

ENVIRONMENTAL TAX. ARE VEHICLE REGISTERS IN THE EU PREPARED?

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Abstract

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The market system is unavailable to reflect negative externalities, caused by road motor traffic, in the realized prices. For that purpose, it would be appropriate to implement a general environmental road tax in the European Union member states. The question is whether the national registers of vehicles are prepared for such a change. Whether this is the case at present, may be found out by means of analyses of the available national registers. The next step is synthetic: the data must be subsequently completed on the basis of the knowledge of needs of currently existing systems of road motor vehicles taxation. In the end, the identified results may be supplemented with the known data published by international institutions. The results of the research show that the present systems of road motor vehicles taxation are utterly different and distortive. Only 12 countries of the European Union have registers which were clearly identified as prepared for the application of the environmental tax. Registers of the remaining countries do not contain one or more data that are necessary for the implementation of the environmental tax. For this reason we may assume that regardless of other determinants, environmental road tax shall not be introduced throughout the European Union in the foreseeable future.

Keywords: environmental road tax, register of vehicles, European Union, CO₂ emissions

INTRODUCTION

The theoretical solution of externalities of automobile traffic is easy and well-known as the so-called Pigovian tax. This is a remedial tax, whose main benefit is the possibility of imposing taxes on the externality generator in the amount corresponding to the costs borne by the society (Holman *et al.* 1999). According to Santos (2010), externalities of road motor transport not reflected in market prices are environmental damage, accidents, traffic congestions and dependence on oil. However, it is very difficult to quantify the social costs of motor vehicle use. Cnossen (2005) says that significant externalities in this area may be quantified and the less significant consequences may be disregarded. The reason why CO₂ emissions represent a serious impact is obvious e.g. from the statistics prepared by the Ministry of Transport of the Czech Republic (2011), which states that

private car transport accounts for more than a half of the production of that pollutant by transport.

The system containing externalities of vehicles operation may be deemed ready for the introduction of the environmental tax itself. However, is the situation similar in the area of road motor vehicles registration in the EU countries? This critical area of considerations about the environmental road tax may be assessed against the knowledge of the existing needs of systems of motor vehicles taxation and against publicly available data concerning vehicle registers in the EU countries. The aim of this text is to assess whether the national registers of vehicles are prepared for potential implementation of environmental road tax in the EU member states.

Literature review

The introduction of CO₂ emission values into the tax system would at least partially eliminate

externalities caused by motor traffic and enable the collection of funds that could be used toward the mitigation of their impact. This alternative was identified by Proost *et al.* (2009) who did not notice significant reduction in traffic volume after the introduction of tax on emissions generated by operation of road motor vehicles. On the contrary, Johansson, Burman and Forsberg (2009) recorded the reduction in automobile traffic after imposition of higher road taxes in the experiment carried out in Stockholm. The below mentioned broader study has brought more possibilities of general conclusions. According to Low Carbon Vehicle Partnership (2011), in the United Kingdom the number of vehicles with low levels of CO₂ emissions doubled in 2010 compared with 2009. The average CO₂ emission levels in new passenger cars registered in 2010 dropped by 4 % compared with 2009, which evidences the existing trend of reducing average levels of emissions in newly registered motor vehicles after the introduction of taxation based on emission levels.

We often encounter proposals for solutions that would lead to market distortion, see e.g. Sergeant *et al.* (2008), who suggest introducing and increasing fees for parking, transit and entrance to selected places as part of the reduction of air pollution. At the same time, these authors offer a much better alternative in the form of quality and environmentally friendly alternative forms of transportation of passengers and goods, which may be seen as a useful complement to the correctly determined tax on the operation of road motor vehicles.

