Shared, Automated, Electric: the Fiscal Effects of the "Holy Trinity"

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1 ABSTRACT

Initially discussed primarily from a technological perspective, the topic of connected and automated vehicles begins to take root in interdisciplinary discourses held in spatial planning and urban research. Numerous discussions appeal to the „holy trinity" – shared, automated and electric vehicles – that should lead the way to a more sustainable urban mobility. Connectivity, as a precondition for shared mobility services is also considered. Research foci go beyond the transport technology and include primary or secondary effects that could be borne by in the mobility and urban system. Among the secondary effects, financial implications for public budgets are subject of this text. Fiscal effects could be triggered by both automation and connectivity, possible changes in vehicle ownership, sharing, and the need for (new) infrastructures. This paper presents a qualitative analysis of the fiscal effects of automation, connectivity, electrification and sharing for individual road transport. For this purpose, the primary effects are analysed on the basis of current international studies, and the resulting secondary effects are derived for the subnational level of Austria. Finally, the significance or value of the affected revenue and expenditure categories in the budgets of the federal provinces and municipalities in Austria is illustrated. Losses of sources of revenue like the duty on vehicles based on fuel consumption, the engine-related insurance tax or the parking management which affect the budgets of Austrian provinces and municipalities directly or via the fiscal equalisation system as well as perspectives on the resulting investment requirements and subsequent costs for urban infrastructure are shown. Overall, it becomes clear that new sources of revenue would have to be developed if these effects occur cumulatively.

Keywords: sharing, holy trinity, automated vehicles, fiscal effects, mobility

2 INTRODUCTION

In view of the increasing role of automation and digitalisation within the mobility system, cities face a In view of the increasing role of automation and digitalisation within the mobility system, cities face a special challenge. Although stakeholders attribute high relevance to the topic (Berger 2018), possible effects and ways to respond remain vague at crucial points. However, the long planning and development processes in cities make it necessary to first identify preparations that can be meaningfully started and open intensive exchanges between practice and research. Among other things, these preparations include a study of possible effects on city budgets, that migh occur as a result of an increasing role of connected and automated vehicles in the future mobility system.

Previous research on connected and automated transport has mostly focused on the technical functions or the impact on the traveler (Milakis et al., 2017: 40). Possible effects on city budgets have so far only been discussed in isolated studies in the US (e.g. Clark et al 2017, Leimenstoll, 2017) or the United Kingdom (e.g. Transport Systems Catapult 2017); a study in the German-speaking world is still missing.

This article contributes to the study of these effects and, using the example of the affected categories of revenue and expenditure in the budgets of the provinces and municipalities in Austria with a special focus on Vienna, shows the significant impact that a change in the mobility system could bring. First of all, a qualitative evaluation of possible effects of connected, automated and electric vehicles is presented and the possible magnitude or scope is shown on the basis of the current situation in the federal states and municipalities in Austria as well as for the city of Vienna.

Thus, the study combines the three major future trends in private transport 1) sharing (as a primary effect of automation and connectivity), 2) automation, and 3) electric mobility. At times enthusiastically referred to as the "holy trintiy " of future mobility. While the probable interaction of automation and new mobility services (Mobility as a Service, MaaS) is repeatedly emphasised in the literature (e.g. Katsuki & Taniguchi 2017), there is no intrinsic connection to electromobility (Kollosche & Schwedes, 2016). Even if automation and electrification are not linked, the decision to include electromobility emphasises the simultaneity of the two phenomena (Bormann et al., 2018: 12). The budgetary effects of a simultaneous change in public transport are not dealt with in this text.

A three-level structure is applied to describe the financial impact of connected, automated and electric vehicles. Automation, electrification and a focus on mobility services (that require connectivity) could lead to possible changes of vehicle ownership and infrastructural requirements (primary effects). The primary effects lead to changes in revenue and expenditure of the public sector, described as secondary (fiscal) effects. Further secondary effects as well as basic conditions and indirect (fiscal) effects are not considered in the article.

Fig. 1 gives an overview of the new phenomena in private transport as well as the considered effects and the related structure of the article.

