases by about 3,100 kilometers against inspection mileage, and the coefficient is statistically significant at the 5% level. Column (2) compares letters 2, 3 and 4 against receiving no letter, and columns (3) to (6) repeats the exercise, but comparing individual letters against the no-letter group each in separate regressions. Column (7) combines those receiving letters 3 or 4 and compares them against the group receiving no letter, and column (8) compares these against those either receiving no letter or receiving the neutral letter 1.

The individual letter treatments are not alone very robustly statistically significant in columns (3) through (5), perhaps in part due to the relatively low number of observations. When we compare letter 4 to the no-letter group, we estimate a positive and statistically significant estimate of almost 3,000 no-longer-missing kilometers. Also, combining letters 3 and 4 tends to produce a statistically significant estimate of reducing tax evasion in the form of missing mileage. This evidence suggests that offering information about the

availability of third-party information decreases the misreporting of individuals. These effects are non-trivial, as the pre-treatment mean difference is approximately 8,500 kilometers. Therefore, the results suggest an approximately 35% decrease in misreported mileage.[19]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARS	L1v2,3,4	L0v2,3,4	L0v1	L0v2	L0v3	L0v4	L0v3,4	L01v3,4
DD	3,101**	2,026*	-1,203	1,396	1,831	2,922**	2,388**	2,731***
	(1,582)	(1,050)	(1,657)	(1,462)	(1,412)	(1,274)	(1,114)	(1,040)
Const.	7,650***	5,671***	6,036**	4,012	7,223***	3,968	6,242***	6,992***
	(2,272)	(1,998)	(2,424)	(2,644)	(2,433)	(2,434)	(2,108)	(1,867)
N	23,636	32,181	20,397	20,427	20,301	20,395	26,225	32,151
R^2	0.251	0.257	0.255	0.270	0.257	0.252	0.250	0.248

Table 6: The effect of RCT on missing mileage

Note: Table shows the regression results on the mileage difference reported between car tax declaration and inspection. Column (1) shows the effect of receiving any one of the treatment letters (letters number 2, 3 or 4) compared to receiving letter 1 (the neutral letter). Column (2) compares letters 2, 3 and 4 against receiving no letter, and columns (3) to (6) compare individual letters 1, 2, 3 and 4 against the no-letter group, respectively. Column (7) compares groups receiving letters 3 and 4 against the group receiving no letter, and finally, column (8) compares groups receiving 3 and 4 letters against those receiving no letter or receiving the neutral letter 1. Heteroscedasticity consistent standard errors are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

We next repeat these regression analyses, but replace the outcome as an indicator for having a negative difference in excess of 5,000 kilometers between the car tax filing and the lowest subsequent inspection observation. Table 12 in Appendix F presents the results of this exercise. An estimated negative coefficient is consistent with a treatment restraining missing-miles tax evasion. The columns are organized in the same order as in Table 6. We find some weak evidence of a statistically significant decline in tax evasion in response to receiving a tax enforcement letter making tax evasion less attractive.

Finally, we turn to an analysis of how the letter treatments affected the number of cars imported, in order to assess whether or not the knowledge of expanded enforcement of evasion made importing less attractive. In principle, the expanded enforcement could not only affect evasion but also the "real" decision of whether or not to import a car: some marginal importers might import a used car only if the tax liability could be reduced by evading. The extensive margin here is important, because that could bias the previously presented mileage results, if a different number of cars were imported in different groups

[19]Table 11 in the Appendix E shows the regression estimates for the same analysis as presented in Table 6, but narrowing the number of days between tax filing and inspection to under 31 days. These results are very similar to those presented in Table 6, diminishing the concern that our baseline definition of observing comparison mileage information "soon after" tax filing – four months difference between tax filing and inspection – would affect the results.

as a response to the letters. We calculate the number of cars imported per person before the experiment, either by quarter or throughout the entire before and after periods. The before period is defined to be from January, 2012 to June, 2014, and the after period is from July, 2014 to September, 2015.

We first present the time trends of the number of car imports in the different treatment groups in Figure 11. The upper panel of the figure shows the number of cars imported per person and per quarter (conditional on having imported), reflecting intensive margin responses. The lower panel shows the probability of importing at least one car per person and per quarter, including the extensive margin decision (whether or not to import). Neither panel shows an obvious effect. The intensive margin response shows some decline in some of the letter groups, especially in the letter 2 group compared to the control groups, but the differences are not systematic across groups or over time, and neither they are statistically precise. The extensive margin response declines in all groups at the start of the treatment (i.e., at time zero), because the baseline population was selected based on having imported a car prior to the treatment (explained in detail above). However, there are no discernible differences in whether or not to import a car between the randomized groups even after the treatment.

To quantify these responses, we perform regressions with individual-level fixed effects using again a DD estimation strategy and calculating robust standard errors throughout. Table 7 shows the DD results for the number of cars imported (the intensive margin response) by person and counting together all used cars that have been imported before and after the treatment. Column (1) reports the estimated effect of receiving letters 2, 3 or 4 against receiving letter 1 (the neutral letter). Columns (2) to (4) compare the control letter against other letters individually. Columns (5) to (7) compare letters 2, 3 and 4 against receiving no letter in individual specifications. None of the point estimates is statistically significantly different from zero. The point estimates across different specifications are not statistically significant and are both negative or positive, indicating that the treatments did not change the number of used cars imported. Expanded enforcement apparently reduced evasion without affecting in a detectable way the volume of used car imports. This result helps to explain that the effects on mileage reported above did not arise due to extensive margin responses rather than reducing the overreporting within the cars that would have been imported regardless of the treatment.

