# DISTRIBUTIONAL EFFECTS OF ENERGY AND TRANSPORT RELATED TAXES: AN INCIDENCE ANALYSIS

FIORENZA CARRARO, ANDREA ZATTI

# Distributional effects of energy and transport related taxes: An incidence analysis [a]

Fiorenza Carraro[b]
Andrea Zatti[c]

**Abstract**

The use of economic instruments in the field of environmental and energy policies involves several benefits. In fact, they do not only create market-based incentives for environmentally friendly behaviors, but also represent an effective opportunity for collecting revenues. In this context, energy and transport related taxes play a major role, even if the extensive use of such fiscal levies has raised several concerns over equity issues. The main objective of the paper is to investigate the redistributive burden of existing energy and transport related taxes on Italian households. An incidence analysis is carried out on a sample of more than 23.000 Italian families for the year 2009. Some different policy options are also analyzed such as tax exemptions and rebates on the vehicle ownership tax. The aim is to provide some suggestions on how to countervail the potential negative regressive effects. In order to get a better indication of the progressivity or regressivity of certain policy designs, we rely on some summary indexes such as: the Kakwani measure of progressivity; and the Reynolds-Smolensky measure of redistributive capacity of a tax.

**Keywords:** energy taxes; vehicles taxes; distributional impacts

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[b]Department of Political and Social Sciences, University of Pavia, Corso Strada Nuova 65, 27100 Pavia, Italy. e-mail: fiorenza.carraro@unipv.it

[c]Department of Political and Social Sciences, University of Pavia, Corso Strada Nuova 65, 27100 Pavia, Italy. e-mail: chopin@unipv.it

# 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 (EC, 2007, 2001; EEA, 2006, 2000; OECD, 2006, 2001, 1997, 1996). 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, p. 105).

Beyond this regulatory role[4] an increased and renewed attention has been paid to environmental levies as an effective opportunity for collecting revenues not necessarily earmarked for environmental expenditures. This budgetary role has become crucial in the framework of the recent economic crisis, where the need to change the tax mix - reducing income taxes and increasing the tax burden on consumption, property and environmentally related resources - is widely advocated and shared (Bernardi, 2011; EC, 2010; OECD, 2010; Green Fiscal Commission, 2009; Veermend et al., 2009).

In this context, transport taxes, and in particular those applied to the road subsector, can positively influence both environmental and revenue raising objectives.

On the one hand, an adequate mix of levies on vehicles' ownership and use helps to better target external costs, including global effects and local ones. At present, the main findings are quite clear: existing taxes are not quantitatively and qualitatively adequate (EC, 2008; ECMT, 2003) and full internalization is likely to be strongly revenue-positive, entailing a net increase in government receipts (OECD, 2009).

On the other hand, they reveal positive features simply as means for collecting revenues. The tax bases are large and cyclically stable, granting reliable sources of substantial revenue even with fairly small rates (Speck and Gee, 2011; Kosonen, 2010; Green Fiscal Commission, 2009; Leicester, 2006). They contribute to increasing the tax burden on consumption and capital stocks, representing a promising instrument to lowering labor taxes and changing the tax mix[5]. Moreover, their fiscal incidence is connected with both the benefit and the ability to pay principles, contributing to combine the two principal approaches of apportioning the fiscal burden. Finally, taxes on vehicles' ownership and use can be profitably shared among different levels of government, becoming effective tools to finance fiscal decentralization processes (Carraro and Zatti, 2012).

Yet, the enthusiasm for such regulatory and fiscal instruments is practically tempered, if not highly lowered, by concerns over equity (Hasset et al., 2007; Kriström, 2006; Larsen, 2006; OECD, 2006; Walls and Hansen, 1996). Distributional impacts, in fact, are central to the political acceptability and social fairness (EEA, 2011; Johnstone and Serret, 2006), so that the development of green levies may be feasible only if they show reasonable social profiles. In particular, the regressivity of environmental/transport taxes has become a key issue in the theoretical and policy debate (OECD, 2006), to be necessarily tackled for an effective and quantitatively substantial implementation.

The paper is organized as follows. After a brief introduction on the distributional matters under discussion (this section), Section 2 reviews the main literature results on these issues. Section 3 provides an overview of the main energy and transport

[4]I.e. justified by the need to pursue allocative efficiency through the correction of market failures.

[5]This opportunity seems to be particularly important in Italy, where the reduced incidence of consumption taxes is one of the characterizing features of the fiscal system (Bernardi, 2011; Eurostat, 2011).

taxes currently appllied in Italy, focusing on fuel excise duties (Section 3.1), vehicle ownership taxes (Section 3.2) and excise duties on gas and electricity (Section 3.3). The data and the methodology applied are discussed in Section 4. Section 5 presents the distributional results. First, the analysis of current transport related taxes (Section 5.1) and gas and electricity expenditures is carried out (Section 5.2); then, the impacts of differrent policy designs for the vehicle ownership tax (Section 5.3) is considered. Section 5.4 evaluates the redistributive impact of some alternative tax sources exploitable to gather a fixed revenue amount. Finally, Section 6 concludes providing some insights for policy makers.

# 2 Distributional impacts of energy and transport related taxes: a brief overview

The issue of equity is a highly debated and controversial topic when considering environmental taxes (Speck and Gee, 2011). Four main distributional impacts across society are commonly envisaged (EEA, 2011): the direct effects of increasing taxes; the consequences of recycling revenues through compensation and mitigation packages; the broader economic impact on employment and prices; and the environmental effects on different socio-economic groups.

Even if all the four clusters of effects matter to influence the social outcome,[6] we focus only on the direct distributional consequences of environmentally related taxes for two kinds of reasons. Firstly, during strict budget constraint periods, as those characterizing many national and local governments nowadays, the revenue neutrality hypothesis turns out to be largely impracticable. Different fiscal sources, including environmentally related taxes, are mostly taken into account as means to consolidate budget deficits and debts, with few opportunities to neutralize regressive impacts through automatic redistribution and compensation. Secondly, in terms of political acceptability, it is acknowledged (EEA, 2011) the redistribution side of policy packages is poorly perceived and the majority of the population is much more aware and influenced by the direct taxation burden.

Along this view, most of the studies on the overall incidence of environmental taxes identify weak to mild regressive effects, regardless of the models used and the countries reviewed (EEA, 2011; Hasset et al., 2007; Bork, 2006; Bruha and Scasny, 2006; OECD, 2006; Jacobsen et al., 2003; Johnstone and Alavalapati, 1998; Pearson and Smith, 1991). This result, however, varies deeply according to the specific characteristics of the analysis.

