PROGNOSIS OF ECONOMIC RETURN OF INVESTMENT AFTER EXTENSION OF THE ELECTRONIC TOLL SYSTEM TO THE ROADS 1ST AND 2ND CLASS IN THE CZECH REPUBLIC

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Abstract

It is recommended to build electronic technologies for the collection of fees for transit as sophisticated intelligent systems that can provide and ensure a wide range of traffic information. The actual collection of the fee should represent only one of the partial tasks of this system. Electronic toll collection systems at a national level should not be built only as standalone systems but should be included into telematics instruments of the Intelligent Transport System at the national level. A suitable electronic system for collection of the toll depends on the specific conditions of the given country and it is necessary to maintain the endeavor for interoperability within the European Union. It is important to distinguish the decision-making on the level of the firm – the transport operator, which is based on the decision about managing its own resources, from the decision-making of the government and public institutions, which is based on setting preferential aims and decision-making about the investment of public resources. Interference with the existing system can cause fundamental changes in the proportion of the toll collection and the impact on the economy of the given country and therefore every intended step must be examined through a thorough analysis.

Key words: electronic toll, traffic flow, road, vehicle, analysis

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Introduction

Along with the trend of growing economy and the development of the demands on the logistics in the individual states of the European Union there has been an extensive growth of the freight traffic on the road network.

The speed of increase of the road freight traffic after the Czech Republic became a member of the European Union and especially of the Schengen area was extreme. During the years 2000 and 2005 the intensity of the freight traffic increased by 42%. Rather exceptional

are the indicators of the increase of the road haulage transport – on the roads approximately by 80% and on the motorways by 160%, in total on the roads and on the motorways by 105%.

The European transport policy responded to this situation by a recommendation to effectively charge for the specific road network, which is the main "backbone" for the individual national and international flows/directions of transport. The answer to the demand for an effective charging system in Europe is the Electronic Fee Collection technology (EFC).

In the successfully implemented projects we can find four different types of the EFC technology. The main differences lie in the way of the communication between the toll equipment and its facilities, the unit on the vehicle dash-board OBU (if this is requested), and sometimes also depending on the distance on which the communication is carried out. (Melichar, 2004)

The systems are based on various technologies and therefore it is difficult to maintain their interoperability for the area of electronic toll collection within the EU countries. Therefore it is necessary to look for the benefits and drawbacks of the systems, carry out a thorough analysis and having considered the needs of the users design the most suitable EFC system for the Czech Republic.

1 Toll in the Czech Republic

There are charges on the use of the selected network of motorways and expressways. By “charge” we understand a certain sum which is payable for the right to use the vehicle on certain chargeable terrestrial communications for a certain period of time. A common and fair method of charging for the use of the road infrastructure is the toll or performance charge. In comparison with the charge for the use, which is set depending on the length of time period during which the right to use the road network is paid, toll is stipulated in relation to the real driving distance. By toll we understand a certain sum which is paid for driving of the vehicle between two points of the road network. This sum is set depending on the driven distance and the type of vehicle. In the past, the toll was traditionally collected on the motorways manually, which demanded building of extensive toll stations. At present, this traditional way of toll collection is being abandoned and is being replaced by the electronic toll collection systems. (Ministerstvo dopravy, 2013)

1.1 Assessment of the possibility of application of further extension of the toll to the class 1 and 2 roads from the point of costs and benefits

At present, the European directives require charges on the roads of the motorway types and in the event of non-existence of an integrated network in the given country also allow charges on the roads of lower classification. (Směrnice Evropského parlamentu a rady, 2006/38/ES)

Czech Republic, Slovakia and Poland took advantage of this opportunity because they have an unfinished spine network of motorways. In the Czech Republic, fees are charged only on less than 200 km of class 1 roads, which substitute the motorways towards the border crossings or they could serve for bypassing of the motorways on which the toll is charged.

The decisive parameter of all deliberations regarding the extension of the toll system to other class 1 roads and possibly also class 2 roads is the economy of the toll collection. The average proceeds from the class 1 roads are dramatically lower than those collected from motorways and expressways – average proceeds from the class 1 roads in 2013 were only CZK1.66 million per one kilometer whereas the proceeds from the motorways and expressways were on average CZK7.94 million. The plans to introduce charges on the road network must be supported by a calculation based on the intensity of the traffic on the individual stretches of roads and not only by an extrapolation of proceeds of the current chargeable network. On the other hand, increasing toll rates and decreasing prices of technologies will be the factors supporting the idea of introducing charges.

