



The German HGV-toll

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Abstract

After many delays, technological problems, and renegotiations between the government and the system operator Germany has successfully introduced a satellite based tolling system for heavy goods vehicles (HGVs) in January 2005. Since then the system is running smoothly. Currently the toll applies only to state motorways (the so called Autobahnen) but there are plans to extend it to the secondary level of federal long-distance roads (the Bundesfernstraßen).

This paper describes the political and economic background of the introduction of the HGV-toll in Germany. The paper sketches the history of the implementation process, describes the major structural elements of the toll, and discusses current problems and possible future developments. Finally some policy conclusions are drawn.

Keywords: Road Pricing; Road Transport; HGV-toll

1. Introduction

In January 2005 Germany has introduced a toll for heavy goods vehicles (HGVs). The toll system started with a delay of two years due to many technological, managerial and political problems which were covered by the media at great length (sometimes scathingly). But since the starting date the system is running smoothly. The only major area of discussion today seems to be the problem of toll avoidance traffic, that is, traffic deviating from the motorways to secondary roads in order to avoid paying the toll. Currently the toll applies only to state motorways (the so called Autobahnen) but due to avoidance traffic there is discussion to extend it to the secondary level of federal roads (the Bundesfernstraßen). Unfortunately official data on avoidance traffic are not publicly available yet (although they are known to exist). Estimates of avoidance traffic therefore have to rely on anecdotal evidence and on simulation exercises.

This paper sketches the political and economic background of the introduction of the HGV-toll in Germany (section 2), describes the history of the implementation process (section 3), presents the structure of the toll (section 4), presents the results of a

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simulation study done at Dresden Technical University concerning avoidance traffic (section 5) and draws some policy conclusions (section 6).

2. The background

Due to substantial budgetary deficits on all federal levels Germany is currently facing severe problems with the financing of the country's infrastructure. These problems exist with respect to maintenance as well as with respect to new investment. The need to spend more on maintenance is illustrated by looking at the so-called "degree of modernity"¹ of the German road network over time. This measure has decreased from around 80% in the 70s to around 70% in 2002. In accordance with this statistical evidence road-users in Germany are facing a substantial amount of congestion due to frequent road-works and the bad technical condition of the road network in general.

But apart from maintenance new investment is urgently required. First, there is the need to remove "old" bottlenecks, some of which have now existed for quite a while. Second, "new" bottlenecks have arisen due to German reunification and the enlargement of the European Union. After EU enlargement Germany has become the main transit country for freight transport in Europe. Dramatic increases in freight transport are forecast. According to official forecasts published by the Federal Ministry of Transport and Housing HGV traffic will grow by 70%-83% in the period from 1997 to 2015.² As part of this development the traffic volume between Germany and the new member states in the east (CEECs) will almost treble.³ Already today 35% of HGV-transport (in ton-km) on the German motorway system is operated by foreign trucks.

The German government reconized these financing problems already during the 90s. In the summer of 1999 a High Commission for Financing the Federal Transport Infrastructure was established to examine these problems and to develop policy proposals to remedy the situation. The Commission (called the Pällmann-Commission, after its chairman Wilhelm Pällmann) came up with the proposal to convert the system of infrastructure financing from a tax-based regime to a regime of usage based charging.⁴ To this end the commission advocated to set up a special highway funding company (Fernstrassenfinanzierungsgesellschaft) that should act largely independent from the state. The commission proposed that the proceeds from the toll should be earmarked for road-building only. There was to be no cross-subsidizing between road-

¹ The degree of modernity is defined as the ratio of net assets to gross assets.

² See Bundesverkehrsministerium für Verkehr, Bau und Wohnungswesen (BMVBW), Verkehrsbericht, Kurzfassung, Bonn: BMVBW. See also: Verkehrsprognose 2015, in: Internationales Verkehrswesen (53) 12/2001, p.591.