As far as the object of taxation is concerned, clear regressive effects are commonly obtained for taxes on household energy consumption: electricity, gas, and heating oil (EEA, 2011; Fullerton et al., 2008; Leipprand et al., 2007; Bork, 2006; Leicester, 2006; Aasness and Larsen, 2003), so that limited political scope is recognized for further increasing the tax burden (EEA, 2011). Other specific green levies (on water, waste, retail containers) are found to be even more regressive (EEA, 2011; Jacobsen et al., 2003). Yet, the evidence on transport taxes shows mixed distributional results (Sterner, 2012; Speck and Gee, 2011), making easier to blend equity and budget

[6]For example, policy packages based on compensation and mitigation measures can deeply change the redistributive profile (EEA, 2011; Kriström, 2006; OECD, 2006; Johnstone and Serret, 2006; Metcalf, 1999; Johnstone and Alavalapati, 1998; OECD, 1996), potentially leading to a welfare increase for all the involved social groups (EEA, 2011).

needs. For both fuel and car ownership/purchasing taxes, for example, several studies (EEA, 2011; Green Fiscal Commission, 2009; Bork, 2006; Leicester, 2006) report a progressive distributional effect in lower-income brackets (inverted U-shaped pattern). In certain countries, the incidence of car related taxes increases also in higher income groups (Jacobsen et al. (2003) for Denmark). The same happens with some other levies in the field of transportation (as those on air flights, expensive cars, taxis, and leisure travels) that seem to work progressively for almost the whole income distribution (Larsen, 2006; Aasness and Larsen, 2003).

For both energy and transport taxes, impacts can vary according to specific categories within each income decile/quintile. Typically, residential location matters, as rural households are more sensitive to environmental taxes, mainly because of transport requirements (EEA, 2011; Green Fiscal Commission, 2009; Brännlund and Nördstrom, 2004; Jacobsen et al., 2003)[7]. Negative distributional effects are found to be more pronounced for families with children with respect to single people and married couples without children (EEA, 2011; Leipprand et al., 2007; Bork, 2006; Larsen, 2006).

Policy design is a key aspect influencing redistributive effects. Tax exemptions, tax-free basic amounts of consumption, progressive taxation and the selection of tax bases affecting more richer household are the main options to neutralize regressive consequences without renouncing to a positive budget effect[8] (EEA, 2011; OECD, 2006). In the Netherlands, for example, to mitigate the adverse equity effects of the electricity tax, each household is entitled to an annual tax-free allowance of consumption. In the field of transport taxes, rates penalizing larger and/or more expensive vehicles (as those applied in Denmark and Norway to first-time motor vehicle purchase) deeply enhance the progressivity of the tax burden (Jacobsen et al., 2003). Instead, results are less favorable for low income groups in the case of emission rate-based ownership taxes, since poorer households not only own older cars but even dirtier than the average (Jacobsen et al., 2003; Walls and Hansen, 1996).

Finally, results are influenced by the adopted methodological approach. On the one hand, several studies (Sterner, 2012; Hasset et al., 2007; Kriström, 2006; Metcalf, 1999; Poterba, 1991) suggest environmental taxes are more regressive when annual income is used as a measure of economic welfare instead of proxies for lifetime income (as total consumption expenditures). Accordingly, common concerns over the distributional impact of environmental taxes may have been overstated if based solely on current income data. On the other hand, analyses focused only on the direct-short term effects of taxes do not take into account that households may adjust consumption patterns in response to tax changes (Kriström, 2006; OECD, 2006) and that behavioral responses of different income groups can affect the distributional impacts of the policy (Johnstone and Serret, 2006). Even if the outcomes on this issue are mixed, it is commonly observed (Kriström, 2006) that higher income households tend to have a higher price elasticity for stationary uses of fuels[9], while in the case of transport related taxes the greatest behavioral responses are among the poors. Thus, if empirical studies on transport taxes assume no repercussions in

[7]According to some studies, rural households tend not only to have a higher demand for motorized transport, but also to consume more household energy (EEA, 2011).

[8]The revenue redistribution can help to mitigate the distributional effects; however, at the same time, it narrows the space to consolidate public deficits and debts.

[9]This clearly reinforces the regressivity of energy taxes.

demand, results can be realistically interpreted as upper bounds of their potential regressive effect (*ibidem*).

# 3 Transport & energy taxes in Italy

In Italy, the rate of environmental revenues out of GDP and total revenues has experienced a decreasing trend over the last two decades. While in 1995 the values were the highest out of the entire EU (3.5% and 9.1% respectively), this edge has progressively scaled down, pushing the Italian position near the average (Table 1). The reduction of energy taxes (from 3.1% to 2.1% out of GDP, and from 7.9% to 4.9% out of total taxation) has played a crucial role in driving the overall trend during the period 1995-2009.

Energy and transport taxes account respectively for about 77% and 22% of total environmental taxes (Eurostat, 2011).

Table 1: Environmental taxes by typology (2009)

| | Italy | | Euro Area-17* | | EU-27* | |
|---|---|---|---|---|---|---|
| | % GDP | % Total taxation | % GDP | % Total taxation | % GDP | % Total taxation |
| Environmental tax revenues | 2.6% | 6.1% | 2.3% | 6.0% | 2.4% | 6.3% |
| Energy tax revenues | 2.1% | 4.8% | 1.7% | 4.4% | 1.8% | 4.7% |
| *Of which, transport fuel taxes* | 1.5% | 3.5% | 1.3% | 3.4% | 1.4% | 3.7% |
| Transport tax revenues** | 0.5% | 1.2% | 0.5% | 1.3% | 0.5% | 1.4% |

Source: Eurostat (2011).

*Notes*: * Values are GDP-weighted.
** Transport tax revenues include one-off and recurrent levies on vehicles (registration taxes, ownership taxes, insurance premium taxes, etc.)

Actually, nearly $\frac{3}{4}$ of energy tax revenues are collected on transport fuels, so that the real burden on the transport sector amounts to 2% on GDP and 4.7% on total tax revenues. These two values are slightly above the EU-27 average in the case of GDP (2% against 1.9%) and below in the case of total revenues (4.7% against 5.1%). Italy ranks $13^{th}$[10] (on GDP) and $19^{th}$ (on Total revenues) for transport fuel taxes; $14^{th}$ for vehicle related taxes (both on GDP and Total revenues).

As a whole, energy and transport taxes seem to represent an interesting opportunity to change the tax mix during a period of "strong" fiscal consolidation. This hypothesis appears particularly promising given that the Italian fiscal system is mainly based on labor income taxes. In 2009 these accounted for 51.2% of the GDP[11], and have experienced a 5.7% increase with respect to 1995. The great role played by labor taxes comes along with the reduced incidence of consumption taxes, where most of the environmental levies are included[12]. In 2009, they accounted for

[10] A country scored 1 collects the highest share of revenues.

[11] These values correspond to an implicit tax rate on labor of 42.6%: the highest in Europe and well above the EU-27 average (36%) and the Euro-17 one (38.2%) (Eurostat, 2011).

[12] Consumption taxes include primarily: Value Added Taxes (VATs), excises, taxes on pollution and some direct taxes of various types (expenditure taxes, license taxes, vehicle taxes, etc.).

22.8% of the total collected revenues (9.8% of the GDP)[13], well below the Euro-17 averages (26.6% and 10.4% respectively) and in decline with respect to thirteen years ago. This trend is mainly justified by the reduced weight of VATs and excises duties[14], that represent the two main components of consumption taxes.

