Energy Mix and Energy Taxation: A Comparison between the EU, Italy and Turkey

Rossella BARDAZZI* and Maria Grazia PAZIENZA**

Abstract

Recent years have seen increasing worldwide attention being paid to the broad issue of energy and, in particular, to the aspect of energy security. The issue is even more crucial in Europe and Turkey, which are both energy dependent and are trying to diversify their strategies in order to secure energy availability and to moderate energy price increases. This paper aims to highlight similarities and differences between the European and Turkish energy frameworks and related energy policies, with a special focus on energy taxation. Among the EU countries, particular attention is paid to Italy, whose degree of energy dependency and use of energy taxation are among the highest in Europe. We argue that the use of market-based instruments such as energy taxes is an effective tool for policymakers to influence consumers' energy consumption and change the energy mix towards less polluting and domestically produced fuels.

Key Words

Market-based instruments, energy taxation, decoupling, energy uses, energy demand elasticities.

* Assoc. Prof. Dr., The School of Political Sciences "Cesare Alfieri", Department of Economics and Management of the University of Florence, Italy.

** Assoc. Prof. Dr., The School of Political Sciences "Cesare Alfieri", Department of Economics and Management of the University of Florence, Italy.

Introduction

Recent years have seen increasing worldwide attention being paid to the broad issue of energy and, in particular, to the aspect of energy security. The issue is even more crucial in Europe and Turkey, which are both energy dependent and are trying to diversify their strategies in order to secure energy availability and to moderate energy price increases. On the one hand, Europe suffered a serious energy crisis as a consequence of the 2009 Russian-Ukrainian conflict over gas transit fees. Such crises constitute an abrupt warning, clearly revealing the weakness of European external energy policy and bringing its key role to general attention. The ongoing new conflict between Russia and Ukraine has exposed EU vulnerability once more, and in May 2014 the European Commission approved an Energy Security Strategy[1] to reduce EU energy dependence and to promote resilience to these shocks and disruptions to energy supplies. On the other hand, Russian-Ukrainian tension is also a very hot issue in Turkey, because almost 25 % of Turkey's total natural gas imports are supplied by a pipeline passing through

Ukraine, Romania and Bulgaria. Recent decisions by the Russian government to cancel the South Stream pipeline project and to replace the Black Sea portion with a pipeline to Turkey- the so-called Turkish Stream- makes clear the key role of Turkey as a player in securing its energy supply and in becoming a potential energy hub for southern Europe. Indeed, the EU and Turkey have a long-lasting tradition of cooperation and coordinated policies (the EU and Turkey signed a cooperation agreement in 1963 and Turkey made a formal application for accession in 1987), with energy gaining increasing importance as recently testified by the Trans Adriatic Pipeline project. Furthermore, energy is also a field of cooperation under the Instrument for Pre-Accession Assistance (IPA II), which is the main financial instrument for providing EU support for the implementation of reforms to move Turkey towards EU membership.

Recent decisions by the Russian government to cancel the South Stream pipeline project and to replace the Black Sea portion with a pipeline to Turkey- the so-called Turkish Stream- makes clear the key role of Turkey as a player in securing its energy supply and in becoming a potential energy hub for southern Europe.

Energy security is a multidimensional and dynamic concept, as recently surveyed by Winzer.[2] Despite different conceptualizations of energy security, which has to do with variation in different stakeholders' perceptions of what security means, this issue is generally concerned with risks. A variety of factors can be considered sources of threats as they can affect the flow of energy. According to Masson et al.[3] two specific dimensions can be distinguished that are relevant to the perspective of this study as they are both related to energy security for consumers: a physical and an economic dimension. The first relates to the availability and accessibility of energy supply, while the second dimension refers to price volatility and affordability: prices should give a signal to indicate a situation of scarcity or oversupply. Both dimensions are included in the EU Commission energy security strategy, and this in turn is defined as 'inseparable' from the 2030 Framework for climate and energy,[4] which aims to deliver a competitive and low-carbon economy by exploiting renewable and indigenous sources of energy. Lastly, energy and climate change are part of the EU Sustainable Development Strategy[5] as well as of Turkey's Sustainable Development Report *"Claiming the future,"* presented in 2012 at the Earth Summit in Rio de Janeiro.

Indeed, both the EU and Turkey are using market-based instruments as their main policy pillars: the EU with its Emission Trading Scheme, renewable source incentives and a plan for common carbon taxation; Turkey by using energy taxation and starting to incentivise renewables.

Climate and energy security policies have common goals and instruments: increasing energy efficiency, changing the energy mix and promoting decoupling are ways to combat climate change and to foster energy independence. These goals can be reached by means of several tools, among which market-based instruments- policies setting a price signal designed to induce a change in agents' behaviour- are considered the most efficient ones because they have the characteristic of reaching the target at least cost. However, all policies acting on prices may have an adverse impact, raising an equity issue. High energy prices may conflict with the energy security goal as energy security also encompasses the idea of energy affordability.

Indeed, both the EU and Turkey are using market-based instruments as their main policy pillars: the EU with its Emission Trading Scheme, renewable source incentives and a plan for common carbon taxation; Turkey by using energy taxation and starting to incentivise renewables. Among the EU member states, special attention needs to be devoted to Italy, because its degree of energy dependency and use of energy taxation are among the highest in Europe. Indeed, both Italy and Turkey are characterized by high energy dependency and top energy tax rates at the world level. Starting from a comparison of the characteristics of energy sources and energy dependency in the two countries, this paper aims to assess the role of energy taxation in fostering a decoupling between growth and energy use. We argue that market-based instruments are effective in providing a signal to households and industries and can induce fuel substitution by consumers toward less polluting fuels and improve energy-saving behaviour by economic agents.

