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MOTOR VEHICLE TAX COLLECTION AND ITS POSSIBLE IMPACT ON THE NUMBER OF TRAFFIC ACCIDENTS: A CORRELATION ANALYSIS

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Abstract

The aim of this paper is to investigate the impact between motor vehicle tax collection and the number of road accidents in the Visegrad Group (V4) countries between 2017 and 2023. The research hypothesises that the level of tax revenue can influence road safety, either directly through infrastructure investment or indirectly through regulatory influence on driver behaviour. The study used correlation analysis to examine the links between tax collection, traffic accidents and road conditions. The results showed that in Slovakia and Poland there is a positive correlation between the amount of revenue and the number of accidents, while in Hungary a slightly negative correlation was identified. In the Czech Republic, no significant relationship was found. The study concludes that the amount of taxes collected alone is not a determinant of road safety. Efficient reinvestment of tax revenues and transparent financing of infrastructure are shown to be key to improving road safety.

Keywords: motor vehicle tax; road safety; public finances; road accidents

1. Introduction

In many countries, one of the components of state budget revenue is the motor vehicle tax. The introduction of this type of tax was initially presented not only as a source of revenue for the state budget but also as a tool for influencing road safety. Transport is a major part of the economic infrastructure of modern countries, but it is also one of the main factors that have a negative impact on the environment, public health and road safety.

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The sector is currently facing many challenges, not only in terms of reducing emissions, but also in terms of financing infrastructure and sustainability. In this context, the motor vehicle tax has a dual role, both as a source of revenue for the national budget and as an economic instrument that can influence the behaviour of road users and, ultimately, the number of road accidents.

In recent years, the motor vehicle tax has become the subject of studies in the context of environmental impacts and achieving global efforts to reduce the carbon footprint and implement green economic principles [1, 2]. In India, for example, green taxes have become part of the fight against automobile pollution; likewise, China has been able to adapt its taxation model in response to fleet electrification. These examples clearly show that tax policy can influence the composition of the vehicle fleet through changes in motor vehicle tax.

A similar trend can be observed in the European region, where a link between vehicle taxation and investment in road infrastructure, where better funding for road repair and maintenance can reduce road accidents, has been shown [3]. A similar analysis of the vehicle fleet was carried out in Croatia, finding that the structure and age of vehicles, which are affected by taxation policy, are the main factors in reducing road accidents. The structure and age of vehicles influenced by tax policy have a direct impact on road safety. Equally important are innovative approaches to traffic management and taxation that reflect the digital transformation of the economy [4]. For example, an important conclusion of the study in the Czech Republic is that even small tax interventions, such as registration fees based on emission parameters, can influence the structure of the vehicle fleet and reduce the number of technically obsolete vehicles, which in turn can have an indirect positive impact on road safety [5]. In Russia, a study was conducted that proposed a more efficient tax collection mechanism. The latter is based on artificial intelligence and vehicle usage data that can improve the efficiency and addressability of tax collection while promoting sustainable transport [6].

On the other hand, the literature also points to the limitations of traditional tax instruments such as fuel taxes or the motor vehicle tax. As the share of electric vehicles increases and fuel efficiency increases, the amount of fuel taxes collected decreases, undermining the ability to finance transport infrastructure from these sources. This raises the question of whether the current tax model adequately reflects changes in economic, technological and environmental conditions [7, 8].

Based on the above, it is clear that taxes on motor vehicles are not only an important source of revenue for the state budget, but also an instrument that can influence the technical quality of the vehicle fleet, investment in infrastructure and thus the number of traffic accidents. However, there are no studies in the academic and professional environment that examine the relationship between the number of resources collected for the state budget and road safety. The aim of this paper is to investigate the potential statistical correlation

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between the amount of motor vehicle tax revenue and the number of recorded traffic accidents. Through this correlation analysis, the study seeks to determine whether there is evidence of an observable relationship that might suggest a broader socio-economic or behavioural link. The findings of this research could contribute to more informed fiscal policy decisions and provide a basis for further investigation of the indirect effects of fiscal instruments on traffic safety.

2. Materials and Methods

Within the European Union, Council Directive 1999/62/EC was issued for road infrastructure charging, which introduced the possibility for Member States to charge for selected sections of the road network [9]. The Directive did not set the rate at which selected sections were to be charged, rather it introduced rules for the application of charging. This Directive was later supplemented by other Directives which specified particularly in the factors to be taken into account by Member States when introducing charges for the use of the road network [10]. The aim of the international regulation was to harmonise the way in which the Member States of the European Union may impose charges for the use of their road infrastructure.

