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The reform of the European Energy Tax Directive: does data disaggregation matter? The Italian case

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Abstract: In 2011, the European Commission (EC) proposed a new version of the Energy Taxation Directive (ETD), a tax affecting the price of energy products. The main aim was to increase the effectiveness of the instrument through stronger fiscal pressure and to coordinate the environmental taxation with the Emissions Trade System (ETS) introduced in 2005. However, in May 2012 the European Parliament did not approve the reform.

Italy, already characterized by high energy taxation rates, has recently expressed a commitment to increase the use of environmental taxation by explicitly referring to the amendments proposed by the EC in 2011. This study analyzes the effect of the 2011 ETD reform on prices in Italy, if it were implemented. The main finding is that the new tax regime would have a low impact on prices. This result implies that the reform would not significantly orient consumption and production towards more environmentally-friendly patterns.

JEL Codes: C67, D57, H23, Q48, Q53.

Keywords: Energy Tax, Price Impact, European Union, Italy, Green House Gases Emissions.

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1. Introduction

There are several policy instruments that try to control emissions in order to cope with risks of atmospheric contamination. Many of these tools use economic mechanisms to influence the existing production and consumption patterns. These economic mechanisms, generally classified in price-mechanisms and quantity-mechanisms, should minimize abatement costs by creating an incentive to develop alternative technologies or to use alternative energy products.

Concerning Europe, the EU countries have two levels of regulation, the Community level and the national level. On the one hand the European Union (EU) takes part in the regulation process creating a common framework in order to reach its environmental commitments and in order to standardize, at least partially, the different national approaches; on the other hand each member state has the legal competency to regulate emissions.

The European Union (EU) has two important economic mechanisms for emission control: the Emissions Trade System (ETS) -a cap and trade system introduced in 2005 that directly affects the emission quantity- and a system of environmental taxes on energy products.

With regard to environmental taxes, the European Energy Taxation Directive (ETD) approved in 2003 (European Council, 2003) governs the current regime. The ETD resulted from a process started in the early 90s aimed at harmonizing carbon and energy taxes in the EU. Given this aim, the 2003 directive fixed different minima tax rates on the use of different energy products that countries had to take into account when enacting their national implementations. The minima rates were further differentiated depending on the energy content of each energy product, resulting in different rates for the different purposes each energy product was used for (as a motor fuel, for heating, or industrial use). Although the ETD clearly reflected environmental concerns, it was also shaped by the need to ensure that the internal market operated correctly. This explains why the legislation considered the dependence and intensity in the use of energy products for some industries and the consequent impact of taxation in terms of competitiveness by proposing a complex system of reductions and exemptions in different sectors.

In 2011, the European Commission (EC) proposed a new version of the ETD (European Commission, 2011a) aimed at increasing the fiscal pressure on energy products and coordinating the environmental taxation with the ETS. This new version contained three main changes (see details in Appendix A, Table A.1). Firstly, the text fixed higher rates in an attempt to cause a shift towards less polluting production and consumption patterns. Secondly, the reform split the existing energy taxes into two components that, taken together, determine the overall rate at which a product is taxed. The two components are energy taxation specifically linked to CO_2 emissions, and energy taxation based on the energy content of the products. This novelty should help establish a comprehensive and consistent CO_2 price signal outside the EU ETS. Finally, the reform also tried to restructure and simplify the framework of reductions and exemptions, towards the general rule of limiting them to the second component, that is the energy taxation based on the energy content of the products.

Nonetheless, in May 2012 the European Parliament stopped the ETD reform. The main worry seemed to be the effect of such proposal on competitiveness; in particular the concern regarded sectors that would be mostly affected given their intensive use of energy products.

The Italian position concerning environmental taxation is quite peculiar. In 2007 the country introduced its current legislation (Italian Government, 2007) to implement the 2003 European ETD. This legislation places Italy halfway between the northern and the other southern European countries. The first ones typically implement higher energy taxation, while southern European countries are usually characterized by a lower environmental tax burden. Nowadays Italy has a relatively high level of energy taxation on diesel for transport and on heavy fuel oil (HFO) for heating and industrial use. However, the fiscal rates imposed on other energy products such as liquefied petroleum gas (LPG) or natural gas are below the 2011 ETD proposal. Moreover, Italy has recently expressed a commitment to increase the use of environmental taxation (Chamber of the Deputies and the Senate of the Republic, 2014). To review excise duties on energy products and electricity, the Parliament explicitly referred to the reform of the ETD proposed by the EC in 2011 (European Commission, 2011a).

