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## Article

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# Economic instruments for the internalization of external costs of road transport<sup>1</sup>

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**Abstract:** In this article, the functioning of economic instruments related to the exploitation of road transport vehicles is elaborated. A critical overview of characteristics of different instruments as well as the usefulness of these instruments from the point of view of opportunities for application to a system of internalization of external costs related to the exploitation of road transport vehicles is provided in the context of advantages and disadvantages of the instruments.

**Keywords:** *road transport, economic instruments for environmental management, internalization costs, external costs of transport*

## 1. Introduction

The realization of environmental policy depends to a large extent on the selection of properly constructed economic instruments, which are aimed at influencing the level of costs for economic entities as well as the level of welfare of consumers, in order to achieve positive effects for the environment. Although certain policy instruments aiming at making transport more sustainable (e.g., the EURO norm) can be assessed as effective and reducing the pressure of road transport on the natural environment (Trela, 2011: 322), it is necessary to construct a whole system of economic instruments that allow for the realization of the multiple aims of sustainable

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transport in an effective way. The basis for such a system is the selection of a proper set of instruments.

The aim of this article is to provide a critical overview of the existing economic instruments in Poland directly aiming at internalizing external costs related to the exploitation of road transport vehicles (taxes and fees). In this article, internalization of external costs (or: internalization) is interpreted as including the external costs in the internal accounts (expressing the private costs) of the economic entity causing the external costs (Graczyk, 2005: 135). In reality, economic units (individuals or companies) most often take decisions based on private costs, not taking the negative external effects into consideration, as these effects are borne by others (diffused among a group of victims) (Trela, 2012: 175). When applying the so-called polluter pays principle, instruments are needed to let the polluter face the full social costs of its polluting activity, in order to provide incentives to reduce pollution. In order to make complete internalization of external costs possible and for instruments to be effective, it has been argued that a marginal cost and benefit approach should be used (Fiedor and Graczyk, 2006). The idea is that when aiming at reducing the pollution, the extra benefits of such a reduction should be compared to the extra costs generated. Such an approach makes it possible to relate the size of negative externalities to measurable parameters such as amount of kilometers driven, type of car or type of infrastructure used for road transport.

The economic instruments to deal with negative externalities can be divided into the following categories (Fiedor and Graczyk, 2006: 13):

- 1) taxes and/or fees,
- 2) subsidies,
- 3) emission rights.

Focus in this article is on taxes and fees. First of all, the other two instruments are not applied in road transport in Poland. Furthermore, subsidies and emission permits underlie a different logic than the marginal cost and benefit approach. For analytical purposes, it is assumed that negative externalities can be measured, which in reality poses great challenges due to the indirect, uncertain and long-term impact of many negative environmental effects (Fiedor and Graczyk, 2006).

## 2. Fuel fee

The fuel fee is a fee to be paid when “... bringing on the national market engine fuels and gas, with the exception of biocomponents in the meaning of the Act on Liquid Biocomponents and Biofuels from 25 August 2006 (*Ustawa z dnia 25 sierpnia 2006 r. o biokomponentach i biopaliwach ciekłych*) (Journal of Laws No. 169, p. 1199 and from 2007, No. 35, p. 217), ... used for ... vehicles in the sense of art. 2 point 31 from the Act on Law of Road Traffic from 20 June 1997 (*Prawo o ruchu drogowym*)”. In practice, this means that these fees are imposed on gasoline, diesel as well as LPG, CNG oraz LNG.

The fee should be paid by the producer, the importer or the economic unit purchasing the fuel on the market. The revenues are obtained by the National Road Fund (*Krajowy Fundusz Drogowy*) and the Rail Fund (*Fundusz Kolejowy*), obtaining 80% and 20% of the total revenues respectively.

The fuel fee depends on the marginal costs generated by the the user of a road vehicle, as the emission of carbondioxide (CO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>) is directly related to the amount of fuel used. Thus, from this point of view a fuel fee can be an effective part of a system for internalizing negative externalities in road transport.

The fact that 80% of the revenues is received by the National Road Fund may seem at first sight a positive fact. Road infrastructure in Poland is underdeveloped compared to other EU member states. Thus, funds are needed for maintenance and development. However, when developing road infrastructure more quickly than rail infrastructure, the demand for passenger and freight transport by road may increase, leading to increased fuel use and, as a consequence, pollution in the future (see Sterman, 2000).

## 3. Carfare

Depending on the category of means of transport, based on observations the authors distinguish three types of carfares for using road infrastructure:

- 1) one-time fee,
- 2) vignette,

3) the fee to be paid by an electronic toll collection system.