It is important to recall that one of the objectives of charging has been, and continues to be, to contribute to the financing of road infrastructure, which means dealing with emergency situations on the roads, developing the road network and regular maintenance of existing roads. In view of this objective, it should be clear that if the collection of these charges is to increase year on year, it is right that the amount of funding allocated to this objective should also increase over time. Member States have been given the option of introducing truck taxes, tolls or vehicle user charges, while setting their own procedures for levying and collecting taxes [9, 10]. This is subject to compliance with the minimum tax rates laid down in the Directive. In order to reduce the negative externalities of transport, rates may favour or exempt more environmentally friendly or other selected vehicles. The revenue from the set road charges is a revenue for the national budget of the Member State.

In this paper, we focus on a quantitative analysis of the possible relationship between the level of motor vehicle tax collection and the number of traffic accidents in the V4 countries in the time span from 2017 to 2023. For the purpose of the research, we have chosen the descriptive-correlation method, which aims to verify the existence and intensity of the relationship between the variables under study. The main source of data for this research is the official statistics of the national ministries of the V4 countries. The data on the collection of motor vehicle tax were drawn from the national budgets and the number of traffic accidents were obtained from the national transport yearbooks of each country. The main variables are:

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- Motor Vehicle Tax (MVT) collection – expressed in PPP absolute valfor each calendar year.
- Number of road accidents – total number of road accidents recorded in the V4 countries during the period 2017–2023.
- Number of traffic accidents – the total number of traffic accidents caused by poor road conditions recorded in the V4 countries during the period 2017–2023.

We assume that if the quality of infrastructure improves as a result of increasing motor vehicle tax collections, then the incidence of accidents caused by poor road quality will also decrease proportionately. To eliminate the impact of inflation, all financial figures have been adjusted at purchasing power parity (PPP) to ensure the real value of tax collections in constant base year prices. In order to verify the existence of a relationship between the volume of road tax collection and the incidence of traffic accidents caused by the poor technical condition of the road network, we applied a classical correlation analysis. Standard statistical relationships were used to calculate pairwise correlation coefficients:

$$r_{yx1} = \frac{\sum y_i x_{1i} - \frac{1}{n}\sum y_i \sum x_{1i}}{\sqrt{(\sum y_i^2 - \frac{1}{n}(\sum y_i)^2(\sum x_{1i}^2 - \frac{1}{n}(\sum x_{1i})^2)}} \tag{1}$$

$$r_{yx2} = \frac{\sum y_i x_{2i} - \frac{1}{n}\sum y_i \sum x_{2i}}{\sqrt{(\sum y_i^2 - \frac{1}{n}(\sum y_i)^2(\sum x_{2i}^2 - \frac{1}{n}(\sum x_{2i})^2)}} \tag{2}$$

$$r_{x1x2} = r_{12} = r_{21} = \frac{\sum y_{i1} x_{2i} - \frac{1}{n}\sum y_{1i} \sum x_{2i}}{\sqrt{(\sum x_{1i}^2 - \frac{1}{n}(\sum x_{1i}^2(\sum x_{2i}^2 - \frac{1}{n}(\sum x_{2i})^2)}} \tag{3}$$

where:
y – road tax collection values,
x_1 – total numbers of accidents,
x_2 – number of accidents due to poor road quality.

3. Results

From a public policy perspective, road tax can also be used as a regulatory tool, for example through progressive tax rates, to discourage the use of older, less safe or less environmentally friendly vehicles. Higher tax rates can also reduce traffic flow and ultimately accident rates. The Table 1 shows the evolution of road tax revenues for the V4 countries' state budgets.

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Tab. 1. Revenue to the national budget of the countries concerned from road tax in PPP

Year	Slovakia	Czechia	Hungary	Poland
2017	182 466.94	333 519 190.42	385 883 506.66	1 018 162 902.56
2018	182 249.21	330 736 695.44	395 686 354.97	1 134 269 498.35
2019	185 247.40	323 703 568.21	400 501 754.58	1 179 268 891.94
2020	170 858.69	295 339 611.31	379 343 975.79	879 893 960.46
2021	143 100.77	254 139 479.93	397 393 982.48	920 630 510.21
2022	157 825.81	78 557 536.59	439 690 539.40	1 002 399 737.67
2023	164 888.03	22 422 442.50	480 564 196.95	1 150 906 302.90

Slovakia has seen relatively stable motor vehicle tax collections between 2017 and 2019, ranging around 182–185 thousand PPP. However, in 2020, there is a decline to 170.9 thousand PPP (-7.77%), which can be attributed to the COVID-19 pandemic and the associated constraints on economic activity. The reasons for this development can also be explained by a combination of economic and legislative factors. During the pandemic, the automotive industry, which is dominant in Slovakia, was affected by both production disruptions and a drop in sales, which may have affected vehicle registrations and operations. In 2021, the decline deepened to 143.1 thousand PPPs (-16.25%). The following years saw a slight recovery, with a 10.29% increase in 2022 and a 4.47% increase in 2023, indicating a gradual recovery of the economy and a return to more normal tax collection, it is clear that tax collection will stabilize, although it has not yet reached pre-pandemic levels.