³ There have been some doubts about these forecasts. It has been argued, for example, that there were association agreements between Germany and the CEECs already before the official membership of these countries, so that trade was already liberalized before EU enlargement. It has also been argued that in modern economies the service sector is more important than manufacturing. Nevertheless, the substantial growth that is currently underway in the new member countries is probably the dominant factor. In addition, and relatedly, it remains the case that the low labour costs in these countries stimulate relocation of manufacturing activities into the east generating a substantial increase of transportation of the manufactured goods back to the west. A special aspect of low labor costs are the low cost for HGV operators in the new member countries who increasingly operate in Germany from their own home base. This contributes to the growth of international HGV traffic on German roads.

⁴ Kommission Verkehrsinfrastrukturfinanzierung (2000).

infrastructure and other modes of transportation. In the end, however, the German government chose not to follow this advice (see below). It decided that 50% of the revenues are to be used to finance infrastructure investments of railways and inland-waterways.

Apart from remedying financing needs the toll is intended to serve other policy goals as well.

German road hauliers have complained for a long time that foreign truckers do not pay a fair share of Germany's road infrastructure cost. Given the fact that the German road infrastructure is largely paid out of the proceeds of the gasoline tax and given the large capacity of modern HGV tanks foreign trucks can avoid paying infrastructure costs simply by not refuelling within Germany.⁵ Therefore the introduction of a usage dependant HGV-toll was seen as a major tool to generate equal competitive conditions for the national trucking industry.

A further goal that was to be served by the introduction of the HGV-toll was to influence the current modal split in freight transport in favour of rail and inland-waterways and to create "fair" competition between road and rail. Currently rail transport in Germany has a share of around 14% of all ton-kilometers, inland-waterways a share of around 13% and road transport of around 70% (measured in ton-kilometres).⁶ By making road-transport more expensive it was thought that the two other modes would become more attractive to shippers. However, in a study predating the introduction of the toll (Doll and Rothengatter 2002 predicted only very limited modal shift effects at the current level of the toll. According to their calculations notable substitution effects would only occur at a toll level of 40 cents per kilometer provided the German railroads would be able to meet the increased demand with offers of sufficient quality and logistic sophistication.

Likewise the government saw the toll as a means to further environmental goals. The toll contains some differentiation according to emission classes. But the main effect on the environment was expected from the incentives of the toll on route optimization, fleet management and a shift towards rail and inland waterways.

Finally, there was a strong element of industrial policy in choosing a satellite based tolling system and sticking to it, notwithstanding the substantial technological problems that emerged during the implementation process.

Roughly the German system works as follows: The onboard unit is equipped with a GPS receiver for satellite signals and a microwave transmitter. Based on the GPS satellite signals the onboard unit is able to locate the truck's position and to compare it continuously with a map which is stored in the onboard unit. The onboard unit calculates the corresponding amount of the toll and sends these data via microwave technology to the system's central data processing unit which does the billing.

The German technology can be extended to other types of vehicle (provided corresponding onboard units can be installed at reasonable costs) and it can be extended to the secondary road network without major difficulty. The system can easily be extended to the territory of other European countries and it can be exported to Non-European countries as well. The German system is certainly the technologically most ambitious system in Europe. It should be noted, however, that this advantage is bought at a cost. It is reported that currently 16-20% of the toll-revenues (approximately 0,6

⁵ The capacity of modern tanks allows a truck to travel 2500-3000 km without refueling.

⁶ Bundesminister für Verkehr, Bau- und Wohnungswesen: Verkehr in Zahlen 2003/4, Hamburg, p. 239. Verkehr in Zahlen is the standard reference for transport statistics in Germany.

billion € p.a.) go to the system operator Toll Collect. Probably not all of the proceeds are used to cover operating costs but at least this figure gives some indication of the systems cost.

A further technological advantage of the German system consists in the fact that it provides the technological basis for a host of value-added services that can be offered “piggy-back” to the system, like navigation systems, tracking and tracing, generation of consumer patterns, etc. There is concern (also on the part of the EU Commission) that the operator of the German tolling system, Toll Collect, might acquire a monopoly over these services, and that suitable access provisions should be legislated. Some of these value added services may also cause problems of data protection. It cannot be denied, however, that with this system the political aim to establish Germany among the world’s technology leaders with respect to tolling-technology has been reached. It has to be mentioned in this context that the European Commission is strongly in favour of satellite based tolling systems.⁷