A one time fee is a payment made at the gate entrance and / or exit of the road for which the fee has to be paid. Such a fee is most commonly used the motorcycles, cars and light commercial vehicles (GVW no more than 3.5 tons). In the case of heavy vehicles (GVW over 3.5 tonnes) more often monthly or yearly subscriptions are a common way of payment.

A vignette is a kind of subscription allowing to drive on the paid road for a certain time. This type of payment is used for all types of road vehicles. When the vehicle has proper equipment, this payment can be made via an electronic toll collection system. Depending on the type of system used, the process of calculation of the fee and the devices for detection are different.

In the first case, a device installed in the car communicates with the devices along the length of the toll section of the road. Based on the parameters associated with the vehicle and the number of kilometers traveled, the corresponding fare is calculated. This way of calculating the fee is used in one of the most popular systems using dedicated short-range (wireless) communication (DSRC)

A more advanced technological system of electronic toll collection is based on satellite technology GNSS. For calculation of the fee, a GPS transmitter installed in the car is used. This GPS transmitter localizes the car and calculates the proper fee for the particular type of car. When using this technology, no infrastructure / devices is needed along the road for calculating the fee. The fee is received by the National Road Fund or is received by the the company that constructed and / or operates the road (e.g. for maintenance).

The carfare as an economic instrument should be the basis of the whole system of internalization of negative externalities caused by the use of road transport vehicles. The reason for this is that the fee can be determined by the marginal costs of basic pollution caused by road transport such as: nitrogen oxides (NO<sub>x</sub>), non-metallic volatile organic compounds (NMVOC), particulate matter (PM<sub>2,5</sub> and PM<sub>10</sub>), and can also depend on the marginal costs of noise and congestion.

This instrument is the only one that can include more negative external effects at the same time, such as the effects mentioned above. Without the application of a carfare, new instruments should be created in order to deal with the negative externalities, while these instruments should function according to the same principles as the car fare. The new instruments would be complex

in construction, and there can be difficulties with the indicative calculation of the size of the fee for the car drive that is not yet taking place.

#### **4. Excise tax on fuel**

An excise tax is a direct tax imposed on goods with a high level of profitability, i.e., a large difference between the sales revenue and production costs. These goods are rather characterized by a low price elasticity of demand, i.e., the quantity demanded changes slowly compared to the change in the price. Excise tax has become an important source of revenue for the government.<sup>2</sup> The tax is imposed on gasoline, diesel, natural gas, electric energy (except for energy from renewable resources) etc., meaning that in fact for every road vehicle using fuel taxes are paid. This creates a problem with government policy, as there are now multiple goals related to the tax. On the one hand, it should lead to reduced use of fuel. However, this effect may be small due to the low price elasticity of demand for fuel due to the lack of good substitutes (e.g., car needed for work, truck needs to drive in order to deliver freight), leading in turn to high revenues for the government. The importance of the high revenues may create a disinterest in a real decline in use of fuel (see Begg et al., 1994), in particular as the revenues from excise taxes from fuel are not directly used by the government for aims related to road transport. Like with a fuel fee, the level of tax should depend on the level of external costs related to CO<sub>2</sub> and SO<sub>2</sub> Emissions. While theoretically this instrument may be a useful part of a system of instruments for internalizing negative external effects, a condition for effectiveness is the use of revenues for activities aimed at further reduction of the negative environmental impacts of road transport.

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<sup>2</sup> Informational brochure regarding excise tax on the Website of the Ministry of Finance. Available at: [http://www.mf.gov.pl/\\_files\\_/podatki/broszury\\_informacyjne/broszura\\_\\_20080318.pdf](http://www.mf.gov.pl/_files_/podatki/broszury_informacyjne/broszura__20080318.pdf), s. 1. Accessed: 11 February 2012.

## 5. Vehicle tax collected by the municipality

Road vehicles with a GVW over of 3.5 tonnes (with the exception of trailers and semi-trailers used only for agricultural activities carried farmers) are subject to tax on means of transport. The following road vehicles are exempted from this tax:<sup>3</sup>

- “means of transport in the possession of diplomatic, consular and other foreign missions,
- means of transport kept in stock for mobilization,
- special vehicles and vehicles used for special purposes,
- means of transport (excluding buses), which are used for delivery in a range of 150 km (in a straight line) on Polish territory in combined transport,
- historic vehicles (registered as monuments or included in the provincial register of monuments).”

The height of the tax is established by the municipal council. However, by law a maximum level of tax is set<sup>4</sup> while the Ministry of Finance sets each year a minimum level.<sup>5</sup> The level of tax can differ depending on the impact of the means of transport on the environment, the year of production and the number of passengers (in case of autobuses).