The development in the Czech Republic has been a turning point, especially after 2021, as the amendment of Act No 142/2022 of the Collection Act has made fundamental changes to the collection of this tax [11]. In 2017–2019, the collection was around EUR 330 million. In 2022 and 2023, however, there was a dramatic drop: in 2022 to 78.6 million PPP (-69.09%) and in 2023 to 22.4 million PPP (-71.46%). The reduced collection of this tax is due to the aforementioned legislative change, which has brought about many changes, among the most important of which is the abolition of the collection of road tax for cars and vans up to 12 tons and the adjustment of the calculation of this tax for vehicles of categories N and O. In 2023, the collection of road tax reached only 22.42 million PPP (i.e. this is a further decrease of 71.46%). Thus, overall, the road tax revenue has decreased by more than 92% compared to the 2019 figure.

Hungary has a long history of stable and increasing collection of MVT [12]. In the period 2017–2023, revenues increased from EUR 385.9 million to EUR 480.6 million. PPP EUR, an increase of +24.5%. In particular, a significant increase was recorded in 2021–2023, when revenues increased by +20.9% This relatively stable collection of the motor vehicle tax may be due to the small number of exemptions in the Motor Vehicle Tax Act LXXXII of 1991 and the second aspect is the way the tax is calculated where the resulting tax liability depends on the engine power in kW and the tax rate, which ranges from HUF 345/kW to HUF 140/kW.

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The paradox is that compared to the Slovak Republic, newer vehicles have a higher rate than older ones.

Poland has the highest and relatively stable PPP revenues per PPP. From 2017 (€1.018 bn PPP) to 2023 (€1.150 bn), revenues grew by +13%, with the most significant decline in the pandemic year 2020 (–25.4% vs. 2019). The following years brought a continuous increase, with a year-on-year growth of +14.8% from 2022–2023. This development confirms the significant share of motor vehicles in tax revenues in a country with a high car ownership rate and a stable tax framework.

A comparison of the evolution of motor vehicle tax collection in the V4 countries reveals a variety of approaches and responses to economic challenges. Slovakia and Hungary have experienced more stable developments with slight fluctuations, while the Czech Republic has adopted significant legislative changes leading to a dramatic decline in tax revenues in this area. Poland has maintained the highest tax collection, posting significant growth after a pandemic decline. These differences reflect not only economic conditions, but also the political choices and priorities of individual countries in the field of transport and tax policy.

As regards the development of road accidents in the Visegrad Four (V4) countries, some common but also individual trends can be identified between 2017 and 2023. In 2020, the COVID-19 pandemic led to a significant decrease in traffic accidents, which was also reflected in Poland, where the number of accidents fell to around 23 000. Since 2021, the accident rate in Poland has been decreasing slightly (Figure 1).

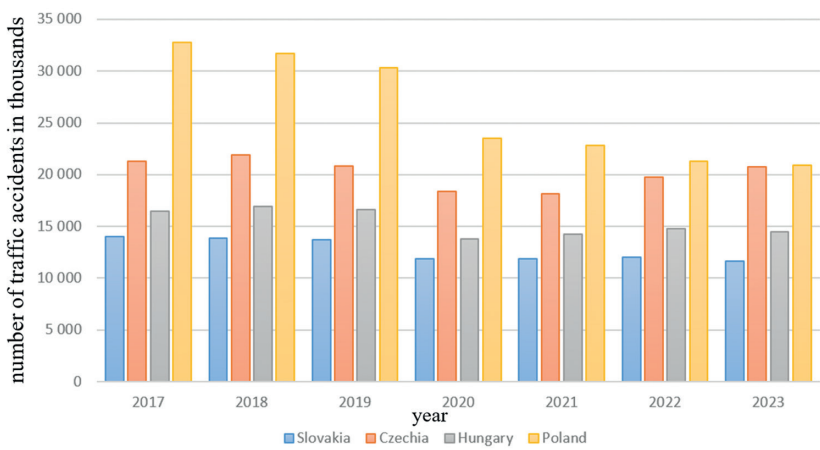

Fig. 1. Evolution of the number of road accidents in the V4 countries

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In the Czech Republic, a relatively stable trend with slight fluctuations was observed throughout the period under review, reaching a peak in 2018 (more than 22 000 accidents), followed by a decline in 2020. In the following years, a gradual return to the original level is expected, with the number of accidents returning to a pre-pandemic situation by 2023. The trend in Hungary is similar to the other countries: a slight increase until 2019, followed by a significant decrease in 2020 (from around 17,000 accidents to 13,000), after which the situation stabilises at around 14,000 accidents per year. Slovakia had the lowest number of road accidents of all V4 countries in the period under review. Between 2017 and 2019, approximately 14 000 road accidents per year were detected, but in 2020 this number will decrease to below 11 000. Between 2021 and 2023, the number is between 11 000 and 12 000, stabilising slightly but below pre-pandemic levels.