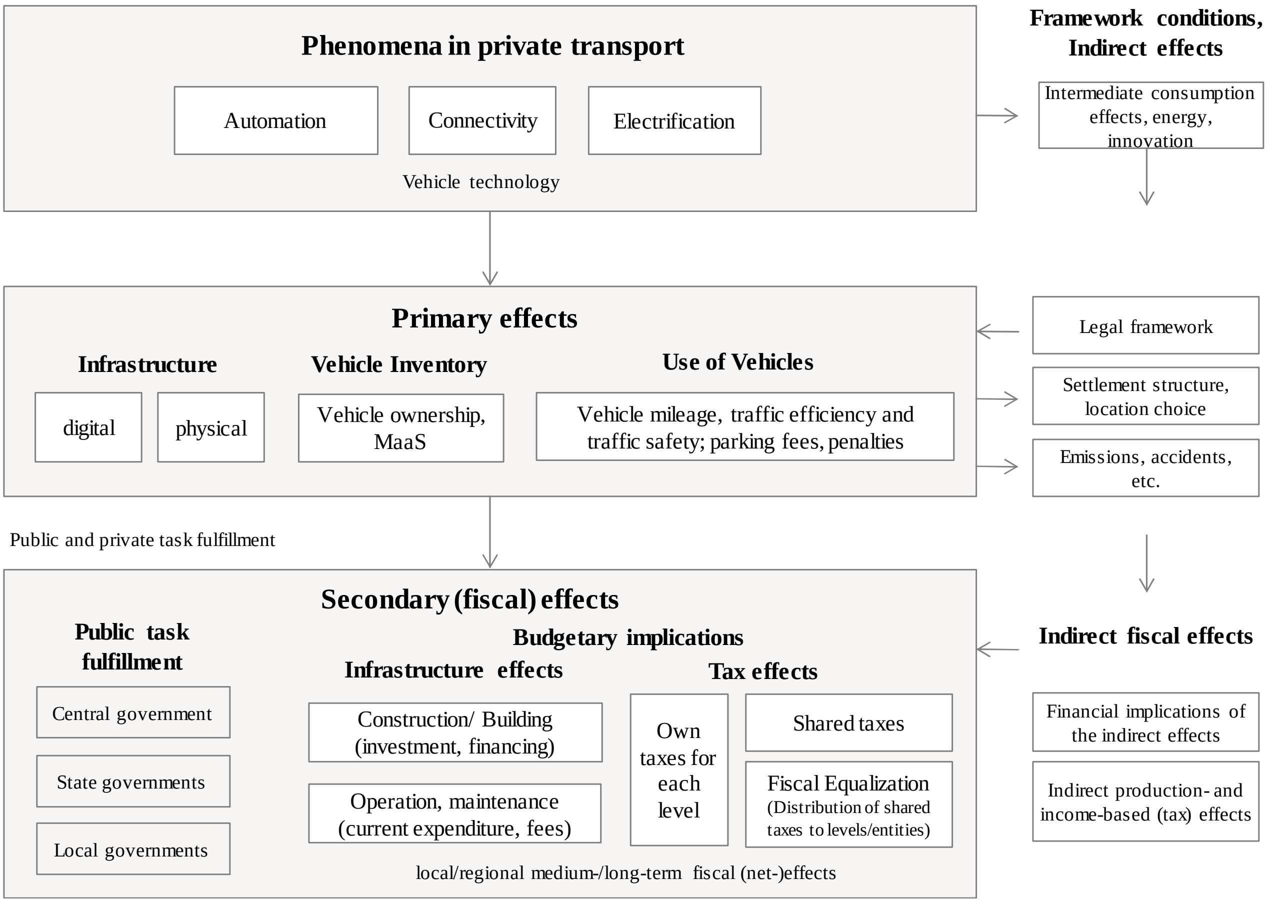

Figure 1: Overview: phenomena in private transport as well as primary and secondary (fiscal) effects through automation, connectivity and electrification (source: own representation)