Anyway, even if Italy stated the will to increase the use of energy taxes and did not oppose the reform proposed by the Commission in 2011, some economic agents declared a negative opinion against the reform and they called on the European Parliament and the Council to disassociate them from the proposed increase in taxation.[1]

Given that Italy is planning to introduce changes in the existing legislation considering the 2011 Commission proposal, the aim of this study is to analyze the effect that the 2011 ETD reform would have had in Italy, if implemented. In particular, this work tries to verify the robustness of the results previously found in Rocchi et al. (2014). While the previous analysis was based on the multi-region World Input-Output Database (WIOD), we now take advantage of a detailed dataset on energy use obtained for Italy. Compared to WIOD, the main advantage of the data obtained for Italy is that they offer information on energy use disaggregated in different purposes. For each economic sector and each energy product analyzed, they show what share has served for heating use, for transport use, and for other energy use with or without combustion. This data disaggregation fits the scope of our analysis. Since the reform proposed different levels of taxation depending on the use of energy products, the detailed database on energy use permits to avoid some transformations needed in the previous analysis.

However, since disaggregated data are available only for Italy, we carry out the analysis within a single-region framework. Single-region models were more frequently applied before multi-region databases were made available. Lately more comprehensive multi-region frameworks have substituted them, offering more reliable information about technological processes used to produce goods and services domestically and abroad. On the contrary a single-region framework assumes that products imported in a region have been produced using the same technology available in the region analyzed ("domestic technology assumption"). Anyway, in this analysis we use a single-region framework because it makes it possible to employ more detailed information on energy products use. The comparison between the results obtained in this analysis with the results previously obtained permits to show if the framework strongly biases the results, or if

[1] Three major European automobile manufacturer associations ("Associazione Nazionale Filiera Industria Automobilistica" for Italy, "Comité des Constructeurs Français d'Automobiles" for France and "Verband der Automobilindustrie" for Germany) have issued a joint statement against the proposed increase in diesel taxation. The main claim was an expected negative impact on the European automobile market as the demand for diesel and gas car models would decrease considerably due to the increase in taxation. See National Association of the Automotive Industry et al. (2011).

single-region models can still be a reliable instrument that permits to use information not available at a multi-region level.

Environmental taxes are largely analyzed as they are important as emissions control tools, and the literature on the topic is quite rich. Studies go from basic economic analyses on functions of abatement costs to analyses of more complex implications, such as the effects of environmental tax on competitiveness and the case of double dividend, or the tax incidence and the effects in terms of social welfare and redistribution.

Regarding Italy, Montini (2000) describes the relation between the Italian policies and the international legal framework such as the United Nations Framework Convention on Climate Change (UNFCCC) or the Kyoto Protocol. Besides this descriptive analysis, Tiezzi (2005) analyzes the effects of the Italian carbon tax introduced in Italy at the beginning of 1999. Using true cost of living index number and compensating variation, she studies the welfare effects and the distributive impact on Italian households. Although she finds substantial welfare loss, the redistribution does not reveal that the Italian carbon tax of 1999 was regressive. Afterwards, Martini (2009) extended the work of Tiezzi, analyzing more in details different types of households and macro-regions, and she proposes additional policy scenarios. Bartocci and Pisani (2013), and Cingano and Faiella (2013) estimate the effects of possible carbon taxes on private transport. They use, respectively, a general equilibrium model and a hybrid model to find out the effect on energy demand, total emissions, and other macroeconomic implications. Both analyses find that the carbon tax would reduce emissions reducing the demand for private transport.

As far as we know, only Mongelli et al. (2009) estimate the effect of different carbon tax rates on prices at a sector level. They find that a carbon tax of 20 euro per ton of CO_2 would produce a modest increase in prices. Our analysis falls into this last research line, but unlike Mongelli et al. (2009) we do not propose hypothetical carbon taxes but we analyze the effects on prices that the 2011 ETD reform would have had in Italy if implemented, using detailed data about sectoral energy consumption. Moreover the comparison with the results obtained in Rocchi et al. (2014) permits to verify if, in the case analyzed, a single-region model can be a good approximation of more realistic multi-region models.

After describing methodology and data in Sections 2 and 3, Section 4 shows the main results, and Section 5 concludes.

2. Methodology

In this analysis we consider one region with n sectors, each sector producing one product j. The total production cost for j depends on its inputs and its value added. The input-output table contains information about all region's inter-industry deliveries: in this table the j-th column shows the total value of the j-th industrial output as the sum of the production cost $x_j = \sum_{i=1}^{n} x_{ij} + v_j$, where x_j is the total j-th sector's output, x_{ij} is the input that the j-th sector needs from the i-th sector, and v_j is the value added.[2] In matrix terms, we have $\mathbf{x}' = \mathbf{A_t}\hat{\mathbf{x}} + \mathbf{v}'$, where $\mathbf{A_t}$ shows the technology of the region, whose elements are $a_{ij} = x_{ij}/x_j$. The single-region input-output model assumes that the region acts as a closed economy: matrix $\mathbf{A_t}$ shows the total input coefficients, considering both domestic and foreign inputs.