The revenues of this tax are received by the municipality where the owner of the vehicle is registered or the owning company has its seat. There are no regulations on whether the tax revenues have to be used for aims related to road transport. The tax itself is not based on the marginal costs of using the vehicle, as it is a tax on the possession of the vehicle paid each year. The vehicle tax is advantageous when using the revenues for, for example, increasing the safety in transport or the road infrastructure itself in the municipality. However, in this case only some negative externalities are reduced, while not internalizing the total amount generated directly by the use of road vehicles. Thus, this instrument is difficult to integrate in a system aiming at internalization of negative externalities, in particular when not using the revenues for this purpose.

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<sup>3,4</sup> Act on Local Taxes and Fees from 12 January 1991 (Journal of Laws from 2010, No. 95, p. 613)

<sup>5</sup> Statement of the Minister of Finance on the tax rates of vehicles.

## 6. Fee for using and changing the environment

The Law on Environmental Protection (*Prawo ochrony środowiska*, (Journal of Laws from 2001, No. 62, p. 627, Art. 273) obliges to pay a fee for the release of gases and dust by entrepreneurs who own the means of transport as well as individuals using the environment to the extent that a permit is required. This fee is proportional to the amount of fuel (in tonnes) and depends on the type of vehicle, the year of first registration and the EURO norm of the vehicle.

The height of the fee is determined by the user of the environment and shall be paid to the Marshal's Office of the voivodship (Polish administrative unit between municipality and state). The height of the fee can be verified by the voivodship's environmental protection inspector and, if discrepancies are discovered, the Marshal established the amount of fee to be paid. Furthermore, entities subject to the payment for the use of the environment are also required to submit to the Marshal of the voivodship as well as the environmental protection inspector information and data on the extent of use of the environment and the amount of fees due in accordance with a fixed formula.

In accordance with Article 289 of the Law of Environmental Protection, the fee for using the environment does not have to be paid when the amount is smaller than PLN 400 (about 100 euro) in a half year period. However, also in this case information and data on the extent of use of the environment have to be provided.

The fee for using and changing the environment is partly based on the marginal external costs, as pollutants such as CO<sub>2</sub> and SO<sub>2</sub> depend on the amount of fuel used. However, other pollutants such as NO<sub>x</sub>, NMVOC, PM<sub>2.5</sub> and PM<sub>10</sub> do not depend on the amount of fuel used, but rather on the exhaust gas treatment technology used in the engine. The dependency of the fee for using the environment on the amount of fuel used and the EURO norm at the same time *de facto* causes the lack of possibility of relating the fee with marginal costs, which makes the applicability of this instrument in a system for internalizing negative externalities of transport doubtful.



## 7. Compulsory civil liability insurance of vehicle owners

The owners of transport vehicles are obliged to buy a civil liability insurance for the car (as established in the Act on Obligatory Insurances, Insurance Guarantee Fund and Polish Motor Insurers' Bureau from 22 May 2003 (*Ustawa o Ubezpieczeniach Obowiązkowych, Ubezpieczeniowym Funduszu Gwarancyjnym i Polskim Biurze Ubezpieczycieli Komunikacyjnych*). This insurance covers the damage to property and health of victims caused by accident caused by the holder of the liability insurance. In accordance with the Act on Obligatory Insurances, every company selling the civil liability insurance guarantees the same maximum amount of compensation for damage done to property or injury.

The liability insurance premium depends on the engine capacity of the vehicle and the place of residence of the owner. The insurance company may increase or lower (give a discount) the premium taking into consideration conditions such as age, previous damages due to accidents, the continuation of insurance or payment in installments. There are no legal constraints on the maximum insurance premium. Thus, market forces determine the level of the premium, and in turn the revenues for the insurance company.

This instrument should be part of the system of internalization of external costs as a system where the damage caused by the driver is compensated, and the risk of causing an accident is included in the driver's cost function. However, currently the height of the insurance premium is not dependent on the marginal value of the risk of causing an accident, while the insurance is on the car owner and not on the individual driver (e.g., a family member, a person borrowing the car). It would be necessary to put the insurance on the driver, and not on the car owner. Furthermore, the liability insurance premium should be made dependent on the amount of kilometers driven as well as the type of roads driven on. As a consequence, the premium would only be calculated at the end of the insurance period. This not only would change the current way of paying the insurance premium, but also create a problem with calculating the risk of causing an accident as when an accident would happen, this already would be known. While a solution is extremely difficult, a possible solution is the application of a two-stage system of payments for liability insurance. According to this concept, in the first stage, at the beginning of the insurance period, a flat fee should be charged related to the calculation of risk of accidents based on the characteristics of the insured driver. In the second stage, at the end of the insurance period, the

fee for the number of kilometers and type of roads driven on should be paid. However, in reality there may be an incentive among drivers to report a smaller amount of kilometers and do not tell the truth on the type of roads driven on. This would require controlling equipment in cars, and complicates the introduction of such a system. However, when connecting this with a GPS system, this could be combined with, for example, a rush-hour tax in order to internalize the external costs of congestion.