None of the existing tax systems, i.e. levy of annual road tax, excise tax on mineral oils or registration tax can be considered a perfect method of compensation for harmful consumption, represented by the utilization of automobiles. This also applies to the system used in the United Kingdom, which is the best developed one due to rates based on bands, applied only for vehicles registered since the year 2000. If we disregard other than emission impacts of the automobile traffic, such as infrastructure wear, noise or accidents, there are theoretical possibilities of the optimal taxation of motor vehicles. The measurement of real emissions of the respective vehicles would require a sophisticated high-tech system (Borger and Mayeres, 2006). The really generated emissions could be measured by a meter installed in each vehicle. The technology providing for such a system would have to meet the conditions of cost-effectiveness, reliability, misuse resistance and protection of personal data (Santos *et al.*, 2010). However, this method seems excessively expensive and also prone to tax evasion.

Despite grave doubt about the objectivity of the declared information about emissions, we must admit that the system of annual road tax using the declared emissions generated per kilometer of travel is at present the best feasible option of taxation of harmful effects of road motor traffic in terms of emissions. However, the annual road tax

does not take into account the really driven distance or specific circumstances and vehicle condition; thus its information value concerning the generated emissions is not sufficient. Consideration of emissions of the relevant automobile make and type according to the technical documentation fails to provide information on the real emission volume with respect to the vehicle use. Nevertheless, the study of Blanc and Derkenne (2010) proves the effect of the overall emission reduction. The best feasible way of environmental taxation has been identified in the form of real emission values of a certain make and type of vehicle, which contains certain imperfections, but on the other hand is not devoid of the desired environmental aspect.

In general, emission levels of vehicles produced prior to the year 2000 are not stated in the technical documentation. Road tax for such vehicles may be assessed using the existing tax systems, as the case is in the United Kingdom. However, this leads to the dual nature of road motor vehicle taxation, which brings about uncertainty regarding this system and distrust of taxpayers including a low degree of awareness concerning the necessity of such tax. From this point of view, it will be more efficient and equitable to calculate emissions of old vehicles on the basis of existence and knowledge of other characteristics of the vehicles. A solution to this issue is offered by David and Křápek (2015) in the form of calculation formulas for the determination of emission values based on other variables with a proved link to the level of CO₂ emissions.

MATERIALS AND METHODS

The situation in the area of national regulation of road motor vehicles is rather complicated. The case is similar for national registers of vehicles. If we use logical and systematic methods and available data, the compatibility of individual systems of the European Union with the proposal of environmental tax is possible to assess. At the same time, it is appropriate to consider the issue with regard to the legal framework of European standards.

Data concerning the fleet, which are needed for the application of environmental tax may be divided into data on new vehicles and data on old vehicles. The information concerning new cars are only their CO₂ emission levels as stated in the technical documentation. With older vehicles, where the emission levels are not provided, the alternative data according to David and Křápek (2015) must be known. These substitute parameters can be substituted with information about consumption.

Initial sources of data shall be primarily national registers of vehicles. We must stress that it is only possible to use publicly available sources. Therefore it must be admitted that a really existing register may theoretically contain a larger range of information than that disclosed to public. The data shall be taken

from electronic registers published by the national authorities maintaining the registers.

Another source of data on the compatibility of national systems of taxation of vehicles by environmental tax shall be the respective currently applied systems of taxation of road motor vehicles available from ACEA (2016). Within these systems, the base for tax on ownership shall be monitored. The individual variables contained in the tax base shall be recorded and subsequently assessed whether they comply with the requirements for environmental road tax.

Finally there are data of international institutions available, obtained from national authorities, concerning the form and composition of the fleet in the given country. We may assume that if the international institution has the statistics, it must have been obtained from a national authority that disposes of such statistics. This step can at least partially eliminate the risk of differences between the public and non-public forms of vehicle registers in the individual countries.

RESULTS

Regulation of emission generation by motor vehicles in the EU

The Council began to deal with the issues of air pollution by motor vehicles emissions in 1970, the year of enacting Council Directive 70/220/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type approval of motor vehicles and their trailers. Directive 70/220/EEC was amended by Directive 94/12/EC of the European Parliament and the Council relating to measures to be taken against air pollution by emissions from motor vehicles, later it was amended by Directive 98/69/EC of the European Parliament and the Council relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC, then by Commission Directive 2003/76/EC amending Council Directive 70/220/EEC relating to measures to be taken against air pollution by emissions from motor vehicles.