Overall, 2020 represents an important tipping point for road traffic accidents in all V4 countries, due to reduced population mobility due to the ongoing pandemic. Subsequent developments have shown a partial return to pre-pandemic levels, although there are still some differences between countries.

Road infrastructure maintenance is a key factor in ensuring transport safety, efficient mobility, and economic stability in countries. In the V4 countries, which have extensive motorway and road networks, the amount of funds allocated to maintenance varies depending on budgetary policy, infrastructure priorities, and the historical condition of the road network. The aim of this analysis is to compare road infrastructure maintenance expenditure in Slovakia, the Czech Republic, Hungary, and Poland in the period 2017–2023 and to identify the main trends and differences between countries (Figure 2).

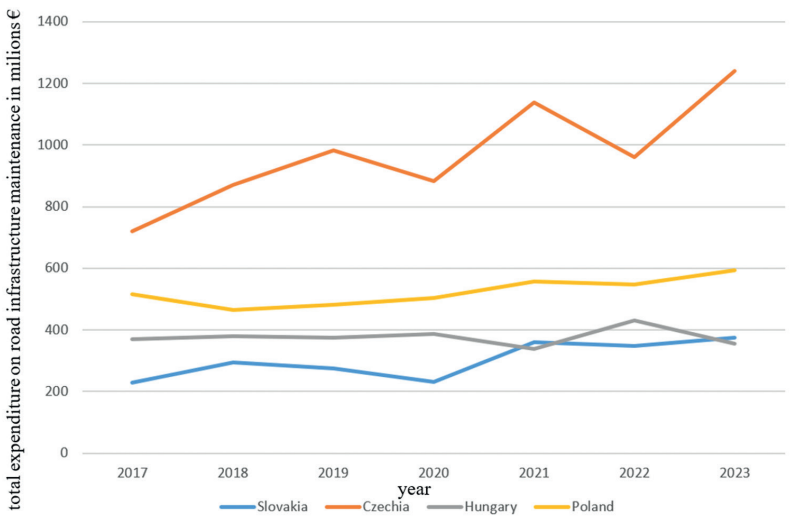

Fig. 2. Evolution of total infrastructure maintenance expenditure

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Slovakia recorded a gradual increase in expenditure from €230 million in 2017 to €376 million in 2023, with a more significant year-on-year increase recorded in 2021. This trend may be related to the reconstruction and modernization of key motorway sections, as well as to the gradual increase in budget allocations for the maintenance of older infrastructure. In the Czech Republic, road infrastructure maintenance expenditure was the highest among the V4 countries, growing from €721 million in 2017 to more than €1.24 billion in 2023. The high volumes of funding reflect a combination of an extensive road network, intensive maintenance of older motorways, and ongoing modernization projects, with fluctuations in 2022 possibly resulting from a shift of funds to investment projects or a change in financing methodology.

Hungary shows relatively stable spending, ranging between €337 million and €432 million, with a slight peak in 2022. This conservative approach to maintenance may be the result of effective operational maintenance and a lower need for major reconstruction, with an emphasis on priority sections of the road network. Poland is a significant investor in road infrastructure, with expenditure rising from €517 million in 2017 to nearly €593 million in 2023. This steady growth reflects a systematic program to modernize the extensive road network, with a significant portion of the funds allocated to the maintenance of highways and expressways with high traffic intensity.

Classical correlation analysis was used to analyse the relationship between the total number of accidents, the number of accidents caused by inadequate road quality and the revenue to the national budget from the collection of the motor vehicle tax. The calculation of this relationship was carried out by setting sample values for the pairwise correlation coefficients. For each V4 country, the Pearson correlation coefficient (r) was calculated separately as the dependence between the annual amount of road tax collected and the number of road accidents. This coefficient takes values from –1 to 1, where:

values close to 1 indicate a strong direct (positive) linear dependence,
values close to –1 indicate a strong indirect (negative) dependence,
values close to 0 indicate weak or no linear dependence.

To assess statistical significance, r values were also interpreted with respect to the number of observations ($n = 7$ years) and the corresponding critical value for $\alpha = 0.05$. The critical value for the Pearson test at $n = 7$ is approximately ± 0.754, which means that only correlation coefficients with an absolute value greater than 0.754 can be considered statistically significant at the 5% significance level. Result of correlation analysis is in Table 2.