## 3.1 Fuel excise duties

In Italy excise duties represent a notable share of vehicles' fuel prices. The majority of them have been introduced in the very past[15] as temporary measures to face extraordinary events; however, notwithstading some of the causes have ceased to exist, to this day they have not been repealed yet. Moreover, given fuel demand is mostly inelastic to price and income changes, at least in the short run, the excise duties on energy represent one of the primary fields of intervention when budget shortages arise[16].

The current structure of the average price of oil products in Italy is provided in the following table (Table 2). Excise duties account for 41% of the gasoline price (59% VAT[17] included), while for 37% of the diesel price (55% VAT included)[18].

Table 2: Average fuel price of oil products (26-06-2012, €/l)

| Product | Final price | Excise duty | V.A.T. | Total taxes | Price net of taxes |
|---|---|---|---|---|---|
| Gasoline | 1.755 | 0.724 | 0.305 | 1.029 | 0.726 |
| Diesel | 1.649 | 0.613 | 0.286 | 0.899 | 0.750 |
| GPL | 0.783 | 0.147 | 0.136 | 0.283 | 0.500 |
| Heating gas oil | 1.401 | 0.403 | 0.243 | 0.646 | 0.755 |

Source: Ministry of economic development (2012).

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

[13]These values correspond to an implicit tax rate of 16.3% in 2009: well below the EU-27 average value of 18.9% and the Eu-17 value of 18.5% (Eurostat, 2011).

[14]The rate of the revenues out of GDP (2.1%) and total revenues (4.9%) collected in Italy through excises duties is among the lowest three in the EU-27.

[15]The oldest one dates back to 1935 and it had been introduced for the financement of the Abyssinian war.

[16]Only in 2011 the Italian government has intervened four times raising fuel excise duties:

- 0.0071-0.0055 € for the culture financing;
- 0.040 € to handle the issue of Lybian immigration;
- 0.0089 € to face the damages caused by the floods of Tuscany and Liguria;
- 0.082 € to face the economic crisis with the so called 'Save Italy' decree (Lgs. Decree n. 201/2011).

More recently, the Decree n. 74/2012 established a further increase of 0.02 €/l to face the damages of the earthquake in Emilia Romagna.

[17]The VAT on fuels is 21%.

[18]Besides by excise duties and VAT, fuels are also charged with the fuel tax on producers.

12) plus another component which varies region by region. The recent Lgs. Decree n. 68/2011 on fiscal federalism repealed the gasoline revenue sharing provision, with the aim of substituing it with the sharing on the personal income tax. This decision turned out to be surprising given that the gasoline revenue sharing had been traditionally used to establish a financial link beetween private mobility (where revenues were mainly collected) and the public transport sector (where most of the collected revenues should have been addressed). This could be the reason why Decree n. 201/2011 broght back the idea of the regional revenue sharing on the national fuel excise duties, whose values are going to be established[19] within the end of September 2012.

Lgs. Decree n. 398/1990 created the possibility for the Regions with ordinary statute to introduce a regional surtax on gasoline. The maximum level allowed for the surtax is 0.0258 €/l (Law n. 662/1996). More recently, the Decree n. 225/2010 opened up the possibility/necessity for those regions facing extraordinary events to increase the regional surtax on gasoline until 0.05 €/l beyond the base level (0.0258 €). Basically, in case of extraordinary disasters, the Regions hit by the event had first the obligation of fully exploting their own fiscal instruments, such as the regional surtax on gasoline, to gain then access to the central state resources. However, the Supreme Court (Decision n. 22/2012) decleared illegitimate this provision given that, according to the subsidiarity principle, the lower levels of government should not be obliged to use their revenues to cover expenditures whose responsibility relies on the central state (Tucciarelli, 2012). The last decree in this field (Decree n. 59/2012) allows the Regions to increse the gasoline surtax untill 0.05 € in case of calamitous events. However, no mention is done to the fact that the own financial resources should be exploited first.

## 3.2 Vehicle taxes

While fuels taxes primary burden the car/vehicle usage, vehicle taxes are meant to hit ownership. The vehicle ownership tax is a regional duty due every year. Its value is uniformly defined by the central state; however, the Regions with ordinary statute have the possibility to increase its rate up to 10% of the national one[20].

Tax rates differ according to the engine power (expressed in KW) and environmental class of vehicles (Euro 0 - Euro 5). 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 is to favour the modernization of vehicles and create a direct link between the polluting effects of a car and the tax paid.

Since 2011, a national surtax on the vehicle ownership tax has been introduced[21]: its value is 10 € for every KW of engine power greater than 225 KW. Subsequently, the Decree n. 201/2011 has increased its value. As of 2012, the surtax is set to 20 € for every KW of engine power greater than 185 KW.

Apart form the vehicle ownership tax, directly involved in the empirical analysis of the following sections, a mention has to be made to other two kinds of taxes affecting vehicle ownership: the registration tax and the motor vehicle insurance tax.

[19] Both for gasoline and diesel.

[20] Law n. 296/2006.

[21] Decree n. 98/2011 modified by Law n. 111/2011.

Table 3: Vehicle ownership national tax rates(€/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.

The vehicle registration tax is the tax charged to register a vehicle to the Italian Automobil Club Agency (ACI). It has been introduced by Lgs. Decree n. 446/1997 and its minimum value established with Decree n. 435/1998[22]. The collected revenues are devoted to the Provences, which have the possibility to increase the tax rates up to a 30%.

The motor vehicle insurance tax is paid on the value of the insurance premiums that each vehicle owner is obliged to pay. According to Decree n. 68/2011, its tax rate (12,5%) can be increased or decreased up to 3,5 percentage points. As in the previous case, the collected revenues accrue to the Provinces.

## 3.3 Excise duties on electricity and gas

Due to its inelastic nature[23], energy consumption has been and still is extensively hit by taxes as a means for collecting revenues.

The electricity supply costs are made up of four components: energy price, electricity network services, system charges[24] and, finally, taxes. These comprehend: the excise duty on electricity consumption[25] and the value added tax[26]. All together they account for about 14% of the final electricity price of 18,29 c€/kWh (AEEG, 2012)[27].

The excise duty varies according to the level of consumption (Lgs. Decree n. 504/1995). In particular, when households rely on less than 1.5 KW of installed power and consume less than 150 kWh/per month, the excise duties are not applied[28]; but if their monthly consumption increases above this level, the tax exempted kWh progressively decrease[29].

[22]Decree n. 435/1998 established base values for the registration tax differentiated according to the type and engine power of vehicles.

[23]At least in the short run.

[24]The system charges are identified by the law and are aimed to support initiatives of general interest such as: the prompting of renewable energy sources and of R&D activities; the promotion of energy efficiency at the level of final consumption; etc. On average they account for about 7% of the household electricity bill.

[25]The excise duty has been recently raised to 0.0227 €/kWh by the Decree n. 304/2011. Such an increase is due to compensate for the repeal of the municipal and provincial surtaxes on residential electricity consumption (Decree n. 16/2012).

[26]The value added tax on householods electricity consumption is 10%.

[27]In 2009, the year of our analysis, taxes and duties accounted for 14.1% of the final price which was then 16.80 c€/kWh.

[28]Tax exemptions are applied to the place of residence only.