For the success of expanding of the collection of the toll on the lower class roads it will be necessary to set the rates per kilometer appropriately. Whilst the logic of paying in accordance with the comfort of the travel would lead to substantially lower charges on the lower class roads, when we consider the impact on the health and the environment of the local residents it would lead to opposite results. A substantial portion of roads of class 1, 2 and 3 actually runs through the centers of villages, which has a negative impact on the health and quality of the environment of the local residents. It will be necessary to find a balanced compromise between both of these options. Besides, the toll rates must be set in such a mutual proportion that bypassing the motorways and expressways would cease to be worth it.

1.2 Extension of collecting the toll to majority of the road network will only bring increase in prices of consumer goods, especially foods, and it will not any positive effect on the distribution of the transportation in favor of the rail network

Switzerland is an inspiring example. The toll is collected on the entire road network at the rate per kilometer, which is several times higher than the one in the Czech Republic. Two thirds of

the collected amounts are used in accordance with a law passed by a referendum for the development of the public transport and the railway routes through the corridors of the Alps. The remaining third is divided between the individual cantons and used for public transport or other costs. Regions with worse transport accessibility additionally get a compensation bonus. Thanks to this model the volume of goods transported by the rail over the Alps in the territory of Switzerland is more than 2/3 higher than the amount of goods transported on the same route by trucks on a long term basis.

It can therefore be expected that the extension of the toll to the lower class roads will not cause any significant increase of the prices of consumer goods in the Czech Republic either. The bigger part of the increased costs of transport will be compensated in other ways.

The heavy goods vehicles with a maximum permitted weight over 12 tons cause approximately 75% of wear of the communications. The public service should only start claiming the toll on the lower class roads after they have been repaired to a proper state. (Kuták, 2012)

2 The analysis of the proceeds for the extension of the electronic toll with introduction of the performance charges on the roads of class 1 and 2 for vehicles over 3.5 tons

2.1 Topology of charges on the roads of class 1 and 2

Czech Republic has a thick network of roads of class 1, 2 and 3. Unlike the network of motorways, expressways and selected sections of the class 1 roads on which the toll has been charged until now, where the charges were imposed on the transit routes, by imposing charges on the lower class roads the charged road network will give several options of choosing various transport routes.

The transport routes in the network of the lower class roads strongly depend on the places of manufacture and consumption and the transport accessibility by the local residents given by the distribution of the population. Changes in the behavior of the existing traffic flows can be anticipated only in a very limited way if it is not possible to change the distribution of the manufacture and consumption locations. (Cempírek, 2005)

Setting of the length of chargeable class 1 roads for the calculation of the potential proceeds

As of the 1st June 2013, there were 5 827.1 km of class 1 roads in the Czech Republic, of which 210.7 km were subject to toll (which stands for 3.6%).

The calculation of the potential toll imposed on the class 1 roads was carried out on the complex from the national numeration of transport in 2010 for the length of 4 164 km of the class 1 roads.

Setting of the length of chargeable class 2 roads for the calculation of the potential proceeds

As of the 1st June 2013 there were 14 626.2 km of class 2 roads in total. There was no stretch of class 2 roads subject to toll.

The calculation of the potential toll imposed on the class 2 roads was carried out on the complex from the national numeration of transport in 2010 for the length of 970 km of the class 2 roads.

2.2 Consideration of the emission class

For this analysis we will keep the division of vehicles into emission classes the same way as is stipulated for the existing system. Division of the vehicles for the emission class EURO 0 – 2, EURO 3, 4 and EURO 5+.

For the purposes of the analysis interim indexes of the growth of the toll rates were set. From the existing toll rates which are divided by the period of time and also depending on the number of axles and the classification of vehicles into emission classes, it is necessary to introduce toll coefficients, i.e. average toll rates – see table 1.

Tab. 1: Coefficients of toll rates

Emission categories	EURO 0 – 2			EURO 3, 4			EURO 5+		
Numbers of axles	2	3	4+	2	3	4+	2	3	4+
Toll rates in CZK/km	1.08	1.77	2.55	0.79	1.37	1.96	0.79	1.37	1.96
Emission proportional	21%			59%			20%		

Source: authors

2.3 Parameters of the calculation of proceeds

a) The first year when the charges were imposed on the extended network of the class 1 and class 2 roads is the year 2013.
b) The year analyzed and indexed is the year 2013.
c) The final date of the analysis is 2020.

d) In the calculation are included only the road sections which:
   - do not include already chargeable expressways,
   - do not include urban roads listed in the national numeration of transport in 2010.

e) The limit intensity of the traffic of the extended network of roads of class 1 and class 2 is set as 420 vehicles with the weight over 3.5 tons within 24 hours.

f) In the calculations are not included effects of any lowering of the toll rates, introduction of the new emission class, and introduction of bulk discounts. All these effects would cause a decrease of toll proceeds.

The starting values of the traffic performance and the toll rates for the following years would be indexed by coefficients which did not take into account the effect of economic cycles affecting the traffic performance.

