Distributional effects of transport taxes: some insights

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Abstract

The interest towards green fiscal reforms has been growing in recent years in Europe. However, to this day the local dimension of environmental taxation has not been extensively analyzed. Environmental taxes such as fuel excise duties as well as car registration and vehicle ownership taxes are strongly linked to the territorial context and therefore could represent essential instruments to make citizens pay for the services they benefit from and for the local negative externalities they generate. However, fuel and vehicle taxes can also exert negative effects on the equity side.

Our work applies a microsimulation procedure to Istat data for the year 2009 with the aim of estimating the impact of either energy excise duties and vehicle ownership taxes on Italian households. The distributional measures are computed on the household total expenditures and are examined using subsamples of households corresponding to certain socio-economic characteristics. In fact, even if with duties on fuel sources and vehicle taxes some distributive problems might arise, these could be countervailed or at least limited with the proper tax design and the provision of tax rebates or exemptions for certain households categories.

Keywords: Vehicle taxes; fuel excise duties; distributional impacts

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1 Introduction

The benefits involving the use of economic instruments in the field of environmental policy have been widely analyzed and discussed in the last decades (EEA (2006);EEA (2000)EC (2007)EC (2001a)EC (2001b);OECD (2006)OECD (2001);OECD (1997); OECD (1996a)). Basically, environmental taxes have been identified as major tools "to get the price right and to create market-based incentives for environmentally friendly behaviors"(EC, 1993).

At the same time, an increasing interest has been addressed to fiscal decentralization as an opportunity to provide local governments with greater efficiency and accountability (Bird (2003); Bird (2001); Oates (1999); OECD (1996b)).

The need to foster fiscal autonomy and to find new own resources at the local level makes environmental taxation a promising opportunity for the future of local entities. This connection can be justified by several reasons.

First, environmental taxation represents not just a regulatory instrument (capable of curbing certain negative externalities) but also an effective tool for collecting revenues not necessarily earmarked for environmental expenditures.

Secondly, to be effectively realized, fiscal decentralization needs to provide local entities with an adequate gamut of their own financing instruments, opening up the path to the formulation and exploitation of new revenue sources.

Thirdly, local public bodies are increasingly taking responsibility for matters related to environmental protection and valorization: land transformation and planning, mobility, quality of life, pollution abatement, etc.

As a whole, if the greening of local taxes could also bring about better fiscal accountability in local administrations, the traditional concept of double dividend would enlarge to comprehend the benefits granted by those fiscal systems having a strong link between expenditure responsibility and revenue sources: transparency and visibility, better representation of individuals' preferences, prevention of fiscal illusion phenomena, better legitimation of the government leaders, etc.

The greening of local taxation seems to be particularly promising in Italy where, since 2001, the consitutional reform[3] has started a long process of decentralization.[4] Moreover, the recent approval of Law n.42/2009 on fiscal federalism (and its related decrees) laid down the basis for the concrete autonomy of local entities, stressing how fiscal devolution should be addressed to the valorization of territoriality.

In Italy environmental taxes accounted for 5.9% of total collected revenues (2,5% out of GDP) in 2008. Of these, 77% come from taxes levied on energy sources, 22% from transport and the remaining 1% from taxes levied on pollution and natural resources depletion.[5] In the majority of cases these instruments are under the re-

[3]Const. Law n.3/2001.

[4]The new version of Article 119 Const. on financial autonomy states that:

- Municipalities, provinces, metropolitan cities and regions have financial autonomy regarding revenues and expenditures.
- Municipalities, provinces, metropolitan cities and regions have autonomous resources. They establish and implement their own taxes and revenues, in harmony with the constitution and in accordance with the principles of coordination of the public finances and the taxation system. They receive a share of the proceeds of state taxes related to their territory.
- The law of the state establishes an equalization fund to the benefit of areas where the fiscal capacity per inhabitant is reduced, with no restrictions as to the allocation of its proceeds.

[5]For a more deep insight on the Italian fiscal revenues see Carraro and Zatti (2011).

sponsibility of the central state, which sets tax bases, rates, exemptions, rebates etc. and is also responsible for revenue collection and redistribution. The part taken by the lower levels of government is absent or marginal.

The involvement of local governments in these fields, with the opportunity to identify new tax sources and bases or at least improving and managing the existing ones, would bring about several benefical effects.

Taxes on consumption would acquire a major role with respect to labor income taxes.[6] The local taxation would be informed to the principle of territoriality[7], thus attaining the scope of the recent provisions on fiscal decentralization. Finally, if properly defined, green levies at the local level could solve or partly countervail the equity issues that might arise with traditional forms of taxation.

Basically, in the field of local taxation, two main environmental measures of this kind could be taken into account: fuel taxes and vehicle ownership taxes. In the case of gasoline and other fuels, we refer to taxes designed by the Central government.In the case of vehicle ownership taxes, we still refer to taxes designed by the Central government but with the possibility for regional administrations to differentiate them, mainly in terms of tax rates.

The interest devoted to these measures is due to the fact that they are partially connected to the benefit principle, but to this day these characteristics have not been concretely exploited. In fact, although vehicles are responsible for considerable impacts on a territory and bring about high additional costs (roads, car parking, pollution, congestion, etc.), in Italy the local governments have few responsibilities for their taxation. The lower levels of government play a relevant role in influencing consumer behaviour in the transport area. The use of fiscal levies can help to penalize the least desirable choices granting at the same time additional resources to be subsequently employed on the expenditure side (e.g. new public transport infrastructures, park and ride facilities etc.).