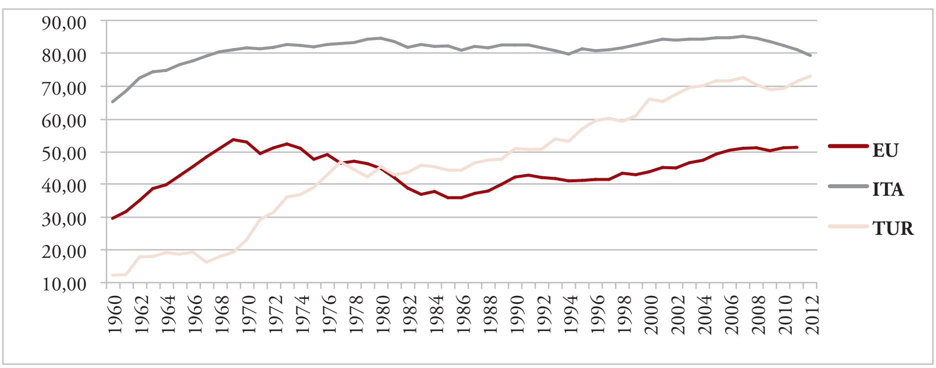
The main features of energy consumption and intensity are presented in Section 2. After a discussion of the role of taxation in developing green growth, the structure of energy taxes in the two countries is presented and discussed (Sections 3.1 and 3.2). Subsequently, results from the literature about energy demand elasticities in Italy and Turkey as a way of assessing the efficacy of energy taxation are discussed (3.3). Section 4 presents our conclusions.

The Energy Structure: Similarities and Differences

Although the energy balance is highly differentiated among member countries, on average the EU can be considered highly energy dependent, and the same problem characterizes Turkey. Energy dependence can be defined as the vulnerability of a given State or area to energy supply or price shocks, which may imply competitiveness and growth losses, inflationary pressures and trade balance deterioration.[6] Arguably, the EU and Turkish economies will continue to be exposed to serious risks related to energy availability and prices, including potential oil shocks or gas shortages because of the severe conflicts occurring in strategic supply countries, and recent high fluctuations in oil prices make this very unstable scenario even gloomier.

Although an in- depth analysis of energy dependency and vulnerability should encompass several indicators, a general idea can be sketched by using the import share of energy use[7], which is one of the most widely used indicators. Figure 1 shows that in Europe in 2012 imports accounted for 50% of energy use, more or less the same figure recorded in the mid-sixties. With the exception of Denmark, all EU countries exhibit a deficit on their energy trade balance, even those with substantial energy exports, such as the UK and France. Moreover, member countries are also characterized by high heterogeneity, and very different patterns. As an example, Denmark's import share of energy use – not shown in the figure- reached 98% just after the oil crisis in the seventies, and became negative (meaning that Denmark is now an exporting country) in 1998. The United Kingdom experienced the opposite pattern: it was an exporting country during the 80's and 90's- thanks to North Sea oil- and it is nowadays a dependent country. Italy shows a much more stable pattern: since the late sixties its import share of energy use has always been around 80%.

Figure 1: Energy Imports as a Share of Energy Use (1960-2012)



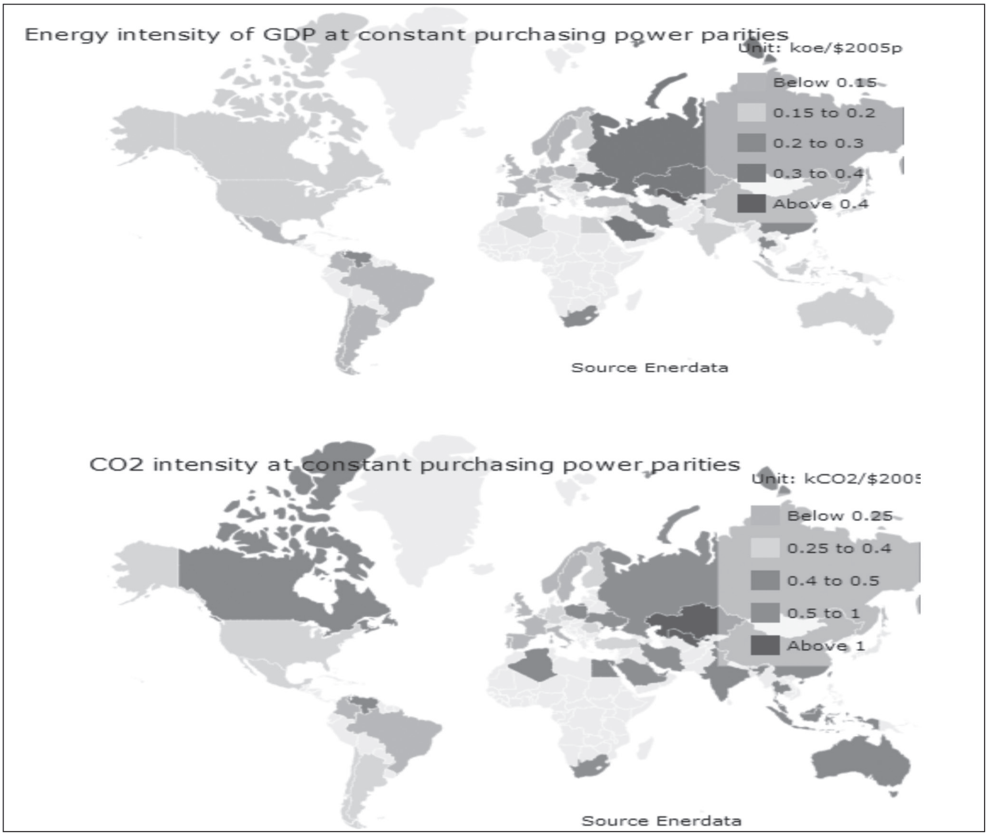
Source: IEA Database, *Energy Policies of IEA Countries: Turkey 2009 Review*, Paris, 2009

The increasing trend of the industrial sector with respect to the residential sector in Turkey is in opposition to the trends observed in most industrialized countries, which are due to different stages in economic development, to a switch from industry to service-oriented production, and also to long-standing policies implemented by governments to encourage the introduction of energy-saving technologies.