3. History of the implementation process

The current HGV toll in Germany has replaced the Eurovignette system which was introduced in 1995 in tandem with the Benelux countries and Denmark. Sweden joined the Eurovignette group in 1998. The Eurovignette applied for HGVs with a weight over 12t. It was time based and was sold in variable time chunks (1 year, 1 month, 1 week or 1 day.) Introducing the Eurovignette was a first attempt to reduce the fiscal imbalances that existed in the European trucking sector. In tandem with the introduction of the Eurovignette gasoline and vehicle taxes were harmonized although some inequalities remained. These remaining differences together with the possibilities of foreign trucks to avoid the German gasoline tax by not refuelling in Germany caused sympathies on the part of the German truckers for the government’s plans to change from tax financed system of highway financing to a usage based system.

In 1999 the High Commission for Financing the Federal Infrastructure was established which recommended this change to be made. It advocated the founding of a Highway Funding Company. This company was to be a joint-stock company whose shares, however, were to be held exclusively by the federal government (with the option to sell part of the shares later). The company was to finance its investments partly out of the revenues of a distance based toll and partly out of raising debt on the capital markets. The proceeds of the toll were exclusively to be earmarked for motorways. No cross-subsidies to other modes of transport were to be possible.

This company was in fact established in October 2003, however, with several important changes to the commission’s recommendations. First, it was legislated that cross-subsidies to rail and inland-waterways were to be possible. This change shows up already in the name of the company which was changed from Highway Funding Company (Fernstraßenfinanzierungsgesellschaft) into Infrastructure Funding Company (Verkehrsinfrastrukturfinanzierungsgesellschaft, VIFG). 50% of the toll revenues are now earmarked for investments into the infrastructure of these two competing modes.

⁷ See for example T. Howes: Developing an interoperable European road charging framework. Presentation given to the EU Road User Charging 2004, 30 November 2004, London, particularly the remarks on EU-Directive 2004/52.

(Rail is to obtain a share of 38%, inland-waterways a share of 12%.) Second, it was legislated that the toll revenues should not flow to the company directly but first to the federal government which then would distribute the revenues to the company.⁸ In this way the High Commission's important postulate that the company's budget should be totally independent from the state budget seems to be in question. This is important because the German government had always argued that the toll would not just be "another tax".

In the fall of 2001 after public tender the system operator Toll Collect was selected. Toll Collect is a consortium of Deutsche Telekom (the dominant telecommunications operator in Germany), Daimler Chrysler, and Cofiroute (the French operator, which holds a share of 10%). The choice of Toll Collect was contended by the competitors but was upheld by the courts so that Toll Collect was finally awarded the official licence in 2002. (The licence has a duration of 12 years.) In April of the same year the necessary legislation for raising a HGV toll in Germany (Autobahnmautgesetz, ABMG for short) went into effect.

It was expected that Toll Collect's proposed system would be operative in August 2003. Instead a series of technological problems lead to two postponements of the starting date. The main difficulties related to the on-board units which interfered with other board electronics of the vehicle and which exhibited compatibility problems with radio antennae. In addition, the software did not work properly. After extremely critical reporting in the press and after several rounds of renegotiations between the Federal Ministry of Transport and Housing and Toll Collect in February 2004 there was a cancellation of Toll Collect's contract followed, however, by a withdrawal of the cancellation shortly after under the condition that Toll Collect would be restructured.

The situation was even more strange given the fact that the government had prematurely abolished the Eurovignette in August 2003. This entailed that domestic hauliers paid neither vignette nor toll until January 2005. As a consequence the government suffered substantial financial losses which are now the subject of a law suit concerning penalties for Toll Collect.

Finally it was agreed that the toll would be introduced in two steps. A preliminary version was to be installed in January 2005 and the "full version" by January 2006. The preliminary version still exhibits a limited functionality of the onboard unit. The improved version of the onboard unit ("OBU II") will contain better software which, in particular, will make it possible to include secondary federal motorways (Bundesfernstraßen) into the tolling system. This fact is important, given the current discussion about deviation or avoidance traffic from the primary motorways to the secondary motorways.