An essential step to be taken in the area of measures against air pollution by motor vehicles emissions is to determine the limit values of carbon dioxide emissions. These values were determined and gradually decreased by Council Directive 74/290/EEC of 28 May 1974 and were added the limits of other harmful substances by Commission Directive 77/102/EEC of 30 November 1976. The limits of three pollutants (carbon monoxide, unburnt hydrocarbon and carbon oxides) have been reduced by Directives 78/665/EEC, 83/351/EEC and 88/76/EEC.

Since the end of the 1990s, the European Union strives to ensure fulfillment of commitments from the Kyoto Protocol. Such commitments included the reduction of average emissions from the new

fleet to 120 g CO₂ per km by 2012. The commitment to reduce emissions to 120 g/km was changed by the Commission to 130 g/km in 2006, and the date of fulfillment was postponed until 2015.

In 2005 the Commission presented the proposal for Directive COM 2005/261 on passenger car related taxes. The proposal also dealt with introducing an element linked to CO₂ emissions in g/km into the tax base of annual circulation tax (ACT) and registration taxes. Although the proposal was declined by the Council in 2007, the long legislative process and consultations between the participants inspired a number of the EU countries to incorporate this element into their tax systems.

The Commission launched Clean Air for Europe (CAFE) Programme in March 2001. This programme led to the adoption of Thematic Strategy on Air Pollution through the Commission communication of 21 September 2005. One of the conclusions of the Strategy was that the reduction of emissions from the transport sector, from households and from power-engineering sector, agriculture and industry is necessary in order to achieve the European goals. These measures led to the establishment of standards EURO 5 and 6 aiming at the reduction of emissions from motor vehicles. Regulation (EC) No. 715/2007 of the European Parliament and of the Council on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information was adopted on 20 June 2007.

CO₂ emission standards for new light commercial vehicles were introduced by Regulation No. 510/2011 of 11 May 2011, setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO₂ emissions from light-duty vehicles. The Regulation set the target of 147 g of CO₂/km since 2020 as average emissions of new light commercial vehicles registered in the European Union.

It follows from the above mentioned facts that although the decision-making in the area of road motor vehicle taxes is mostly in the jurisdiction of the respective states, such sovereignty cannot be guaranteed in the future. We must also note that harmonization of car registration fees and road taxes on the EU level have not been established. Therefore, double or multiple taxation and potential tax discrimination occurs.

Registers in the EU countries and their availability

Classification of data in registers of vehicles in the EU countries is based on Regulation (EC) No. 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS), followed by Commission Regulation (EC) No. 105/2007 of 1 February 2007 amending the annexes to Regulation (EC) No. 1059/2003 of the European Parliament and

of the Council on the establishment of a common classification of territorial units for statistics (NUTS), and Regulation (EC) No. 176/2008 of the European Parliament and of the Council of 20 February 2008 amending Regulation (EC) No. 1059/2003 on the establishment of a common classification of territorial units for statistics (NUTS) by reason of the accession of Bulgaria and Romania to the European Union. The classification offers only general information on the numbers of vehicles with emphasis on their quantitative distribution in administrative divisions of the respective the EU countries. Therefore, the above regulations are not beneficial for the intention of general application of environmental road tax in the EU.

The EU member states may be divided into four categories in terms of user availability and relevance of the data from registers of vehicles. These are registers with the relevant, sufficient or insufficient data for the purposes of implementation of environmental road tax, and registers that are completely unavailable.

The only available register with relevant data is found in the United Kingdom (GOV.UK, 2016). Its database contains information on emissions as well as substitute parameters necessary for the calculation of emission levels of old vehicles in the form of the vehicle make, fuel type, engine capacity and year of first registration of the vehicle. Information on the number of registered vehicles classified not only according to the manufacturer but also the model of the vehicle may be obtained from this exhaustive database.