However, fuel and vehicle taxes can also exert negative effects on the equity side.[8] For this reason the analysis of the distributional impacts of environmental taxes can help better understand the possible implications involved.

In the literature, the distributional effects of environmental taxes on households, and particularly energy taxes, have been widely analyzed.

A first branch of studies compute distributional impacts with a two-stage approach: first the effects of an increase in a certain tax rate is estimated with an input-output model; then the obtained results are used to simulate the distributive effects on a sample of individuals.

Labandeira et al. (2009) follow this method to explore the effects of a tax levied

[6]The Italian fiscal system is vastly based on labor income taxes. In 2008 these accounted for 50.5% of total collected revenues (21.6% out of GDP), experiencing a 5% increase (3.4% out of GDP) compared to 1995. The distinguishing feature is not represented by the absolute incidence, not far from the European averages, but, instead, by its trend, since in the Euro-16 area the share of revenues collected through labor income taxes experienced a contraction of 1.9% in the same period (0.8% with respect to the GDP). Moreover, the rate of the revenues collected through excise duties out of GDP (1.9%) and total revenues (4.5%) is the lowest in EU-27.

[7]According to the territoriality principle, the revenues collected trhough taxes levied on local tax bases should be devoted to the financing of local entities; at the same time local entities should take a leading role in the setting and management of tax rates whose tax bases are local.

[8]For example, part of the literature (Jacobsen et al. (2003); Leicester (2006); Lefranc, 2010) supports the idea of duties and excises on energy consumption being weakly regressive (Metcalf (1999)); while taxes on vehicle ownership seems to be partially progressive (at least until a certain level of income (West and Williams, 2004)).

on Spanish energy related CO_2 emissions. First they employ an input-output demand model to calculate the price changes after the introduction of carbon taxation; then, they simulate through households micro-data the environmental and economic effect of a Spanish carbon tax. They calculate the impact of carbon taxation on aggregate government receipts, CO_2 emissions, monetarized environmental benefits and the distribution of burdens across households. According to their results, there are not significant differences in the relative tax payment increase by demographic breakdown. The variation of equivalent losses across total expenditures deciles is inconclusive on the regressivity or progressivity of the reform, although the reform has a greater effect on household with older heads.

A similar approach has been followed by Symons et al. (2000) to examine the impact of environmental taxes in Europe. They find that the analised European countries do not show similar patterns. In Germany and France environmental and energy taxes seem to be regressive; while the contrary occurs in the UK and Italy.

Hasset et al. (2007) estimate the direct and indirect incidence of a carbon tax in the U.S. using current income and two measures of lifetime income to rank households. The results suggest that carbon taxes are more regressive when annual income is used as a measure of economic welfare than when proxies for lifetime income are used. Hasset et al. (2007) report the average carbon tax paid per household across regions and finds that regional variation is modest. Differences in driving and heating habits as well as the weather conditions seem to play a role.

Metcalf (1999) analyses the distributional impact of a green tax reform in the U.S. using both annual and lifetime income measures. Measuring the effects of a green tax shift equal to ten per cent of federal revenues, he finds that such a tax reform has a negligible impact on the income distribution when the funds are rebated to households through reductions in the payroll tax and personal income tax.

Johnstone and Alavalapati (1998) review some of the distributional implications of environmental tax reform in the residential energy, road transport and agriculture sectors in the UK. An input-output framework is employed so as to account for the indirect effects of environmental taxation, the potentially mitigating effects through different forms of revenue recycling, the distribution of social and environmental effects such as health and exposure to pollutants. They argue that in many cases the distributional consequences of environmental tax reform may be distinctively regressive. However, if properly designed, an environmental policy package can meet both environmental and equity objectives.

A second branch of studies concentrates directly on micro-data, with the aim of better curbing the consumers heterogeneity and infer the potential policy option alternatives.

Tiezzi (2005) relies on Italian microdata to estimate the welfare and distributive effects of a carbon tax through an Almost Ideal Demand System. The welfare effects are calculated using True Cost of Living index numbers and Compensated Variation. According to her results, the welfare loss is quite substantial and affects Italian households in a non negligible way, but the distribution of welfare losses across different levels of total monthly expenditures does not allow sustaining the regressivity of Carbon taxation.

Aasness and Larsen (2003) analyze the distributional and environmental effects of taxes on transportation in Norway. They rely on Engel, child and adult elasticities and a wide range of empirical estimates of environmental hazards from transportation consumption. Their results show that higher tax rates on high-pollution luxury

modes of transport such as air flights and taxis reduce inequality and increase environmental quality. On the contrary, lower tax rates on low-pollution necessities such as buses, bicycles and mopeds reduce inequality and increase environmental quality. Higher taxes on gasoline have favorable environmental effects, but increase inequality somewhat. Railway passenger transportation is found to be distributionally neutral.

Bruha and Scasny (2006) estimate an econometric model for non-durable energy and transport consumer demand in Czech Republic through an Almost Ideal Demand System. Consumer response is analyzed for different households groups to address equity issues associated with environmental taxation. They rely on marginal Gini index and Suits Index to measure partial and overall tax regressivity. They find heat taxation will have strongly adverse social effects if it is not adequately compensated for, while the burden of fuel taxation will be spread more evenly. According to their results, revenue recycling through the lowering of car insurance payments mitigates the adverse distributional impact for the lowest decile.