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Tab. 2. Result of the correlation coefficient between the motor vehicle tax collection and the number of road accidents in the V4 countries

Correlation	Slovakia	Czechia	Hungary	Poland
motor vehicle tax and total traffic accidents	0.8080	0.1132	–0.2852	0.3782
motor vehicle tax and the incidence of road infrastructure defects	0.6560	–0.3424	–0.1260	0.4128
the number of traffic accidents and road defects	0.7995	0.3081	0.7775	0.6811
number of traffic accidents and infrastructure maintenance expenses	–0.5722	–0.3061	0.0366	–0.7759

Slovakia shows a significantly positive correlation between the amount of motor vehicle taxes collected and total traffic accidents ($r = 0.8080$), as well as between MVT and the incidence of road infrastructure defects ($r = 0.6560$). An equally strong relationship was confirmed between the number of traffic accidents and road defects ($r = 0.7995$). These results can be interpreted as suggesting that increased tax revenues are associated with increased traffic activity, which translates into higher accident rates and more frequent road defects. At the same time, however, it may signal a lack of reinvestment of collected tax funds back into the maintenance and upgrading of transport infrastructure, which could mitigate the negative externalities of increased mobility. The correlation coefficient result of ($r = –0.5722$) is interesting, indicating a moderately strong negative correlation between infrastructure renewal investments and the total number of traffic accidents. This result implies that higher road maintenance expenditures are associated with fewer traffic accidents, supporting the assumption that regular maintenance and modernization of the road network contribute to increased traffic safety.

In the case of the Czech Republic, the analysis did not reveal any strong correlations – the coefficient between VMT and accident rates was low ($r = 0.1132$), while the relationship between VMT and road defects was slightly negative ($r = –0.3424$), and the dependence between the total number of traffic accidents and investments in infrastructure ($r = –0.3161$) represents a weaker negative correlation. This result suggests that the amount of motor vehicle taxes collected may not be the primary factor influencing traffic safety in the Czech Republic. Other variables, such as the quality of the legislative framework, the effectiveness of police surveillance, the level of public lighting or the technological modernization of the transport network, may have a much more significant impact. These factors could also explain the lower rate of road defects associated with higher tax revenues. The trend of decreasing traffic accidents with higher investments in infrastructure is still present, but its intensity is lower than in Slovakia, which may be related to the different technical condition of roads, traffic intensity, or other factors that were not included in the analysis.

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Hungary presents an interesting contrast, as the results show a weak to slightly negative correlation between MVT and traffic accident rate ($r = -0.252$), as well as between MVT and road defects ($r = -0.1260$). These results can be interpreted as an indication of efficient redistribution of tax revenues, higher tax collection is invested in probably preventive, road maintenance or safety features, which results in a reduction of traffic risk. A significant correlation between accident rates and road defects ($r = 0.7775$) is also found, together with the first trip for the elimination of accidents, which is in line with findings in transport economics. As regards the correlation between the volume of expenditure on road infrastructure maintenance ($r = 0.0366$), this indicates an almost zero correlation between maintenance expenditure and the number of traffic accidents. This result suggests that infrastructure expenditure did not have a significant direct impact on road safety during the period in question, or that other factors, such as traffic culture, speed control, or the proportion of unmaintained sections, had a greater impact on the number of accidents.

Poland has a moderate positive correlation between the MVT and the two variables examined, road traffic accidents ($r = 0.3782$) and communication failures ($r = 0.4128$). This situation may be the result of the dynamic development of the car industry, where the growing number of vehicles leads to higher tax revenues, but also to an increased burden on the road network and an increase in the risk of accidents. The strong correlation between the accident and the state of the infrastructure ($r = 0.6811$) again underlines the importance of investment in road maintenance and modernisation as a key tool for improving traffic safety. Poland shows a very strong negative correlation between infrastructure investment and the total number of traffic accidents ($r = -0.7759$). This result suggests that higher investment in road infrastructure maintenance is closely linked to a significant decrease in the number of traffic accidents. The strong negative correlation may reflect high spending efficiency, a systematic approach to road modernization, and maintenance of high-traffic sections where investments have the greatest impact on safety.

The results of the correlation analysis suggest that road safety in the V4 countries is shaped by a combination of financial and non-financial factors. Investments in road maintenance and tax revenues allocated to transport play an important role, but their effectiveness varies between countries. Slovakia and Poland show a moderate to strong negative correlation between infrastructure spending and the number of traffic accidents, suggesting that higher investment and efficient use of resources can contribute to reducing the number of accidents. In the Czech Republic, this relationship is weaker, pointing to the greater importance of a systemic approach, transport culture, and other non-financial factors. In contrast, in Hungary, the near-zero correlation suggests that tax revenues and infrastructure spending have a minimal direct impact on the number of accidents, with effective preventive measures likely to play a more significant role.

Overall, these findings suggest that while financial resources, whether in the form of road maintenance spending or through tolls and road taxes, are important, road safety is the

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result of a complex interaction between investment, systemic management, infrastructure quality, and road user behavior. Effectively combining these factors, with an emphasis on optimized resource use and strategic preventive measures, appears to be a key prerequisite for improving road safety in the V4 countries.