The Czech Republic, Estonia and the Netherlands maintain public registers including at least substitute parameters, i.e. sufficient information in the form of the vehicle make, fuel type, engine capacity and year of first registration. Also Estonia possesses transparent registers, maintained by the Road Administration (Maanteeamet, 2016). Their website offers a detailed summary of vehicles registered in Estonia. The register is elaborate, with no incorrect data. In the Netherlands, the database is not publicly available as a whole; data concerning individual vehicles are accessible upon inquiry in the special application for the calculation of road tax (Mijnwegenbelasting, 2016). The system displays a number of data for the vehicle concerned, including the make, fuel type, engine capacity and year of first registration of the vehicle. There is also the possibility to enter the emission value; however, very often this figure is missing.

In the Czech Republic, it is the Ministry of Transport that administers and owns the data in the Central Register of Vehicles. The Central Register of Vehicles was part of the agenda of the Ministry of the Interior until the year 2012. The disclosure of data is subject to Act No. 101/2000 Coll. on the Protection of Personal Data, and no information that could identify a particular natural person can be obtained from the register. Older records (until 2005) contained only vehicles with pre-defined make and

type of vehicle. This method practically prevented any typing errors and other mistakes. However, in later years, information on all the vehicles is maintained in the same form as manually entered by the registration point, i.e. the competent municipality. This resulted in many mistakes in the vehicles records and the Ministry of the Interior was not allowed to change the information in any way. The Ministry of the Interior (2012) states that the total error in the databases is lower than half a percent, although a third of the data shows a mistake in some of the parameters entered (David and Křápek, 2015). Since July 2012, the operation of the Central Register of Motor Vehicles has been in the jurisdiction of the Ministry of Transport. The web portal of the Ministry of Transport (2016) contains summary statistics and monthly statistics, which are regularly updated. The current register is divided into detailed categories. There are databases classified according to the year of production, vehicle make, fuel type or engine capacity; vehicles may also be classified according to the original regions and district of registration or, for instance, the color of the vehicle.

Countries that fail to provide sufficient amount of information in their registers include in particular Spain, France, Slovakia, Denmark, Ireland and Cyprus. In these countries, information about the number of registered vehicles is only provided according to the vehicle types (passenger vehicles, motorcycles, buses, agricultural machinery etc.), or according to regions. Information about registered vehicles in Slovakia and Spain are similar. The data are divided into the vehicle types and subsequently according to regions of registration.

Provision of information from the register of vehicles is not a standard procedure in other countries of the European Union, either. For instance, the databases of vehicles in Belgium and Germany are only intended for the purposes of the police, insurance companies and similar institutions. Other countries such as Latvia, Luxembourg, Poland or Austria collect fees for access to the database, and permission from the organization administering the database must be obtained. The only publicly available information in Italy is notification of the number of newly registered vehicles, which is updated on a monthly basis. The data are not classified in any manner in such summaries of new vehicles. Brief information on the registered vehicle may also be obtained in Greece, where the data are divided according to manufacturers. Slovenia offers the service of information provision upon entering identification data from the registration certificate of a concrete vehicle. No data can be obtained without entering such information.

In certain countries, no details of vehicles registered in that country are publicly available. Such countries include Hungary, Malta, Portugal, Romania, Bulgaria, Finland, Croatia and Lithuania.

