ROAD PRICING IN EUROPE AND ITS POLICY IMPLICATIONS FOR KOREA

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ABSTRACT

Road pricing has attracted much attention and has become a major issue of debate in European transportation. After the establishment of the European Union (EU) in the early 1990s, the EU has recognized the necessity for a concerted effort to solve worsening transportation problems that include traffic congestion, accidents, prolong travel times, and the negative impact of transportation as a whole on the environment. This awakening has led to a change of approach to the use of roads, that is, the emergence of road pricing based on 'polluter pays' principle. This study first examines two EU road pricing cases by focusing on the London's Congestion Charge Scheme (LCCS) and the Germany's Heavy Goods Vehicles (HGVs) Charges, in order to draw policy implications for South Korea, a country in which roads are generally construed as public property and thus are provided for free and open to all with the exception of motorways. After discussing recent efforts by the South Korean government concerning road pricing, this paper explores key pre-conditions and possible solutions for EU-type road pricing schemes to be successfully implemented in South Korea.

1. INTRODUCTION

Road pricing was not a familiar practice in most European countries such as the UK, Germany, and Sweden until the 1980s, although it was widely used in some southern European countries, notably Italy, Spain, and France, in which motorway tolling has been accepted as a useful way for infrastructure financing. From the early 1990s, however, this began to change. The establishment of the European Union (EU) and its policy focus on the environmental concerns required its member countries to reconsider their transportation policies. Deviating from the traditional belief in the 'Right of Way', various EU countries began to accept the principle of the 'polluter pays' for the first time in their history (Viegas, 2005; Kim, 2010).

In regards to the spread and implementation of this new principle, various reports and literature confirms two different types of road pricing schemes: urban road pricing and inter urban road pricing. The congestion charge in London and Oslo may be considered an example of the former, while Germany's Heavy Goods Vehicles (HGV) charge is considered an example of the latter. Despite some differences, these two types of road pricing schemes share a common ground in that both try to internalize the external costs incurred in the transportation sector in the form of taxes or charges.

At the same time, the emergence of this new principle in transportation and road pricing measures has also become a new source of influence and, consequently, a challenge for Korean transportation sector. In South Korea, the public traditionally has had free and open access to the use of roads with the exception of motorways. Yet, even motorway tolling in South Korea has been allowed usually under strict conditions (e.g. within the recovery of infrastructure costs and the existence of free alternative roads). However, the

emergence of the EU's road pricing schemes based on 'polluter pays principle' has led the Korean government to re-examine their philosophy and perspectives on the use of roads. In turn, the Korean government has been debating to internally answer: should the use of roads be a public right or be, essentially, a target of tax burden?

This study will look at the emergence of new road pricing schemes in Europe by focusing on two real cases: the UK's congestion charging scheme (as the representative case of urban road pricing) and the German HGV toll system (as the representative case of inter-urban road pricing). Based on these case study outcomes, this study further examines pre-conditions and solutions for the successful introduction of new road pricing policies in Korea.

1.1. Road Pricing Policies in Europe

From a historical perspective, the use of road pricing, e.g. tolls, has not been a new concept in Europe. In England, the first Turnpike road was authorized in 1663 for a section of the Great North Road in Hertfordshire. The Turnpike Trusts, an organization responsible for maintenance and improvement of all turnpikes in England and Wales, was established in 1706--long before there was motorized transport. As well, similar types of toll roads had spread across Europe, in particular the Western Europe. Turnpikes, however, began to wane from the 1850s, when railways began to emerge as the new power of transportation by virtue of industrial development (Viegas, 2005).

Since then, road pricing had been submerged as a 'non-issue' until the early 1960s until a group of economists suggested it as a viable option for tackling worsening road congestion in urban areas (see Walters 1961; Vickrey 1963; Johnson 1964). The economists had claimed that excessive congestion was caused by unpriced roads system because, in this system, drivers pay only for their own congestion--not those of others (i.e. marginal cost pricing). Alternatively, these economists suggested the introduction of marginal social cost pricing which forces drivers to pay 'the direct cost borne by their own, but also the costs to the external environment and other drivers'. Despite its popularity in academia, however, their arguments fell on the deaf ears of policy makers who were particularly keen not to take political risks in elections (Richardson and Bae, 2008).

Eventually, the situation began to change from the early 1990s. In 1992, the Treaty on European Union was finally ratified and, thus, the European Union was formally inaugurated. After its establishment, the EU soon recognized a necessity of concerted efforts to solve worsening transportation problems among its member countries. The rapid increase of traffic in the past decades across Europe had created further increases in traffic congestion, vehicular accidents, extended commute/travel times, and further negative environmental impacts.