4. Discussion

The aim of our analysis was to examine the relationship between the level of motor vehicle tax revenue and the number of road accidents in the Visegrad Four (V4) countries in the period 2017–2023. The results of the correlation analysis showed considerable variability between countries: Slovakia recorded a strong positive correlation between tax revenues and accident rates ($r = 0.8080$), while Hungary had a weak to slightly negative correlation ($r = -0.2852$) and the Czech Republic only a very weak relationship ($r = 0.1132$). In Poland, a moderate positive correlation was observed ($r = 0.3782$).

These differences suggest that the amount of revenue from motor vehicle taxes alone is not a sufficient explanation for changes in road safety. The key factor is how these resources are used, whether they are effectively redistributed and reinvested back into transport infrastructure and its maintenance. As international research shows, it is economic investment in road construction and maintenance that contributes to reducing mortality, with its effectiveness varying depending on a country's level of economic development. If tax revenues are not directed to these areas, the regulatory and preventive potential of the tax and its ability to contribute to a safer and more sustainable transport system is weakened [13]. These results support the argument that the key to improving safety is not the level of taxation itself, but the effective and targeted use of revenues. In this context, toll collection systems also play an important role, as they represent a flexible and sustainable source of revenue for infrastructure financing. In addition, electronic and dynamic toll systems offer greater efficiency and transparency, which can strengthen public acceptance and contribute to a fairer distribution of costs among transport network users [14, 15]. This may be the case in the Czech Republic.

In Hungary, a negative correlation was observed, which may indicate that higher tax collections were reinvested in preventive measures, maintenance and improvement of infrastructure, which correlates with lower accident rates. This conclusion is consistent with the model of efficient allocation of tax funds, according to which targeted allocation of tax funds at the local level significantly improves road quality [14]. From a practical point of view, it is therefore crucial that transport tax policy is coupled with a transparent and targeted use of the funds collected. Modern technological solutions for toll collection (e.g. electronic systems, mileage fees) can increase the efficiency and fairness of the system [15, 16]. However, their implementation requires a strong institutional background and public trust, which can only be achieved if the funds are used in a meaningful and visible way [17, 18].

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In the case of Poland, although tax revenues are increasing, they are only slightly positively correlated with the number of accidents. This discrepancy suggests that Poland could benefit from an approach similar to the one introduced in Indonesia, where a separate road fund was created to which fuel taxes (PBBKB), taxes on registered vehicles (PKB) and taxes on the sale of luxury vehicles (PPnBM) were channelled. This fund was administered by an independent agency at the provincial level and was earmarked exclusively for road infrastructure maintenance and development. The implementation of a similar fund in Poland – i.e. the separation of transport revenues from the general state budget – could ensure a more stable and transparent flow of funds for transport and have a positive impact on safety [19].

However, the Slovak positive correlation suggests a more complex mechanism. The amount of tax revenue may not fully reflect the effective improvement of road infrastructure or safety. Rather, the Slovak data reflect economic activity and mobility, where higher tax collection is associated with an increase in the number of vehicles on the road, and hence a higher risk of accidents, which may correspond to a quantitative rather than a qualitative effect [20]. Effective tax collection and fair distribution is a prerequisite for social stability and taxpayer confidence. Although [21] deals primarily with the general relationship between taxation and economic development, its implications are also transferable to the field of road transport. Transparency and trust in the tax system create the conditions for the acceptance of fiscal measures that finance infrastructure and indirectly contribute to greater road safety. The existence of formally established rules in the form of tax laws also plays an important role, but without changing informal institutional frameworks and strengthening their enforcement, the impact of tax collection on road safety remains limited, which may be the reason why higher tax collection has not been associated with increased safety in the Slovak Republic [22].

The results of the correlation analysis between road infrastructure maintenance expenditure, tax revenues, and road safety in the V4 countries reveal a complex relationship between financial investment, systemic management, and transport activity. In Slovakia and Poland, there is a more pronounced negative relationship between road maintenance expenditure and the number of traffic accidents, suggesting that the effective use of resources can contribute to reducing mortality and serious accidents. Road maintenance expenditure and the share of motorways reduce road fatalities, while greater investment in new construction can paradoxically lead to a temporary increase in fatalities [23].

Conversely, in Hungary, the near-zero correlation suggests that road maintenance spending alone may not be sufficient to influence safety if it is not supported by an effective risk management system and the implementation of RISM best practices [24]. This approach emphasizes the need to evaluate the transport network not only in terms of the amount of investment, but also the quality and efficiency of its allocation, meaning that road quality affects not only economic well-being, but also the ability to prevent negative externalities such as accidents and increased living costs [25].