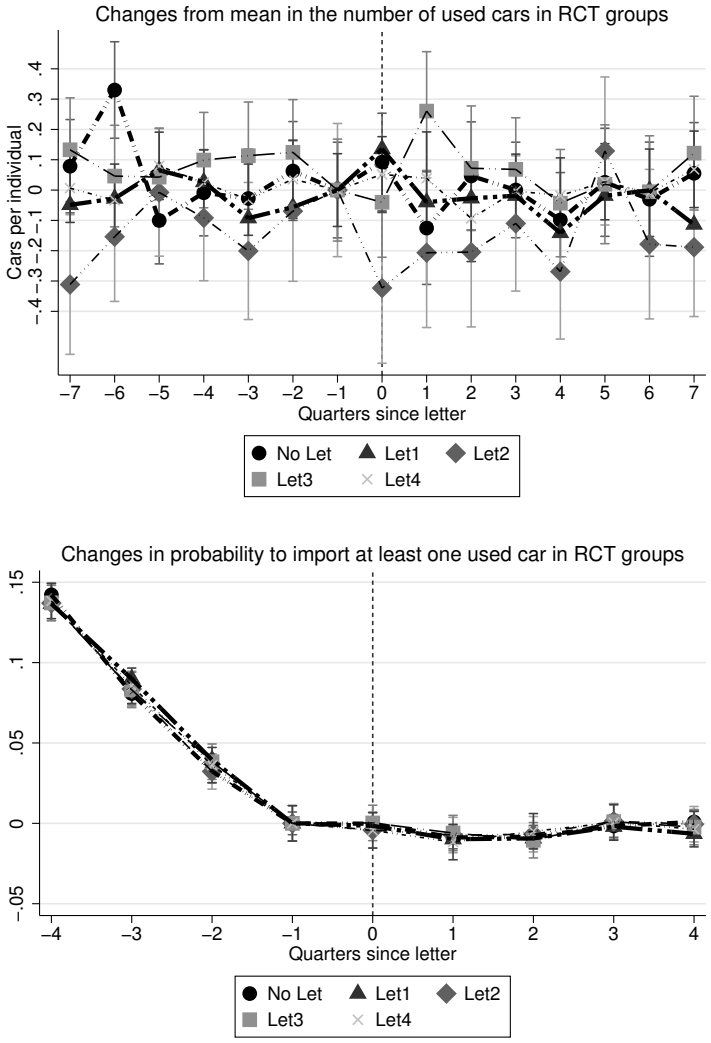

Figure 11: Time trends in the upper panel of changes in number of used cars imported per person and in the lower panel of the probability of importing at least one car

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARS	L1v2,3,4	L1v2	L1v3	L1v4	L0v2	L0v3	L0v4
Diff-in-Diff	-0.358	-0.098	-0.032	0.030	-0.103	-0.047	0.011
	(0.269)	(0.083)	(0.041)	(0.036)	(0.078)	(0.042)	(0.036)
Constant	1.687***	1.346***	1.174***	1.142***	1.325***	1.230***	1.210***
	(0.112)	(0.088)	(0.046)	(0.047)	(0.063)	(0.044)	(0.046)
N	17,434	9,308	9,204	9,330	15,999	15,895	16,021
R^2	0.026	0.029	0.042	0.029	0.018	0.017	0.014
N of indiv.	14,358	7,540	7,537	7,565	12,996	12,993	13,021

Table 7: The effect of RCT letters on the number of imported cars

Note: Table shows the difference-in-difference estimates on the number of imported used cars. Column (1) shows the effect of receiving any one of the treatment letters (letters number 2, 3 or 4) compared to receiving letter 1 (the neutral letter). Columns (2)–(4) compare letters 2, 3 and 4 against receiving letter 1, respectively. Columns (5)–(7) compare letters 2, 3 and 4 against receiving no letter, respectively. Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In sum, the RCT results suggest that offering information about the usage of third-party information in the tax enforcement can reduce the misreporting of individuals. The letters created responses only for treatments that included information about the usage of third-party information, while the treatment providing information about the public disclosure of information did not decrease the amount of tax evasion. However, offering salient information about the usage of third-party information in tax collection or public disclosure information seemed not to have any effects on the number of cars imported.

5 Conclusions

This paper studies the importing behavior of used cars to Finland. We focus on tax evasion responses to the tax system relying on a unique trace of tax evasion based on comparing the mileage reported upon import, which affects the car tax liability, with the mileage recorded in annual and mandatory car inspections. Observing that the mileage of a car *is lower* in inspections about at the same time as the mileage is reported in car tax declaration is a strong indicator of tax evasion.

Our results show that missing-miles tax evasion is a fairly common phenomenon in Finland, detected in approximately 10% of imported cars. This kind of tax evasion is relatively more common among imports of cars that face higher car tax rates, suggesting a positive correlation between tax rates and tax evasion. However, when we use the variation in tax rates created by the tax reform of 2012, we observe that the tax rates have a relatively strong effect visible as a clear deviation from pre-reform trends on used car imports among non-evaders. For evaders the same variation in car tax rates has a much smaller and not statistically significant effect. Thus, the natural experiment evidence creating exogenous variation in tax rates suggest real responses for non-evading car importers but not for the extent of tax evasion.

We offer descriptive evidence that a stricter enforcement regime reduced tax evasion. To provide more compelling evidence of the causal effect of the enforcement regime, we study the results from an RCT design that shows that offering salient information about more effective tax enforcement initiatives enhances the efficiency of tax collection. Increasing the salience of the use of third-party information on mileage to detect evasion in the RCT reduced the mileage reported upon import, while not affecting the number of imported used cars. However, offering information about the public disclosure of mileage reported did not change the reporting behavior of car importers.

Our results produce rich detail about the interaction between tax evasion and real behavior. We find that only non-evaders respond to the tax rate changes by decreasing the number of imported used cars after the tax increase, while evaders do not: the statutory rates matter less to those planning to evade their burden. We also find a clear reduction in tax evasion due to the improvements in enforcement practices and

after offering information about them. These results together show that the real margin responses (the number of imported cars) and the evasion responses (missing miles) depend on different factors. These results suggest that, in this setting, different remedies should be targeted to the different policy concerns: enforcement improvements and information about them to tackle tax evasion, and tax rate adjustments to affect real behavior.