Post-multiplying by $\hat{\mathbf{x}}^{-1}$ and re-writing the expression, we obtain the cost per unit of output as $\mathbf{p}' = \mathbf{w}'(\mathbf{I} - \mathbf{A_t})^{-1} = \mathbf{w}'\mathbf{L_t}$, where $\mathbf{w}$ represents the cost of primary inputs per unit of output and $\mathbf{p}$ is the price vector in which each price is indexed and equal to 1. The price vector depends on primary input cost and on the Leontief matrix $\mathbf{L_t}$ derived from the matrix of total input coefficients $\mathbf{A_t}$.

Whenever an additional cost per unit value of output $\mathbf{t}$ is added, a new price vector is considered; then the new price would be defined by $\tilde{\mathbf{p}}' = (\mathbf{w}' + \mathbf{t}')\mathbf{L_t}$. The increase in prices is given by the difference between the new prices vector and the old one: $\Delta\mathbf{p}' = (\mathbf{t}')\mathbf{L_t}$.

The analysis considers the increased energy taxation as additional cost. So, regarding the new cost $\mathbf{t}$, it is necessary to work out the additional tax per unit of product that each sector would have faced if the reform proposal

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[2] Matrices are indicated by bold, upright capital letters; vectors by bold, upright lower case letters; and scalars by italicized lower case letters. Vectors are columns by definition, so that row vectors are obtained by transposition, indicated by a prime. A circumflex indicates a diagonal matrix with the elements of any vector on its diagonal and all other entries equal to zero. The notation $\mathbf{i}$ is used to represent a column vector of 1's of appropriate dimensions.

had been implemented. Given this aim, it is necessary to know, for each sector, the consumption of the different energy products per unit of output, and the additional taxation on each energy product. So, vector $\mathbf{t}$ is computed as, $\mathbf{t} = (\mathbf{D} \circ \mathbf{R})$ where $\mathbf{D}$ is a matrix of coefficients of energy use by energy product and by purpose, $\mathbf{R}$ is a matrix of tax rates variations, i is a column vector of appropriate dimension, and $\circ$ is the element-wise product of matrices $\mathbf{D}$ and $\mathbf{R}$. In particular, $\mathbf{D}$ is obtained considering a matrix $\mathbf{E}$ of energy flows disaggregated by purpose from energy-producing sectors to all sectors and considering the output $\mathbf{x}$ produced by each sector $\mathbf{D} = \mathbf{E}\hat{\mathbf{x}}^{-\mathbf{1}}$.

As for the analysis at the EU level, we compare the cost of the basket of goods that characterizes households' consumption before the implementation of the new energy tax with the cost of the same basket after the reform. This price index W takes into account that the EU energy tax reform also applies to energy products consumed directly by households:

$$W = \frac{\sum_{i=1}^{n} \tilde{p}_i q_i + \sum_{e=1}^{m} t_e q_e}{\sum_{i=1}^{n} p_i q_i} \tag{1}$$

Being q_i the quantity of goods and services i consumed by households, p_i the initial price of the commodity i, $\tilde{p}_i$ the new price after the proposal implementation, t_e the tax variation of each energy product e applied to households' consumption, and q_e the quantity of each energy product consumed by households.

3. Data description

To analyze the effects of the 2011 ETD reform in Italy three databases have been used.

First, economic information on Italian productive system is available in the Italian input-output tables (ISTAT, 2011). We use the year 2008 as an approximation of 2011. [3]

Second, to work out the additional tax per unit of product that each sector would have faced we use information regarding the present tax rates applied in Italy (European Commission, 2011b)[4] and the environmental tax rates proposed by the 2011 ETD reform (European Commission, 2011a).

Finally, the matrix of energy use coefficients is derived using the energy use tables estimated by the Italian National Statistical Institute (ISTAT).[5] In particular, as regards the industrial use of energy products, the analysis takes advantage of detailed information recorded by ISTAT: indeed, the institute compiles three-dimensional energy use tables annually. These tables provide data about intermediate and final consumption of energy, desegregated by energy product,[6] by activity[7] and by purpose. More in detail, purposes are classified in three main blocks: energy use with combustion, energy use without combustion, and non-energy use. These blocks are further divided as Table 1 shows.