3 AUTOMATION, CONNECTIVITY AND ELECTROMOBILITY AS NEW PHENOMENA IN PRIVATE TRANSPORT

3.1 Automation

Automated driving means the (complete) performing of the driving task, i.e. longitudinal control (accelerating and braking) and the lateral control (steering) of a vehicle, through a system (VDA 2015: 15; Kollosche & Schwedes 2016: 21). The most common systematisation of the progress of vehicle automation today are the six SAE levels (table 1). In the current version (SAE International 2018) the classification includes level 0 (not automated) up to level 5 (fully automated). It is assumed that the leap between level 3 and level 4 has to be accorded special importance from the point of view of local fiscal effects. Up to and including level 3, the human being is the fallback mode in the event that the automated driving system can no longer cope with a driving task. In practical terms, this means that the driver remains a driver, but is free to retire to a monitoring function, while the driving automation system takes over longitudinal and lateral steering as well as the acceleration (and braking) of the vehicle. Beginning with level 4, the driver turns into a passenger. The attention of the person in the vehicle is no longer relevant to the dynamic driving task (SAE International 2018: 17, Kollosche & Schwedes 2016: 21). The decisive factor is that the performance of the highly automated driving system is limited within level 4. The automated driving system operates under previously designated and known conditions, i.e. operational design domain (SAE International 2018) for example at low speeds, good visibility, under the exclusion of other road users or in a geographically defined area. Fully automated driving systems (level 5) work at all times, on all roads and under all conditions.

Level	Name	Monitoring of the environment	Fall-back level	Performance of the system	
0	No Driving automation	Driver	Driver	-	
1	Driver Assistance	Driver	Driver	Some applications	
2	Partial Driving Automation	Driver	Driver	Some applications	
3	Conditional Driving Automation	System	Driver	Some applications	
4	High Driving Automation	System	System	Route	Infrastructural requirements, vehicle ownership, mobility services
				Campus, Pedestrian Zone	
				Motorway	
				Roads in urban area	
5	Full Driving Automation	System	System	All applications	

Table 1: Levels of automation based on systematisation of SAE (source: Mitteregger 2018 adapted from SAE International 2018)

Whereas there are no official statistics for Austria, for Germany figure 2 shows that the share of new registered passenger cars equipped with different driver assistance system increased in Germany from 2015 to 2016. It is expected that this share will further increase in the coming years.

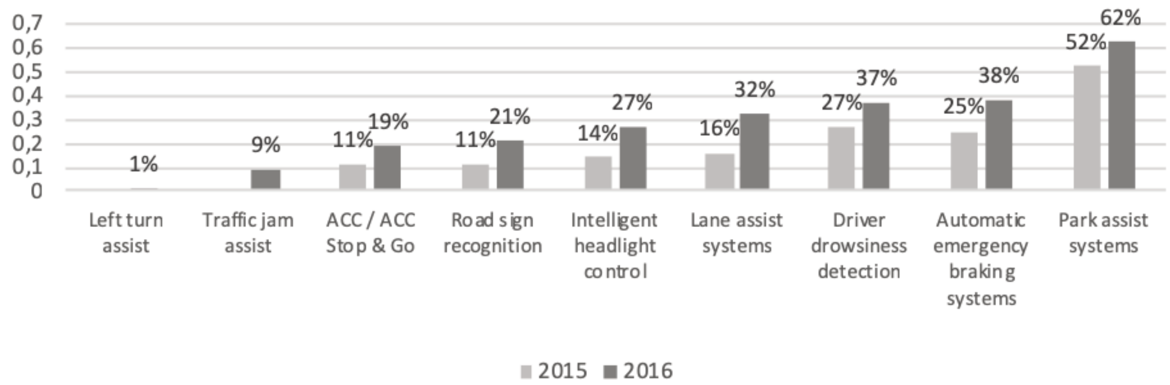

Figure 2: Share of new registered passenger cars equipped with different driver assistance systems in Germany 2015 and 2016 (source: Bosch 2018)

3.2 Connectivity

Connectivity is the requirement for the connection of vehicles with the environment and describes the transmission of data between the vehicle and other entities (Car-to-X-Communication, C2X). It can be further differentiated here whether (1) data is transmitted between vehicles (car-to-car communication, C2C) or (2) between the vehicle and the infrastructure (car-to-infrastructure communication, C2I) (Perret et al., 2017: 6). Connectivity is of considerable importance since many of the effects expected of automated vehicles (see, for example, Section 3.3) can only occur with connectivity (Perret et al., 2017: 6). An example of this would be the higher throughput per lane (increases in road capacity), which presupposes that vehicles communicate with one another (Friedrich, 2015: 341). The question still remains open as to whether and to what extent, especially in urban areas, it will be necessary for vehicles additionally to be connected with infrastructural components (traffic lights, traffic information and control systems). However, it can also be assumed that vehicles generally exchange considerably more information with their manufacturer or operator. Connectivity is of importance in the present study as it makes possible automated mobility services and thus affecting vehicle owenership.