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A Appendix: Estimating the Tax Value of Mileage

We employ a linear relationship between car taxes and mileage in the analysis, conditional on car make, age and CO2 value. The rationale for this assumption is that as far as we know, Customs uses a linear predictor in mileage in determining the taxable value of car. Figure 12 shows a binscatter between car tax residuals from regression, where car taxes are estimated against car make, model, car age cells and CO2 cells, and mileage. Although the linear assumption fails slightly in the tail ends, overall the assumption is supported relatively well by the figure.

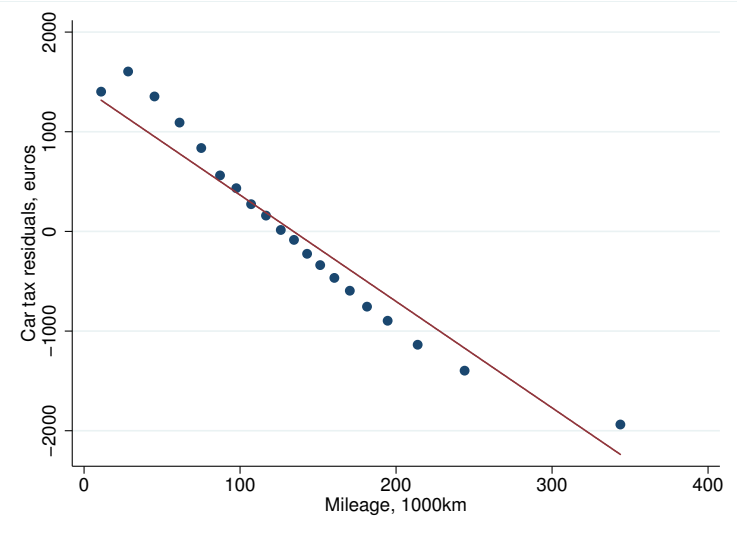

Figure 12: Binscatter between car tax residuals and mileage

In this appendix, we discuss the regressions in Section 3.1 that are used to draw Figure 13. Separately for each CO2 quintile, an estimation is first made that explains the amount of car taxes actually remitted. We use a specification that explains through covariates the taxable value of a car, and which is likely to be very similar to what the Customs actually uses when calculating the taxable value of a car. One of the covariates is the reported mileage, which is the coefficient we use for calculating the euro value of missing miles. The other important covariates are a vector of 100 dummies for CO2 values, the age of the imported used car in years at the time of importing and fixed effects for the make of the car. The equation to be estimated takes the following form.

$$Tax_c = \alpha + \beta_1 mileage_c + \beta_2 CO2_c + \beta_3 CarAge_c + \mu_c + \epsilon_c$$

The coefficient β_1 explains the contribution of mileage to the euro amount of car tax liability. We then take this coefficient for each car and multiply that coefficient by the absolute value of miles estimated to be inflated in the car tax report, i.e. the difference between reported mileage and the lowest inspection mileage at the time of importing the

car or later. The result of the multiplication is informative of the euro amount of tax evasion for each car. The figures are drawn from the CO2 quintile averages.

VARS	(1)	(2)	(3)	(4)	(5)	(6)
	All	Q1	Q2	Q3	Q4	Q5
km	-5.411***	-3.915***	-3.814***	-4.102***	-5.601***	-7.141***
	(0.630)	(1.053)	(1.247)	(1.118)	(1.360)	(1.248)
$CO2$	29.739***	-2.479	-445.265***	-1,339.565***	1,073.463***	-147.086***
	(4.155)	(3.556)	(140.191)	(195.900)	(125.515)	(33.119)
$CO2^2$	-0.027**	0.124***	1.365***	3.591***	-2.432***	0.301***
	(0.011)	(0.015)	(0.416)	(0.518)	(0.294)	(0.062)
T btw. info	-18.971***	-13.671***	-17.553***	-23.201***	-16.692***	-27.623***
	(0.570)	(0.634)	(0.724)	(0.835)	(0.962)	(2.208)
Constant	3,375***	2,505***	43,363***	133,952***	-107,324***	29,462***
	(474.604)	(295.447)	(11,782.686)	(18,525.852)	(13,375.176)	(4,474.997)
N	186,322	35,202	38,318	38,092	36,881	37,829
R^2	0.320	0.516	0.507	0.512	0.436	0.235

Table 8: Estimates for the relationship between mileage and car taxes with other covariates
Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In Table 8 the outcome is car taxes remitted on a car, in euros. The main explanatory variable is mileage on a car in 1,000 kilometers. Other covariates include the CO2 value, linearly and in cubic form, the time between importing and observing the mileage in months, car age dummies at the time of importing and make fixed effects. Column (1) is for all cars in the sample, column (2) for cars in the first CO2 quintile, column (3) for cars in the second CO2 quintile, and so forth. The estimated negative coefficient of -5.4 in column (1) indicates that 1,000 kilometers more reduce car taxes by 5.4 euros for an average car. The result is that, across CO2 quintiles, higher CO2 values are associated with larger coefficients of mileage in absolute value. This relationship that average taxes reduce more with higher mileage arises from car tax rates increasing with CO2 values. Also, cars that have higher CO2 values tend to be more expensive, making the taxable value larger.

B The Aggregate Amount of Missing-Miles Tax Evasion

To shed further light on the extent of the missing-miles phenomenon, we approximate the amount of tax evasion in euros. To perform this calculation, we first estimate a regression of actual car tax liability against the reported mileage for each CO2 quintile separately. The amount of car taxes of each car is regressed against the reported mileage, denoted *mileage*. The regression includes also other covariates, X, to be able to fully explain the determination of car taxes. These other covariates include CO2 values linearly and in cubic form (which is quite flexible given that we already estimate this separately for five different CO2 bins), fixed effects for the make of a car, μ_c, and eight dummies for the age of the car in years when the car was imported to Finland. The regression equation is estimated separately for each CO2 quintile as follows.

$$Tax_c = \alpha + \beta_1 mileage_c + \beta_2 X_c + \mu_c + \epsilon_c \tag{4}$$

The results of this regression are shown in Appendix A in Table 8. In summary, the results confirm that higher mileage is associated with lower car taxes on average: 1,000 more reported kilometers reduce the car taxes on average by about 5.4 euros. The relationship increases in absolute value with CO2 classes. In order to estimate the amount of uncollected tax, we add to the predicted car taxes a number of missing miles multiplied by the coefficient from the regression estimate of to what extent higher reported mileage reduces car tax liability. To calculate evasion, we used only those cases where the "missing miles" exceeded 5,000 kilometers. For example, consider a car that, based on the reported values, is estimated to have remitted 3,000 euros in car taxes. However, for that car we observe 100,000 kilometers missing from the car tax report. The example car is in the second highest CO2 quintile, for which an additional 1,000 reported kilometers reduces the car tax liability by an average of 5.6 euros. Thus, in this case we add 560 euros to the 3,000 euros to get to the true tax liability for this car, 3,560 euros.