Turkey has experienced a never-ending increase in energy dependency: as a latecomer, the country has seen a transformation of its energy use (from domestic to industrial and transport use) and energy mix (from wood to oil and gas). As a result of these important and rapid transformations in its energy structure, its import share of energy use increased from 12% in 1960 to 73% in 2012, a share very close to the Italian one. The IEA energy balances for the year 2011 show how total final energy consumption is distributed among users: the Turkish industrial and residential sectors consume similar shares- 30 and 29 % of total consumption respectively- followed by transport, with a share of 18 %. Conversely, the largest Italian energy-consuming sector is transport (30 %), then households (25 %) and manufacturing (22 %). The increasing trend of the industrial sector with respect to the residential sector in Turkey is in opposition to the trends observed in most industrialized countries, which are due to different stages in economic development, to a switch from industry to service-oriented production, and also to long-standing policies implemented by governments to encourage the introduction of energy-saving technologies.

A point of similarity is represented by the low energy and CO_2 intensities which characterize Turkey, the European Union and, among European countries, Italy in particular. The two maps in Figure 2 show that Western Europe and Turkey are currently among the regions in the world with the lowest energy and carbon intensity.[8]

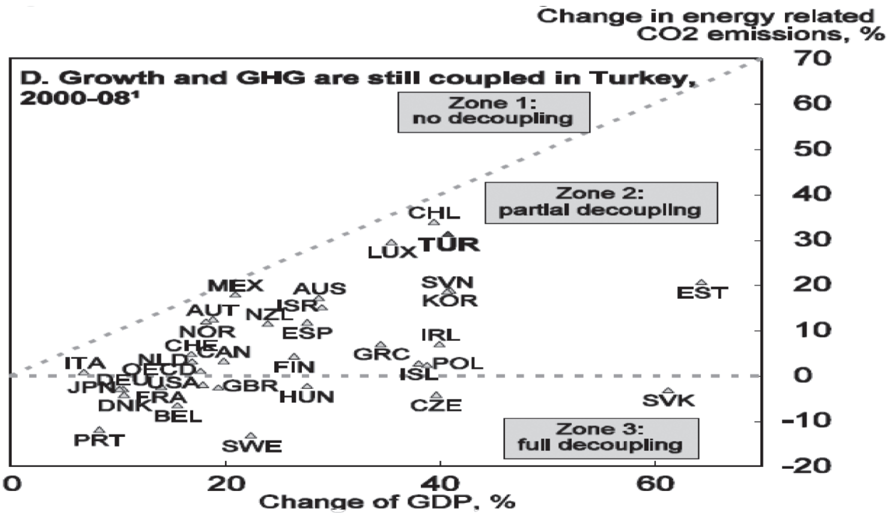
Figure 2: Energy and CO_2 Intensity Maps (in 2005 PPP dollars)



Source: Enerdata, *Global Energy Statistical Yearbook*, at http://yearbook.enerdata.net/#CO2-intensity-data.html

Table 1 presents detailed data for the three areas. The table shows that despite being characterized by similar indicator levels Turkey has been using more and more energy in recent years with respect to Europe, as a result of a much more intense GDP growth. Unfortunately, Turkey still seems far from decoupling growth and carbon emissions. Indeed, energy-related emissions have more than doubled since the nineties and are expected to rise further following a significant increase in energy demand. Figure 3 shows the relative positions of OECD countries in terms of growth and CO_2 emissions. Due to its high GDP growth, Turkey is located in the right-hand side of the graph, but towards the top, close to the 'no decoupling' zone.

Figure 3: GDP and Carbon Emission Changes in Selected OECD Countries (2000-2008)



Source: OECD: *OECD Economic Surveys: Turkey,* Paris, 2012.

Conversely, the use of electricity, as represented by per capita megawatt hours, is still quite moderate in Turkey, which is partly due to its young and only recently urbanizing population (Table 1).

Table 1: Selected Indicators for EU, Italy and Turkey (2011)

	EU	Italy	Turkey
TOE per capita	3.29	2.76	4.52
TOE/GDP	0.11	0.10	0.18
MhW per capita	6.11	5.39	2.68
t Co2 per capita	7.04	6.47	3.86
t Co2/GDP	0.24	0.22	0.46

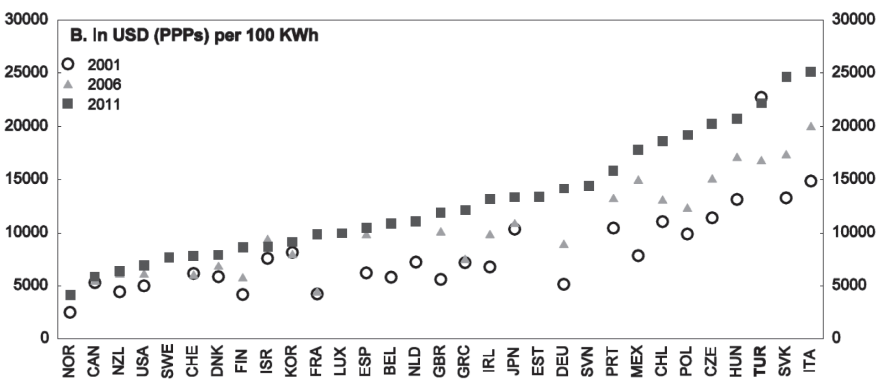
Source: IEA database, at www.iea.org

Due to their mix of energy dependence and high energy taxes, European countries and Turkey also have high energy prices in common.