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[3] When the following analysis was done, the year 2008 was the last available for both input-output tables and energy use data.

[4] As for Italy, the information is updated to August 2011. The database refers to the legislative decree 504 of 1995 (Italian Government, 1995), updated in 2007 (Italian Government, 2007). These acts are the implementation of the Council Directive of 2003 96/EC (European Council, 2003; European Parliament and Council, 2003), directive restructuring the Community framework for the taxation of energy products and electricity.

[5] These tables are not published, but for this study we obtained from ISTAT the energy use table related to 2008.

[6] Energy products comprise 27 types: coal, lignite, peat, natural gas, crude oil, waste, electricity, coke, coke oven gas, non-energy coal products, gas work gas, blast furnace gas, LPG, refinery gas, naphtha, motor gasoline, aviation gasoline, jet fuel, kerosene, diesel oil, fuel oil, petroleum coke, white spirit, bitumen, lubricants, chemical products, ETBE. Each product is expressed in terajoules (TJ).

[7] As regards activities, tables record data regarding household as well as production activities that are classified using the NACE classification. In particular, up to the year 2008, the used classification is the NACE Rev 1.1, that is the same classification used for the input-output tables available.

Table 1. ISTAT classification by purposes in the energy use tables

Purposes		Production activities	Households
Energy use with comb.	Heating use	Heating (office building, factory, …)	Heating (home)
	Road transport use	Road transport carried out both as principal and secondary activity and as ancillary activity (own account)	Road transport by households (own account)
	Off-road transport use	Railway, air and maritime transport as well as all operations of ships, boats, tractors, construction machinery, lawn mowers, military and other equipment	Off-road transport by household (mainly operations of boats and lawn mowers)
	Transf. in electricity	Energy products used to produce electricity (transformation in electricity)	
	Other energy use with combustion	Energy products used in production processes (excluding heating, transport and transformation)	Energy products used for cooking and for hot water
Energy use without combustion		Energy products used to produce other energy products (transformation in energy products different from electricity); use of electricity for all purposes	Use of electricity for all purposes
Non-energy use		Energy products used to produce non-energy products (transformation in non-energy products); energy products used for non energy purposes (degreasing, dry cleaning,…)	Energy products used for non energy purposes (degreasing, lubrication,…)

Source: Femia et al. (2011).

As explained in Femia et al. (2011), there are three main advantages in using these data. The first advantage is that data are recorded following the principle of residents units and this is consistent with national accounts and input-output tables. Second, the three-dimensional split of the tables avoids the "double counting" typical of datasets expressed in gross terms where data are not classified in different purposes. Finally, this three-dimensional data desegregation (by sector, energy product and purpose) fits the scope of the analysis since the ETD and its reform propose different rates depending on the purpose the energy product is used for.

Given the different sources used, it is necessary to transform some data to have a coherent database. Since data on the consumption of energy products are classified by industry, and the environmental taxation is applied to industry consumption of energy products, we estimate an "industry-by-industry" input-output table of 57 sectors.

Data are then selected depending on the scope the reform is expected to have in Italy. Regarding the energy products, the 2011 ETD reform would have caused an increase in the tax rates for LPG, kerosene, gas oil, natural gas and fuel oil. In the same way, we only consider the purposes that the reform would have affected, that is, heating use, motor fuels and other energy use with combustion. In this case, the main transformation is the conversion of energy data recorded by ISTAT in units coherent with the European taxation directive (European Council, 2003), the Commission proposal (European Commission, 2011a) and the environmental taxation database (European Commission, 2011b). Appendix A, Table A.2 describes the different units and the conversion factors applied.

Finally, we need to estimate the tax rate variation that the 2011 ETD reform would have caused in Italy.[8] To this purpose, we compare the current and the proposed rates (see Appendix A, Table A.3) taking into account the current Italian situation regarding rates and exemptions (see Appendix A, Table A.4) and the different treatment for sectors already belonging to the other economic mechanism of emissions control, the ETS (see Appendix A, Table A.5). For these sectors reduced rates should be permitted since only the energy component of the tax would have been applied.

4. Results

Table 2 describes the effects on prices that the 2011 ETD reform would have caused in Italy. The table shows, first, the direct additional cost the reform would imply for each sector (columns 1 to 4) and then its total cost taking into account all the sectoral interdependencies. (columns 5 to 8). In both cases, the analysis considers three different effects separately: tax changes related to transportation use (columns A), tax changes related to heating use (columns B) and finally tax changes that regard other energy use with combustion (columns C).

[8] When the new minimum proposed is lower than the present rate no change in taxation is assumed.