Using the framework explained above, we can calculate the expected tax liability, the estimated tax evasion, and the estimated true tax liability for all cars. We then aggregate the data across the CO2 quintiles to come up with average taxes paid and average car tax evasion by CO2 quintile. We draw Figure 13 from these averages. The 95% confidence interval is based on the standard error for the mean.

Figure 13 shows, for each quintile, the average taxes from an average car imported, from a car imported that has been detected having tax evasion and what these taxes would on average be when the amount of tax evasion is added to the reported taxes. The figure suggests that missing miles tax evasion leads to a significant reduction of car tax collections in all CO2 quintiles. The tax evasion is more pronounced in the higher

quintiles, likely because in higher quintiles more taxes are being evaded and because a given amount of overstated miles contributes more to the tax bill in the higher quintiles. However, tax evasion is statistically and economically significant in all quintiles.

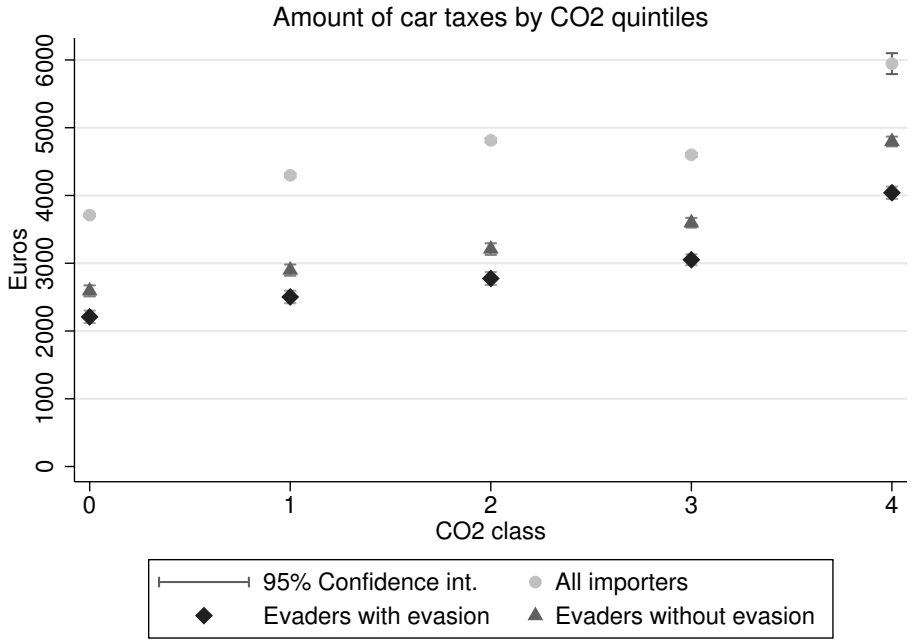

Figure 13: Euro amount of car taxes by CO2 quintiles with controls

We show the aggregate statistics of these tax evasion estimates in Table 9. Columns (1) to (3) show average numbers in euros, and columns (4) to (6) show aggregate numbers in thousands of euros. Column (1) shows the average car tax remitted by all used car importers, and column (2) shows the tax remitted by those who have been detected of evading. Column (3) shows the average amount of tax evasion estimated by the method described above. Column (4) shows the aggregate car tax remitted by all importers, and column (5) the aggregate tax remitted by the importers that have been detected of evading. Column (6) shows the aggregate amount of tax evasion. The first five rows refer to CO2 quintiles, and the last row shows the sum over all cars in the column.

CO2cl	Tax All (1)	Tax owed by evader (2)	Estimated evasion (3)	Total tax owed by all (4)	Total tax owed by evader (5)	Total estimated evasion (6)
1	3710	2209	383	150756	4128	717
2	4298	2503	396	177370	5601	886
3	4814	2775	434	196355	8673	1356
4	4601	3052	547	182262	11664	2089
5	5946	4041	756	245380	20033	3749
Total	23369	14580	2516	952123	50099	8797

Table 9: Descriptive statistics of estimated tax evasion in euros

Table 9 shows, that of the total amount of taxes of approximately 952 million euros over the eight-year inspection horizon (column (4)), we estimate that evasion totalled 8.8 million euros (column (6)). Furthermore, the evaders remitted as an aggregate only 50 million euros (column (5)), and thus evaded about 15% of the tax revenue they should have remitted. We believe that this tax evasion measure is probably a lower bound of true tax evasion due to, for example, incomplete detection of "inflated" mileage in the car tax reports.

C Appendix: The Likelihood of Evading

Next, we present evidence on the likelihood of importing cars and evading car taxes around the 2012 reform for the low and high CO2 emission groups. This is based on regressions of half-year indicators on the dummy of whether or not the reported mileage was 5,000 kilometers higher than the comparison information separately for the two groups separately. The equation to be estimated is as follows:

$$D(diffkm > 5000)_{ct} = \alpha + \sum_{t=1}^{8} \beta_t Halfyear_t + \zeta_1 CO2_c + \zeta_2 Obsmileage_{ct} + \epsilon_{ct}. \quad (5)$$

In equation (5), the outcome is the dummy for having a discrepancy of more than 5,000 kilometers. This is regressed against 8 indicators for $Halfyear$, $CO2$ value and the time difference between the import and the inspection ($Obsmileage$) of a car c in half year t. The variable ϵ_{ct} is the residual error term. In the figure the two lines are centered at zero in period -2, and the lines represent deviations from the trend around this point.