The low energy intensities experienced by the two areas can be attributed to a number of factors, including the structure of manufacturing industry, the share of energy-intensive sectors, specific public policies and high energy prices. In order to limit high energy vulnerability, the governments of the two areas have implemented a wide range of policies and programmes, such as diversification of energy sources and energy partners, financial incentives aimed at developing renewable sources, energy efficiency standards and market-based instruments- more specifically taxes- to discourage the use of energy-intensive devices. All these policies have been implemented in some form both in the European Union and Turkey, but the EU has a much wider set of goals and policy mechanisms, partly due to the high priority it gives to environmental protection. In fact, the integration of environmental protection within all other community policies became a requirement after the adoption of the Amsterdam Treaty in 1997.

Due to their mix of energy dependence and high energy taxes, European countries and Turkey also have high energy prices in common. This is particularly evident for Italy and Turkey, which, as previously mentioned, have import shares of energy use around 80%. As an example, Figure 4 shows electricity prices: Italy and Turkey are among the three most expensive countries with regard to electricity prices.

Figure 4: Electricity Prices in Selected OECD Countries

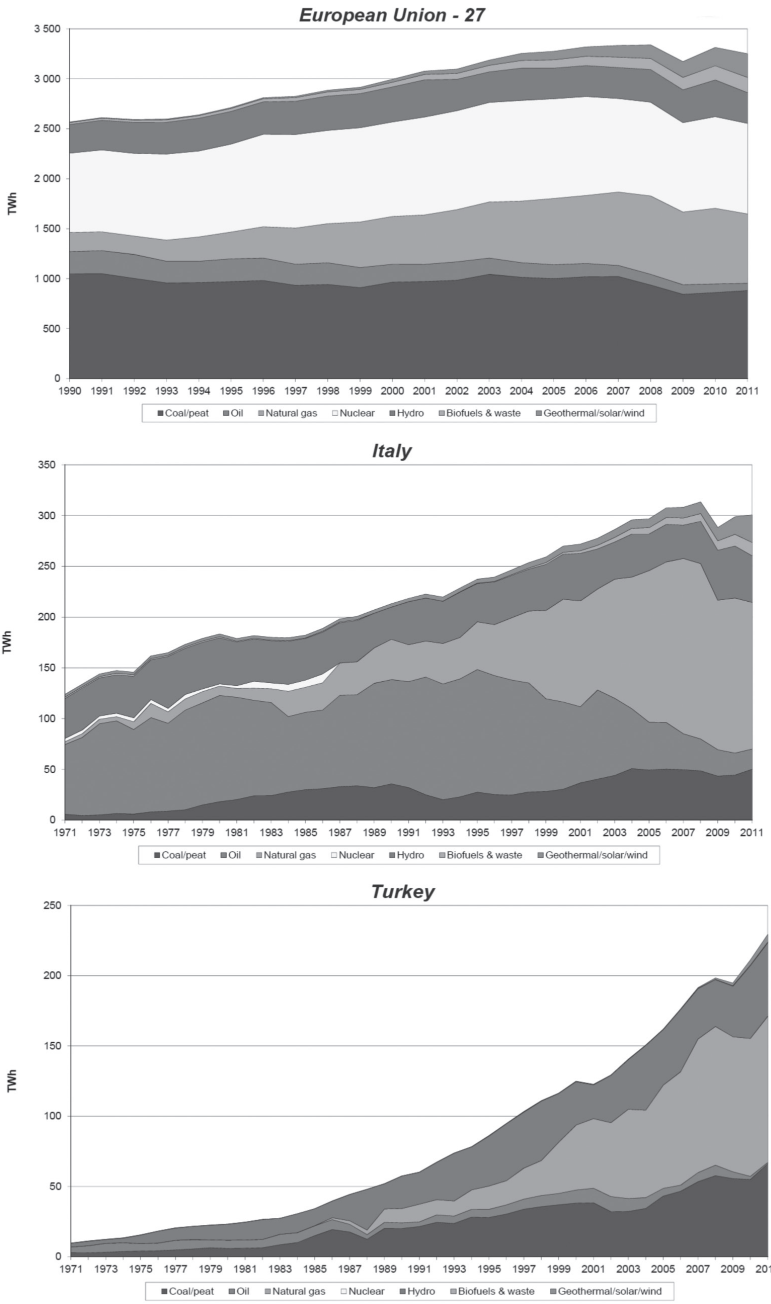


Source: OECD, *OECD Economic Surveys: Turkey*, Paris, 2012.

Turkey's electricity demand is expected to double in a few years, and in order to satisfy this increase in demand the Turkish government is determined to utilise coal reserves and nuclear power, facilities for which are currently under construction. Italy, on the other hand, has created incentives to maximize the use of renewables and banned nuclear power after a popular referendum.

Among the main factors that influence electricity prices, the primary energy mix of fuels to produce electricity deserves attention (Figure 4). Both Italy and Turkey use a significant share of natural gas and hydro to produce electricity, much more than the European average. On the other hand, they do not currently employ any nuclear power, whereas the average EU share is around 30%. However, the two countries have chosen different strategies: Turkey's electricity demand is expected to double in a few years, and in order to satisfy this increase in demand the Turkish government is determined to utilise coal reserves and nuclear power, facilities for which are currently under construction. Italy, on the other hand, has created incentives to maximize the use of renewables and banned nuclear power after a popular referendum. It is worth stressing that these two opposite strategies probably respond to the two very different demand forecasts: as previously mentioned, Turkey is going to see a further and even faster increase in energy and electricity demand, whereas in Europe and Italy electricity production and demand are substantially stable, due to modest GDP growth and to the efficacy of the energy saving policies implemented in recent decades.

Figure 5: Electricity Generation by Fuel



Source: IEA Database, *Energy policies of IEA countries: Turkey 2009 Review*, Paris, 2009.