In 1993, the EU addressed the burgeoning transportation issue with the publication of Commission Paper 'The Future Development of the Common Transport Policy'. The paper highlighted the necessity and importance of policy transition for efficient, safe, and environment-friendly road transportation. To provide a practical guideline for this transition,

the European Union published another seminal report in 1995: the Commission Green Paper on 'Towards Fair and Efficient Pricing in Transport (now referred simply as 'The Green Paper)'. The Green Paper concluded that a significant mismatch between prices paid by individual users and the prices paid for a travel existed and, thus, suggested the development of a fairer and more efficient pricing scheme, that is, the adoption of marginal social cost pricing (EU 1995).

More specifically, the Green Paper advised policy makers to expand the scope of transportation costs by including external costs as well as internal costs. By this, it meant that the price of transport costs should reflect the direct costs that are borne by the person who engaged in the transport activity (e.g., driver's time, vehicle cost, fuel costs, etc.), but also the indirect costs that are borne by the whole society (e.g. accident costs, delay costs, noise disturbance costs to others).

The pricing classification of social costs had been further elaborated and specified in the 1998 Commission White Paper on 'Fair Payment for Infrastructure Use' (i.e. White Paper). While suggesting the detailed components of marginal social costs, it advised its member countries to change transportation pricing structure by reflecting both internal and external costs together at EU and national levels (CEC, 1995).

At the EU level, the emphasis on marginal social cost pricing was first materialized in the form of 'Directive 1999/62/EC', a legal framework for charging Heavy Goods Vehicles (HGVs) for road use traveling within its member countries. Since there was a general consensus that HGVs did not proportionately carry the burden to the costs incurred, the European Union assumed that they could at least be a reasonable example of a marginal social cost pricing. The 1999 Directive was revised in 2006 by addressing the key suggestions of the 2001 Commission Report entitled "European Transport Policy for 2010; Time to Decide[1]".

The 2006 Directive (2006/38/EC) reiterated the importance of the strict application of "user and polluter pays" within member countries. The Directive prescribed that all HGVs weighing over 3.5 tonnes were liable to pay for their contribution for infrastructure damage, levels of congestion, and accidents, thus assessing a fairer and efficient road charging system. It also specified that scientific calculation principles should be developed to measure the external costs incurred by HGVs.

At the individual national levels, this principle of marginal social cost pricing has been implemented in the form of a congestion charge or tax in some EU countries. In the UK, a congestion charge was introduced into Durham and London in 2002 and 2005, respectively, while a congestion tax was implemented in Stockholm, Sweden in 2007

[1] In this paper, the Commission proposes some 60 measures aimed at developing a European transport system capable of shifting the balance between modes of transport, revitalising the railways, promoting transport by sea and inland waterways and controlling the growth in air transport (http://ec.europa.eu/transport /strategies/2001_white_paper_ en.htm).

through referendum. Unlike the HGV charge, a congestion charge or tax targets all types of vehicles entering a specially designated city and time zone.

1.2. Case Analysis

Concerning the classification of road pricing, two types have been previously mentioned so far depending on the roads types they cover: 'urban road pricing' and 'inter-urban road pricing'. Although both of them have the common objective to reduce congestion by allocating traffic to other less congested alternatives and hours, urban-road pricing targets roads within urban areas whereas inter-urban road pricing centers on roads connecting cities or regions (Lundberg, 2003). This study deals with both cases. The London Congestion Charge Scheme (LCCS) is an analysis of urban road pricing while the KM charge for HGVs in German motorways explores inter-urban road pricing.

1.3. London Congestion Charge Scheme (LCCS)

Background

The history of road pricing debates in the UK can be dated back to 'the Smeed Report' of 1964 commissioned by the UK government, in which first considered the impacts of the introduction of road user charges in the UK cities to deal with the traffic-related problems such as congestion, accident and environment issues as well as recovering the construction and maintenance costs. Although this report failed to be implemented due to the lack of political support and public consensus, its key principles survived to affect the further debates over road pricing in the UK (Richards, 2008).