Figure 14 shows the coefficients of interest,β_i. It is clear from the figure that the trends in the two groups follow each other fairly closely prior to the reform, but as soon as the reform happens (i.e., starting in April 2012) the likelihood of import tax evasion jumps up for the high CO2 emission group by about 4 percentage points, with no estimated increase for the low CO2 emission group. The estimated likelihood of evasion stays on a higher level for two years after the reform for the high CO2 group relative to the low CO2 group. The figure establishes that the two groups can be meaningfully compared, and that tax rates seem to increase the extent of tax evasion quite significantly.

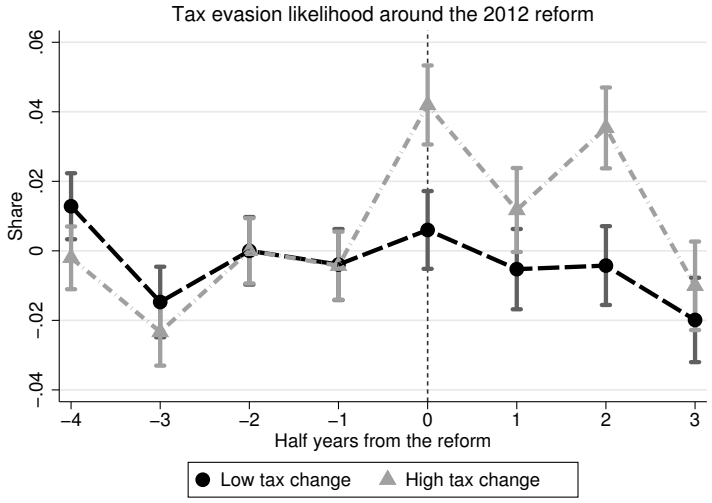

Figure 14: Likelihood of tax evasion around the 2012 reform

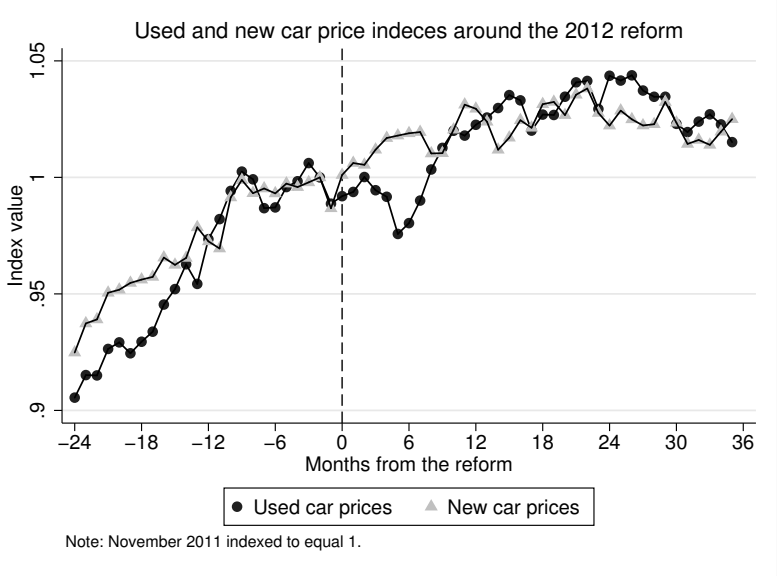

Figure 15: Price index values for new and used cars around the 2012 reform

Note: Figure shows the price indexes for used and new cars around the 2012 reform relative to November 2011.

D Appendix: Elasticity Calculations

In this Appendix we show that used car prices in Finland developed smoothly around the 2012 reform and quantify the value of tax evasion and import response to tax rates in monetary terms.

Figure 15 shows the new and used car price indices in the Finnish car markets around the 2012 reform that increased car taxes on average for imported cars. The indices show that although the indices do not develop completely smoothly, they do not seem to respond to the reform, and instead continue on the same trend as before the reform. This serves as a robustness check of the general equilibrium effects on the imported used cars.

Next, we calculate the estimated amount of tax revenue lost due to missing miles utilizing the same framework that was described in Figure 14 and Table 10. The estimated euro amount of tax evasion is the outcome of a regression that is estimated as follows:

$$\log Evasion_{ct} = \alpha + \beta_1 \log(1 + MTR)_{ct} + \zeta_1 X + \epsilon_{ct} \tag{6}$$

In equation (6) the outcome ($\log Evasion_{ct}$) is the log of the euro amount of estimated evasion, and the explanatory variables are the log of the tax price (one plus the car tax rate) and a vector of covariates for car c observed at half year t. The variable ϵ_{ct} is the residual error term. The covariates used include fixed effects for the make of a car, dummies for the age of the car at the time of import, dummies for CO2 emissions and dummies for the weight of a car in 20 bins. The data is restricted to the six years around the 2012 reform by the year of import.

One feature in this setting is that observed tax evasion is a combination of the continuous choice of how much tax to evade, and whether or not to import a used car and possibly evade taxes. In an attempt to control for the importing behavior, we impose a two-stage structure, where we first estimate a differences-in-differences model in which the outcome is the number of imported used car in cells defined by make, CO2 and car age dummies as well as tax evasion dummy. Apart from the outcome variable, the model specification is the same as in Table 10. We then predict how the tax reform affected the extensive margin choices of what kind of cars are being imported and use this as an additional covariate in the elasticity estimation. If the tax rate variable has a statistically significant coefficient even after controlling for this extensive margin behavior, then the intensive margin evasion depends on tax rates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARS	Evasion	Evasion	1^{st} stage	Evasion	Evasion	Taxes	Taxes
Elasticity	3.108***	1.174**		2.427***	-0.107	1.235***	0.265***
	(0.369)	(0.594)		(0.367)	(0.589)	(0.075)	(0.041)
DD			-0.207***				
			(0.014)				
Pred N ev.				-0.286***	-1.998***	0.231***	-0.207***
				(0.020)	(0.304)	(0.005)	(0.027)
High CO2	0.279***	0.113	-0.206***	0.282***	-0.655***	0.154***	0.300***
	(0.040)	(0.244)	(0.075)	(0.039)	(0.248)	(0.008)	(0.052)
After	-2.871***	-2.058***	-0.318***	-2.910***	-3.338***	0.175***	0.234***
	(0.030)	(0.079)	(0.029)	(0.030)	(0.207)	(0.006)	(0.019)
Constant	3.595***	3.657***	-0.060	4.270***	3.104***	7.230***	7.712***
	(0.069)	(0.384)	(0.144)	(0.083)	(0.390)	(0.021)	(0.101)
N	23,010	23,010	97,230	23,010	23,010	94,053	94,053
R^2	0.293	0.355	0.308	0.300	0.371	0.093	0.814
Controls		X	X		X		X