Energy Related Taxation: Similarities and Differences

Energy Taxation: Main Effects

The choice of the optimal policy instrument is still an open question since several tradeoffs may arise if competing evaluation criteria are considered. A very broad and well-known classification of policy instruments divides them into "command and control" and "market-based" instruments.[9] Market-based (or incentive-based) instruments are generally suggested as the main policy tool to be used due to their cost effectiveness (the optimal solution is reached at the minimum total cost) and therefore to a higher degree of neutrality regarding agents' choices. In the context of energy use, a decrease in energy intensity and polluting emissions can be achieved by means of carbon/ energy taxes, which are by far the most popular tool in the market-based group.[10] The reaction of agents to the price signal embedded in energy-related taxes is good news as regards both policy perspectives: a 'reactive' curve- where reactivity is measured with demand and supply elasticities- usually signals an ability to avoid the price increase, through either greater energy efficiency or a change of energy mix. Some of these positive reactions may be associated with a win-win perspective: if energy efficiency improves after energy taxes, it can be said that there were unexploited opportunities for saving resources that only became evident to agents after implementation of the policy.

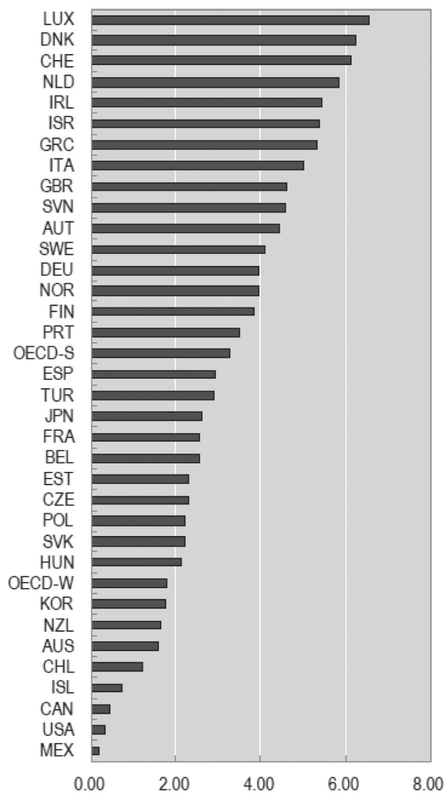
Notwithstanding these important characteristics, market-based instruments are criticised for their easily identifiable impact on prices. If alternative energy products (considering both domestic energy inputs and less polluting sources) are not available or the elasticities are low, these policy instruments are ineffective but still produce increasing costs and raise the general price level in the short run. Therefore, it is crucial to assess the efficacy of energy taxes in different country contexts. After a review of the current level of energy-related taxes in the two areas in section 3.2, section 3.3 considers elasticity estimates as a basis for assessing the role of energy taxes in addressing energy and climate security goals.

Energy Tax Rates in Practice

The EU has promoted the use of market-based instruments as a way to efficiently reach environmental and energy-strategic goals in a number of documents and pieces of legislation. Italy and Turkey heavily utilize energy and environmental taxation. Although frequently driven more by revenue needs than efficient policy design, taxes have proved to have had positive effects in moderating energy use and altering the energy mixes of consumers and firms. However, taxing energy uses, whatever the ultimate goal, is not a panacea. On the contrary, it is necessary to employ particular care as market-based instruments also have a long list of drawbacks (adverse distributional impacts, political opposition, competiveness loss, inflation) and energy taxes may also distribute benefits and costs unevenly, creating *winners* and *losers* among the economy's households and firms.

Figure 6 shows effective tax rates on energy, which range from € 0.18 euro GJ in Mexico to 6.58 per GJ in Luxembourg. The highest overall effective tax rates tend to be in European countries, where the Energy Taxation Directive sets minimum tax rates for a variety of energy commodities. In particular, Italy is located in the top part of the graph (around € 5 per GJ), whereas Turkey is located below the simple average level for OECD countries (less than € 3 per GJ).

Figure 6: Implicit Tax Rate on Energy (€ per GJ, 2012)



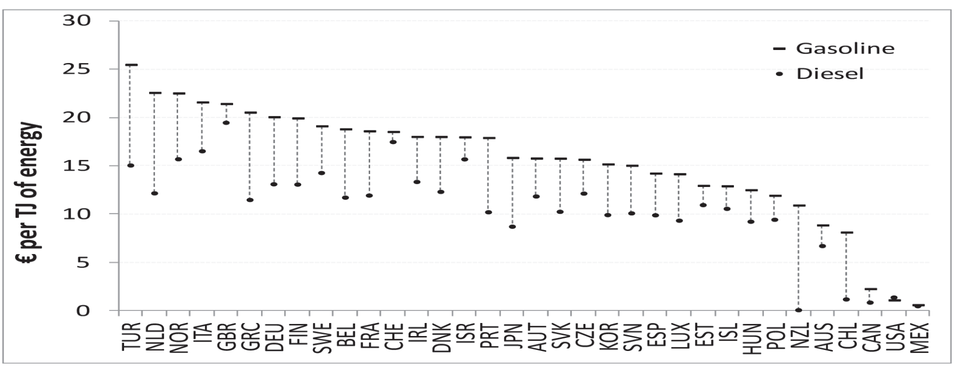
OECD-S and OECD-W are simple and weighted averages respectively.

Source: OECD Database, *OECD Economic Surveys: Turkey,* Paris, 2012.

In almost every country, fuels used in transport are taxed significantly more than energy products used for other purposes. This is particularly true for Turkey and Italy, which, as shown in Figure 7, are characterized by the highest tax rates among OECD countries. This high taxation on transport fuels can be explained by the high externalities of transport or simply by the fact that fuel demands are usually inelastic and therefore taxing transport fuels is convenient from a revenue-raising perspective. In fact, in both countries the energy tax rate levels cannot be considered optimal because they are not clearly linked to energy or carbon content, and the tax preference for diesel, which has a higher carbon content, confirms this form of inefficiency. As regards fuels for transport, both countries should pursue other ways to implement efficiency such as developing fuel efficiency standards for vehicles or imposing direct emission limits. At present in Turkey a programme called 'cash for clunkers' has been adopted to remove old and inefficient vehicles from the road and new emission labelling for vehicles may induce drivers to prefer energy-saving vehicles.[11] However, the tax revenue from gasoline enjoyed by governments may represent an obstacle to implementing alternative policies to increase efficiency, such as increasing the use of energy-saving fuels and public transportation.