In the field of cross country studies, Pearson and Smith (1991) find that carbon taxes tend to be more regressive in northern European countries than in southern ones. This seems to be due to two kind of reasons: first, taxes on petrol tend to be more progressive in the South of Europe than in the North; second, heating needs are traditionally greater in the colder areas of the North. Taxes on vehicles instead are found to be neutral in Europe on average; while taxes on petrol in the U.S. can have regressive effects, especially in rural areas.

Blow and Crawford (1997) present an empirical model of car use conditional on ownership which investigates the distributional effects of increases in road fuel duty in the U.S.. They find that the demand for car mileage is relaitively unresponsive to changes in the cost per mile of driving. The greatest behavioral responses are amongst poor households in urban areas. Concerning the overall distribution of the welfare effects, the results show that poorer households are relatively less affected since they tend not to own cars. However, among car owners the welfare effects are greatest for poorer households, particularly in rural areas.

Poterba (1991), in order to reassess the claim that gasoline taxes are regressive, computes the share of total expenditures that high spending and low spending households devote to retail gasoline purchases. He finds that gasoline taxes are regressive (but less regressive than conventional analyses suggest) relying on total expenditures instead of income.

Walls and Hansen (1996) analyze the distributional impacts of motor vehicle emission taxes in the U.S. They analyse three different kind of taxes: a tax on total annual emissions; a tax on emissions rates; a tax on annual emission miles traveled. The incidence of these taxes is computed against annual households income and lifetime income. They find that all the three fees look regressive; both on the basis of annual and lifetime income–though much less so on a lifetime income basis.

Jacobsen et al. (2003) compute the distributional effect of environmental taxes in relation to households income, socio-economic class, residential location and family status. The authors analyze three categories of environmental taxes (green taxes, energy taxes and duties, transport related taxes). They find that the distributional effect varies a great deal between different environmental taxes, with transport-related taxes reducing after-tax inequality and green taxes increasing inequality. Moreover, residential location matters, as rural households are more sensitive to environmental taxes because of transport requirements.

Our work stems from these last analysis and is aimed at empirically studying the distributional implication of energy taxes and vehicle taxes. In this field, we mainly concentrate on taxes on private road transport at least for two reasons. First, they represent important targets of environmental taxes/objectives and are likely to be increased in the future. Second, the private transport is a sector in which the consumer expenditures are quite direct and generally do not arise through inputs into other sectors (Johnstone and Alavalapati, 1998).

The analysis relies on ISTAT[9] survey data on Italian households for the year 2009. The distributional impacts of fuel excise duties and vehicle ownership taxes are computed on hosehold total expenditures instead of income, given that most of the literature (Poterba (1989); Poterba (1991); Metcalf (1999)) supports the idea of total expenditures being a better indicator of well-being.[10] The distributional implications are examined using subsamples of households corresponding to certain socio-economic characteristics.

The paper is organized as follows. Section 2 provides some insights on energy and transport taxation in Italy devoting particular attention to fuel excise duties (Section 2.1) and vehicle ownership taxes (Section 2.2). Section 3 presents the data and the methodology applied. In Section 4 we discuss the results obtained for the whole sample and for certain groups of individuals. Finally, Section 5 contains concluding remarks.

2 Taxes on energy and transport in Italy: revenues and administrative levels of control

In Italy energy and transport taxes account for respectively 77%[11] and 22% of total environmental taxes (Eurostat, 2010). In the majority of cases these instruments are under the responsibility of the central state, which sets tax bases, rates, exemptions, rebates etc., and is also responsible for revenue collection and redistribution. The part taken by the lower levels of government is absent or marginal.

The involvement of local governments in these fields would bring about several benefical effects. In fact, from a multilevel governance perspective, whenever a process of fiscal decentralization is going on or planned, major attention can be directed to the opportunity to fill in the fiscal gap, at least to some extent, through a major recourse to environmentally related taxes.

Table 1 provides an overview of the main transport levies currently applied in Italy and their corresponding collected revenues.

Fuel excise duties have been largely used in the past, and still are, as revenue raising instruments. Their fairly stable and large tax bases made them become primary instruments where to intervene in case of budget shortages or extraordinary events. Most of these levies is set at the national level, the lower levels of government have an ancillary role on large revenue raising tax bases.

[9] The National Institute of Statistics.

[10] Income may vary across years, whereas consumption is supposed to be driven by long run income. According to Friedman (1957), Modigliani and Brumberg (1954), using annual income as a basis for calculating the tax incidence can be misleading because the individuals' consumption patterns are mainly influenced by what is called the *permanent income*, or earnings over their life cycle.

[11] According to the Eurostat database, this percentage comprehends fuel excise duties, which in Table 1 we consider part of the transport sector.

Table 1: Revenues from taxes on transport (2009, Million Euro)

Tax or duty	Administrative level	Revenues
Taxes on transport		
National fuel excise duty	National	9.234
Revenue sharing on the national fuel excise duty	Regional	3.383
Surtax on the national gasoline excise duty	Regional	583
Vehicle registration tax	Provincial	1.180
Vehicle insurance premium tax	Provincial	1.982
Annual tax on vehicle ownership	Regional	1.393
Annual tax on vehicle ownership (families)	Regional	4.455
Parking and road pricing	Municipal	160**
Fines and penalties related to the road code	Municipal	1.545
Total taxes on transport		*23.915*

Source: Istat (2010).

Notes: ** Estimate.