4. Main elements of the German toll

The Pällmann commission (see above) had proposed a basic average toll level of 15 Cents per kilometer. This figure was based on a study by IWW Karlsruhe which relies

⁸ At present an amount of approximately the same volume as the revenues from the former Eurovignette is subtracted in order to compensate the Ministry of Finance for the income loss. In addition, the system's operating costs are subtracted.

on a fully distributed cost methodology.⁹ In order to compensate German truckers for still remaining competitive fiscal disadvantages in comparison to foreign trucks the final level was set slightly lower at 12,4 Cents per kilometer. This reduction corresponds to a volume of 600 Mio € for the German trucking industry as a whole and is to be phased out over the next years. In addition, the German government legislated several other compensation measures to make the toll more palatable to German hauliers. It was decided to lower the vehicle tax to the absolute minimum compatible with EU directive 1999/62. In addition, truckers are allowed to subtract the gasoline tax from the toll. This applies to foreign HGVs as well as to domestic HGVs but is considered a temporary measure. Finally, there is a state financed programme of subsidies for the acquisition of new HGVs with a better emission performance.

The current level of 12,4 Cents per kilometer is only the basic average level of the toll. The toll is differentiated according to emission standards and number of axles. There is no differentiation, however, according to time or place. The toll currently applies only to HGVs over 12 tons and only on federal motorways (the Autobahnen) which in total have a length of approximately 12 000 kilometers. Interestingly, busses are not included. Substitute roads are not covered by the toll although there are plans to include at least some of the secondary motorways.

There are two ways of payment: First, the user can pay manually by using a terminal at a gasoline station or via the Internet. Second, the user can be billed automatically via his onboard-unit. The second option requires prior installation of the onboard-unit, of course. The onboard-unit is supplied free of charge by Toll Collect. The truck owner only has to pay for the technical installation of the unit. At the time of this writing approximately 400 000-500 000 units are installed. The total number of liable trucks is around 800 000. Enforcement occurs by video cameras installed on gantries or via mobile control vehicles, which move within the traffic flow. At present the violation rate is below 2% (out of a total volume of 8,5 million vehicles that were checked).

It is expected that in its first year (2005) the toll will have generated revenues of 2,867 billion € of which 0,6 billion € will go to the system operator Toll Collect. The Eurovignette, for comparison, only generated around 450-460 million € per annum. Moving to the toll system therefore has generated a substantial increase in revenues for the German state.

It has to be remarked that apart from the just mentioned temporary possibility to subtract the gasoline tax from the toll the German government has no plans to lower the gasoline tax permanently as a compensation for the toll (as was recommended by the Pällmann commission). This fact is interesting because attempts of economists to allocate infrastructure costs according to vehicle type have shown that currently the gasoline tax payments by HGVs in Germany exceed the cost share of trucks considerably (DIW 2000). These calculations depend on the fully distributed cost methodology and are therefore to some extent arbitrary. Nevertheless the government has depended on these calculations in setting the level of the toll. Thus, in principle a

⁹ Institut für Wirtschaftspolitik und Wirtschaftsforschung (IWW) (2000): Berechnung wegekostenorientierter Benutzungsentgelte für die Bundesfernstrassen und Abschätzung der wirtschaftlichen Auswirkungen, In: Kommission Verkehrsinfrastrukturfinanzierung (2000), Appendix 2. With some slight modifications this study, in turn, relied on the methodology developed by the Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Research). For a description of this approach see: H. Link et al.: The Costs of Road Infrastructure and Congestion in Europe, Berlin, Heidelberg, New York, 1999, Chapter 3.

lowering of the gasoline tax would have been possible and consistent with the whole policy approach of changing from a tax financed to a usage financed system.

The government bases its denial to lower gasoline taxes on a budgetary principle taken from the German public finance literature, the so-called “Non-Affektationsprinzip”. This principle states that taxes (as opposed to user charges) by definition cannot be earmarked but have the purpose to cover *all* types of state expenses, not specific ones. This view is open to discussion. In fact, past German governments have already departed from the non-affectation principle and earmarked at least increases in the gasoline tax for the purpose of road building. Even today a part of the gasoline tax is earmarked for infrastructure investments in public transport.