High taxation on transport fuels can be explained by the high externalities of transport or simply by the fact that fuel demands are usually inelastic and therefore taxing transport fuels is convenient from a revenue-raising perspective.

Figure 7: Implicit Tax Rates on Gasoline and Diesel (2012)

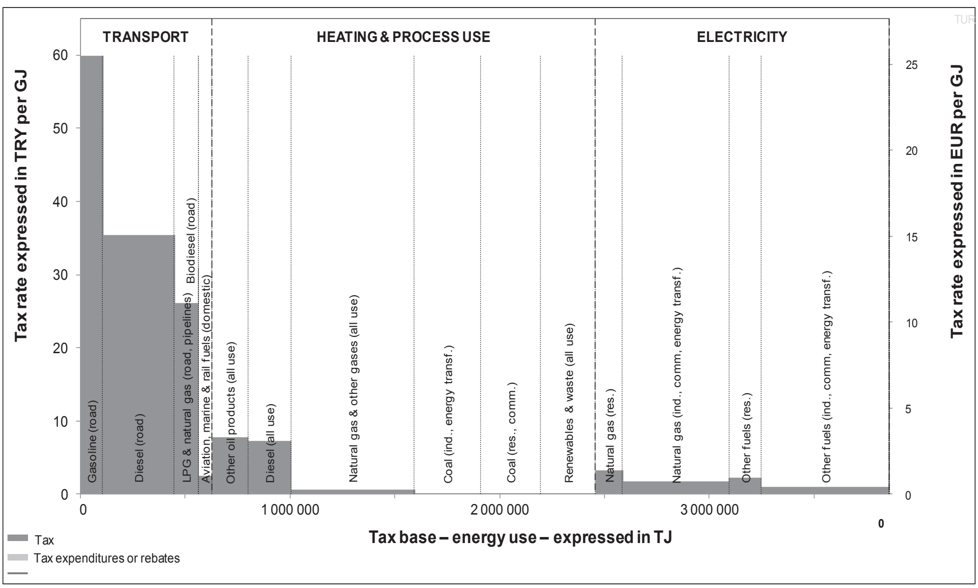


Source: OECD, *Taxing Energy Use- A Graphical Analysis*, Paris, 2013.

The fact that energy taxation is highly concentrated on transport fuels is also confirmed by Figures 8 and 9. In both figures, the horizontal axis represents energy products for each type of energy use (grouped into transport, heating and electricity production) and the vertical axis represents tax rates.[12] It is evident from Figure 7 that in Turkey almost all energy-related revenue comes from transport fuels and all other fuels have very low tax rates. Coal and natural gas uses are practically not taxed at all and therefore relevant tax differences between emission sources remain. Moreover, taxes are different between users: according to IEA data, in both the cases of electricity and natural gas, tax rates for Turkish industries are considerably higher than in other countries, whereas taxes for households are relatively lower, implying a form of cross- subsidies in favour of households.

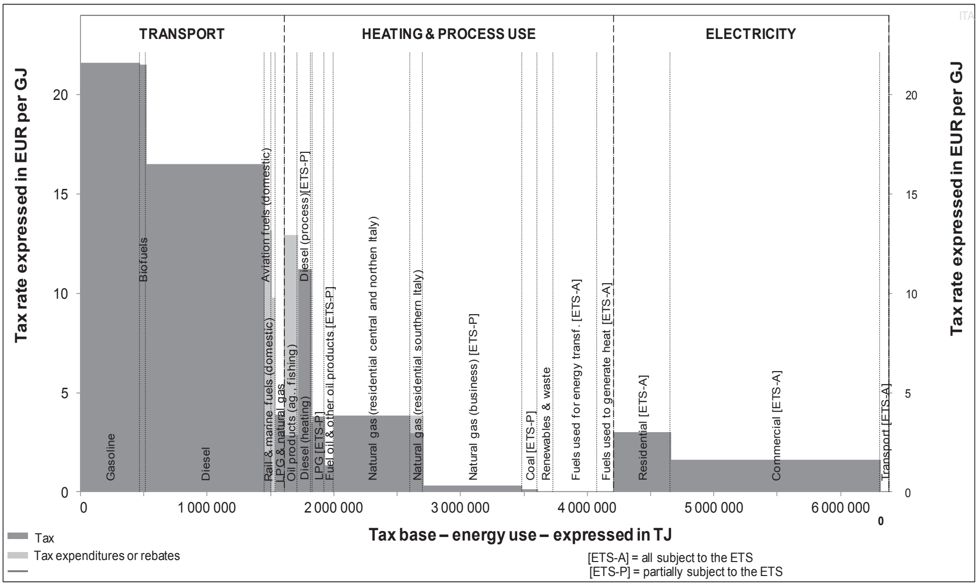
Figure 8 shows that Italy, despite having a high share of energy-related revenue coming from transport fuel, has slightly more homogenous taxation, and energy products are also taxed when used to produce electricity. This is more coherent with the market-based instrument principle, according to which there must be a unique price signal- the cost of carbon with reference to climate externality- for all energy products.

Figure 8: Energy Taxes and Energy Use in Turkey (2012)



Source: OECD, *Taxing Energy Use- A Graphical Analysis*, Paris, 2013.

Figure 9: Energy Taxes and Energy Use in Italy (2012)



Source: OECD, *Taxing Energy Use- A Graphical Analysis*, Paris, 2013.