In the field of transport, fuel taxes (Section 2.1) are mainly shared by regional governments according to rates predefined by the central state.[12] However, there is the possibility of adopting a small surtax (0,026 euros/l) on gasoline consumption. The fear of tax competition and cross border effects seems to have prevented the opportunity to give more freedom to the more mobile taxable units (e.g. fuel consumption); while lower concerns pertain to car registration/ownership taxes. Vehicle ownership and registration tax rates can be set by regional governments[13] between a minimum and a maximum established by the national law (Section 2.2).

Finally, parking and road pricing are earmarked taxes ruled at the municipal level. They represent compulsory payment that make road and city users pay for the services and functions they benefit from, discouraging private mobility and traffic related externalities.

2.1 Fuel excise duties

In Italy excise duties represent more than 50% of the car fuel prices. The majority of them have been introduced in the very past as temporary measures to face extraordinary events; however, notwithstading the causes have ceased to exist, to this day they have not been repealed yet. Nowadays the excise duties on car fuels are:

- 1.90 lire for the Abyssinian war of 1935 (0.001 euros);
- 14 lire for the Suez crisis of 1956 (0.007 euros);
- 10 lire for the Vajont dam disaster of 1963 (0.005 euros);

[12] In this field, Lgs.D. 69/2011. established the abolishment of the regional revenue sharing on gasoline excise duty since 2013 (Art.8 p.4).

[13] Lgs.D. 69/2011. established since 2013 the regions can decide to devote part of the revenues collected through the vehicle ownership tax to their provinces (Art. 19 p.2.)

- 10 lire for the Florence flood of 1966 (0.005 euros);
- 10 lire for the Belice earthquake of 1968 (0.005 euros);
- 99 lire for the Friuli earthquake of 1976 (0.051 euros);
- 75 lire for the Irpinia earthquake of 1980 (0.039 euros);
- 205 lire for the military mission in Lebanon of 1983 (0.106 euros);
- 22 lire for the military mission in Bosnia (0.011 euros);
- 0.020 euros (39 lire) for the renewal of the contract of rail and tram employees in 2004;
- 0.005 euros for the purchase of eco-buses in 2005;
- 0.0071-0.0055 euros for the culture financing in 2011;
- 0.040 euros to handle the issue of Libyan immigration of 2011;
- 0.0089 euros to face the damages caused by the floods of Tuscany and Liguria in november 2011.

Besides these components, the fuel tax on producers as well as the value added tax (21%) must be taken into account. The current structure of the average price of oil products in Italy is provided in the following Table 2.

Table 2: Average fuel price of oil products (2011, euros/l)

Product	Final price	Excise duty	V.A.T.	Total taxes	Price net of taxes
Gasoline	1.577	0.622	0.274	0.896	0.681
Diesel	1.529	0.481	0.265	0.746	0.783
GPL	0.725	0.125	0.126	0.251	0.474
Heating gas oil	1.425	0.403	0.247	0.650	0.775

Source: Ministry of economic development (2011).

The setting, monitoring and control of these duties pertain the national level. The Regions are allowed to share part of the revenues collected through the excise duties on gasoline and diesel. Lgs.D. 56/2000 established regions gain 250 lire (0.13 euros) for every litre of gasoline sold within the regional territory[14]; while the revenue sharing for diesel accounts for 0.00307 euros/litre (Law 296/2006 Art.12).

D.Lgs. n.398/1990 created the possibility for regions with ordinary statute to introduce a regional surtax on gasoline (Art.17, p.1). The maximum level allowed for the regional tax is 0.0255 euros/litre (Art. 154 Law 662/1996).

[14]Lgs.D. 69/2011. established the abolishment of the regional revenue sharing on gasoline excise duty since 2013 (Art.8 p.4).

2.2 Vehicle ownership tax

The vehicle ownership tax is a regional duty due every year. Its value is uniformly defined by the central state; however, regions with ordinary statute have the possibility to increase its rate up to 10% of the national one.[15]

Tax rates differ according to engine power (expressed in KW) and environmental class of vehicles (Euro 0 - Euro 5). The reasoning underpinning the mechanism has been to reward the most efficient and less polluting cars with lighter tariffs. Basically, the national law follows principles of progressivity given that the tariff increases with the engine power of the car and the level of emissions it is responsible for (Table 3). Main aim of this provision was to favour the modernization of vehicles and create a direct link between the polluting power of a car and the tax paid.

Table 3: Vehicle ownership national tax rates (Euro/KW)

Type of vehicle	Until 100 KW of engine power	For every Kw>100
Euro 0	3.00	4.50
Euro 1	2.90	4.35
Euro 2	2.80	4.20
Euro 3	2.70	4.05
Euro 4 and 5	2.58	3.87

Source: Law n. 296/2006.

3 Data and methodology

The data are mainly based on the National Insitute of Statistics (ISTAT) "Survey on Family Budgets" for the year 2009. It is an extensive survey of more than 23000 households chosen over 470 cities representative of the socio-economic features of the Italian population. The inquiry covers family expenditures over a variety of issues and provides information on social and economic aspects of living and housing conditions.

The data are collected through two different techniques of data gathering: a weekly diary registering the expenditures over certain goods, a face-to-face interview to investigate the main features of the house as well as information from the last bill for electricity and natural gas and the expenditures on other fuels (liquified petroleum gas, kerosene, diesel oil, coal and wood). Concerning vehicles, the database provides infomation on the number of car per household, on the expenditures on fules as well as on the kind of energy source used to fuel the motor vehicle. Information on income is not provided by the dataset.