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The long-term effects of infrastructure investment are reflected in a delayed but permanent reduction in traffic fatalities. This corresponds with our findings for Slovakia and Poland, where investments in road maintenance are associated with a reduction in the number of accidents, while the short-term effect may not always be apparent, as can be seen in Hungary [26].

The effectiveness of infrastructure investments varies by region and depends on technical and organizational factors, which may explain the differences between the V4 countries. Based on this, it can be concluded that road safety is the result of the interaction between financial investment, infrastructure quality and management, and the behavior of road users, and that increased spending alone does not guarantee improved safety unless it is complemented by an effective management system and preventive measures [27].

Methodologically, the main limitation of our study is the relatively short time period ($n = 7$ years) and the limited number of variables. Although correlations allow for the identification of associations, they do not allow for the determination of causality. Further research should therefore consider a wider range of factors, such as road maintenance expenditure, level of enforcement of traffic rules, legislative changes or technological innovations. In conclusion, the collection of motor vehicle taxes has a mixed impact on road safety in the V4 countries. Countries such as Hungary, where tax revenues are more likely to be used for specific transport purposes, show more positive results in accident reduction. Conversely, in countries such as Slovakia and Poland, systemic reform of tax revenue redistribution needs to be considered, with an emphasis on transparency, targeting and institutional strengthening. Only in this way can the tax system be perceived as not only a fiscal instrument, but also a regulatory and preventive one.

5. Conclusions

In this paper, we investigated the relationship between the level of motor vehicle tax collection and the number of traffic accidents in the Visegrad Four countries between 2017 and 2023. The aim of the research was to determine whether there is a direct or indirect relationship between road tax revenues and the evolution of traffic accidents, as well as to assess the extent to which road safety is affected by tax policy.

The findings showed that there is no consistent relationship across the V4 countries between the level of motor vehicle tax revenues and road safety. In the Slovak Republic and Poland, a positive correlation was observed between tax revenues and the number of road accidents, suggesting that increasing tax revenues are related to increased mobility rather than to increased safety. In the Czech Republic, the relationship was found to be insignificant and in Hungary a slightly negative correlation was identified, which may point to a more efficient use of tax revenues in favour of transport infrastructure and prevention.

The results confirm that increasing tax collection alone does not guarantee a reduction in the number of traffic accidents without effective reinvestment of the collected funds. The study also highlighted the importance of allocating funds to transport infrastructure and the need for greater transparency and efficiency in the use of tax revenues. It is not the amount of investment in infrastructure that is decisive, but above all its effectiveness and proper targeting to improve road safety. The significance of the results lies in emphasizing the need for tax policy reform in countries where higher tax revenues do not lead to improved road safety.

Future research could be extended to analyse other variables such as direct investment in road infrastructure, the level of enforcement of road traffic rules, technological innovations in transport or socio-economic factors influencing road user behaviour. Longer time series and more comprehensive econometric models could provide even deeper insights into the relationships between tax policy and road safety in the Central European regions.

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7. References

[1] Romani MS. The Internet of Things as A Tool to Improve Environmental Taxation within the EU: A Case Study on the Design of Annual Road and Motor Vehicle Taxes. Intertax. 2024;52(5):387–398. https://doi.org/10.54648/taxi2024042.

[2] Anguralia N, Singh S. A Comparative Study on India's Green Tax Policies Vis-a-Vis China with Reference to Environmental Justice in the Automobile Industry. Nature Environment and Pollution Technology An International Quarterly Scientific Journal. 2024;23(4):2283–2290. https://doi.org/10.46488/NEPT.2024.v23i04.032.

[3] Poliakova A. Allocation of financial sources for road transport incidents decreasing. 2020 12th International Science Technical Conference Automotive Safety Automotive Safety 2020. 2020:9293498. https://doi.org/10.1109/AUTOMOTIVESAFETY47494.2020.9293498.

[4] Rešetar M, Pejić G, Lulić Z. Changes and trends in the Croatian road vehicle fleet – Need for change of policy measures. Transport Policy. 2018;71:92–105. https://doi.org/10.1016/j.tranpol.2018.08.005.

[5] Sejkora F. Analysis of impact of registration fee in the Czech Republic. Engineering for rural development. 2018:2118–2122. https://doi.org/10.22616/ERDev2018.17.N385.

[6] Gashenko IV, Zima YS, Makarenko EN. The Transformation of Motor Vehicle Taxation in a Climate of Digitization of the Economy of the Russian Federation. Lecture Notes in Networks and Systems. 2020;91:247–253. https://doi.org/10.1007/978-3-030-32015-7_28.

[7] Fonseca C, Jiang H, Zeerak R, Zhao JZ. Explaining the adoption of electric vehicle fees across the United States. Transport Policy. 2024;149:139–149. https://doi.org/10.1016/j.tranpol.2024.02.005.