It can also be noticed that Italy and European countries also employ an Emission Trading Scheme as a tool to incentivise fuel-saving technology and emission abatement among electricity producers.

Electricity use is highly taxed in both countries and this may help to explain their high prices and relatively low electricity intensity, as shown by the previously discussed Table 1 and Figure 2. It can also be noticed that Italy and European countries also employ an Emission Trading Scheme as a tool to incentivise fuel-saving technology and emission abatement among electricity producers. Moreover, high electricity prices imply high distributional impacts[13] and represent an obstacle to reaching a high degree of electrification of the economy, one of the main policy objectives clearly stated by the European Union.[14] As Atiyas *et al.* show with IEA data for Turkey,[15] the path of electricity prices has been significantly differentiated between industry and households by means of different tax rates: household retail prices are close to the OECD average whereas prices for industry are substantially higher.

Are Energy Taxes Effective in the Two Areas?

The efficacy of energy taxation in terms of fuel consumption strongly depends on the elasticity of demand: if price elasticity is high, a small change in price resulting from the tax component can induce fuel substitution by firms and households toward less polluting fuels and can improve energy-saving behaviour in economic agents. As regards Italy, in several applied studies energy elasticities have been estimated for different fuels both for industries and households. In general, household energy price elasticities are relatively low in the short run- due to the highly energy-efficient behaviour of households- and much higher in the long run. Bianco at al., as an example, estimate a short-run price electricity elasticity of -0.06 and -0.24 in the long run.[16] In the case of Italian manufacturing industries, energy demand shows a considerable reactivity to price changes as its price elasticities are both negative and greater than one.[17] Interfuel substitution has also been investigated in several studies[18] and a general substitutability link is found between electricity, natural gas and diesel used by Italian industrial firms with lower values for electricity (-0.3) and natural gas (-0.5), these two being the main fuel inputs and also more difficult to replace than other inputs.[19] Recent studies for the Turkish case show that natural gas demand elasticities are quite low,[20] while for the electricity demand of the residential sector it has been recently estimated[21] that the short-run and long-run price elasticities are -0.09 and -0.38 respectively.[22] On the other hand, for the industrial sector price elasticity values are lower (-0.16).[23] Similar results to those reported above can be found in Serletis et al., where interfuel substitution for major energy commodities (coal, oil, gas and electricity) is estimated for a group of countries including Italy and Turkey.[24]

Notwithstanding the different methods and data used for these elasticity estimations, which may seriously affect their magnitude and significance, we may conclude that in both countries there is room to influence agents' behaviour toward energy-saving choices and to stimulate a change in the energy product mix, which may also be induced by a carefully planned energy tax rate design.

The use of market-based instruments is an additional tool for policymakers: energy taxes could pursue additional goals beside their fiscal function, such as giving a price signal to economic agents to shift the energy mix toward less polluting fuels and favouring the introduction of energy-saving technologies in production.

Conclusion

Turkey's economy has developed very rapidly in recent years, in comparison to the sluggish growth of most European countries. However, this progress has come at a cost in terms of increasing energy imports and harm to the environment, with pollution increasing dramatically. As Akan and Bozkurt (2014)[25] show, decoupling between growth and emissions is still far from being realized in Turkey, whereas, thanks to the economic crisis, it is almost a fact in the EU, where public policies have been oriented towards addressing energy security, energy efficiency and environmental protection. However, ensuring an energy supply to satisfy the growing demand has attracted in Turkey more focus than other policy goals (IEA, 2009). Nevertheless, as shown by Turkey's 2012 Sustainable Development Report, it is evident that a sustainable development strategy is on the government agenda. Furthermore, the National Climate Change Action Plan 2011-2023 suggests developing a taxing and pricing system to switch to cleaner fuels and limit greenhouse gas emissions from motor vehicles. European countries, such as Italy, began to face this challenge earlier and their policy experiences can be useful in the Turkish case. Several strategies can be followed to decouple economic growth from increasing GHG emissions: increasing the use of renewable sources, introducing technologies to abate emissions and to save energy, improving people's awareness of environmental issues, etc. The use of market-based instruments is an additional tool for policymakers: energy taxes could pursue additional goals beside their fiscal function, such as giving a price signal to economic agents to shift the energy mix toward less polluting fuels and favouring the introduction of energy-saving technologies in production. The key economic variable to investigate the potential efficacy of energy taxes is demand elasticity with respect to energy prices. A review of selected literature has shown that household demand elasticity in relation to the electricity price is similar in the short run in Italy and Turkey (lower than 10 %) while it is notably higher for Turkish families if the longer term is considered (around 30 % on average). As regards industry, while Italian firms are quite reactive to energy price changes and interfuel elasticities are significant, in the case of Turkey estimated demand

> Especially for households, substitution between fuels and energy-saving behaviour could be influenced by a change in relative prices by tax variation.

elasticities for the industrial sector are generally lower. Therefore, especially for households, substitution between fuels and energy-saving behaviour could be influenced by a change in relative prices by tax variation. Furthermore, a comparison between Italy and Turkey of the existing structure of energy tax rates has highlighted that certain measures could be employed to produce more homogeneous energy taxation with the aims of increasing energy efficiency and of taking carbon related to climate externalities into account. On the one hand, homogeneous taxation with respect to energy content implies a uniform policy incentive, avoiding policy- induced and non-transparent preferences for selected technologies or specific groups of users. On the other hand, given the unavoidability and the urgency of policies to combat climate change, a uniform carbon price is the necessary condition for following the carbon abatement path with the least cost.

Endnotes

1 European Commission, *European Energy Security Strategy, Communication of the European Commission*, COM (2014) 330 final, 2014.