Vehicle ownerhip taxes have been computed through a two-step approach. First, wighted averages of the engine power (expressed in KW) and wighted averages of the environmental class (Euro 0-5) of the Italian vehicle stock[16] have been calculated.

[15] Law n. 296/2006.

[16] The data are provided by ACI (2010).

In this field, in order to reflect somehow the regional differences in the vehicle stock, the 20 Italian administrative regions have been grouped into 5 macro areas:

- North-West: Piemonte; Valle d'Aosta; Lombardia; Liguria
- North-East: Trentino Alto Adige; Veneto; Friuli Venezia Giulia; Emilia Romagna
- Centre: Toscana; Umbria; Marche; Lazio
- South: Abruzzo; Molise; Campania; Puglia; Basilicata; Calabria
- Islands: Sicilia; Sardegna

Then, the obtained values have been subsequently applied to the vehicle ownership tariffs as established by Law 296/2006 (see Table 3).

Italian households spend a high share of their total expenditures on energies, fuel and transport realted services. According to our sample, energy expenditures account for 10% of households total monthly expenditures. This percentage can be split into: 31% heating; 19% electricity; 40% gasoline and 11% diesel oil (Figure 3). Expenditures on car fuels make up more than half of the energy spending faced by Italian families.

On average, households have more than one car (mean 1.22).[17] The average monthly expenditures related to the car ownership account for 7.9% of total expenditures. Of these, 7,21% are vehicle ownership taxes; 62.4% car fuels expenditures and the remaining 30.39% insurance premiums.

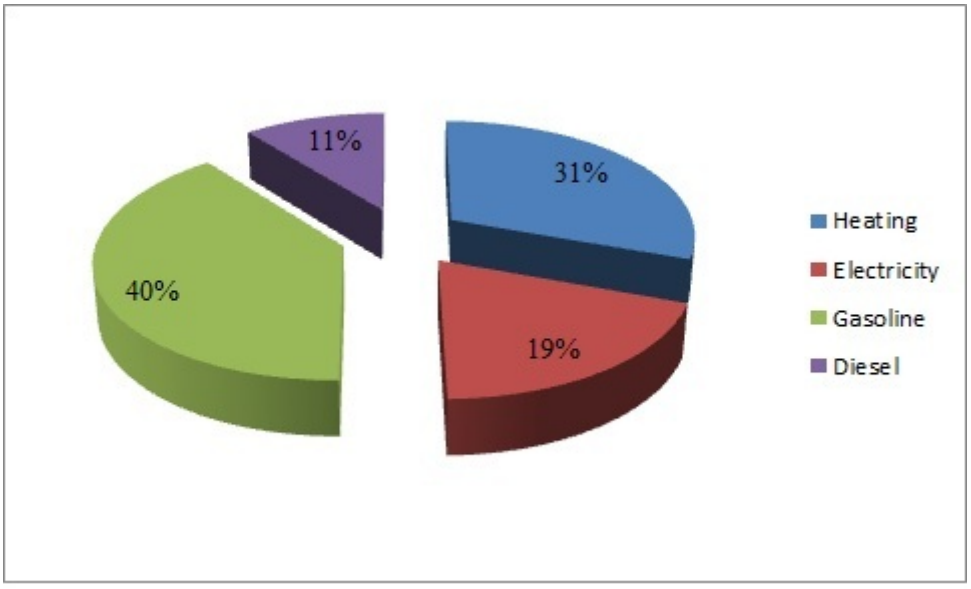


Figure 1: Energy expenditures (% over total households expenditures)

This paper is aimed at investigating the impact of fuel and vehicle taxes on Italian households. The isat data set provides information on gasoline and diesel oil expenditures, but not on the amount of fuels consumed. Given that, deriving the

[17]The proportion of car owning households by income quintile shows that the poorest families sometimes do not have any car (mean 0.51), while the richest have more than one (mean 1.79).

effective tax payments was not possible, and the incidence analysis has been carried out using the monthly fuel expenditures of each family.

The households in the sample are grouped into fifths (quintiles) from poorest to richest, with approximately 4601 in each. Subsequently, an incidence analysis is carried out so as to determine who bears the burden of energy expenditures and vehicle taxes.[18]

The distributional implications are derived by looking at the fuel energy payments and vehicle taxes relative to the households total monthly expenditures. Following Poterba (1991) and Metcalf (1999), we rely on total expenditures as a proxy for income. In fact, using annual income as a basis for calculating the tax incidence can be misleading because the individuals' consumption patterns are mainly infuenced by what is called the permanent income, or earnings over their life cycle (Friedman (1957), Modigliani and R.H. (1954)). Income may vary across years, whereas consumption is supposed to be driven by long run income.

In order to get a better indication of the progressivity or regressivity, we rely on the graphic representation of the Lorenz curve of total expendidures and concentration curves of fuel expenditures and vehicle ownership tax payments. Then, a summary index is calculated relying on the Kakawani measure of progressivity (Kakwani (1977); Bracewell-Milnes (1979)).

4 The results

In the following we provide some results on the distributional implications of fuel expenditures and vehicle ownership taxes. As pointed out in the previous section, the equity effects are derived by computing fuel expenditures and vehicle ownership tax payments relative to total expenditures. If the share of expenditure for fuels and vehicle taxes increases with quintiles, the taxes are progressive. Otherwise, if the share decreases, the taxes are seen as regressive.