[29]When the installed power falls between 1.5 and 3 KW, the first 150 KW of electricity consumed are tax exempted if the monthly electricity consumption is less than 200 kWh; otherwise, the

To make the taxes levied on electricity consumption less regressive, the Regulatory Authority for Electricity and Gas (AEEG)[30] has introduced an *electricity bonus*[31] granted to low income[32] and large families[33] for the electricity consumed in the place of residence. The bonus is aimed at producing on average a 20% reduction in the electricity expenditures of households.

Concerning gas, the supply costs comprise capacity and operating costs of gas production, storage and transportation; plus the excise duties and taxes accounting for 34% of the final price of 87.92 c€/$m^3$ (AEEG, 2012)[34].

Taxes include the national excise duty on consumption, the regional surtax and the value added tax.

The national component varies progressively according to different levels of consumption[35], and geographically, since the southern regions benefit of lower rates.

Regions[36] may also set a surtax on gas consumption between a minimum and a maximum as established by the law[37].

The value added tax is 10% for the first 480 $m^3$ of gas consumed, while 20% for the remaining.

In order to contain the regressive effects that might arise when energy taxation is concerned, the Regulatory Authority for Electricity and Gas, in accordance to Law n. 2 /2009, has introduced a *gas bonus*, that is a reduction in the gas bill for low income and large families. The bonus is granted exclusively to the network gas (and not to gas cylinders or GPL) consumed in the place of residence and can allow up to a 15% rebate on the average esteemd gas expenditure[38].

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exemped kWh gradually decrease. Finally, households with more than 3 kWh of installed power do not benefit of any tax exemption.

[30]The Regulatory Authority for Electricity and Gas (AEEG) is the independent body which regulates, controls and monitors the electricity and gas markets in Italy. It has been established by Law n. 481/1995 with the purpose to protect the interests of users and consumers, promote competition and ensure efficient, cost-effective and profitable nationwide services with satisfactory quality levels.

[31]Ministerial Decree of the $28^{th}$ of December 2007.

[32]Low income families are those whose ISEE is not greater than 7.500 €. The ISEE, Equivalent Economic Situation Indicator, assesses the economic situation of the families needed to apply for social benefits or subsidized care services. It takes into account income, assets (movable and immovable) and family features.

[33]In this case, the electricity bonus is granted to families whose ISEE is not greater than 20.000 € with more than three children.

[34]In 2009, the year of our analysis, taxes and duties accounted for 35.6% of the final price which was then 79.33 c€/$m^3$.

[35]The decree identifies 4 different ranges of consumption: 0-120, 120-480, 480-1560 and more than 1560 $m^3$ per year.

[36]The Regions with special statute do not apply the regional surtax.

[37]Initially, these two limit values have been set to 10 lire (0.005165 €) and 50 lire (0.025823 €) respectively by Lgs. Decree n. 398/1990. The upper value has been subsequently upgraded to 60 lire (0.030987 €) by Law n. 662/1996 (the Budget Law for 1997) and to this day it has not been updated yet. Moreover, Law n. 68/1993 has introduced a further limitation, establishing the regional surtax can never exceed half the value of the corresponding excise duty.

[38]The bonus is differentiated according to:

- the purpose of gas usage (cooking and water heating; space heating; cooking, water & space heating all together);
- the number of persons living in the house;
- the weather conditions, so as to take into account the heating needs of different sites.

# 4 Data and methodology

The basic unit of analysis of the study is the household. Data are mainly based on the National Institute of Statistics (ISTAT) "Survey on Family Budgets" for the year 2009. It is an extensive survey of more than 23.000 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, gasoline, diesel oil, coal and wood).

Concerning vehicles, the ISTAT sample provides information on the number of cars per household, on the expenditures on fuels[39] as well as on the kind of energy source used to fuel the motor vehicle[40]. Information on income is not available; the sum of total expenditures is used instead.

Vehicle ownership taxes have been added to the dataset through a two-step approach. First, weighted averages of the engine power (expressed in KW) and weighted averages of the environmental class (Euro 0-5) of the Italian vehicle stock[41] have been calculated on a macro-area level[42]. Then, the vehicle ownership tariffs, as established by Law 296/2006 (see Table 3), have been applied to the obtained values[43].

Households in the sample are grouped into fifths (quintiles) from poorest to richest, with 4601 in each. Then, an incidence analysis is carried out so as to determine who bears the burden of energy expenditures and vehicle ownership taxes[44] in the

[39]The effective fuel tax payments are not distinguished in the ISTAT dataset, neither any guidance on the quantity of fuel consumed is provided. Therefore, the total monthly expenditures on fuels are used as a proxy for the calculation of the distributional impacts of the fuel excise duties.

[40]Nothing is known about the kind of vehicles they drive, neither in terms of engine power or vehicle class.

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

[42]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.

[43]The values obtained for the different regional macro areas are:

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

[44]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)

current situation and in the case of alternative policy options and fiscal measures[45].

The distributional implications are derived by looking at the energy payments and taxes relative to the households total expenditures. Following Metcalf (1999) and Poterba (1991), we rely on total expenditures as a proxy for lifetime income. In fact, 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 (Friedman, 1957; Modigliani and Brumberg, 1954). Income may vary across years, whereas consumption is supposed to be driven by long run income and also by in kind transfers. This rational seems to be strengthened in the case of Italy where, due to the high incidence of households working in the "underground economy", income is most of the time misreported.

In order to get a better indication of the progressivity or regressivity of certain policy designs, we rely on summary indexes such as: the Kakwani measure of progressivity (Bracewell-Milnes, 1979; Kakwani, 1977) and the Reynolds-Smolensky measure of redistributive capacity of a tax (Reynolds and Smolensky, 1977).

# 5 The results

In the following we provide some results on the distributional implications of current transport (Section 5.1) and energy related payments (Section 5.2). Then, Section 5.3 carries out an incidence analysis applying alternative tax desings for the vehicle ownership tax in a revenue neutral context. Finally, Section 5.4 compares an increase in the VAT to some alternative fiscal measures such as a different setting of the vehicle ownership tax or the further increase of fuel excise duties.

## 5.1 Distributional impacts of fuel expenditures and vehicle ownership taxes

Table 4 and Figure 1 show the share of payments over total expenditures for the different instruments analyzed.

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

| | Obs | Exp (€/month) | Gasoline Exp /Exp | Diesel Exp /Exp | Vehicle 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% |
| K Index* | | | -0.1236 | -0.0793 | -0.0741 |

Source: Authors' creation.

*Notes*: * Kakwani index of progressivity

on the poor than the rich (Haughton and Khandker, 2009).

[45]In the case of tax increases/shifts, behavioral effects are not included and only first-order financial effects are evaluated (Sterner, 2012; Jacobsen et al., 2003).

The share of gasoline payments over total expenditures increases by 1.89% from the $1^{st}$ poorest quintile to the $2^{nd}$ one, exhibiting a progressive pattern. Then, the incidence remains practically the same for the $3^{rd}$ quintile and starts decreasing 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 the previous literature (Sterner, 2012; Leicester, 2006; Jacobsen et al., 2003). It can be justified by two kind of reasons: first, the poorest quintile is made up of households that are less likely to own a car; second, richer households generally have more than one car and drive more.