Some experts have argued that the current level of the gasoline tax for trucks is justified because the margin of the tax level over allocated costs can be viewed as an implicit environmental tax imposed on HGVs. It may be true that such an environmental tax might be desirable nevertheless the principles of taxation require that the existence of such a tax should be made explicit and be decided upon in the political process. To the knowledge of this author this has never occurred.

There are plans to extend the toll to HGVs under 12 tons but over 3,5 tons and there are also plans to extend the toll to 15 substitute long distance roads which suffer particularly from traffic seeking to avoid the toll on the primary motorways. In addition, some of the federal states of Germany recently have brought forward the proposal to introduce a toll for private cars within their territory as well. Technically speaking it would be possible to extend the HGV tolling system in this way. Doing this would require, however, that in Germany 45 million private cars would have to be equipped with onboard units. At present the corresponding investment costs seem far too high (although economies of scale and technological progress may change this in the near future). Likewise, operating and enforcement cost are considered to be prohibitive. Moreover, there are two different jurisdictions involved. The current tolling system is operated under the authority of the federal ministry of Transport which is responsible for the motorways (the “Autobahnen”) and the long distance federal roads. The federal states are responsible for the road network within their own territory. Decisions to extend the HGV toll nationwide would require cooperation between the federal states and the federal government.

5. First results and the problem of avoidance traffic

At the time of writing this paper official data on the effects of the toll are still scarce. Nevertheless, the Minister of Transport and Housing in a recent interview¹⁰ indicated that there have been significant modal-shifts from road to rail. This statement is contradicted, however, by the Federal Agency for Road Transport (Bundesamt für Güterverkehr, BAG) which claims that there is no shift in general but only a small shift in favour of intermodal transport. According to the minister inland transport of containers terminals has increased by 7%. Likewise the amount of inefficient no-load trips has decreased by 15%.

Some federal states and communities have reported a substantial increase in HGV traffic since introduction of the toll. Unfortunately up to now there is only casual

¹⁰ “Maut-Einnahmen auf Rekord Niveau“. In: Die Welt, Sunday, October 8, 2005, p.4.

evidence available although the government had promised systematic and official data for autumn 2005.¹¹ Two examples therefore must suffice to illustrate the problem.

The small wine-growing village of Oppenheim located on federal route B9 with 7000 inhabitants has seen an increase of 1600 trucks per day. This means an increase by a factor of three and implies a density of more than 1 truck per minute.

On federal road B1 the number of HGVs has risen from 338 to 771 vehicles per day which corresponds to an increase of 128%.

The federal states and the communities have reacted to these developments by prohibiting or rationing through-traffic and by imposing detours or drastic speed-limits. Whereas in April 2005 the federal government still denied the existence of serious avoidance traffic it has admitted lately that there are problems at some regional focal points. The Minister of Transport and Housing announced that up to 15 secondary roads might have to be included in the tolling system to remedy the overload of trucks at these focal points.

Some experts doubt that these measures will work. Casual evidence seems to show that a large share of the HGVs on German roads is based in the new member states, in particular Slovakia, Hungary, and Poland. Labor costs in these countries are so low that detours have no high opportunity costs. The sceptics therefore assert that if the German toll is extended to secondary roads HGV operators from these countries will simply incur even greater detours to avoid the toll.

In a study conducted at Dresden Technical University Henninger (2005) has used the VISUM traffic simulation software to simulate the effects of the HGV toll for the federal state of Bavaria. Bavaria was chosen for two reasons. First, Bavaria has the longest road network in Germany. Second the motorway (Autobahn) network is not too dense (unlike, for instance, the motorway network of Northrhine-Westfalia). Thus in Bavaria deviating to secondary federal roads is really an economic option. The network of Bavaria is modelled in the so-called VALIDATE network that was developed by the consulting firm ptv AG in cooperation with Kessel and Partner who implemented in VALIDATE a special model for simulating freight traffic.

Henninger performed two sets of simulations based on two different route choice models. The first route choice model is the TRIBUT model developed by INRETS especially to model the effects of tolls and the second is the so called Multilernverfahren ("Multilearning Procedure") developed by Lohse (Schnabel, Lohse 1997 and ptv 2004). Both methods use value of time (VoT) to estimate the opportunity costs of possible route alternatives. The latter model allows for dynamic adjustment processes of route choice. In contrast to the Multilernverfahren methodology TRIBUT uses the VoT in a variable way to reflect existing differences between individuals in a better way.