[8] Kirk RS, Mallett WJ. Funding and financing highways and public transportation (update). Transportation: Congressional Issues, Financing and Improvements. Cincinaty: University of Cincinnati, 2019.

[9] Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures. Official Journal of the European Communities, L 187, 20.7.1999, 42–50.

[10] Directive (EU) 2022/362 of the European Parliament and of the Council of 24 February 2022 amending Directives 1999/62/EC, 1999/37/EC and (EU) 2019/520 as regards the charging of vehicles for the use of certain infrastructures. Official Journal of the European Union, L 69, 4.3.2022, 1–40.

[11]. Act No. 142/2022 Coll., amending Act No. 16/1993 Coll. on Road Tax, as subsequently amended, Collection of Laws of the Czech Republic, Part 63, published on 27 May 2022.

[12] Act LXXXII of 1991 on Motor Vehicle Tax, promulgated in the Official Gazette of Hungary (Magyar Közlöny) No. 93/1991, entered into force on 1 January 1992.

[13] Navarro-Moreno J, Calvo-Poyo F, de Oña J. Investment in roads and traffic safety: linked to economic development? A European comparison. Environmental Science and Pollution Research. 2023;30(3):6275–6297. https://doi.org/10.1007/s11356-022-22567-y.

[14] Chavan S, Chaube MG| PA, Pardhi H. Tax Collection. International Journal of Trend in Scientific Research and Development Journal. 2024;8(5):550–557. Avaible from: https://www.ijtsrd.com/other-scientific-research-area/other/69416/tax-collection/harshal-pardhi (accessed on 9 September 2025).

[15] Delhaye E, De Ceuster G, Vanhove F, Maerivoet S. Internalisation of external costs of transport in Flanders. Reflets et perspectives de la vie économique. 2017;56(2):55–74. https://doi.org/10.3917/rpve.562.0055.

[16] Duncan D, Nadella V, Giroux S, Bowers A, Graham JD. The road mileage user-fee: Level, intensity, and predictors of public support. Transport Policy. 2017;53:70–78. https://doi.org/10.1016/j.tranpol.2016.09.002.

[17] Flores-Macías G, Sánchez-Talanquer M. Building the Modern State in Developing Countries: Perceptions of Public Safety and (Un)willingness to Pay Taxes in Mexico. Politics & Society. 2020;48(3):423–451. https://doi.org/10.1177/0032329220943848.

[18] Siebrits K, du Plessis S, Jansen A. The limits of laws : traffic law enforcement in South Africa. South Africa South African Journal of Economic and Management Sciences. 2020;23(1):a3430. https://doi.org/10.4102/sajems.v23i1.3430.

[19] Gultom THM, Tamin OZ, Sjafruddin A, Pradono. The road maintenance funding models in Indonesia use earmarked tax. AIP Conference Proceedings. 2017;190:060009. https://doi.org/10.1063/1.5011563.

[20] Adrian MF. Analysis of the Influence of Regional Tax Fund Allocation on the Quality of Road Infrastructure in Medan City. Zona Law and Public Administration Indonesia. 2024;1(5): 449–458. Available from: https://ejournal.zona-edu.org/index.php/ZLPAI/article/view/111 (accessed on 27 July 2025).

[21] Abdin MJ. Relationship between Taxation and Economic Development of a Country, 2018. Available from: https://papers.ssrn.com/abstract=3295458 (accessed on 27 July 2025).

[22] Surjanti LPN, Nugroho DWPS, Sulistyawati A. I. Motor Vehicle Tax Compliance Levels: An Empirical Study And The Determining Factors. Economics and Business Solutions Journal. 2019;2(2):21–31. https://doi.org/10.26623/ebsj.v2i2.1178.

[23] Calvo-Poyo F, Navarro-Moreno J, de Oña J. Road Investment and Traffic Safety: An International Study. Sustainability. 2020;12(16):6332. https://doi.org/10.3390/su12166332.

[24] Persia L, Usami DS, De Simone F, Beaumelle VFDL, Yannis G, Laiou A, et al. Management of Road Infrastructure Safety. Transportation Research Procedia. 2016;14:3436–3445. https://doi.org/10.1016/j.trpro.2016.05.303.

[25] Gertler PJ, Gonzalez-Navarro M, Gračner T, Rothenberg AD. Road maintenance and local economic development: Evidence from Indonesia's highways. Journal of Urban Economics. 2024;143:103687. https://doi.org/10.1016/j.jue.2024.103687.

[26] Välilä T. Road safety and road infrastructure expenditure: A bivariate analysis. Transport Policy. 2023;140:148–162. https://doi.org/10.1016/j.tranpol.2023.07.002.

[27] Cheng M, Lu Y. Investment efficiency of urban infrastructure systems: Empirical measurement and implications for China. Habitat International. 2017;70:91–102. https://doi.org/10.1016/j.habitatint.2017.10.008.