2 Christian Winzer, "Conceptualizing Energy Security", *Energy Policy*, Vol. 46 (2012), pp. 36-48.

3 André Månsson, Bengt Johansson, and Lars J.Nilsson, "Assessing Energy Security: An Overview of Commonly Used Methodologies", *Energy*, Vol. 73 (2014), pp. 1-14.

4 European Commission, *A Policy Framework for Climate and Energy in the Period from 2020 to 2030*, COM(2014) 15 final, 2014.

5 European Commission, *A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development,* COM(2001)264 final, 2001; European Commission, *On the review of the Sustainable Development Strategy. A platform for action,* COM (2005) 658 final, 2005.

6 European Commission, "Member States' Energy Dependence: An Indicator-Based Assessment", *European Economy Occasional Papers,* No. 145 (2013).

7 Two countries with high import shares can differ, as vulnerability depends on the geopolitical risk of supply partners and on the actual use of imported energy.

8 Energy intensity, in particular, measures the amount of energy (tonnes of oil equivalent, or TOE) each country needs to generate a unit of gross domestic product (GDP), whereas energy divided by the country population represents per capita energy consumption.

9 In the case of command and control (such as technology standards, non-marketable quotas, prohibition) the policy target and agents' behaviour are generally well specified and the policy target is achieved by imposing mandatory obligations or restrictions on agents' behaviour. On the contrary, market-based instruments (taxes, fees, marketable quotas, subsidies, liability systems) operate by creating incentives to change behaviour since they modify the relative prices that consumers and firms face. Market-based instruments rely on a price signal and therefore do not specify how agents should behave to comply with the policy target, unlike regulatory (or mandatory) instruments. On the characteristics of energy and environmental instruments, see, Roger Perman, Yue Ma, James. McGilvray, and Michael. Common, *Natural Resource and Environmental Economics*, Wesley, Pearson Addison, 2013.

10 For the use of other market-based instruments in Turkey, see Ozge Kama, Zeynep Kaplan, "Energy Efficiency Policies in Turkey: The Case for Standards and Labels", *International Journal of Energy Economics and Policy*, Vol. 3, Special Issue (2013), pp. 62-73.

11 Izak Atiyas, Tamer Çetin, Gurcan Gulen, *Reforming Turkish Energy Markets*, New York, Springer, 2012.

12 As the quantity used is the energy tax base, the rectangle in grey is the tax revenue coming from each product for different uses.

13 For the distributional impact, see, Zhang for Turkey and Miniaci et al. for Italy. Fan Zhang, "Distributional Impact Analysis of the Energy Price Reform in Turkey", *World Bank Working Paper,* (2012), DOI: 10.1596/1813-9450-5831; Raffaele Miniaci, Carlo Scarpa and Paola Valbonesi, "Distributional Effects of Price Reforms in the Italian Utility Markets", *Fiscal Studies,* Vol. 29, No. 1 (2008), pp, 135-163.

14 The Roadmap for moving to a competitive low carbon economy in 2050 includes a push towards the electrification of the transport sector. See, European Commission, COM/2011/0112 final.

15 Ibid.

16 Vincenzo Bianco, Oronzio Manca and Sergio Nardini, "Electricity consumption forecasting in Italy using linear regression models", *Energy*, Vol. 34 (2009), pp. 1413- 1421.

17 Rossella Bardazzi, Filippo Oropallo and Maria Grazia Pazienza, "Is it Time for a Revival of ETR in Italy? Energy Elasticities and Factor Substitutability for Manufacturing Firms", *Rivista di Politica Economica*, July- September (2009), pp, 205-240; Juan Medina and Juan A. Vega-Cervera, "Energy and the Non-energy Inputs Substitution: Evidence for Italy, Portugal and Spain", *Applied Energy*, No. 68 (2001), pp. 203- 214.

18 See the survey by Stern. David I. Stern, "Interfuel Substitution: A Meta- aAnalysis", *Journal of Economic Surveys*, Vol. 26, No. 2 (2012), pp. 307- 331.

19 Rossella Bardazzi, Filippo Oropallo, Maria Grazia Pazienza, *Firms' energy demand and the role of energy taxes: Elasticities estimation of industrial firms in Italy*, Proceedings of the 9th International Conference on the European Energy Market, European University, 2012, pp. 1-8.

20 Erkan Erdoğdu, "Natural Gas Demand in Turkey" *Applied Energy*, Vol. 87, No. 1 (2010), pp. 211-219.

21 Zafer Dilaver and and Lester C. Hunt, "Industrial Electricity Demand for Turkey: A Structural Time Series Analysis", *Energy Economics*, Vol. 33, No. 3 (2011), pp. 426- 436.

22 In previous studies, Halıcıoğlu (2007) found short- and long-run price elasticities of residential electricity demand of -0.33 and -0.52 respectively, whereas Erdoğdu (2007) found the long-run price elasticity of total electricity demand to be -0.30. Erkan Erdoğdu, "Electricity Demand Analysis Using Cointegration and ARIMA Modelling: A Case Study of Turkey", *Energy Policy*, Vol. 35, No. 2 (2007), pp. 1129-1146; Ferda Halicioglu, "Residential Electricity Demand Dynamics in Turkey", *Energy Economics*, Vol. 29, No. 2 (2007), pp. 199-210.

23 Zafer Dilaver and Lester C.Hunt, "Modelling and Forecasting Turkish Residential Electricity Demand", *Energy Policy*, Vol. 39, No. 6 (2011), pp. 3117-3127.

24 Apostolos Serletis, Govinda.R. Timilsina, Olexandr Vasetsky O., "International Evidence on Sectoral Interfuel Substitution", *The Energy Journal*, Vol. 31, No. 4 (2009), pp. 1-29.

25 Yusuf Akan and Cuma Bozkurt, " Economic Growth, CO2 Emissions and Energy Consumptions: Turkish Case", *International Journal of Energy Economics and Policy,* Vol. 4, No. 3 (2014), pp. 484-494.