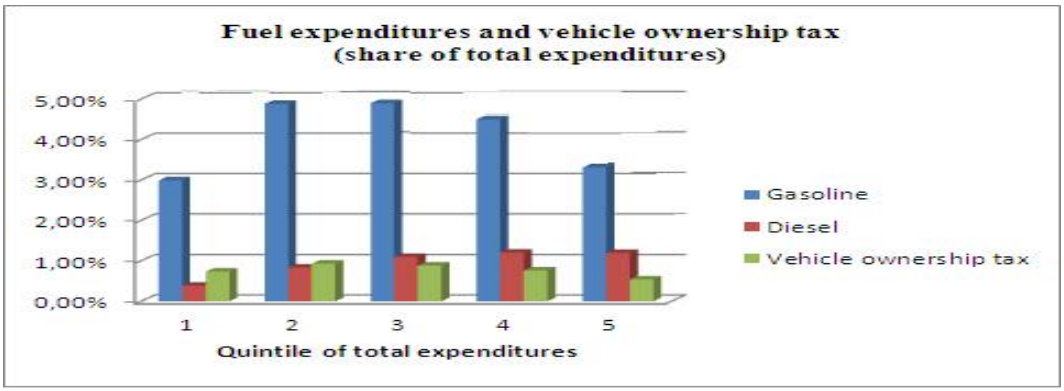


Figure 1: Fuel expenditures and vehicle ownership tax (share of total households expenditures)

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 regressive (Figure 2). 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.

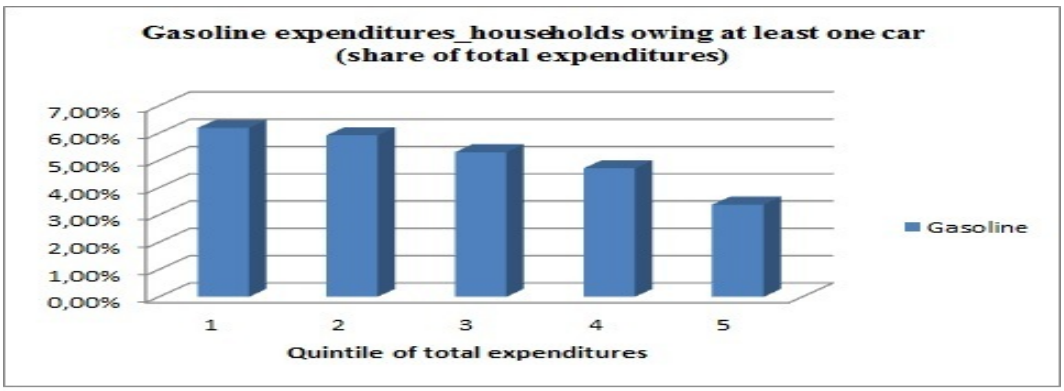


Figure 2: Gasoline expenditures-households owing at least one car (share of total expenditures)

Diesel oil expenditures are mildly progressive (Figure 1). The share of diesel expenditures relative to total expenditures increases steadily from the $1^{st}$ to the $4^{th}$ quintile. Basically, households belonging to the richest quintiles of the population pay comparatively more. The reason for this finding can be at least partially justified by the fact that cars fueled by diesel oil are generally more expensive than vehicles fueled by gasoline, and therefore more widespread among richer households.

Vehicle ownership taxes show the same pattern of gasoline expenditures (Figure 1). 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[46].

The socio-economic features of the households are another important factor to take care of.

Households located in rural areas seem to be affected by fuel expenditures more than those located in cities. According to our sample, rural households spend on average 13% more on gasoline and 41% more on diesel oil than their counterparts located in cities. Likewise, vehicle ownership taxes paid by rural households are 14% higher. These values vary greatly if the shares by quintile are considered. Just to give an example, rural households belonging to the first quintile spend 37% and 94% more on gasoline and diesel oil respectively (27% in the case of ownership taxes), than the households located in cities in the same quintile[47]. The higher expenditures on diesel oil of rural households seem to suggest they prefer cars fueled by diesel; these are generally more efficient, and diesel oil costs less than gasoline. Households located in cities own less cars and, mostly, drive less; while households in rural areas drive more and sometimes do not have any other option apart form their own means of transportation. It is worth noting that, in the case of vehicle ownership taxes, the higher incidence on rural households may be compensated by other forms of property taxation (mainly on houses) commonly heavier for urban households[48].

The number of persons making up a household also matters in terms of distributional effects. On average, households made up of three or more individuals spend on gasoline (4,96%), diesel (1,09%) and vehicle ownership taxes (1,04%) more than their counterparts[49] (3,61%; 0,8% and 0,61% respectively)[50]. Looking at the shares by quintile, it is remarkable that households of three or more components belonging to the first quintile spend more than twice on either fuel expenditures and vehicle ownership taxes than singles and couples. Concerning the vehicle ownership tax, this shows a clear regressive profile when families are concerned, while a "bell shaped" profile in the case of singles and couples[51].

In order to have a summary measure of progressivity vs. regressivity, the Kakwani index[52] has been computed[53]. This accounts for -0.1256 in the case of vehicle ownership taxes and -0.0793 for gasoline expenditures, meaning they are regressive. The evidences are largely in line with the previous literature analyzed in Section 2. The Kakwani index for diesel oil expenditures is surprisingly positive (0.0741). A result that, as mentioned before, seems to suggest richer households do prefer cars fueled by diesel oil, that are generally more expensive.

[46]The analysis suffers from the fact that the vehicle ownership tax is calculated on an average base, without considering the real engine power and emission class of the cars owned by each household member. As established by Law n. 296/2006, the vehicle ownership tax rates vary progressively according to the engine power and regressively according to the environmental class of cars. As a result, the overall effect is quite controversial.

[47]Detailed results by quintile are available from the authors upon request.

[48]So that the overall fiscal incidence may result more balanced.

[49]These are singles or couples.

[50]These percentages are shares over total expenditures.

[51]Detailed results by quintile are available from the authors upon request.

[52]The Kakwani index is defined as the negative difference between the Gini coefficient for total expenditures and the concentration coefficient of the tax payments. The measure is positive for a progressive tax, zero for a tax that is proportional, and negative for a regressive tax.

[53]The values have been computed with 1000 bootstrap replications and are all 99% significant.

## 5.2 Distributional impacts of expenditures on electricity and gas

Table 5 presents the share of electricity and gas[54] payments[55] over total expenditures for the whole sample, and for certain subgroups of individuals.

Table 5: Households expenditures on gas and electricity (share of total expenditures)

| | Whole sample | | Rural | | Large families | |
|---|---|---|---|---|---|---|
| | Electricity | Gas | Electricity | Gas | Electricity | Gas |
| 1 | 3.88% | 3.25% | 4.09% | 2.56% | 5.88% | 1.99% |
| 2 | 2.69% | 3.18% | 2.85% | 2.57% | 4.03% | 2.35% |
| 3 | 2.27% | 2.90% | 2.48% | 2.41% | 3.06% | 2.45% |
| 4 | 1.90% | 2.71% | 2.10% | 2.23% | 2.28% | 1.95% |
| 5 | 1.35% | 2.00% | 1.48% | 1.79% | 1.73% | 1.75% |
| K Index* | -0.21 | -0.1234 | | | | |

Source: Authors' creation.