For Austria, Statista (2019) estimates a total number of 970.000 existing connected cars for 2019 and predicts a rather strong growth to nearly two million connected cars until 2023 (figure 3).

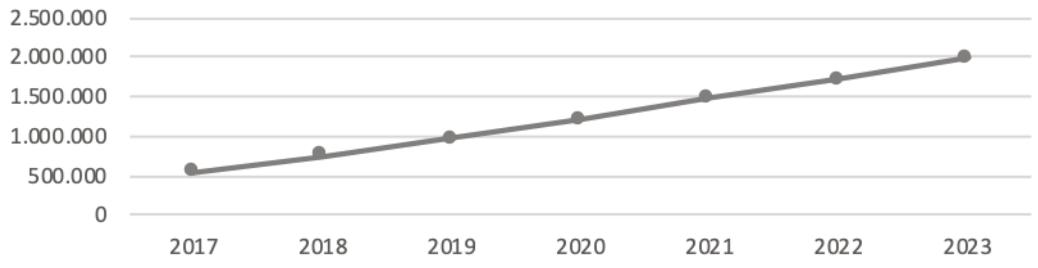

Figure 3: Number of existing connected cars in Austria (prediction) (source: Statista 2019)

3.3 Electrification/Electromobility

Electrification/electromobility is the process of increasing the number of electrically driven vehicles that have an energy storage device (battery). Such vehicles do not produce any exhaust emissions during operation and therefore gain increasing importance, especially against the background of sustainability aspects (recognition that conventional combustion engines burn a resource that is dwindling in the foreseeable future to produce climate-damaging CO_2) and local emission limit values (Thomes et al 2013: 15, Kollosche & Schwedes 2016: 20, Bormann et al 2018: 13).

As emphasised above, the automation of vehicles and electromobility are not directly related. Since the partially automated vehicles currently available on the market are also often electrically driven (Perret et al., 2017: 7, VDV 2015: 8), it is assumed that an electric drive form could also be used more widely along the automation side, although automated vehicles could also be equipped with conventional internal combustion engines.

In Austria electrically driven vehicles are gaining increasing importance. Figure 4 shows that number of new registered battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) increased from 112 in the year 2010 to 7.154 in the year 2017. Although the share of electrically-driven vehicles of all new registered vehicles was 2,02 % in the year 2017, it increased considerably in the last years and it is predicted that this share will further increase in the next years (figure 4).

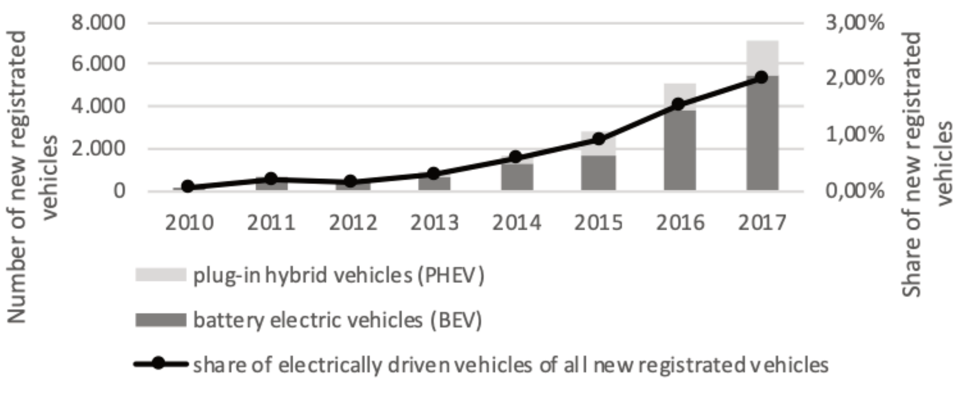

Figure 4: Number and share of new registered BEV and PHEV of all new registered vehicles (source: Austriatech 2018)

4 PRIMARY EFFECTS: INFRASTRUCTURE, VEHICLE INVENTORY AND USAGE

The new phenomena of automation and connectivity as well as increasingly electric vehicles are causing effects in the areas of infrastructure and vehicle inventory as well as regarding the use of vehicles (primary effects) (Milakis et al., 2017: 21).