## **8. Concluding remarks**

In this article, instruments belonging to the category taxes and fees have been analyzed. Subsidies and emission rights were not elaborated, as subsidies (e.g., on the purchase of a new car while depositing the old car) and emission rights (e.g., a licence for entrance of a city centre) are not applied in Poland, while also not relying on analysis of the marginal costs and benefits of pollution. A licence to enter a city centre have a unitary price, independent of the number of kilometers driven in the centre. As such there is no direct relation between the marginal cost of the negative external effect generated and the price paid. Emission rights can be related to the marginal costs of using a car. However, the moment an emission right is obtained, the instrument functions similar to the mentioned licence to enter a city centre, with the difference that additionally it is necessary to create and monitor the market for emission rights, which could lead to high economic costs, which makes its feasibility disputable in the context of road transport.

Subsidies on new, more environmentally-friendly, cars are completely independent from the size of negative externalities prevented, as they are given only once on a special occasion (the purchase of a new car), while the parameters influencing the size of the negative externalities (e.g., amount of kilometres driven) are no element of the calculations on environmental impact.

Taking into consideration the arguments on subsidies and emission rights, it may be argued that instruments for internalizing negative externalities should belong to the category of taxes and fees, as they directly influence the cost function of the economic unit taking the production or consumption decision. Within this category, based on analysis provided in this article, it may be argued that the most effective instruments are fuel fees, carfee and the obligatory liability insurance for the car owner.

The fuel fee, similarly to an excise tax on fuel, can be used for the internalization of external costs related to the emission of CO<sub>2</sub> and SO<sub>2</sub>. However, as 80% of the fees go to the National Road Fund, a question is whether the problem will be solved. As discussed, the price elasticity of demand for fuel is low, and, assuming environmental damage can be calculated exactly, the question remains whether fuel use would be reduced enough. The moment the fees would be used, for example, for research and development activities on developing more energy-efficient road transport, a synergy effect between the polluter pays principle underlying taxes/fees and positive effects of subsidies can be achieved. However, the moment the revenues are used only for investment in physical infrastructure, the effect becomes uncertain. A better infrastructure tends to make driving a car or road freight transport more attractive compared to, for example, rail transport. In such a case, the dynamic effect of using funds obtained from taxes and fees may be opposite to the intended effect.

The car fare seems to be the only instrument where the size of the payment directly depends on the number of kilometers driven. At this moment, theoretically it is possible to include the external costs of emission of NO<sub>x</sub>, NMVOC, PM<sub>2,5</sub>, PM<sub>10</sub>, as well as congestion and noise into the payment.

The civil liability in Poland in its current form does not make the internationalization of the risk of causing a car accidents. However, it is the only existing instrument that should fulfill this role, as is emphasized in the document entitled “Opinion of the Committee of the Regions on Greening the transport sector” (Committee of the Regions, 2009). Changes in the system should take the marginal external costs of causing an accident into consideration. A problem with the current system is that it is the obligation of the car owner to have an insurance. The moment someone else drives the car, this person drives on the insurance of the car owner. A better system to internalize the negative externalities caused by accidents is an insurance on the driver instead, as can be found in the United Kingdom. At this moment, the driver always bears the financial consequences, including the loss of rebates for driving without accident for several years.

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*Instrumenty ekonomiczne internalizacji kosztów zewnętrznych w transporcie drogowym*

*Streszczenie*

W artykule poddano analizie funkcjonujące instrumenty ekonomiczne związane z eksploatacją pojazdów transportu drogowego w Polsce. Analiza obejmuje charakterystykę poszczególnych instrumentów, określenie przydatności wyszczególnionych instrumentów z punktu widzenia możliwości ich zastosowania w systemie internalizacji kosztów zewnętrznych wynikających z eksploatacji środków transportu drogowego, a także wskazanie zalet i wad tych instrumentów.

**Słowa kluczowe:** *transport drogowy, instrumenty ekonomiczne zarządzania środowiskowego, internalizacja kosztów, koszty zewnętrzne transportu*