To calculate the avoidance effects Henninger differentiates between long-distance traffic (>150 km), regional traffic (51-150 km), local traffic (<50 km), and between trucks and cars. She assumes a value of time of 34,59 €/h for long distance traffic which corresponds to the values assumed in the German federal infrastructure planning procedure. Not surprisingly higher values of time would lead to less avoidance traffic in the simulation.

¹¹ The government has commissioned two studies concerning the effects of the toll. These studies are completed but not publicly available at the moment because they serve as input into the decision processes of the federal states of Germany (the Länder) concerning the question of which of the secondary roads should be included in the tolling system. The Länder have been asked by the Federal Ministry of Transport and Housing to develop a position on this question.

Both types of route choice modelling identify the same Bavarian roads as candidates for avoidance traffic. The average substitution volumes in both models are as follows:

Table 1: Average changes of traffic volumes on motorways according to TRIBUT.

<i>Vehicle Type/Type of Traffic</i>	<i>Average Change</i>
Cars	+4,46%
HGVs under 12t	+16,55%
HGVs over 12t	
Long distance traffic	-1,3%
Regional Traffic	-21%
Local traffic	-7%

Source: Henninger 2005, p.65.

The increase in cars reflects the time savings of private car owners due to less congestion by HGVs.

Table 2: Average changes of traffic volumes on motorways according to Multilearningprocedure.

<i>Vehicle Type/Type of Traffic</i>	<i>Average Change</i>
Cars	+7,12%
HGVs under 12t	+4,33%
HGVs over 12t	
Long distance traffic	-21,09%
Regional Traffic	-27,80%
Local traffic	-32,03%

Source: Henninger 2005, p.63.

It can be seen from the two tables that although the precise values differ somewhat the effects are nevertheless substantial. It will be interesting to compare these numbers with the official data when these become finally available.

6. Policy conclusions

It comes as a surprise that the German toll was accepted without much discussion and without much resistance. The major reason seems to have been that there was a “grand coalition” of actors who supported the toll. Politicians advocated it because of the hoped for gains to the federal budget and the hoped for position of Germany as a worldwide technology leader in tolling systems. Truckers favoured it because they saw it as a major step towards establishing a level playing field in the competition with foreign hauliers. The environmental groups and the green party advocated it because they generally believe that transport is “too cheap”, because they saw the toll as a first step towards traffic-management by pricing and as a means to influence the modal split in favour of the more environmental friendly transport by road and inland-waterways. The public at large, in particular the car owners, saw the toll as a means to reduce the substantial amount of HGV traffic on German motorways and to decrease the

corresponding congestion. (The sympathies of private car users for a tolling will probably change when a toll for private cars will be brought on the political agenda.)

Another important factor for acceptance of the toll was that the media concentrated their reporting about the toll mainly on the technical and management problems of Toll Collect and the politicians, not on the economic and social issues. After a while the public seemed to believe that it had become a matter of national honour to get the toll working. Economic and social questions increasingly began to play a secondary role.

On the level of economic theory the German example seems to confirm the mounting evidence that large infrastructure projects involving private firms must be dealt with from the perspective of the theory of incomplete contracts (see Hart (1995) and Hart, Shleifer, Vishny (1997)). Apparently major mistakes were made when the government set up the contract with Toll Collect. It seems to be a worthy object of future research therefore to inquire in how far the theory of incomplete contracts can inform policy making in the area of implementing tolling systems.

Finally, the German example shows the necessity to find binding political mechanisms with respect to the use of the revenues of the toll. It is known from the economic theory of second best that allocating these revenues to road building must not necessarily be the optimal option. On the other hand acceptance may increase if the citizen can be convinced that the toll is not “just another tax.” No matter how this question is decided, politicians must find ways to clarify from the outset how the toll revenues are to be used and ways to commit themselves credibly to these uses.

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Acknowledgements

I wish to thank Mrs. Kathrin Henninger for helpful comments.