4.1 Infrastructure

The impact of connected, automated and electric vehicles on infrastructure depends in particular on the legal requirements yet to be defined, which must be met in the future (Perret et al., 2017: 18). For example, as described above, it is also conceivable that connected, automated and electric vehicles must for the most part be able to handle today's requirements without explicitly investing in the infrastructure. In any case, however, changes could become necessary both in the structural-physical transport infrastructure, in particular with regard to electromobility, as well as in the digital data transmission infrastructure for connectivity and control (Dangschat 2017: 8, Mitteregger 2018).

4.1.1 Structural-physical transport infrastructure

With regard to the transport infrastructure it should be ensured – in particular with regard to the functional operation of automated driving systems – that road markings and traffic signals are clearly visible to sensors. In addition, possible stopping options such as permanent hard shoulders or breakdown bays at motorways or smaller stopping spaces in the urban area would have to be created (Perret et al., 2017: 18). In the field of electromobility, there is also a need for charging infrastructure, especially in urban areas. In addition, a switch to electromobility to a significant extent could also require a reorganisation of the urban electricity grid (Seebauer et al., 2018: 42).

4.1.2 Digital data transmission infrastructure

With regard to the data transmission infrastructure required by connected, automated and electric vehciles, there is likely to be a need for a much more powerful mobile data transmission system (G5; 5G) as the data exchange between the vehicles must be processed in real time (Nokia 2016; Dangschat 2017: 8). In addition to the optimisation of the transmission power, the reliability of the data transmission must be guaranteed and these systems must be set up nationwide or in relevant areas. In addition, standardisation of infrastructure components and their interfaces would also have to take place (Perret et al., 2017: 19).

4.2 Vehicle Inventory

Regarding car and ride sharing services, i.e. the use of individual vehicles by different people sequentially (car sharing) or parallel (ride sharing) in particular the automation of vehicles allows a facilitation of sharing, as the vehicle is supplied to the users independently and also removes itself independently after the use (Lenz & Fraedrich 2015: 188). This eliminates the need for users to first find the location of the sharing vehicles before they could use the vehicle, which facilitates behavioural change from using the personal vehicle to consuming a mobility service (Perret et al., 2017: 7). Connected, automated and electric vehicles could be combined as additional transport services and integrated into a Mobility as a Service platform, thus also leading to a decline in privately owned vehicles (Lenz & Fraedrich 2015: 189, Perret et al., 2017: 7). Numerous modeling and studies (e.g. International Transport Forum 2015, Fagnant et al., 2015 etc.) assume that the number of vehicles to process the current traffic demand in motorised private transport could be reduced by up to 90 % if all private vehicle trips are replaced by automated vehicles with car sharing. Ride sharing can even reduce it by up to 95 % (Soteropoulos et al., 2019). Consequently, the vehicle inventory could be reduced enormously.

4.3 Use of vehicles

4.3.1 Vehicle mileage (vehicle kilometers travelled)

Modeling studies on automated driving (e.g. Hörl et al. 2016, Auld et al., 2017, Kim et al., 2015, Kröger et al., 2018) describe that automation could significantly increase vehicle mileage. On the one hand, it is emphasised that automated vehicles could attract users of other means of transport, in particular public transport, as vehicle use through automation becomes more attractive and also new user groups (children/teenagers, adults without a license) could use such vehicles. On the other hand, for automated vehicles with car sharing also mostly an increase in vehicle kilometers travelled is reported due to empty rides. In addition, the possible savings in time and lower costs of use due to the automation of vehicles could generally lead to a higher consumption of mobility and an increase in vehicle mileage (see Heinrichs 2015: 235).