Table 10: Estimates of elasticity of tax evasion and taxes in euros with respect to the tax price (one plus the car tax rate)
Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10 presents the estimates of the elasticity of the euro value of tax evasion with respect to the tax price. The outcome variable in columns (1) through (5) is the log of the euro value of evasion and in columns (6) and (7) the log of the euro value of car taxes added with the estimated evasion. Columns (1) and (2) present a regression without controlling for the extensive margin behavior. Column (1) presents a simple regression with only the variables visible in the table: the log of tax price, a dummy for high CO2 group, a dummy for after the reform, and a constant. The estimated elasticity is quite high in column (1), 3.11, indicating that higher tax rates lead to significantly more tax evasion from an average imported used car. Column (2) repeats this exercise and adds the

extensive vector of controls described above. The controls reduce the estimated coefficient to 1.17, but it remains highly statistically significant.

This first-stage estimate for how tax rate affects the kind of cars imported is presented in column (3). We then use the prediction from this regression to control for the effect of tax reform on what kind of cars are being imported. Inclusion of this control variable in column (4) produces a somewhat smaller elasticity estimate compared to that in column (1). When we add a full vector of control variables in column (5), the elasticity estimate is no longer statistically different from zero, and the point estimate is close to zero, -0.11. This suggests that the elasticity of tax evasion with respect to the tax price occurs primarily along the extensive margin (whether or not to evade), because controlling for the extensive margin behavior eliminates both the economical and statistical significance of the elasticity estimate (with other controls).

Finally, columns (6) and (7) show the elasticity with respect to the tax price of the true car taxes: the reported car taxes added with the evasion. Column (6) is a sparse specification, and column (7) shows a specification with a full set of controls. The estimated elasticities are 1.23 and 0.27, respectively. These estimates indicate that increasing the tax rate has a modest positive impact on the remitted car taxes.

E Appendix: Details of the RCT

August 14, 2014

Customs develops services relating to car taxes and process of importing cars

Dear Recipient,

You have dealt with Customs on matters relating to car taxes in 2010 or after. This letter is not related to these dealings, but rather it's meaning is to inform you about regulation of car taxes and new services relating to them. One of the new services Customs has set up is electronic form with which to make declaration about registering a new car to be used in Finland.

If you are about to import a used car to Finland, you should follow these steps:

1. Submit the declaration of use form. Now you can do it electronically in web address www.tulli.fi/fi/yksityisille/autoverotus/kayttoonottoilmoitus.
2. Fill in the car tax declaration form. Submit it with the appropriate attachments within five days from filing the declaration of usage form.
3. After you have received a decision on your car taxes and remitted the car taxes, register your car to be used in Finland. You can find more precise instruction from a brochure that comes with this letter, or from the web address www.tulli.fi/fi/yksityisille/autoverotus/.

The amount of car taxes is determined by the taxable value of a vehicle and car tax rate. The taxable value of a vehicle is the general retail sales price of a similar car in Finland. The similarity is based on for example make, model, year-model, condition and mileage of a car. From the general retail sales price a deduction of 5% and amount of 750 euros are deducted. The taxable value of a vehicle is formed like this. Car tax rate is based usually on the CO2 emissions of a vehicle. For example, if the car tax rate is 25 and the taxable value of a vehicle is 10 000 euros, car taxes amount to 2 500 euros.

If you declare incorrect information in car tax form about your vehicle, an addition can be imposed on top of your normal car taxes (at most three times the amount of car tax). The sanctions are announced in more detail in car tax law (59 §).

Kind Regards,

Figure 16: Letter 1: Control group

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August 14, 2014

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Customs provides also as a new service **Internet service for tax information**. With this free service you can inspect the information of any car imported as used found in car tax decision imported, like the CO2 emissions, mileage and the amount of car taxes. The service is in web address www.tulli.fi/fi/yksityisille/autoverotus/MAHTI.jsp

You can use this service as a help when you **assess the value of a used car**. If, for example, mileage of a car is significantly larger in car tax decision than later in the odometer, is the value of this car lower, than a car that has a coherent mileage history.

Internet service for tax information will be developed so that in the future it is even more easy to use. At the moment, one can search vehicles with the vehicle identification number. In the future it is possible to make searches with the register plate number.

The amount of car taxes is determined by the taxable value of a vehicle and car tax rate. The taxable value of a vehicle is the general retail sales price of a similar car in Finland. The similarity is based on for example make, model, year-model, condition and mileage of a car. From the general retail sales price a deduction of 5% and amount of 750

Figure 17: Letter 2: Treatment of public disclosure of information

August 14, 2014

Customs develops services relating to car taxes and process of importing cars

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Customs enforces car taxation of vehicles imported from abroad. In the enforcement of car taxation, Customs has used since 2013 as supplementary source **information collected in registration audits, such as mileage on vehicle**.

To guarantee fair and just car taxation for all, Customs takes into **retrospective audits** all vehicles imported during 08/2014–07/2015, which has a difference in odometer reader and the comparison information **greater than 10 per cent**. In the cases where this occurs, Customs reinitiates the car tax process.