*Notes*: * Kakwani index of progressivity

With respect to the whole sample, both electricity and gas expenditures follow a regressive pattern: those affected the most by these energy expenditures are households of the $1^{st}$ quintile. Notwithstanding on average gas expenditures bear on Italians more than electricity payments, the evidence is reversed for the poorest share of the population. Households belonging to the $1^{st}$ quintile spend comparatively more on electricity (3.88% of total expenditures) than on gas (3.25%). Moreover, while the poorest ($1^{st}$ quintile) spend 62.5% more on gas than their richest counterparts ($5^{th}$ quintile), the figure is even worst in the case of electricity, where the bill is almost twice (187.4%) the one paid by the richest. This evidence seems to suggest the recently introduced gas and electricity bonus are not that much effective in promoting a reduction in the economic burden of low income people. These bonus, in fact, are distributed according to the ISEE indicator (Equivalent Economic Situation Indicator), which taxes into account family features, assetes and decleared income. It might be the case that phenomenon of tax evasion and elusion arise, leading to the bonus being granted to families that otherwise would not benefit of it.

If the subsample of individuals living in rural areas is taken into account, the shares of electricity payments over total expenditures still shows a regressive path, with the $1^{st}$ quintile being hit the most by this kind of expenditures. However, compared to twose living in cities[56], households located in rural zones spend comparatively more on electricity than on gas, and this evidence has solid grounds not just for the $1^{st}$ quintile of the population but for the entire expenditures distribution. Such a finding can be justified by different habits and preferences toward heating and cooking technologies, given that gas is sometimes unavailable to houses located

[54]By "gas" we mean "network gas", gas cylinders are excluded.

[55]The ISTAT dataset does not provide information on the concrete quantity of electricity and gas consumed, neither on the KW of installed power. It has not been possible to apply the data the necessary adjustments to reflect the progressivity the law allows with respect to the levels of consumption. The households expenditures on the two energy carriers are used instead.

[56]Results on the subsamble of households living in cities are available from the authors upon request.

far from the city centres. The share of gas expenditures over total expenditures is almost the same for the $1^{st}$ (2.56%) and $2^{nd}$(2.57%) quintiles and then starts declining.

Finally, turning to the subsample of households made up of couples with three or more children, the incidence analysis shows electricity expenditures are regressive starting from the $1^{st}$ quintile on, as in the whole sample. In the case of gas instead, the expenditures are progressive from the $1^{st}$ to the $3^{rd}$ quintile, an effect that can be explained by the proper functioning of the bonus mechanism and by the emergence of economies of scale in the gas consumption patterns of large families[57].

The Kakwani index of progressivity accounts for $-0.1234$ in the case of gas, while for $-0.21$ in the case of electricity[58], meaning the expenditures on electricity are far more regressive than those on gas.

## 5.3 Distributional impacts of vehicle ownership taxes: some tentative alternative policy designs

The main aim of this part of the analysis is to suggest some alternative policy designs. Three fundamental objectives are simultaneously kept in mind: taxing "bads" and prompting environmentally friendly behaviors; collecting consistent revenues; countervailing equity problems.

We concentrate on different designs of the vehicle ownership tax.

Given the nature of the gasoline market, it is almost impossible or extremely difficult to distinguish between different types of user and in such a way grant tax credits or rebates for those who are hit the most by fuel taxes. Instead, vehicle ownership taxes can be more easily and profitably modified so as to countervail equity problems.

Four alternative tax designs are proposed:

1. Households are taxed progressively according to the number of cars they own. The first car is taxed $\frac{1}{2}x$[59], the second car $x$ and from the third one on, cars are taxed $2x$.

2. Households are taxed more progressively according to the number of cars they own. The first car is taxed $\frac{1}{3}x$, the second car $x$ and from the third one on, cars are taxed $3x$[60].

3. Households are taxed in accordance to the previous rule (Alternative 2); tax credits are granted to families with children: families with one child up to three children[61] benefit of a 50 € credit a year for every child. The revenue loss (53.732 €) is covered by a small increase in the vehicle ownership tax due by each household owing at least one car. Such an increase is set so as to leave

[57] Larger families generally live in larger apartments, suitable to realize economies of scale on gas consumption.

[58] The values have been computed with 1000 bootstrap replications and are all 99% significant.

[59] $x$ is the basic tax defined so as to collect the same amount of revenue of the vehicle ownership tax as computed in Section 5.1. $x$ varies according to the geographical macro areas defined in footnote n. 42.

[60] This option, and to a lesser extent Alternative 1, considers the first car similar to a "necessity". In this way the "fiscal discontinuity" between households without cars and those owing only one is strongly reduced.

[61] The same tax credits are granted to families having one up to three dependent people.

unchanged the relative share of each household in terms of contribution to the total revenue.

4. Households are taxed and benefit of tax credits as in the previous alternative. In this case the revenue loss is covered with a lump sum tax (2,89 €) levied on households owing at least one car.

Table 6 reports the results of the incidence analysis carried out on the four alternatives discussed. These are plotted against a counterfactual "baseline": the vehicle ownership tax as discussed in Section 5.1.

The progressivity of the vehicle ownership tax increases along with the alternatives we suggest.

In case of Alternative 1, the share of vehicle ownership taxes over total expenditures increases from the $1^{st}$ to the $3^{rd}$ quintile and then starts declining from the $4^{th}$ quintile on. Households belonging to the $3^{rd}$ quintile are those affected the most by the tax. With Alternative 2, the share increase from the $1^{st}$ to the $4^{th}$ quintile following a more progressive path than before. Households pertaining to the $3^{rd}$ and $4^{th}$ quintile are those mostly hit by the vehicle ownership tax and for those in these two quintiles the share of vehicle taxes over total expenditures is the same (0,8%). Alternative 3, including tax credits for families with children or dependent people, follows a progressive path from the $1^{st}$ to the $4^{th}$ quintile. Households belonging to the $4^{th}$ quintile spend on average 0,81% of their total expenditures on vehicle ownership taxes. With Alternative 4, the incidence analysis follows a path similar to Alternative 1. The rate increases from the $1^{st}$ to the $3^{rd}$ quintile and then starts declining.

Table 6: Vehicle ownership tax-baseline and alternative options (share of total expenditures)

| | Baseline | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|---|
| 1 | 0.73% | 0.57% | 0.46% | 0.45% | 0.57% |
| 2 | 0.93% | 0.79% | 0.70% | 0.68% | 0.76% |
| 3 | 0.89% | 0.84% | 0.80% | 0.79% | 0.83% |
| 4 | 0.77% | 0.79% | 0.80% | 0.81% | 0.80% |
| 5 | 0.54% | 0.62% | 0.68% | 0.69% | 0.65% |
| RS Index* | -0.0009 | -0.0005 | -0.0002 | 0.0001 | 0.0003 |

Source: Authors' creation.