Table 4: Fuel expenditure and vehicle ownership tax (share of total expenditures)

	Obs.	Exp.	Gasoline exp./Exp.	Diesel Exp./Exp.	Vehicle ownership tax/Exp.
1	4601	1140.10	2.99%	0.38%	0.73%
2	4601	1578.93	4.88%	0.83%	0.93%
3	4601	2036.15	4.87%	1.09%	0.88%
4	4601	2625.35	4.50%	1.20%	0.76%
5	4601	3641.73	3.31%	1.19%	0.54%

Source: Authors' creation.

Table 4 and Figure 2 show the share of payments by total expenditures. Fuel expenditures (such as on gasoline and diesel oil) have been used as a proxy for the

[18] A tax is progressive if it taxes a larger proportion of expenditure as one moves from poor to rich. The other way around, a tax is regressive if it exerts a higher burden (relative to expenditure) on the poor than the rich (Haughton and Khandker, 2009).

due fuel tax payments.

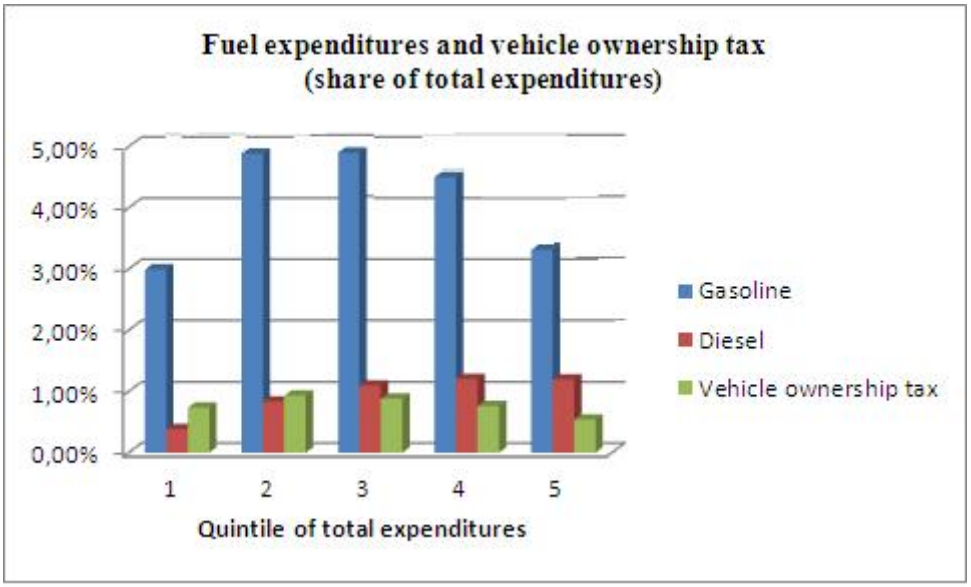


Figure 2: Fuel expenditures and vehicle ownership tax (% over total households expenditures)

The share of gasoline payments over total expenditures increases by 1.89% from the 1^{st} poorest quintile to the 2^{nd} one, exibiting a progressive pattern. Then, the incidence remains practically the same for the 3^{rd} quintile and starts decreasing slowly from the 4^{th} quintile on. Across all households, the largest impact appears to be in the $2^{nd}$and 3^{rd} quintiles. This evidence is not surprising and perfectly in line with previous literature (Jacobsen et al. (2003), Leicester (2006)). It can be justified by two kind of reasons: first, the poorest quintile is made up of families that are less likely to own a car; second, richer households generally have more than one car and drive more, and therefore are harder hit by fuel expenditures.

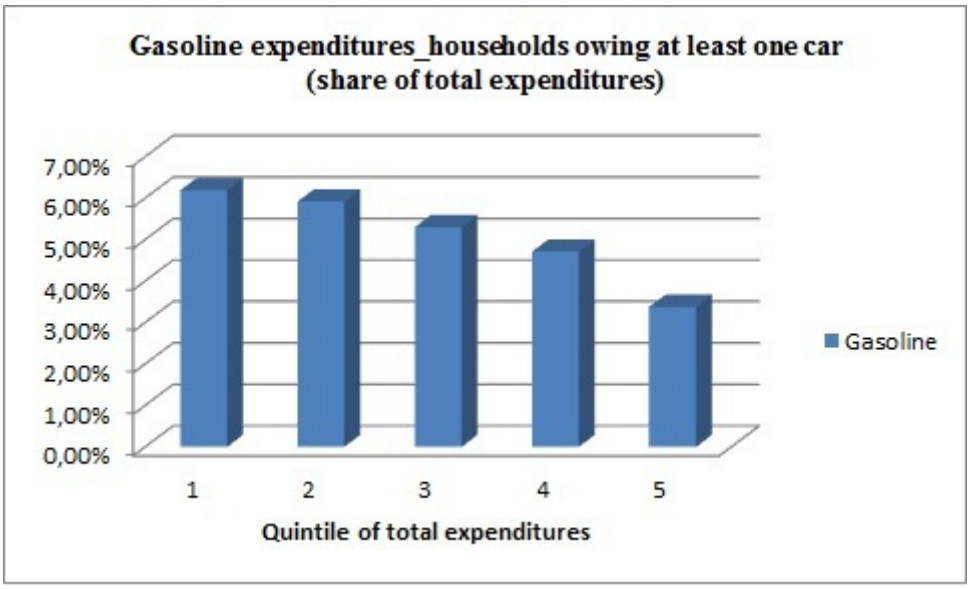


Figure 3: Gasoline expenditures-households owing at leat one car (share of total expenditures)

If the same shares are computed for the subsample of households owing at least one car, the results support the evidence of fuel expenditures being unambiguously regressive (Figure 3). Households in the first two quintiles are those affected the most by gasoline expenditures. This is a matter of great concern, given that gasoline taxes have been, and still are, mainly used for revenue raising purposes. This reading can even worsen if we consider that richer households are normally those capable of shifting towards more fuel-efficient vehicles or alternative fuels.