I: Availability of data from accessible registers in the EU countries

Parameter/country	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE
Vehicle make	x	x	x	x	x	o	x	o	x	x	x	x	x	x
Fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fuel type	x	x	x	x	x	o	x	o	x	x	x	x	x	x
Engine capacity	x	x	x	x	x	o	x	o	x	x	x	x	x	x
First registration	x	x	x	x	x	o	x	o	x	x	x	x	x	x
CO ₂ emissions	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Parameter/country	IT	LV	LT	LU	MT	NE	PL	PT	RO	SK	SI	ES	SE	UK
Vehicle make	x	x	x	x	x	o	x	x	x	x	x	x	x	o
Fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fuel type	x	x	x	x	x	o	x	x	x	x	x	x	x	o
Engine capacity	x	x	x	x	x	o	x	x	x	x	x	x	x	o
First registration	x	x	x	x	x	o	x	x	x	x	x	x	x	o
CO ₂ emissions	x	x	x	x	x	o*	x	x	x	x	x	x	x	o

* emission level is often missing

- x means that the data is not available

- o means that the data is available

Source: Author

Now it is possible to identify the degree of readiness of the EU member states for the introduction of environmental road tax. It is clear that such purpose requires registers containing emission levels of all the vehicles, regardless of the year of registration. Unfortunately, this ideal state was not ascertained in any country of the European Union. If emission levels are known, it is always since a certain year, whereas the earliest data are present in the UK database, namely since the year 2000. Thus the primary problem is the identification of emission levels of older vehicles, where the emission value is not entered in the technical documents. This problem may be resolved by means of substitute parameters necessary for the calculation of emission levels of old vehicles, in the form of the vehicle make, fuel type and consumption, engine capacity and year of first registration of the vehicle (David, 2015). If a particular country is to be prepared for the application of environmental tax, its register must provide data on emissions of new vehicles and the above mentioned substitute parameters for older vehicles. Existence of such data present in national registers can only be assessed where such data are publicly available.

The results of content analysis of registers in the EU member states are shown in Tab. I. It is apparent that only the public registers of the Netherlands and the United Kingdom contain the information necessary for the application of environmental road tax. Public registers of the Czech Republic and Estonia use at least the substitute parameters. The other EU countries either do not use the required data or such data are not published.

Analysis of vehicles taxation systems in the EU

Taxes on vehicles had been levied by means of different instruments in a number of countries until the beginning of the 1990s. High rates of excise tax or of value added tax were applied most often. With the gradual harmonization of indirect taxes within the European Union, such instruments have been replaced with direct taxes, which have developed ever since. Nowadays, three groups of taxation of vehicles may be identified (Tesařová, 2012). The first group includes tax connected with the purchase of the vehicle or with its registration. The second group is represented by taxes related to the ownership of the vehicle, and the third group is taxes involved in the use of the vehicle.

Due to the fact that there are not two states with the identical systems of taxation of road motor vehicles within the European Union, phenomena such as double taxation, distortions and ineffectiveness occur quite often, which hinders correct functioning of the single market. Double taxation mostly occurs with the registration tax, which, together with other administrative barriers restricts free movement of vehicles in the EU countries.

The large variety of taxation methods for vehicles applied at the moment of purchase in different the EU countries hinders the movement of automobiles within the single market, prevents profit from economies of scale in the automotive industry and harms competitiveness. The differing pressures of national laws affecting automobile manufacturers distort their production portfolios. The situation is also aggravated by the distortion of demand due to the above mentioned differences. These circumstances lead to the needless increase of acquisition and operational costs on road motor vehicles, whereby the desired renewal of fleet is

hindered, too. This not only affects the evaluation of meeting the emission limits following from the Kyoto protocol, but also the real quality of the environment.

The taxation of CO₂ emissions has been enacted throughout the EU (ACEA, 2016). Most of the EU member states apply some form of tax on CO₂ emissions at the moment of registration of the vehicle, and/or vehicle ownership tax. The 21 countries that collect any of the taxes on passenger cars partially or entirely based on CO₂ emissions include: Austria, Belgium, Croatia, Cyprus, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, the Netherlands, Portugal, Romania, Slovenia, Spain, Sweden and the United Kingdom. However, the notice of Her Majesty Treasury of 1998 that the road tax in many EU countries does not adequately reflect efforts to compensate for the environmental burden still holds true. This particularly concerns Bulgaria, the Czech Republic, Estonia, Finland, Lithuania, Poland and Slovakia.