2.4 Variants of the toll potential

The potential of the toll assessment (see table 3) is based on the premise that after extending class 1 and class 2 roads subject to toll there will be no changes of the traffic flows, bypassing, lowering of the traffic performance and the assumption that the collection of the toll will be 100% effective. To achieve this ideal state it would be necessary to build an extensive and costly monitoring system covering the entire road network which would cause an increase of costs in relation with staffing of the traffic police or the customs administration that carry out the actual control activity in the field.

Given the stated reasons I calculated the estimated potential of the toll in three variants:

1. Variant A – pessimistic, which presumes lowering of the traffic performances as a consequence of the charging to 65%.
2. Variant B – realistic, which presumes lowering of the traffic performances as a consequence of the charging to 75%.
3. Variant C – optimistic, which presumes lowering of the traffic performances as a consequence of the charging to 80%.

Tab. 2: The estimated potential of the toll assessment on the class 1 and class 2 roads

Road category	Length of additive stretches (km)	Average traffic performance (mill. tkm/y)	Anticipated potential of the set toll (mill. CZK/year)	Potential proceeds from toll per 1 km (CZK/1km/year)	Average toll rate (CZK/km)
Class 1 roads without expressways	4.164	1.479	2.440	586.059	1.65
Class 2 roads	990	223	330	333.374	1.48
Total	5.154	1.702	2.770	919.433	

Source: authors

The potential of the toll assessment in the variant A (65%) will go down by 32% to 1.9 billion CZK – see table 3.

Tab. 3: The estimated potential of the toll assessment in variant A

Road category	Length of additive stretches (km)	Average traffic performance (mill. tkm/y)	Anticipated potential of the set toll (million CZK/year)	Potential proceeds from toll per 1 km (CZK/1km/year)	Average toll rate (CZK/km)
Class 1 roads without expressways	4.164	1.005	1.658	398.235	1.65
Class 2 roads	990	157	232	234.707	1.48
Total	5.154	1.162	1.890	632.942	
Decrease of the traffic performance to: 65%			Decrease by: 32%		

Source: authors

The potential of the toll assessment in variant B (75%) will go down by 23% to approximately 2.2 billion CZK – see table 4.

Tab. 4: The estimated potential of the toll assessment in variant B

Road category	Length of additive stretches (km)	Average traffic performance (mill. tkm/y)	Anticipated potential of the set toll (million CZK/year)	Potential proceeds from toll per 1 km (CZK/1km/year)	Average toll rate (CZK/km)
Class 1 roads without expressways	4.164	1.141	1.882	452.010	1.65
Class 2 roads	990	176	260	262.419	1.48
Total	5.154	1.317	2.142	714.429	
Decrease of the traffic performance to: 75%			Decrease by: 32%		

Source: authors

The potential of the toll assessment in variant C (80%) will go down by 18% to approximately 2.3 billion CZK – see table 5.

Tab. 5: The estimated potential of the toll assessment in variant C

Road category	Length of additive stretches (km)	Average traffic performance (mill. tkm/y)	Anticipated potential of the set toll (million CZK/year)	Potential proceeds from toll per 1 km (CZK/1km/year)	Average toll rate (CZK/km)
Class 1 roads without expressways	4.164	1.208	1.996	479.232	1.65
Class 2 roads	990	185	274	276.536	1.48
Total	5.154	1.393	2.270	755.768	
Decrease of the traffic performance to: 80%			Decrease by: 18%		

Source: authors

2.5 The estimated potential of the toll assessment for the extended network of roads of class 1 and class 2

The traffic performance and potential of the toll assessment in variant A (65%) – see tables 6 and 7.

Tab. 6: The estimated maximum potential of the toll assessment of the class 1 roads

65%	UM	2012	2013	2014	2015	2016	2017	2018	2019	2020
Interannual index of the increase of the chargeable period	%		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Length of charge	km	4.164	4.172	4.181	4.189	4.197	4.206	4.214	4.223	4.231
Interannual coefficient of the growth of traffic performance			1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004
Traffic performance	mil. tkm/year	1.014	1.018	1.022	1.026	1.030	1.034	1.039	1.043	1.047
Interannual index of the toll rates growth	% year		2	2	2	2	2	2	2	2
Average estimable toll rate	CZK/km		2,34	2,39	2,43	2,48	2,53	2,58	2,64	2,69
Potential of the toll assessment	mil. CZK/year		2.423	2.482	2.543	2.606	2.669	2.735	2.802	2.870

Source: authors

Tab. 7: The estimated maximum potential of the toll assessment of the class 2 roads