Road pricing was put back on the agenda in 1997 by the new Blair government. Its introduction was legally allowed by the establishment of the Transportation Act 2000. As the first Act defining the concept of Road User Charge in the UK history, it enabled various road pricing schemes by local governments and also described the procedures needed to implement a Road User Charge. Since then, a number of cities in England and Scotland have attempted to examine the feasibility of road pricing schemes. These cities include Durham, Greater Manchester, Cambridgeshire and Edinburgh (Richards, 2008).2

In addition, 'The Greater London Authority Act' (1999) should also be noted for its unique role of implementing the LCCS. The Greater London Authority Act was an Act of Parliament that established the Greater London Authority, the London Assembly and the Mayor of London, thus giving London a unique local government status and structure. This Act was important in that it allowed the mayor of London to levy congestion charges without the intervention of the central government3.

[2] Among them, only the city of Durham succeeded in introducing congestion charges in 2002 to be the first case in the UK.

[3] Concerning the introduction of the congestion charge scheme, the central government of the UK reserves the power to change or revoke the charging schemes approved by local governments (see Transportation Act 2000/168-3). This, however, does not apply to Greater London Authority due to the autonomous right allowed by the Greater London Authority Act (1999).

Although the LCCS is not the first case of a levied congestion charge in the UK, the significance of London, one of the largest cities in the world with serious traffic problems, could provide policy implications for other large metropolitan cities with similar congestion problems. As a result, a detailed analysis of the LCCS is needed.

1.4. Road to LCCS (1995-2003)

Before the LCCS was enacted, traffic conditions of the London Metropolitan Area were considered worse than any of the other capitals in Europe. The Greater London Area, with a population of 8.5 million and a population density of 4,761 per km2, an average traffic speed was no more than 15km per hour throughout the working day. One in seven Londoners in the central area used their own car everyday. At peak times, over 50,000 vehicles were flowing into central London every hour. In 2002, delay costs in London were estimated to be £6 million daily (Dix 2002).

In fact, working level considerations for an adoption of congestion charge in London had begun in 1995 when the Department of Transport published the 'Report of the London Congestion Charging Research Programme' commission.

It concluded that the introduction of a congestion charge in London would reduce congestion while yielding net revenues in a short time period. Similarly, but more concretely, in 1998, the Government Office for London formed an independent working group of experts and examined a range of practical options for a charging scheme in London (i.e. the Road Charging Options for London; ROCOL). Such diverse options as an area license, a paper license, and electronic road pricing were examined in the ROCOL, although these measures never materialized (Dix 2002, pp.2-3).

In May 2000, Ken Livingstone, who made election promises to introduce a congestion charging scheme, was elected as Mayor of London. Livingstone soon asked Transport for London (TfL) to form a taskforce team to investigate the options for implementing a congestion charging scheme in London while embarking on the process of public consultation. Nearly 400 key stakeholders including London MP's, business groups, transport operators, motoring organizations and disabled groups participated in this process.

In January 2001, the Mayor's first draft of the transport strategy had been published by the taskforce team which opened the door for hot debates between the public, stakeholders, and other interested parties. All throughout the consultation period, a number of opinion polls had been taken to monitor the views of Londoners4. Following this, in February 2002, Mayor Livingstone made public that the LCCS would be introduced in the Central London a year later in February of 2003.

[4] In most opinion polls, the majority of Londoners supported the Mayor's scheme. For instance, an opinion poll carried out during this period by Mori revealed that the 51% of respondents expressed support for the scheme, while 35% of them were against (Dix 2002).

1.5. Analysis of the Scheme

According to Transport for London (TfL), the LCCS has six primary objectives: (i) the contribution to sustainable economic progress, (ii) the enhancement of equality of access and mitigation of the barriers of transport system (iii) the contribution to enhanced health and well-being for Londoners (iv) the promotion of safety and security for the people using London transport (v) the contribution to the mitigation of climate change (vi) the protection of the London's socio-cultural environment and public realm. (Transport for London, 2010a, pp.2-3). Aside from these official explanations, the reduction of traffic congestion and encouraging the use of public transport were the most important objectives of the LCCS along with the reduction of Green House Gas (GHG) emissions (Ho and Maddison, 2008; Richards, 2008).

At the time of implementation (February 2003), the scheme covered the very heart of Central London (21 square kilometres). However, from February 2007, after extensive further investigation, the scheme extended into the westwards of the original central area. This extension, however, was nullified from December 24, 2010, by the new Mayor of London, Boris Johnson[5].