Diesel oil expenditures are mildly progressive. The share of diesel expenditures relative to total monthly expenditures increases steadily from the 1^{st} to the 4^{th} quintiles. Basically, households belonging to the richest quintiles of the population pay comparatively more. The reason for this trend can be justified by the fact that cars fueled by diesel oil are generally more expensive than vehicles fueled by gasoline, and therefore more affordable by richer households.

Concerning vehicle ownerhip taxes, these show the same pattern of gasoline expenditures. The incidence of the tax grows from the 1^{st} to the 2^{nd} quintile and then starts declining. Households in the $2^{nd}$and 3^{rd} quintiles are those mostly affected by the tax. We would have expected a more progressive incidence in this case. However, probably the analysis suffers from the way the vehicle ownership tax has been computed and added to the sample of Italian households. In fact, the Istat data set provides information about the number of cars owned and the total expenditures on gasoline and diesel oil. Nothing is known about the kind of vehicles they drive, neither in terms of engine power or environmental class. Therefore, this variable has been added assuming that every household drives the same kind of car, whose engine power and environmental class have been determined computing weighted averages on the Italian vehicle stock as recorded in the database provided by Aci.

As established by Law n.296/2006, the vehicle ownership tax rates vary progressively according to the engine power and environmental class of cars (see Section 2.2). However, the average car type we used for our calculations falls in the cathegory "less than 100KW of engine power".[19], and this prevented us to apply households data the progressivity the law allows.

Figure 4 graphically assesses the distributional implications analyzed. It depicts the concentration curves of fuel payments and vehicle tax with the Lorenz curve of total expenditures. As expected, the concentration curve for diesel oil expenditures falls outside the Lorenz curve, meaning that the payment is progressive. Regressivity of gasoline expenditures is evident by the fact that the respective concentration curve lies inside the Lorenz curve. The vehicle ownership concentration curve shows the tax is even more regressive than gasoline expenditures.

The Kakwani index of progressivity [20] supports the same results. It accounts for

[19]The obtained values vary according to the regional macro areas:

- North-West: 65.44 KW
- North-East: 66.07 KW
- Centre: 62.14 KW
- South: 56.55
- Islands: 55.52 KW

[20]The Kakwani index of regressivity (K) is defined as the negative difference between the Gini coefficient for total expenditures and the concentration coefficient of the tax payments. The measure will be positive for a progressive tax, zero for a tax that is proportional, and negative for a

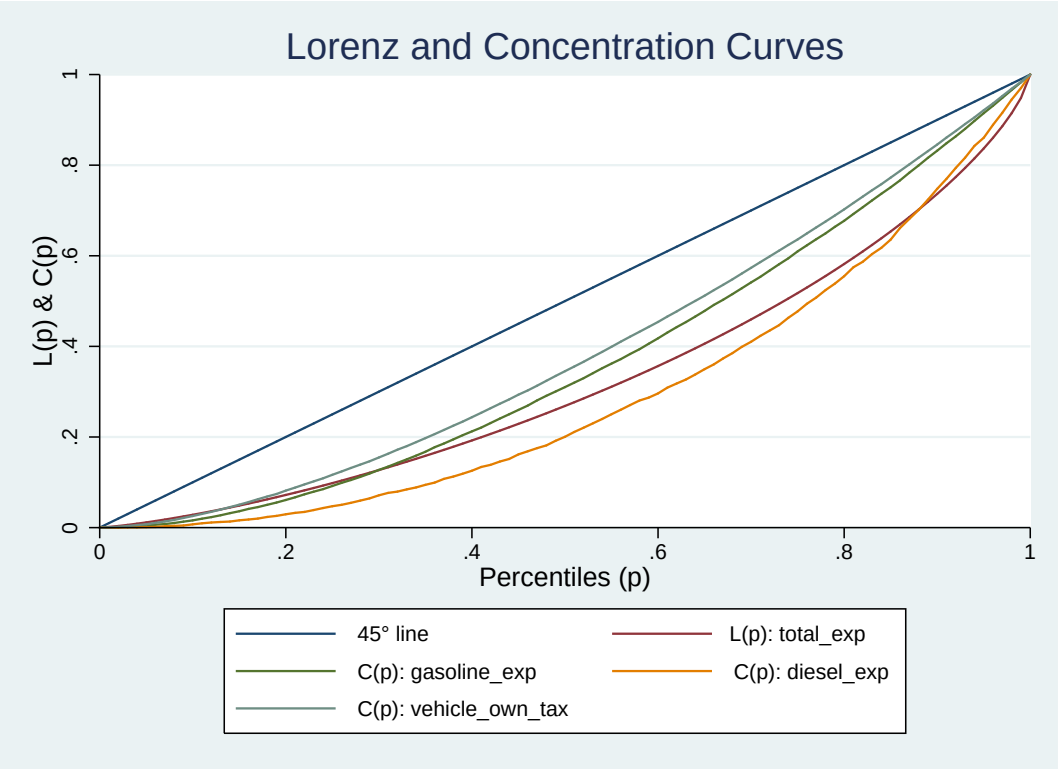
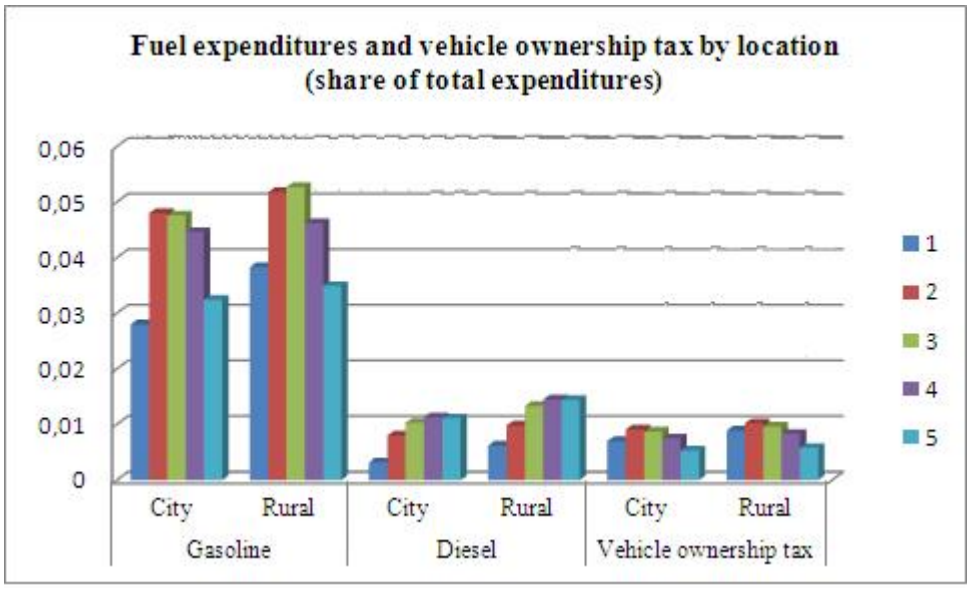