The amount of car taxes is determined by the taxable value of a vehicle and car tax rate. The taxable value of a vehicle is the general retail sales price of a similar car in Finland. The similarity is based on for example make, model, year-model, condition and mileage of a car. From the general retail sales price a deduction of 5% and amount of 750 euros are deducted. The taxable value of a vehicle is formed like this. Car tax rate is based usually on the CO2

Figure 18: Letter 3: Treatment of available third party comparison information

August 14, 2014

Customs develops services relating to car taxes and process of importing cars

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3. After you have received a decision on your car taxes and remitted the car taxes, register your car to be used in Finland. You can find more precise instruction from a brochure that comes with this letter, or from the web address www.tulli.fi/fi/yksityisille/autoverotus/.

Customs enforces car taxation of vehicles imported from abroad. In the enforcement of car taxation, Customs has used since 2013 as supplementary source **information collected in registration audits, such as mileage on vehicle**. Customs takes into **retrospective audits** all vehicles imported during 08/2014–07/2015, which has a difference in odometer reader and the comparison information **greater than 10 per cent**. In the cases where this occurs, Customs reinitiates the car tax process.

Customs provides also as a new service **Internet service for tax information**. With this free service you can inspect the information of any car imported as used found in car tax decision imported, like the CO2 emissions, mileage and the amount of car taxes. The service is in web address www.tulli.fi/fi/yksityisille/autoverotus/MAHTI.jsp. You can use this service as a help when you **assess the value of a used car**. If, for example, mileage of a car is significantly larger in car tax decision than later, is the value of this car lower, than a car that has a coherent mileage history.

The amount of car taxes is determined by the taxable value of a vehicle and car tax rate. The taxable value of a vehicle is the general retail sales price of a similar car in Finland. The similarity is based on for example make, model,

Figure 19: Letter 4: Interaction treatment of public disclosure of information and available third party comparison information

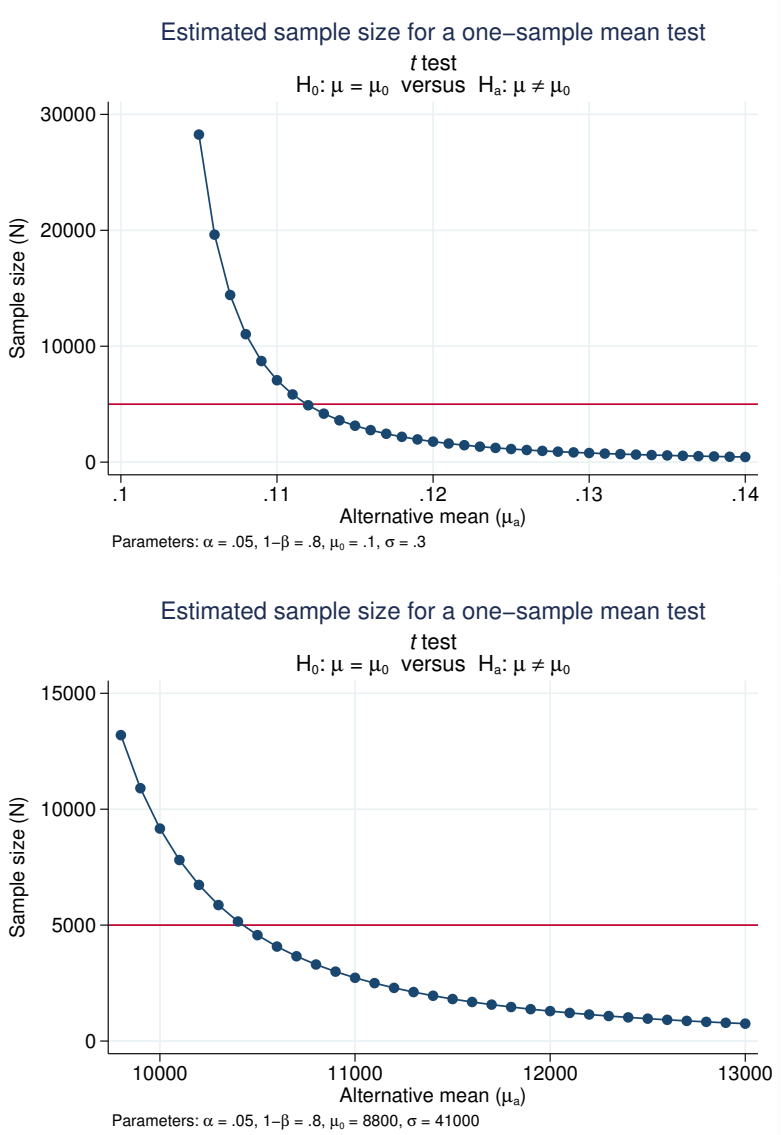

Figure 20: Power calculations for probability to evade car taxes (upper-panel) and mileage difference between car tax declaration and inspection (lower-panel)

Note: Figure shows the power calculations by the sample size (y-axis) and mean response (x-axis) using the pre-reform averages and standard deviations with power of 80%. The horizontal lines mark the selected sample size for each treatment groups. The upper-panel shows the calculations for the probability of car tax evasion, and the lower-panel shows the calculations for the mileage difference between car tax declaration and inspections.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARS	L1v2,3,4	L0v2,3,4	L0v1	L0v2	L0v3	L0v4	L0v3,4	L01v3,4
DD	3,356**	2,013*	-1,422	1,764	1,863	2,531**	2,188**	2,601**
	(1,564)	(1,043)	(1,647)	(1,455)	(1,401)	(1,258)	(1,105)	(1,029)
Const.	7,950***	7,762***	7,084***	6,813***	9,756***	6,339***	8,291***	8,077***
	(2,203)	(1,819)	(1,969)	(2,451)	(2,026)	(1,980)	(1,770)	(1,574)
N	21,118	28,669	18,225	18,186	18,087	18,172	23,371	28,708
R^2	0.168	0.166	0.176	0.174	0.168	0.164	0.163	0.166