4.3.2 Traffic efficiency and traffic safety

Connected and automated vehicles are also often associated with optimising traffic efficiency and increasing traffic safety (see BMVIT 2018). For example, Friedrich (2015) reports that a significant increase in capacity can be expected from connected and automated vehicles, which means that existing transport infrastructures can be used more efficiently (Friedrich 2015: 37). In addition, it is emphasised that savings in fuel consumption are also possible as a result (Barnes & Turkel 2017: 21). Moreover, there are also positive impacts on road safety, especially through automation as automated vehicles explicitly adhere to traffic regulations such as speed limits, etc. (such speed regulations are often also associated with a more efficient traffic organisation) and human errors, which are responsible for the majority of road traffic accidents, disappear (VDV 2015: 8, Anderson et al 2016: 4).

4.3.3 Parking

It is known that private cars are parked an average of more than 23 hours a day, thus claiming space on the private property or in the public space of the street (Canzler 2015: 1). Since automated vehicles could drive themselves and as previously described, far fewer vehicles are required to process the current traffic demand in private transport, this could also have a considerable effect on the parking requirements of cities (Friedrich & Hartl 2016: 7). Modeling studies (e.g. International Transport Forum 2015, Friedrich & Hartl 2016, Zhang et al., 2015) indicate that the parking space requirement could be drastically reduced by 80 % to 90 %, when aussuming that all private vehicle trips are replaced by automated vehicles with car or ride sharing sharing.

5 SECONDARY, FISCAL EFFECTS

Among other secondary effects (see Milakis et al., 2017: 27), this paper focusses on the possible secondary fiscal effects related to the primary effects described above. Here, both revenue and expenditure impacts are expected (see Transport Systems Catapult 2017: 15).

5.1 Overview of possible secondary effects

Table 2 shows the possible secondary fiscal effects of automation, connectivity and electrifcation in private transport resulting from the primary effects described above.

As far as infrastructure is concerned, the public sector could incur considerable expenditure for the installation or adaptation of transport infrastructure due to automation and for the construction of charging infrastructure due to electrification. Also, the establishment of new or the optimisation of existing data transmission infrastructure would mean a high amount of expenditure for the public sector.

The potential reduction in vehicle inventory through automation facilitating car and ride sharing could lead to a reduction in revenue from the duty on vehicles based on fuel consumption, engine-related insurance tax and motor vehicles tax.

In addition, the parking space requirement associated with the lower number of vehicles could also lead to a reduction in revenue from parking space management and parking fees. This means that parking management as a source of revenue for the public sector is drying up, and can no longer be used as an instrument of traffic control.

The lower fuel consumption associated with increased traffic efficiency (through automation and connectivity) could also lead to a possible reduction in tax on mineral oil, although this could possibly be counteracted by the increased use of vehicles (Barnes & Turkel 2017: 21). In any case, however, the electrification of vehicles, i.e. electric driven vehicles, could lead to a reduction in income from the excise tax, as is already the case in Norway today (see POLIS 2018: 7).

Phenomena	**Primary effect**	**Secondary, fiscal effect**	
		Revenue	**Expenditure**
Automation	Infrastructure		*Transport infrastructure*
Connectivity			*Data infrastructure (digital transport infrastructure)*
Electrification			*Charging infrastucture*
Automation, connectivity	Vehicle inventory (Decrease of privately-owned cars)	*Duty on vehicles based on fuel consumption* *Engine-related insurance tax* *Motor vehicles tax*	
	Use of vehicles		

Automation	Parking space requirement	*Parking space management/ parking fees* *Parking/traffic penalties*	*Infrastructure for parking*
Automation and Connectivity	Traffic efficiency and traffic safety	*Tax on mineral oil**	

Table 2: Overview of the described primary effects and the resulting possible fiscal effects (source: own illustration). * The electrification of vehicles also leads to a reduction of income from the mineral oil tax.

The potential reduction in vehicle inventory through automation could lead to a reduction in revenue from the standard consumption tax, motor-related insurance tax and motor vehicle tax.

In addition, the parking space requirement associated with the lower number of vehicles could also lead to a reduction in revenue from parking space management and parking metering. This means that parking management as a source of revenue for the public sector is drying up, and can no longer be used as an instrument of traffic control.