Table 2. Effects on prices of the 2011 ETD reform in Italy

		Direct effect				Total effect			
	Sector	**A**	**B**	**C**	**TOT**	**A**	**B**	**C**	**TOT**
1	Agriculture, hunting	0.00	0.00	0.01	**0.01**	0.01	0.01	0.03	**0.05**
2	Forestry	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**
3	Fishing and fish farms	0.00	0.00	0.00	**0.00**	0.01	0.00	0.01	**0.02**
4	Mining of coal and lignite	0.00	0.00	0.00	**0.00**	0.01	0.01	0.02	**0.04**
5	Extraction of crude petroleum and natural gas	0.00	0.00	0.00	**0.00**	0.00	0.00	0.01	**0.01**
6	Mining of metal ores	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.01**
7	Other mining and quarrying	0.00	0.00	0.05	**0.05**	0.01	0.00	0.07	**0.08**
8	Manufacture of food products and beverages	0.01	0.02	0.06	**0.09**	0.03	0.03	0.10	**0.16**
9	Manufacture of tobacco products	0.00	0.00	0.01	**0.01**	0.00	0.00	0.02	**0.02**
10	Manufacture of textiles and textile products	0.01	0.02	0.15	**0.18**	0.02	0.03	0.22	**0.27**
11	Manufacture of wearing apparel	0.00	0.00	0.01	**0.01**	0.01	0.01	0.08	**0.10**
12	Manufacture of leather and leather products	0.00	0.00	0.02	**0.02**	0.01	0.01	0.06	**0.08**
13	Manufacture of wood and wood products	0.00	0.00	0.03	**0.03**	0.02	0.01	0.05	**0.08**
14	Manufacture of pulp, paper	0.00	0.00	0.00	**0.00**	0.01	0.01	0.03	**0.05**
15	Publishing, printing	0.00	0.03	0.01	**0.04**	0.01	0.03	0.03	**0.07**
16	Manufacture of coke	0.00	0.00	0.00	**0.00**	0.00	0.00	0.02	**0.02**
17	Manufacture of chemicals	0.01	0.01	0.13	**0.15**	0.03	0.02	0.21	**0.26**
18	Manufacture of rubber and plastic products	0.00	0.03	0.02	**0.05**	0.01	0.04	0.08	**0.13**
19	Manufacture of glass	0.00	0.00	0.00	**0.00**	0.01	0.00	0.02	**0.03**
20	Manufacture of basic metals	0.01	0.00	0.00	**0.01**	0.02	0.01	0.03	**0.06**
21	Manufacture of fabricated metal products	0.01	0.00	0.03	**0.04**	0.02	0.01	0.05	**0.08**
22	Manufacture of machinery and equipment	0.00	0.01	0.01	**0.01**	0.01	0.02	0.03	**0.06**
23	Manufacture of office machinery	0.00	0.00	0.01	**0.01**	0.01	0.01	0.03	**0.05**
24	Manufacture of electrical machinery	0.00	0.01	0.01	**0.01**	0.01	0.01	0.03	**0.05**
25	Manufacture of radio, television	0.00	0.01	0.01	**0.02**	0.01	0.01	0.03	**0.05**
26	Manufacture of medical, precision and optical instruments, watches and clocks	0.00	0.00	0.01	**0.01**	0.01	0.01	0.03	**0.05**
27	Manufacture of motor vehicles, trailers	0.00	0.03	0.01	**0.04**	0.02	0.04	0.05	**0.11**
28	Manufacture of other transport equipment	0.00	0.01	0.01	**0.01**	0.01	0.01	0.04	**0.06**
29	Manufacturing of furniture, manufacturing	0.00	0.00	0.01	**0.01**	0.01	0.01	0.04	**0.06**
30	Recycling	0.00	0.00	0.01	**0.01**	0.01	0.01	0.04	**0.06**
31	Electricity, gas, steam and hot water	0.00	0.00	0.00	**0.00**	0.01	0.00	0.01	**0.02**
32	Collection, purification, distribution of water	0.00	0.00	0.00	**0.00**	0.01	0.00	0.02	**0.03**
33	Construction	0.00	0.00	0.00	**0.00**	0.01	0.00	0.02	**0.03**
34	Sale and repair of motor vehicles; fuel	0.01	0.00	0.00	**0.01**	0.01	0.01	0.02	**0.04**
35	Wholesale trade and commission trade	0.00	0.00	0.00	**0.00**	0.01	0.01	0.01	**0.03**
36	Retail trade; repair of household goods	0.01	0.00	0.00	**0.01**	0.02	0.01	0.02	**0.05**
37	Hotels and restaurants	0.01	0.01	0.00	**0.02**	0.02	0.01	0.03	**0.06**
38	Land transport, via railways, via pipelines	0.07	0.00	0.00	**0.07**	0.07	0.00	0.01	**0.08**
39	Water transport	0.00	0.00	0.00	**0.00**	0.02	0.01	0.02	**0.05**
40	Air transport	0.00	0.00	0.00	**0.00**	0.01	0.01	0.02	**0.04**
41	Supporting transport activities	0.00	0.00	0.00	**0.00**	0.01	0.01	0.01	**0.03**

Unit: percentage.