(Tax on ownership) The annual taxation of passenger cars is a widely used tool in the EU countries, present in the tax systems of all the member states. This regular tax is further classified according the vehicle type into tax on passenger cars and trucks and according to use into tax on commercial and private vehicles. Annual tax on private and commercial vehicles is identical only in Denmark; however, taxes here are not based on CO₂ values, either.

(Tax on ownership of passenger cars) The tax on ownership of vehicles not used for commercial purposes is applied by 21 countries of the European Union. These countries do not include the Czech Republic, Estonia, France, Lithuania, Poland, Slovenia and the Slovak Republic. Taxation solely

based on emission levels is applied only in Belgium, Cyprus, Finland, Greece and Ireland. Combination of emissions and another variable included into the tax base is implemented in Latvia, Germany, Luxembourg, Malta, the Netherlands, Portugal, Sweden and the United Kingdom. The variable in question is usually cylinder capacity, vehicle weight or engine power. Cylinder capacity may serve as an independent determinant of the tax duty, used in Romania. Engine power is the sole basis for tax in Austria.

Within the framework of taxes on ownership of commercial vehicles, emission levels are included into the tax base only by four EU countries, namely Germany, Sweden, the Netherlands and the United Kingdom. Besides emissions, also other variables are included in the tax base in these countries.

Vehicle weight is the only variable reflected in the annual road tax base on commercial vehicles in Slovenia. The other countries use vehicle weight most often in combination with the number of vehicle axles. The standard tax base consists of three indicators, most typically the mentioned weight, number of axles and weight per axle. Fuel consumption as part of the tax base is only used in Denmark, in combination with the vehicle weight and fuel type.

Apart from the many differences in taxes on ownership of road motor vehicles in the EU countries, we must mention the existing advantages for vehicles with electric or hybrid drive. Their support is implemented in 9 countries of the European Union. Such advantages either include simple exemption of the vehicle from tax in the Czech Republic and partially in Denmark, Germany and Greece or the mechanism of calculation of the road tax in connection with zero or low CO₂ emission values. In Austria, Cyprus and

II: Availability of data according to the tax on ownership in the EU countries

Parameter/country	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE
Vehicle make	○	○	○	○	○	○	○	x	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	○	x	x	x	x	x	x	x
Fuel type	x	x	x	x	x	x	○	x	x	○	x	x	x	x
Engine capacity	x	○	○	x	○	○	x	x	x	x	○	○	x	○
First registration	x	○	○	○	○	○	x	x	○	○	○	○	○	○
CO₂ emissions	x	○	x	x	○	x	x	x	○	○	○	○	x	○
Parameter/country	IT	LV	LT	LU	MT	NE	PL	PT	RO	SK	SI	ES	SE	UK
Vehicle make	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fuel type	x	x	x	○	x	○	x	○	x	x	x	x	○	x
Engine capacity	x	x*	x	○	x	x	x	○	○	○	○	x	x	○
First registration	x	○	x	○	○	○	x	○	x	○	x	x	○	○
CO₂ emissions	x	x	x	○	○	○	x	○	x	x	x	x	○	○

* Figure available in records made after 2005

- x means that the data is not available

- ○ means that the data is available

Source: Author

France, the bonus-malus system is applied. If you use an electric vehicle in Belgium, your income taxes will be lower.

It is clear from the above mentioned facts that there are significant differences in the conception and application of vehicle taxation in the individual states of the European Union. On the other hand, we may say that fundamental changes have been adopted in many countries in the latest decade, which usually go in the same direction. This includes the reflection of CO₂ emissions in the tax base either as the only indicator or in combination with other existing variables. For instance, emission levels have been included into the ownership or acquisition tax calculations in Spain, Finland, France, Ireland and Malta since 2007 up to now.