The lower fuel consumption associated with increased traffic efficiency (through automation and connectivity) could also lead to a possible reduction in fuel tax, although this could possibly be counteracted by the increased use of vehicles (Barnes & Turkel 2017: 21). In any case, however, the electrification of vehicles, i.e. electric driven vehicles, could lead to a reduction in income from the excise tax, as is already the case in Norway today (see POLIS 2018: 7).

5.2 Extent of the affected revenue and expediture categories in the budgets of the state and local governments in Austria

The exact magnitude of the secondary fiscal effects described above cannot be made within the scope of the article. Based on the qualitative description of the above effects, however, the possible significance of these effects on the public budgets is demonstrated by considering the current significance of the affected revenue and expenditure categories of the state governments (federal provinces, “Länder”) and local governments (municipalities, “Gemeinden”) in Austria with special focus on Vienna. For this purpose, the secondary fiscal effects shown in italics in table 2 are (as far as possible) backed up with data.

5.2.1 Revenue

In Austria, the transport-related tax revenue described above, such as the mineral oil tax, are generally initially levied by the central government (shared taxes). The state and local governments then receive a share, which is determined in the Intergovernmental Fiscal Relations Act, using specific distribution criteria (see BMF 2018, Bröthaler et al. 2017).

Shared taxes

Looking at the shared taxes (table 3), it is clear that in 2017, with around 8.5 billion Euro, transport-related taxes such as mineral oil tax, duty on vehicles based on fuel consumption, engine-related insurance tax, motor vehicles tax and insurance tax, which are affected by connected, automated and electric vehicles as described above, make up about 10.7 % of total volume of shared taxes. The mineral oil tax and the engine-related insurance tax have the largest share of 5.6 % and 3.0 %, respectively. Over time, the share of transport related taxes in shared taxes has been relatively stable.

Shared taxes	2007 (mio. €)	2017 (mio. €)	% p.a.	Share 2017 (%)
Tax on mineral oil	3,689	4,436	1.9	5.6
Duty on vehicles based on fuel consumption	456	469	0.3	0.6
Engine-related insurance tax	1,410	2,389	5.4	3.0
Motor vehicles tax	115	38	-10.4	0.0
Insurance tax	993	1,128	1.3	1.4
Transport-related taxes total	**6,663**	**8,461**	**2.4**	**10.7**
Income taxes / taxes on profits	30,516	39,269	2.6	49.5
Value added tax	19,212	25,519	2.9	32.2
Other taxes	3,870	6,015	4.5	7.6
Total	60,261	79,264	2.8	100.0

Table 3: Revenue from shared taxes in 2007 to 2017 in million euro, % growth per year and % share of total tax revenue (Source: Gebarungsstatistik, Statistics Austria 2018, own calculation)

5.2.2 Allocation to state and local governments according to revenue sharing system

The revenue of the federal states and municipalities after applying the distribution formulas for the shared taxes (table 4) show that, the transport-related levies in 2017 of the state and local governments accounted for 3.7–4.3 % of the entire revenue. The revenue from parking fees and parking penalties described above, which are also affected by connected, automated and electric vehicles, make up about 0.7 % of the total revenue of local governments and 1.5 % of Vienna, respectively.

Revenues 2017	in mio. €			in % of total revenue		
	State gov. (without Vienna)	Local gov. (without Vienna)	Vienna	State gov. (without Vienna)	Local gov. (without Vienna)	Vienna
Transport-related taxes total	1,369	741	631	**4.0**	**3.7**	**4.3**
Income taxes/ taxes on profits	6,344	3,432	2,922	18.4	17.1	19.9
Value added tax	4,232	2,308	1,713	12.3	11.5	11.7
Other taxes	1,298	1,057	793	3.8	5.3	5.4
Share of shared taxes	13,244	7,537	6,059	38.4	37.7	41.2
Parking fees		70	115		**0.3**	**0.8**
Other taxes	679	3,448	1,294	2.0	17.2	8.8
Revenue from taxes total	13,923	11,055	7,468	40.4	55.2	50.8
Parking penalties	50	70	82	**0.1**	**0.4**	**0.6**
Other current revenues	15,789	5,362	4,261	45.8	26.8	29.0
Revenue from capital account	4,705	3,526	2,882	13.7	17.6	19.6
Total revenues	34,466	20,013	14,693	100.0	100.0	100.0