Notes: (A) Only tax changes related to transportation use; (B) Only tax changes related to heating use; (C) Only tax changes that regard other energy use with combustion; (TOTAL) All three changes together.

Source: own elaboration.

Considering the direct additional cost the reform would have, the two sectors mainly affected would have been the “manufacture of textiles” (10)[9] and “chemicals” (17), with a price increase equal to 0.18% and 0.15% respectively.

In both cases, the increment is due to the tax change related to the consumption of natural gas for industrial uses with combustion rather than transport or heating. The rest of sectors are not (or practically not) directly affected by the 2011 ETD reform. In fact, the increase in production costs would represent less than 0.1% increase for the 53% of sectors, and close to 0 for the remaining 44%.

However, industries use energy products to produce goods and services, but they also use intermediate products that need energy to be produced. So, when one sector increases its production costs due to a higher taxation on energy products consumed, this extra cost could be passed on (totally or partially) to other sectors. Taking into account such interdependencies and assuming that sectors fully pass on the cost increase, the results show a different picture (see the remaining columns of Table 2). The percentage of sectors that are almost not affected by the reform decreases from 44% to 9%. On the other hand, besides “manufacture of textiles” (10) and “manufacture of chemicals” (17), four new sectors present a price increase bigger than 0.1%. These are “manufacture of food” (8), “manufacture of wearing apparel” (11), “manufacture of rubber and plastic products” (18), and “manufacture of motor vehicle” (27).

In any case the increase in prices would not be greater than 0.35%. So, even in the most costly scenario,[10] the European tax reform would have meant a negligible cost to final consumers. Considering the representative basket of goods and services consumed by households, its cost after the tax reform would increase only by a 0.08%. In 2011 the variation of the consumption price index was equal to 2.8% (ISTAT, 2012), so the reform would keep it almost unchanged.

Finally, we compare the results obtained in this analysis with the results obtained in Rocchi et al. (2014). There are two main differences between the two analyses. First, they employ different data on the use of energy

[9] The number in parenthesis after a sector’s name refers to sectors numbers in Table 2.

[10] We assume that all sectors fully pass on their cost to the last buyer, and hence the consumer bears the full cost increase of the 2011 ETD reform. In that way, we obtain a synthetic measure to approximate the maximum effects that the tax reform would have had on Italian consumers.

products by sector. Second, they use a different methodological framework: a multi-region input-output model and a single-region input-output model. In particular, this second analysis employs more disaggregated data on energy use but it approximates technological processes considering all the inputs as they were produced domestically. Comparing the results we show if the approximations applied strongly biases the outcome of the analysis.

There are four sectors that show different results in the different analysis: “agriculture, hunting and forestry”, “mining and quarrying”, “textiles and textile products”, and “chemicals and chemical products”. For the first two sectors the analysis with a single-region model would imply a price variation lower than the one found in the previous analysis. The price variation for “agriculture, hunting and forestry” would be, on average, 0.03% with a single-region model, 0.32% with a multi-region model. For “mining and quarrying” the two percentages would be, respectively, 0.04% and 0.23%. Conversely, in the case of “textiles and textile products”, and “chemicals and chemical products” the price variation when we apply the single-region model (0.27% and 0.26% respectively) is higher than the price variation obtained through a multi-region model (0.08% and 0.14% respectively). A possible reason could be that for these sectors a relatively important part of inputs is imported from abroad. In this case the DTA might bias the results more. However, this explanation fits more for chemical products. In fact the sector imports roughly the 30% of its inputs. In this case the single-region model might overestimate the effect of the reform since it applies to all imports the same tax increase of the domestic products. The other three sectors use instead mostly domestic inputs (the 85% of total inputs are domestic), so it is not possible to draw the same conclusion. Another reason could instead be that for these sectors the type of use of energy products is particularly relevant to the outcome of the analysis. To know more in detail what of the two reasons is the most important we would need to apply a multi-region framework with detailed data on energy use, but data are not available.

Anyway, considering all the sectors analyzed, the outcome is similar. For the most part of sectors, the difference between the prices variations obtained under the two models is less than 0.05%. The price index found using the two frameworks is, in both cases, 0.08%. So, except for some specific sectors, we can conclude that the approximations applied in the two analyses do not invalidate the results.