The problem of the possible presence of non-public data in national registers may be significantly eliminated by the inclusion of clearly indispensable data into the application of the existing tax on ownership, regardless of their use for business. Tax on acquisition cannot be used for this purpose as this is a lump-sum tax and there is no certainty that there is a system that would register data determining the tax duty. Thus, our considerations are based on the objective assumption that if a given variable is the subject of the existing tax on ownership, it must be available in the register of the country concerned.

Thirteen EU countries have the emission data of new vehicles available, as shown in Tab. II. We may also assume that the car make is registered by all countries that levy any form of tax on ownership. The only country where the make is not a known attribute is Estonia. The substitute parameters represented by the year of first registration, engine capacity or fuel consumption are not available to the full extent in any country. In most countries, only one or some of the parameters are known. No

variables usable by the tax system are known in Austria, Estonia, Italy, Lithuania, Poland and Spain.

Interconnection of data from registers and national regulations of taxes on ownership

Let us proceed to the synthetic interconnection of the ascertained availability of the necessary variables and applied taxes on ownership.

All the parameters necessary for the application of the environmental road tax are known in Luxembourg, the Netherlands, Portugal and the United Kingdom, as shown in Tab. III. The Czech Republic and Estonia have all the data available except for emission values. Only one of the necessary substitute parameters is unavailable in Belgium, Bulgaria, Cyprus, France, Germany, Greece, Ireland, Slovakia and Sweden. The most frequently missing is the information on the fuel. The least number of data is provided in Austria, Hungary, Italy, Lithuania, Poland and Spain.

Optimization using additional data

More general information about registered vehicles may be obtained from international organizations. One of them is the United Nations Economic Commission for Europe, which publishes the Annual Bulletin of Transport Statistics for Europe and North America. Here you can find the number of vehicles registered in the respective countries, classified according to the vehicle category and its age and type of fuel. The bulletin also contains information about the numbers of newly registered vehicles (UNECE, 2015). Statistics are provided e.g. by the Czech organizations Car Importers Association (SDA) and Automotive Industry Association (SAP). However, their data are not sufficient for the potential implementation of the environmental road tax.

III: Synthetic evaluation of data availability in the EU countries

Parameter/country	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE
Vehicle make	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	○	x	x	x	x	x	x	x
Fuel type	x	x	x	x	x	○	○	○	x	○	x	x	x	x
Engine capacity	x	○	○	x	○	○	x	○	x	x	○	○	x	○
First registration	x	○	○	○	○	○	x	○	○	○	○	○	○	○
CO ₂ emissions	x	○	x	x	○	x	x	x	○	○	○	○	x	○
Parameter/country	IT	LV	LT	LU	MT	NE	PL	PT	RO	SK	SI	ES	SE	UK
Vehicle make	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fuel type	x	x	x	○	x	○	x	○	x	x	x	x	○	○
Engine capacity	x	x	x	○	x	○	x	○	○	○	○	x	x	○
First registration	x	○	x	○	○	○	x	○	x	○	x	x	○	○
CO ₂ emissions	x	x	x	○	○	○	x	○	x	x	x	x	○	○

- x means that the data is not available

- ○ means that the data is available

Source: Author

In case the information on the year of first registration and the fuel type is missing, we can use the international register UNECE (2015). These parameters are added in Tab. IV.

This optimization step has not changed the assessment of Luxembourg, the Netherlands, Portugal and the United Kingdom. These countries have all the data necessary for the implementation of the environmental road tax and they have been joined by Belgium, Cyprus, Germany, Greece and Ireland.

The Czech Republic, Estonia and newly also Bulgaria, Romania, Slovakia and Slovenia have

all the data available except for emission values. Only one of the needed substitute parameters is unavailable in Austria, Croatia, Denmark, Finland, France, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Spain and Sweden. This time, the most frequently missing information concerns engine capacity. The least number of data is thus provided by Austria, Croatia, Hungary, Italy, Latvia, Lithuania, Poland and Spain. Information on emissions, engine capacity and fuel consumption are missing in each of these countries.