Table 4: Revenue of the Austrian state and local governments from taxes and other revenue 2017 in million euro or in % (Source: Gebarungsstatistik, Statistics Austria, 2018, own calculation)

5.2.3 Expenditure

A look at the expenditure of the subnational governments (table 5) shows that the expenditure on road construction and road transport, which could be affected by connected, automated and electric vehicles, accounted for 3.7 % in 2017 (state governments without Vienna) or a share of 7.8 % (municipalities without Vienna) in the total expenditure. For Vienna, € 276 million represents a 1.8 % share of total expenditure. Over time, it has become clear that the share of expenditure on road construction and road traffic of local governments and of Vienna remained on the same level while that of state governments slightly decreased in the last ten years.

Functionspecific expenditure 2017	in mio. €			in % of total expenditure		
	State gov. (without Vienna)	Local gov. (without Vienna)	Vienna	State gov. (without Vienna)	Local gov. (without Vienna)	Vienna
Road construction and transport	**1,283**	**1,783**	**261**	**3.7**	**7.8**	**1.8**
Public Transport	580	161	774	1.7	0.7	5.3
Other expenditure	32,639	21,007	13,658	94.6	91.5	93.0
Total expenditure	34,502	22,952	14,693	100.0	100.0	100.0

Table 5: Expenditure of the federal states and municipalities for roads and public transport (Source: Gebarungsstatistik, Statistics Austria, 2018, own calculation)

Overall, the revenue and expenditure categories affected by connected, automated and electric vehicles thus account for a significant proportion of the total revenue and expenditure of the federal government, the provinces and municipalities, and in particular also the city of Vienna. The study makes apparent the need to adress the topic from the perspective of the public sector, which has so far hardly been achieved, but could be relevant with a significant increase in new registrations of electric vehicles in Austria in the next few years (Austriatech 2018: 1) and thus emphasises the earliest possible consideration of this topic. Moreover, in recent years in Vienna in particular, there has been an increase in the share of expenditure on road construction and road transport in total expenditure. This could continue to increase in the future due to the effects described above and the associated infrastructure expenses.

6 CONCLUSION, DISCUSSION AND OUTLOOK

The article showed that connected, automated and electric vehicles could have very large effects on city budgets – especially, when taking the form of the "holy trinity", with a significant impact in vehicle ownership. On the basis of the consideration of the significance of the affected revenue and expenditure categories in the budgets of the federal states and municipalities in Austria with a special focus on Vienna, it was also possible to see the possible scope and magnitude of these fiscal effects. The analysis indicates that the public sector could loose a significant amount of revenue from the automation, connectivity and electrification of transport and the associated secondary effects. At the same time, depending on the legal framework, the public sector would also have to create infrastructural conditions for the use of such vehicles, which could be linked to further expenditure, which has already increased in Vienna in recent years. In any case, the study could underline the relevance of an early consideration of the topic also by the public sector.

Moreover, the generation of potential new revenue requires public sector action and the implementation of measures: new revenue could be generated, for example, by setting up congestion charges for road use in cities or by introducing new taxation models, such as consumption-based taxes (Uday et al., 2017: 9). The increasing automation and digitisation of transport, reflected in connected, automated and electric vehicles, at least from the point of view of the public sector, also needs equivalent instruments, which use these new trends and opportunities. This becomes particularly clear with the example of the parking management tool, in the present state, which would clearly lose its effectiveness in the future as an instrument of transport policy control.

In the future, from the perspective of the public sector, it will be much more important to deal with these issues and to develop possible solutions and strategies. Already today, in countries such as Norway, which are heavily promoting electromobility through tax incentives, there are declines in public revenue (POLIS 2018: 7); This situation could further enhance with the increasing role of automation and connectivity within transport. Therefore, detailed studies are required in the future to estimate the fiscal effects of infrastructure requirements. First, the infrastructural requirements of connected and automated vehicles need to be understood in more detail. However, the charging infrastructure already set up as a result of the electrification of transport, shows that these infrastructures are associated with considerable costs, which means that new financing options should also be explored and discussed.

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