5. Conclusion

Since Italy has recently expressed a commitment to increase the use of environmental taxation by explicitly referring to the amendments proposed by the EC in 2011, in this work we offer empirical evidence on the effect that the 2011 ETD reform would have had in Italy, if implemented, considering all the industry interdependences. The analysis uses a disaggregated dataset on the energy products used by economic sectors. Anyway, since data are available only for Italy, their use makes it necessary to employ a single-region model. This model assumes that all inputs are produced with the technology available domestically. On the one hand the results of this analysis might be more reliable since we employ highly disaggregated data on energy use. On the other hand the method used approximates the production processes for imported goods.

Results shows that both considering only the direct effect of the reform on prices and considering the sectoral interdependences, only few prices would be affected and the variation in prices would be irrelevant for almost all sectors. The main conclusion of our analysis is that the new energy tax regime might have a really low impact on Italian prices, and consequently there might be no problem for competitiveness and distributional implication. On the other hand, this implies a low capability of this reform to cause an improvement in consumption and production patterns regarding environmental pressure.

Since these results are not enclosed in a general equilibrium framework, neither any input substitution nor any supply-demand interaction is considered. Nonetheless, what this static analysis does show is the maximum effect that this reform would have had in Italy if implemented. Even in the extreme situation of non-substitution and non-interaction between supply and demand, the maximum increase in prices would be lower than 0.3% and for Italian consumers the cost would be negligible (roughly a 0.08% variation in consumption price index). These results are under the assumption of non-substitution, that is, neither firms nor consumers can change the amount of inputs/products consumed. So, although one could argue that it is necessary to introduce further analyses (for instance, the analysis of products' demand elasticity) the expected results would be even smaller.

Regarding the comparison with the results previously found, in general the two analyses provide similar outcomes. A possible conclusion is that single-region model can be still a useful instrument if they make it possible the use of more disaggregated data available only for one or few countries. Anyway, this conclusion might be case-specific. In fact in the comparison we cannot recognize what role data disaggregation and what role the framework used have in influencing the results. The use of a single-region model might be complemented with other information to check its reliability. Finally, although results are similar, this is not the case for some specific sectors, such as: “agriculture, hunting and forestry”, “mining and quarrying”, “textiles and textile products”, and “chemicals and chemical products”. This result suggests the need of further analyses specifically applied to these sectors.

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Appendices

Appendix A. ETD, ETD reform, and Italian rates

Table A.1. Energy Taxation Directive and European Commission reform proposal: main characteristics

Energy Taxation Directive ETD (2003)	
Energy products	Petrol, gas oil, kerosene, liquefied petroleum gas, natural gas, heavy fuel oil, coal and coke, electricity.
Scope	Energy products are taxed when used as fuels, for heating, or other industrial uses that imply combustion. They are not under the directive scope when they are used as raw materials, in chemical reductions or in electrolytic or metallurgical processes.
Main changes between ETD (2003) and EC reform proposal (2011)	
2003	**2011**
The taxable base for mineral oils is the volume while for coal, gas and electricity is the energy content.	For each energy product, the tax rate is calculated according to CO_2 emissions content (20€/tone) and energy content (9.6€/GJ if products are used as fuels, 0.15€/GJ if products are used for heating).
Minimum rates are fixed (see Appendix BA, table A.4).	Higher minimum rates are proposed (see Appendix A, table A.4).
Member States are allowed to differentiate between commercial and non-commercial diesel and provide for a lower rate on commercial diesel.	It is not allowed any more any exemption or reduction below the minima related to the CO_2 emissions content, except for water transport.
Member States can reduce tax rates if businesses are energy intensive.	
Member State can reduce tax rates up to exemption for the agricultural sector.	

Source: own elaboration.

Table A.2. Energy data

Energy data transformation

In the legislative sources rates on different products are expressed in euro related to different volumetric measures. In particular: rates on petrol, gas oil and kerosene are expressed in euro per 1000 liters (l), rates on LPG are expressed in euro per 1000 kilograms (kg), rates on natural gas, coal and coke are expressed in euro per gigajoule. On the other hand, Italian data on energy use by sector are expressed in their energy content (terajoule, TJ). The European Commission makes available conversion factors for each energy product (documentation ancillary to the Commission proposal (European Commission 2011a)

Conversion factors for energy products

Energy product	ISTAT Units	ETD Units	Net Calorific Value (NCV, GJ/1000 kg) Density (D, Kg/m^3) Conversion factor (CF, GJ/1000 kg)	Transformation in ETD units
LPG	TJ	1000 kg	CF=NCV = 46	1000 kg= TJ x 1000/46
Kerosene	TJ	1000 l	NCV=43.8; D=810; CF=NCV x D/1000=35.5	1000 l= TJ x 1000/35.5
Gas oil	TJ	1000 l	NCV=42.3; D=832; CF=NCV x /1000=32.8	1000 l=TJx1000/32.8
Fuel Oil	TJ	1000 kg	CF=NCV= 40	1000 kg= TJx1000/40

Source: European Commission (2011a).