In terms of current operations, all vehicles entering the LCC zone from 07:00 to 18:30 on working weekdays are liable to a daily charge of £8 (£10 on the following day payment). Weekly, monthly, or annual payments are made possible. Payment charges guarantee drivers unlimited number of trips from, to, within, or between the charge zone. Channels of payment include post (mail), telephone, internet, SMS (short message service for mobiles/cell phones), self-service machines, retail outlets, and some petrol (gas) stations. Enforcement is being conducted by ANPR-linked cameras, which stores a photographic image of every single car within the zone and deletes them at the time of payment automatically. An £80 penalty is charged to unpaid vehicle owners, and persistent vehicle evaders will be clamped or removed by contracted-out bailiff companies (TfL, 2008).

Also, a range of discounts and exemptions are available for certain groups and certain vehicles. For instance, residents of the charging area can pay only one tenth of the regular charge, while vehicles using alternative fuels, electrically-propelled vehicles, London licensed taxis, buses and coaches with nine (9) or more seats receive 100 percent discounts (TfL, 2008).

1.6. Impacts of the Scheme

According to Transport for London (2008), the introduction of the LCCS made a meaningful impact on London's transportation. Firstly, a continued trend of declining traffic volumes had been observed during the period of 2002 to 2007. Secondly, the number of total vehicles showed a 14% decrease on average with a notable 34% decrease in cars and minicabs. This shows a stark comparison with a 16% increase of non-chargeable vehicles comprised of public transportation such as buses and coaches, licensed taxis,

[5] Boris Johnson (Conservative Party) claimed that, despite the positive impacts of the extension on environment, it has been creating negative impacts on the local economy and on people living in the zone (TfL, 2010b).

and pedal cycles. On average, there was an approximate 20% reduction in the number of vehicles since the implementation of the LCCS (see Table 1).

Table 1. Changes in the Number of Vehicles (2002-2007)

	2003 vs 2002	2004 vs 2003	2005 vs 2004	2006 vs 2005	2007 vs 2006	2007 vs 2002	Remark
All Vehicles	**-14%**	**0%**	**-2%**	**0%**	**0%**	**-16%**	
4 or More Wheels	**-18%**	**-1%**	**-2%**	**-1%**	**0%**	**-21%**	
Chargeable	**-27%**	**-1%**	**-3%**	**0%**	**1%**	**-29%**	
Cars & Minicabs	-33%	-1%	-3%	-1%	0%	-36%	
Vans	-11%	-1%	-4%	2%	1%	-13%	
Lorries and Other	-10%	-5%	-4%	6%	9%	-5%	
Non-chargeable	**17%**	**1%**	**-1%**	**-1%**	**-1%**	**15%**	
Licensed Taxis	17%	-1%	1%	-3%	-5%	7%	
Buses & Coaches	23%	8%	-4%	-3%	5%	31%	
Powered 2 Wheels	13%	-2%	-9%	0%	-3%	-3%	
Pedal Cycles	20%	8%	7%	7%	12%	66%	

(Source: Transport for London, 2008, p.41)

It was believed the reduction of traffic was much supported by the change of traffic behaviour by car drivers. Instead of sticking their old driving patterns, drivers (i) shifted to the less important modes (bus, metro, carpools, motorcycles, and walking), or (ii) avoided the charging hours, or (iii) reduced trips (Richardson and Bae, 2008).

In addition to the decrease of traffic, the service quality of public transportation was notably improved. In spite of adding hundreds of buses to the city, the number of passengers on each bus increased eighteen percent (18%), while waiting time was actually decreased by thirty percent (30%). Disruptions of bus travel showed a sixty percent (60%) fall after the introduction of the LCCS (Ho and Maddison, 2008).

This reduction of traffic has been hailed by the public. According to the Impact Monitoring 2008 (TfL, 2008) Londoners answered that they were generally satisfied with introduction of the LCCS with the approval rating of 79% in 2006 and 82% in 2007. The satisfaction level for the payment process also remained high at a level of around 85% during the same period.

From 2004 to 2008, a total of £881 million had been collected and net revenues after operational costs and administration costs amounted to £479 million. Most of the net revenue had been reinvested into such areas as bus network operations (82%), roads & bridges (9%) and road safety improvement (5%) (see Table 2).

Table 2. Revenues Analysis of LCC Scheme

(Unit: £ million)

Financial year	Total	2007/08	2006/07	2005/06	2004/05
Scheme Revenues					
Revenues	881	268	213	210	190
OC* & AC**	402	131	90	88	93
Net Revenues	479	137	123	122	97
Use of Revenues					
Bus Network	391	112	101	100	78
Roads & Bridges	41	13	14	14	-
Road Safety	24	4	5	4	11
Walking & Cycling	17	4	3	4	6
Others	6	4			2
Total	479	137	123	122	97
*OC: Operation Costs **AC: Administration Costs					

(Source: author, adapted from TfL Impacts Monitoring, 2005 – 2008)

1.7. Evaluation of the Scheme

Although debates for road pricing in the UK have had a relatively long history (as shown by the publication of the Smeed Report in 1964 and the ROCOL in 1998), practical policies had yet to be formulated until 2000 and 2003 when congestion charge schemes were implemented in Durham and London respectively. Among these, London's case has been attracting special attention as it is considered to be the first attempt made by a large metropolitan to solve such complicated transportation issues as traffic congestion and GHG emission.