65%	UM	2012	2013	2014	2015	2016	2017	2018	2019	2020
Interannual index of the increase of the chargeable period	%		1	1	1	1	1	1	1	1
Length of charge	km	1.000	1.010	1.020	1.030	1.041	1.051	1.062	1.072	1.083
Interannual coefficient of the growth of traffic performance			1,002	1,002	1,002	1,002	1,002	1,002	1,002	1,002
Traffic performance	mil. tkm/year	158	158	159	159	159	160	160	160	161
Interannual index of the toll rates growth	% year		2	2	2	2	2	2	2	2
Average estimable toll rate	CZK/km		2,09	2,13	2,17	2,22	2,26	2,31	2,35	2,4
Potential of the toll assessment	mil. CZK/year		339	347	355	363	372	380	389	398

Source: authors

2.6 Overall estimate of the potential of the toll assessment

On the roads of class 1 and class 2, in consideration of their extent, the estimated potential toll proceeds were lowered due to anticipated avoidance of the toll obligation by the drivers. Ensuring of the similar extent of the control actions as it is introduced in the ESVZ system on the lower class roads would be uneconomical.

Accumulated potential of the toll assessment up to the year 2020 in variant A (65%) on the class 1 and class 2 roads is CZK 24 billion in total – see table 8.

Tab. 8: Potential of the toll assessment, accumulated up to the year 2020, in variant A (65%)

65%	UM	2013	2014	2015	2016	2017	2018	2019	2020
Potential of the toll assessment (1 class)	mil. CZK/year	2.423	2.482	2.543	2.606	2.669	2.735	2.802	2.870
Potential of the toll assessment	mil. CZK/year	339	347	355	363	372	380	389	398
Overall potential of the toll assessment	mil. CZK/year	2.762	2.829	2.898	2.969	3.041	3.115	3.191	3.268
Cumulatively	mil. CZK/year	2.762	5.591	8.489	11.458	14.499	17.614	20.805	24.073

Source: authors

The potential of the toll assessment, accumulated up to the year 2020 in variant B (75%) on the class 1 and class 2 roads is CZK 27 billion in total – see table 9.

Tab. 9: Potential of the toll assessment, accumulated up to the year 2020, in variant B (75%)

75%	UM	2013	2014	2015	2016	2017	2018	2019	2020
Potential of the toll assessment (1 class)	mil. CZK/year	2.755	2.822	2.891	2.962	3.035	3.109	3.185	3.263
Potential of the toll assessment	mil. CZK/year	379	388	397	407	416	426	446	457
Overall potential of the toll assessment	mil. CZK/year	3.134	3.210	3.288	3.369	3.451	3.535	3.631	3.720

Cumulatively	mil. CZK/year	3.134	6.344	9.632	13.001	16.452	19.987	23.618	27.338

Source: authors

Potential of the toll assessment, accumulated up to the year 2020 in variant C (80%) on the class 1 and class 2 roads is nearly CZK 29 billion in total – see table 10.

Tab. 10: Potential of the toll assessment, accumulated up to the year 2020 in variant C (80%)

80%	UM	2013	2014	2015	2016	2017	2018	2019	2020
Potential of the toll assessment (1 class)	mil. CZK/year	2.921	2.992	3.066	3.141	3.218	3.296	3.377	3.460
Potential of the toll assessment	mil. CZK/year	400	409	419	429	439	449	460	470
Overall potential of the toll assessment	mil. CZK/year	3.321	3.401	3.485	3.570	3.657	3.745	3.837	3.930
Cumulatively	mil. CZK/year	3.321	6.722	10.207	13.777	17.434	21.179	25.016	28.946

Source: authors

Conclusion

The rough estimate of the costs of extension of the charges to class 1 and 2 roads divided into the cost of delivery is approximately CZK4.95 million and services approximately CZK8.73 million. The usual share of the purchase cost and the overall cost was set at 36% based on a cost analysis of the ESVZ system and the Slovak toll system. The estimate presumes implementation of a new toll system, which would be securing the charging on class 1 and 2 roads until 2016 and as of 2017 of the whole road network in the Czech Republic. As a result of extending the system to motorways and expressways it will be necessary to increase some of the services and the capacity of the central system and the manual validation centers.

Extension of the charges to class 1 and 2 roads will require a range of further related costs, for example, those of road markings of the chargeable sections of class 1 and 2 roads and on the slip roads, marking of the border crossings by a road sign informing foreign drivers about the Czech toll system and the design work related with the design of the actual road marking.

The costs of the control activity include costs of measuring of the toll system effectiveness and quality control of the services provided, cost of running of the mobile patrols, costs of legal procedures, and costs of possible civil law disputes.

The costs of reducing the use of the ESVZ system and, as the case may be, cooperation of the control systems divided into the cost of the transfer to the new system from the ESVZ system in 2017, costs of compatibility of the ESVZ system necessary especially in the area of enforcement until 2016, cost of liquidation of the ESVZ system and its further use including the OBU units.

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