Table A.3. Minima rates in the 2003 ETD and minima rates in the 2011 reform

	Current minima	Minima proposed in ETD reform		
		Energy content	CO_2 emissions	Total
Motor fuels		**(9.6 €/GJ)**	**(20 €/ton)**	
Petrol (€ per 1000 l)	359	314	46	360
Gas oil (€ per 1000 l)	330	337.9	52.1	390
Kerosene (€ per 1000 l)	330	340.6	50.9	392
LPG (€ per 1000 kg)	125	442	58	500
Natural gas (€ per GJ)	2.6	9.6	1.1	10.7
Heating fuels and motor fuels for industrial use		**(0.15 €/GJ)**	**(20 €/ton)**	**Total**
Gas oil (€ per 1000 l)	21	5.28	52.1	57.37
Heavy fuel oil (€ per 1000 kg)	15	6	61.84	67.84
Kerosene (€ per 1000 l)	0	5.32	51	56.3
LPG (€ per 1000 kg)	0	6.9	58	64.86
Natural gas (€ per GJ)	0.15	0.15	1.12	1.27
Coal and coke (€ per GJ)	0.15	0.15	1.89	2.04
Electricity				
Electricity (€ per MWh)	0.5	0.54	--	0.54

Source: European Council (2003) and European Commission (2011a).

Table A.4. Actual tax rate applied in Italy

Petrol (per 1,000 litres)		
Leaded	571.30	
Unleaded	571.30	
Gas oil (per 1,000 litres)		
Propellant use	430.30	
Industrial/Commercial use	126.90	
Heating	403.21	
Kerosene (per 1,000 litres)		
Propellant use	337.49	
Industrial/Commercial use	101.25	
Heating	337.49	
Heavy fuel oil (per 1,000 kg)		
Heating - Business use	63.75(>1)/31.39(<1)	
Heating - Non-business use	128.27(>1)/64.24(<1)	
Liquid Petroleum Gas (LPG) (per 1,000 kg)		
Propellant use	227.77	
Industrial/Commercial use	68.33	
Heating	189.94	
Natural Gas (per gigajoule)		
Propellant use	0.078	
Industrial/Commercial use	0.32	
Heating - Business use	0.3378	
Heating - Non-business use	1.189(-120mc/y)/4.729(120-480mc/y)/ 4.594(480-1560mc/y)/ 5.027(1560-mc/y)/	
Coal		
	per gigajoule	**per 1,000 kg**
Heating - Business use	0.16	4.60
Heating - Non-business use	0.32	9.20
Coke		
	per gigajoule	**per 1,000 kg**
Heating - Business use	0.16	4.60
Heating - Non-business use	0.32	9.20
Lignite		
	per gigajoule	**per 1,000 kg**
Heating - Business use	0.16	4.60
Heating - Non-business use	0.32	9.20
Electricity		
	per MWh	
Business use	3.10	
Non-business use	4.70	

Source: European Commission (2011b).

Table A.5. Sectors subject to the ETS

Economic activities	**WIOD sector**
Energy activities	
Combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations)	Electricity, Gas and Water Supply
Mineral oil refineries Coke ovens	Coke, Refined Petroleum and Nuclear Fuel
Production and processing of ferrous metals	Basic Metals and Fabricated Metal
Metal ore (including sulfide ore) roasting or sintering installations	
Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tons per hour	
Mineral industry	
Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tons per day or lime in rotary kilns with a production capacity exceeding 50 tons per day or in other furnaces with a production capacity exceeding 50 tons per day	
Installations for the manufacture of glass including glass fiber with a melting capacity exceeding 20 tons per day	
Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tons per day, and/or with a kiln capacity exceeding 4 m3 and with a setting density per kiln exceeding 300 kg/m3	
Other activities	
Industrial plants for the production of (a) pulp from timber or other fibrous materials (b) paper and board with a production capacity exceeding 20 tons per day	Pulp, Paper, Paper , Printing and Publishing
Aviation	
Flights which depart from or arrive in an aerodrome situated in the territory of a Member State to which the Treaty applies	Air Transport

Source: own elaboration from European Parliament and Council (2003) and European Parliament and Council (2008).