Table 11: The effect of RCT on missing mileage for comparison information within one month from tax filing

Note: Table shows the regression results on the mileage difference reported between car tax declaration and inspection observed within one month from tax declaration. Column (1) shows the effect of receiving any one of the treatment letters (letters number 2, 3 or 4) compared to receiving letter 1 (the neutral letter). Column (2) compares letters 2, 3 and 4 against receiving no letter, and columns (3) to (6) compare individual letters 1, 2, 3 and 4 against the no-letter group, respectively. Column (7) compares groups receiving letters 3 and 4 against the group receiving no letter, and finally, column (8) compares groups receiving 3 and 4 letters against those receiving no letter or receiving the neutral letter 1. Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARS	L1v2,3,4	L0v2,3,4	L0v1	L0v2	L0v3	L0v4	L0v3,4	L01v3,4
DD	-0.000	-0.016	-0.016	-0.006	-0.019	-0.022*	-0.021*	-0.016
	(0.013)	(0.010)	(0.014)	(0.015)	(0.014)	(0.013)	(0.011)	(0.010)
Const.	-0.066***	-0.068***	-0.077***	-0.063***	-0.069***	-0.079***	-0.074***	-0.076***
	(0.015)	(0.012)	(0.012)	(0.015)	(0.014)	(0.012)	(0.012)	(0.010)
N	23,756	32,332	20,482	20,516	20,393	20,481	26,345	32,298
R^2	0.042	0.040	0.037	0.043	0.036	0.038	0.037	0.037

Table 12: The effect of RCT on an indicator of having greater than -5,000 kilometers difference

Note: Table shows the regression results on the dummy variable constituted based on the difference reported between car tax declaration and inspection, equaling 1 if the difference is larger than -5,000 kilometers and 0 otherwise. Column (1) shows the effect of receiving any one of the treatment letters (letters number 2, 3 or 4) compared to receiving letter 1 (the neutral letter). Column (2) compares letters 2, 3 and 4 against receiving no letter, and columns (3) to (6) compare individual letters 1, 2, 3 and 4 against the no-letter group, respectively. Column (7) compares groups receiving letters 3 and 4 against the group receiving no letter, and finally, column (8) compares groups receiving 3 and 4 letters against those receiving no letter or receiving the neutral letter 1. Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

F Supplementary Figures and Tables

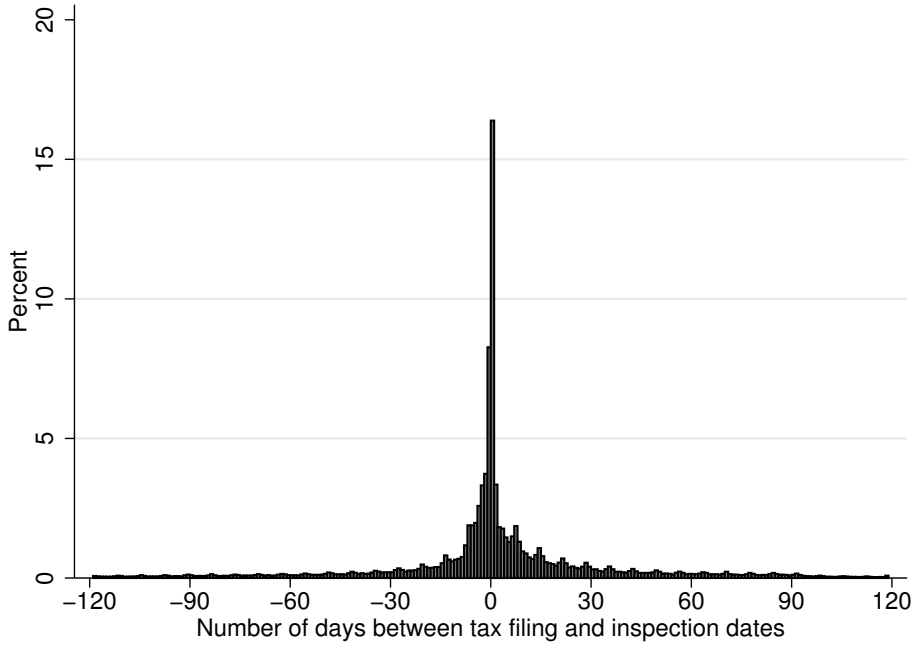

Figure 21: Number of days between tax filing and inspection

Treatment	Δ in km	t-test:	P (Δkm<-5k)	t-test:	Δ in days	t-test:
	mean	0 vs. treat	mean	0 vs. treat	mean	0 vs. treat
0	8754.4		.100		11.548	
1	8723.3	.962	.103	.582	11.326	.333
2	8371.2	.563	.108	.122	11.642	.684
3	8531.9	.737	.096	.406	11.379	.462
4	8250.6	.445	.099	.722	11.312	.304

Table 13: Balancing tests between control and treatment groups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARS	L1v2,3,4	L0v2,3,4	L0v1	L0v2	L0v3	L0v4	L0v3,4	L01v3,4
DD	-0.011	-0.012	-0.002	0.004	-0.013	-0.027**	-0.021**	-0.020**
	(0.012)	(0.009)	(0.013)	(0.014)	(0.012)	(0.011)	(0.010)	(0.009)
EV*DD	0.029	-0.008	-0.036	-0.017	-0.038	0.035	-0.004	0.006
	(0.038)	(0.030)	(0.040)	(0.040)	(0.038)	(0.044)	(0.033)	(0.031)
Const.	-0.049***	-0.032***	-0.031***	-0.030**	-0.016	-0.030***	-0.025***	-0.032***
	(0.014)	(0.010)	(0.010)	(0.012)	(0.010)	(0.010)	(0.009)	(0.009)
N	23,756	32,332	20,482	20,516	20,393	20,481	26,345	32,298
R^2	0.571	0.568	0.563	0.564	0.560	0.570	0.567	0.567

Table 14: The effect of RCT on an indicator of having greater than -5,000 kilometers difference with dummies for previous tax evaders
Heteroscedasticity consistent standard errors presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.