IV: Final assessment of availability of the necessary data in the EU countries

Parameter/country	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE
Vehicle make	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	○	x	x	x	x	x	x	x
Fuel type	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Engine capacity	x	○	○	x	○	○	x	○	x	x	○	○	x	○
First registration	○	○	○	○	○	○	○	○	○	○	○	○	○	○
CO ₂ emissions	x	○	x	x	○	x	x	x	○	○	○	○	x	○
Parameter/country	IT	LV	LT	LU	MT	NE	PL	PT	RO	SK	SI	ES	SE	UK
Vehicle make	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fuel consumption	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fuel type	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Engine capacity	x	x*	x	○	x	○	x	○	○	○	○	x	x	○
First registration	○	○	○	○	○	○	○	○	○	○	○	○	○	○
CO ₂ emissions	x	x	x	○	○	○	x	○	x	x	x	x	○	○

- x means that the data is not available

- ○ means that the data is available

Source: Author

CONCLUSION

From the environmental viewpoint, it is very desirable to introduce the taxation of road motor vehicles in European countries, as also evidenced by conclusions of Blanc and Derkane (2010). Environmental road tax may be based on the amount of emissions generated per unit of a vehicle travel or in case of older vehicles, emissions calculated on the basis of values of substitute parameters of the respective vehicles in the fleet, as suggested by David and Křápek (2015).

Due to the fact that there are not two states with the identical systems of taxation of road motor vehicles within the European Union, as apparent from ACEA (2016), phenomena such as double taxation, distortions and ineffectiveness occur quite often, which hinders correct functioning of the single market. Double taxation mostly occurs with the registration tax, which, together with other administrative barriers restricts free movement of vehicles in the EU countries. Therefore it is desirable to unify the system. If there is a will, the best solution would be the environmental form of tax.

An important factor involved in the efforts to introduce environmental road tax is the factual state of readiness of the respective EU member states for such a change. It is essential on what level the vehicle registers are, i.e. whether they contain sufficient data for the environmental road tax to be implemented. This circumstance was examined here by means of analysis of the existing vehicle taxation systems, available registers in the European Union countries and aggregate international statistics. In the synthesis, it was identified that 9 EU countries maintain registers with enough data to be able to apply environmental road tax. The most frequent deficiency is the absence of emission levels in the register, although all the other information is available. Such situation concerns 6 countries of the European Union. In 5 countries the emission level is recorded, but one of the other necessary substitute parameters is missing. In the registers of 8 EU countries the emission value as

well as some of the substitute parameters necessary for the calculation of emission levels of older vehicles are absent.

Registers in some countries objectively have more information than we have been able to identify in this work. These are cases where the register is not publicly accessible and is used only by government agencies or require a special access permit. Such a condition was identified in 6 countries of the EU. Nevertheless, only in half of these cases the condition of the registers may improve, because 3 of such countries were assessed as having sufficient information after the optimization performed.

Efforts of the EU member states in the area of road motor vehicle taxation are connected both with environmental and with economic and social aspects. A typical example is the Czech Republic, where only vehicles used for commercial purposes are subject to tax. For a relatively long time, the Czech Ministry of Finance has been considering the introduction of road tax for private natural persons; not just for companies and entrepreneurs. However, at present, priority is given to efficient collection of the existing taxes and minimization of tax evasion and fraud. The unwillingness to change may generally be caused by the long-time tradition of the existing taxation systems.

Besides willingness to implement environmental road tax and readiness of national registers, another substantial aspect of the tax is the issue of rates that will have to be determined in monetary units per pollution unit, i.e. per gram of CO₂. We should consider the pricing of emissions or utilization of the existing values based on the emissions trading scheme. However, these are issues to be raised only in case the environmental road tax is to be introduced throughout the European Union. It cannot be expected that the countries which do not maintain the relevant information in their vehicle registers shall be willing to accept such a change, with regard to administrative costs that would have to be expended to overhaul the existing registers and change records for newly registered vehicles.

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