Figure 4: Lorenz and concentration curves

-0.1256 in the case of vehicle ownership taxes, -0.0793 for gasoline expenditures and 0.0741 for diesel oil expenditures.[21]



The socio-economic features of households are another important factor to take care of. Figure 4 compares the incidence of the three payments among households located in cities and households in rural areas. It is worth noting households located in rural areas seem to be affected more by fuel taxes than those located in cities. In fact, household located in cities drive comparatively less and can possibly opt for

regressive tax.

[21] Values are 95% significant.

the public transport; while households in rural areas drive more and sometimes do not have any other option apart form their own means of transportation.

5 Conclusions

Environmentally related taxes can play different non-negligible roles within a process of fiscal decentralisation. They grant resources to compensate local communities where large polluting or detrimental activities are located; when applied to large and fairly stable tax bases, they contribute to covering the fundamental functions delegated to urban and metropolitan governments; they can give cities more flexibility to respond to local conditions, linking revenues to the costs and benefits of services.

In Italy, at present, the role of environmental taxes in local public finance is not properly recognized. The municipalities are almost completely excluded from the revenue raising levies on large tax bases, such as energy and transport.

This article focused the analysis on the main environmental taxes applied to the transport sector: namely fuel excise duties and vehicle ownership taxes.

Vehicles are responsible for considerable impacts on a territory and bring about high additional costs (roads, car parking, pollution, congestion, etc.). Moreover, the lower levels of government play a relevant role in influencing consumer beahviour in the transport area. The use of fiscal levies can help to penalize the least desirable choices granting at the same time additional resources to be subsequently employed on the expenditure side (e.g. new public transport infrastructures, park and ride facilities etc.) However, transport related taxes can also exert negative effects on the equity side.

The main aim of this study has been to infer the distributional implications of fuel excise duties and vehicle ownership taxes.

The outcomes have been obtained carrying out an incidence analysis on a sample of more than 23.000 Italian households.

Concerning gasoline expenditures, the results show that they affect poor households the most. This is a deal of great concern, given that the Italian government has been massively relying on gasoline taxes as a means for collecting revenues not just in case of extraordinary events, but also when budget shortages occourred. Moreover, richer households are normally those capable of shifting towards more fuel-efficient vehicles or alternative fuels, while poor familieas find themselves short of chances.

Diesel oil expenditures have showned a progressive pattern. This can be mainly justified by the fact that cars fueled by diesel oil are generally more expensive than gasoline fueled cars and, therefore, preferred by reacher households.

Vehicle ownership taxes appeared to be regressive, even more than gasoline expenditures. Probably, the extent of regressivity (as recorded by the Kakwani index) has been overestimated because of the problems we encountered adding the variable "vehicle owership tax" to the data set. However, the incidence results for this levy point at regressivity and call for policy intervention.

Vehicle ownership taxes represent one of the most promising tool in the field of environmental fiscal decentralization. In fact, while in the case of gasoline and diesel excise duties, tax competition and cross borders effect might arise, vehicle ownerhip taxes rely on a fairly stable tax base and could profitably be exploited at the local level. The proper definition of tax rates wuold grant the attainment of environmental objectives and equity issues at the same time. High taxes on most

expensive cars could be used to internalize the environmental externalities tipically involved into private transport and finance local public services. Moreover, given the current evolution towards fiscal federalism, vehicle ownership taxes would guarante a consistent and almost constant revenue flow to the local governments.

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