*Notes*: * Reynolds-Smolensky index of redistributive capacity

To get a better indication of the incidence of the different hypothesis suggested, we rely on the Reynolds-Smolensky index[62]. This measure serves as a guide to the impact that a change in a certain tax would have had on the income distribution or poverty. According to the results provided in Table 6, the policy options with the higher redistributive capacity are Alternative 3 and 4. The positive values indicate

[62]The Reynolds-Smolensky index is based on changes in the Gini coefficient. Basically, it measures the difference of the Gini coefficient for pre-tax income and the Gini coefficient for post-tax income. A positive value indicates a progressive tax, because the after tax distribution is less unequal than the original situation. The other way around, a negative result means that the tax is regressive, given that it worsens the income distribution.

progressive taxes with redistributive potential, and Alternative 4 seems even more promising than Alternative 3.

## 5.4 Distributional impacts of alternative fiscal measures: VAT, vehicle ownership taxes, fuel excise duties

Given the recent budget shortages, the Italian government has intervened with Decree n. 201/2011 containing urgent measures for growth, equity and the consolidation of the public finances. According to Art. 18 of the Decree, as of October 2012 the value added tax rates of 10% and 21%[63] are going to be raised by two percentage points.

This fiscal measure has raised several concerns on the perverse distributive effects that might come up. A further increase in the VAT in fact could affect the lowest income households the most (Ravagli and Sciclone, 2012; Tax Research UK, 2010).

In the following we compare three different measures capable of collecting the same revenues that a 2% increase in the VAT[64] would bring about (1.143.017 €). These are:

- Fuel excise duties[65]
- Vehicle ownership tax (Baseline)- The cars owend are taxed in the same way. The tax rate $x$[66] does not change according to the number of cars owned.
- Vehicle ownership tax (Alternative 1)- As in the case discussed in Section 5.3, households are taxed progressively according to the number of cars they own. The first car is taxed $\frac{1}{2}x$ [67], the second car $x$ and from the third one on, cars are taxed $2x$.

Table 7 provides the results of the incidence analysis carried out on the three alternatives mentioned.

In case fuels[68] excise duties are raised, the share of fuel payments over total expenditures increases from the $1^{st}$ to the $3^{rd}$ quintile. Those belonging to the $3^{rd}$ quintile are affected the most by fuel expenditures. The progressivity of the first three quintiles can be justified by the fact that some households with low income do not own any car, accordingly their monthly fuel expenditures are zero.

Turning to the vehicle ownership tax, in case equal tax rates are applied to the cars owned, the share of payments over total expenditures increases from the $1^{st}$ to the $2^{nd}$ quintile and than starts declining. This figure improves if the alternative policy design is considered. In fact, if the tax rates increse along with the number of cars owned, the vehicle ownership tax becomes more progressive. The share of tax payments over total expenditures increases from the $1^{st}$ to the $3^{rd}$ quintile included.

[63] The value added tax was previously raised from 20% to 21% with Decree n. 138/2011. In the following, we analyze the effects of an increase of two percentage points of the VAT as it was in 2009 (20%).

[64] The 2% increase in the VAT has been computed supposing a 2% increase in the total expenditures faced by Italian households in 2009.

[65] The estimate is realized identifying the percentage increase that fuel expenditures should undergo (40.44%) so as to collect the same revenue.

[66] $x$ varies according to the geographical macro areas defined in footnote n. 42.

[67] $x$ varies according to the geographical macro areas defined in footnote n. 42.

[68] Both gasoline and diesel.

Table 7: Households expenditures on gas and electricity (share of total expenditures)

| | Fuel duty | Vehicle ownership tax | |
|---|---|---|---|
| | | Baseline | Alternative 1 |
| 1 | 1.37% | 2.07% | 1.62% |
| 2 | 2.31% | 2.66% | 2.27% |
| 3 | 2.41% | 2.55% | 2.42% |
| 4 | 2.31% | 2.22% | 2.29% |
| 5 | 1.82% | 1.59% | 1.80% |
| RS Index* | -0.0011 | -0.0025 | -0.0013 |

Source: Authors' creation.

*Notes*: * Reynolds-Smolensky index of redistributive capacity

To get a measure of the redistributive capacity each of the alternatives analyzed would have on households income, the Reynolds-Smolensky index is computed. The results suggest an increase in fuel excise duties and vehicle ownership taxes (alternative 1) being the fiscal measures with the best redistributive effects ($-0.0011$ and $-0.0013$ respectively).

# 6 Conclusions

While environmental economists have been traditionally focusing on efficiency issues, considering distributional impacts as a necessary evil, the equity effects of environmental taxes should not be disregarded, especially if their number and fiscal role increases over time. Equity is important in shaping green levies, not lastly because it influences the public debate and general acceptability.

Our study focuses on the main environmental taxes applied to the energy and transport sectors in Italy: namely energy excise duties and vehicle ownership taxes[69]. Their incidence analysis, based on current expenditures, is carried out on a sample of more than 23.000 Italian households.

Our results can be summarized as follows:

- Both gasoline taxes and vehicle ownership taxes are found to be progressive from the $1^{st}$ poorest quintile to the $2^{nd}$ one, almost proportional from the $2^{nd}$ to the $3^{rd}$, and regressive in the last two. This evidence confirms the reverse U shape pattern obtained by most of the literature.

- Diesel oil expenditures, instead, work progressively for almost the whole income distribution. This result can be partially justified by the fact that diesel cars are more expensive than those fueled by gasoline. To our knowledge no other study in the literature displays the same findings, so that further investigations will be necessary.

[69] We concentrate on annual taxes mainly because the European Commission suggests the gradual shift from one-off taxes on car purchases to recursive taxes to be paid at a certain point of time every year (COM(2005)261); and even because recursive revenue sources better suit to the need of a public budget.

- Both electricity and gas expenditures follow a regressive pattern: those affected the most are households belonging to the $1^{st}$ quintile. The evidence supports the idea of the recently introduced gas and electicity bonus being not decisive in promoting a reduction in the economic burden of low income households.

- Geographical and socio-economic features of households deeply influence the redistributive patterns: rural households tend to be affected more within each income quintile. Concerning large families, gas expenditures are mildly progressive (from the $1^{st}$ to the $3^{rd}$ quintile), an evidence that can be explained by the emergence of economies of scales in large families living in big apartments.

- In order to change the redistributive impacts, vehicle ownership taxes can be adapted to the socio-economic characteristics of different households, emphasizing their wealth-related component. We have simulated, under a revenue neutral hypothesis, lower taxes for the first family car and/or tax credits for large families, finding that regressive effects are strongly circumscribed. This opportunity can be further developed with rates based on the car price and/or engine power: an option already applied in Italy, but not investigated here due to data shortages on the characteristics of the vehicles belonging to the single household.

As a whole, at a time where many governments are confronted with the need to raise additional revenues, transport taxes can represent a promising tool to achieve budgetary and environmental objectives. In particular, recurrent ownership taxes meet several qualities of a "good" revenue source, exploitable even at the sub-national level (wideness and stability, visibility, low mobility, low tax evasion, low administrative costs), while at the same time maneuvered to pursue the upgrading of the environment performance of the vehicle fleet. A correct policy design, considering engine power, price, vehicles' age and households' characteristics can probably also weaken the equity fears commonly associated with environmental related levies.

# References


Aasness, J. and Larsen, E. (2003). Distributional effects of environmental taxes on transportation. *Journal of Consumer Policy*, 26(3):279–300.

ACI (2010). Autoritratto 2009. Il parco veicolare in Italia. http://www.aci.it.

Bernardi, L. (2011). Economic crisis and taxation in Europe. *Rivista di diritto finanziario e scienza delle finanze*, 2(1):175–211.

Bork, C. (2006). Distributional effects of the ecological tax reform in Germany: an evaluation with a microsimulation model. In *The distributional effects of environmental policy*, pages 139–170. Edward Elgar.

Bracewell-Milnes, B. (1979). Measurement of tax progressivity. A comment. *The Economic Journal*, 89(355):648–651.

Brännlund, R. and Nördstrom (2004). Carbon tax simulation using a households demand model. *European Economic Review*, 48(1):211–233.

Bruha, J. and Scasny, M. (2006). Distributional effects of environmental regulation in Czech Republic. Charles University Environment Center, Prague, Czech Republic.

Carraro, F. and Zatti, A. (forthcoming, 2012). Environmental taxation and the municipal fiscal federalism: remarks and perspectives on the Italian case study. Economics and Policy of Energy and the Environment.

EC (1993). Towards sustainability. A European Community programme of policy and action in relation to the environment and sustainable development. European Commission (EC): Luxembourg.

EC (2001). Tax provsions with a potential impact on environmental protection. European Commission (EC): Luxembourg.

EC (2007). GREEN PAPER on market-based instruments for environment and related policy purposes. European Commission (EC): Luxembourg.

EC (2008). Communication from the Commission. Strategy for the internalization of external costs, COM(2008)435. European Commission (EC): Brussels.

EC (2010). Communication from the Commission. EUROPE 2020. A strategy for smart, sustainable and inclusive growth, COM(2010)2020. European Commission (EC): Brussels.

ECMT (2003). Reforming transport taxes. OECD Publications, Paris.

EEA (2000). Environmental taxation - recent developments in tools for integration. European Environment Agency.

EEA (2006). Using the market for cost-effective environmental policy. European Environment Agency.

EEA (2011). Environmental tax reform in Europe: implications for income distributions. Technical Report n. 16, European Environment Agency.

Eurostat (2011). Taxation trends in the European Union. Luxembourg.

Friedman, M. (1957). A theory of the consumption function. Princeton University Press.

Fullerton, M., Leicester, A., and Smith, S. (2008). The incidence of a U.S. carbon tax: a lifetime and regional analysis. NBER Working Papers 14197.

Green Fiscal Commission (2009). The case for green fiscal reform. Final report. London.

Hasset, K., Mathur, A., and Metcalf, G. (2007). The incidence of a U.S. carbon tax: a lifetime and regional analysis. NBER Working Papers 13554.

Haughton, J. and Khandker, S. (2009). Handbook on poverty and inequality. The World Bank.

Jacobsen, H. K., Birr-Pedersen, K., and Wier, M. (2003). Distributional implications of environmental taxation in Denmark. *Fiscal Studies*, 24(4):477–499.

Johnstone, N. and Alavalapati, J. (1998). The distributional effects of environmental tax reform. IIED environmental economics programme discussion paper - International Institute for Environment and Development.

Johnstone, N. and Serret, Y. (2006). Distributional effects of environmental policy: introduction. In *The distributional effects of environmental policy*, pages 1–19. Edward Elgar.

Kakwani, N. (1977). Measurement of tax progressivity. An international comparison. *The Economic Journal*, 87(345):71–80.

Kosonen, K. (2010). Why are environmental tax revenues falling in the European Union? In *Critical Issues in environmental taxation: International and comparative perspectives. Vol. VIII.* Richmond Law & Tax Publisher Ltd., Oxford University Press, Oxford.

Kriström, B. (2006). Framework for assessing the distribution of financial effects of environmental policy. In *The distributional effects of environmental policy*, pages 79–136. Edward Elgar.

Larsen, E. (2006). Distributional effects of environmental taxes on transportation: evidence from Engel curves in the United States. *Journal of Consumer Policy*, 29(3):301–318.

Leicester, A. (2006). The UK tax system and the environment. The Institute for Fiscal Studies.

Leipprand, A., Gavalyugova, N., Meyer-Ohlendorf, N., Blobel, D., and Persson, A. (2007). Links between the social and environmental pillars of sustainable development, Task 1D: environmental taxes. Ecologic.

Metcalf, G. E. (1999). A distributional analysis of green tax reforms. *National Tax Journal*, 52(4):655–682.

Modigliani, F. and Brumberg, R. (1954). Utility analysis and the consumption function: an interpretation of cross-section data. In *Post-Keynesian Economics*, pages 388–436. NJ. Rutgers University Press, New Brunswick, New Jersey.

OECD (1996). Implementing strategies for environmental taxes. Paris.

OECD (1997). Environmental taxes and green tax reform. Paris.

OECD (2001). Environmentally related taxes in OECD countries. Paris.

OECD (2006). The political economy of environmentally related taxes. Paris.

OECD (2009). The scope for $CO_2$-Based differentiation in motor vehicle taxes. ENV/EPOC/WPNEP/T(2009)1/Final, Paris.

OECD (2010). Tax policy reform and economic growth. Paris.

Pearson, M. and Smith, S. (1991). The European carbon tax: an assessment of the European Commission's proposals. London: Institute for Fiscal Studies.

Poterba, J. M. (1991). Is the gasoline tax regressive? *Tax Policy and the Economy*, 5:145–164.

Ravagli, L. and Sciclone, N. (2012). L'aumento delle imposte dirette ed indirette: gli effetti distributivi e di gettito dell'addizionale, dell'Imu e dell'Iva. Una stima per la Toscana. IRPET, Osservatorio regionale sul federalismo fiscale.

Reynolds, M. and Smolensky, E. (1977). Public expenditures, taxes and the distribution of income: the U.S., 1950, 1961, 1970. Academic Press, New York.

Speck, S. and Gee, D. (2011). Implications of environmental tax reform: revisited. In *Critical Issues in environmental taxation: Environmental Taxation and Climate Change. Vol. X*. Edward Elgar Publisher.

Sterner, T. (2012). Distributional effects of taxing transport fuel. *Energy Policy*, 41:75–83.

Tax Research UK (2010). Is VAT regressive and if so why do the IFS deny it. http://www.taxresearch.org.uk.

Tucciarelli, C. (2012). Corte costituzionale e federalismo fiscale. www.forumcostituzionale.it.

Veermend, W., Van der Ploeg, R., and Timmer, J. (2009). Taxes and the economy. Pbk ed., Cheltenham & Northampton, Edward Elgar.

Walls, M. and Hansen, J. (1996). Distributional impacts of an environmental tax shift: the case of motor vehicle emissions taxes. Resources For the Future, Discussion Paper 96-11.