Judging from the outcome examined above, it appears that the LCCS has been positively embraced by the majority of the public. After the introduction of the LCCS, traffic volume of London has decreased twenty percent (20%), has generated more than 100 million pound of net revenues annually, and the number of public transport users had significantly increased with their satisfaction levels recorded at nearly ninety percent (90%). In short, the LCCS as an effective method of urban road pricing can be considered a success in that it has benefitted society and has satisfied the general public.

Despite these advantages, however, the LCCS has attracted some criticism. Researchers claim that the pricing charge level is relatively low and insufficient to internalize related external costs incurred in London (see Santos and Fraser, 2006). As well, declining revenues of some central London businesses have been also noted as another negative aspect of the LCCS (Richardson and Bae, 2008).

1.8. The German HGV Tolls

Background

Encouraged by the EU policy shift to sustainable transportation in the 1990s, the German government formed a special body to review its own transport policy and also to draw policy implications (i.e. 'the Commission on Transport Infrastructure Financing). In 2000,

the Commission published a final report in which it recommended the German government to replace the existing tax- based principle with 'user pays' principle. Following this, the government abolished time-based Eurovignette system[6] and decided to adopt new distance-based motorway toll system in 2001.

Furthermore, in September, 2002, the German government selected the ETC consortium comprised of Chrysler, German Telekom, and Cofiroute as the operator of the scheme whose responsibilities were to cover toll collection and general operations notably excluding enforcement. The consortium embarked on examining the technical feasibility of HGVs tolls in German motorways (Doll and Link, 2007; Nash et al. 2008).

At the same time, through a series of the consultations with the public and the parliament, the Motorway Toll Act finally became effective as of January 2005. According to the Act, the prime goals for the introduction of new motorway tolls are as follows: (1) to generate additional funds for financing the federal transportation infrastructure (2) to counter climate change by shifting freight transportation into more environment-friendly transport modes (e.g. rail and inland waterways), and (3) to improve the competitiveness of the German logistic industry. For this, the law prescribed the earmarking of revenue to the federal transport networks (Kossak, 2003; Doll and Link, 2007).

In regards to the use of revenue generated by the HGV scheme, the Act made it clear that revenue would be reinvested into the maintenance and upgrading of transport structure (i.e. the reduction or elimination of bottlenecks on rail, and inland waterway networks, as well as the other types of road investment such as lane expansions). The revenue to be reinvested excluded operation costs such as the expenditure for the operating company and the costs for supervision and enforcement of the scheme.

From the outset, the tolls were designed to be applied to both domestic and foreign vehicles alike, mainly in order to lead to fair and non-discriminatory competition for the road-haulage industry. It was estimated that approximately one third (1/3) of the HGVs mileage on German motorways were done by foreign vehicles, which were causing a detrimental impact to German hauliers (Rothengatter 2002).

The public seems to have positively accepted the introduction of HGV tolls based on the following rationale. Firstly, tolls were applicable only to HGVs and, thus, rarely affected common vehicle users comprising of more than half of motorway users. Secondly, since the HGVs were responsible for much of the cost of construction, maintenance, and operation of the motorways, the public believed that it was natural and fair for hauliers to make a their proportional contribution towards infrastructure costs. Thirdly, the German public seemed to have recognized the environmental benefits of the system (e.g. investment in anti-congestion scheme). Lastly, the German haulage industry supported the introduction of HGVs tolls in the belief that the compensation measures proclaimed by the federal government would give a competitive advantage to local haulage industries (Kossak, 2003; Doll and Link, 2007; Nash et al., 2008).

[6] Before the introduction of HGV tolls system, Germany had adopted Eurovignette system (a road toll for trucks) since 1995 along with other neighboring European countries: Belgium, Denmark, Luxembourg, Netherlands, and Sweden. Since the German government decided to introduce HGVs tolling system, the Eurovignette system was abolished in Germany in 2003.

1.9. Analysis of the Scheme

The initial toll set in January 2005 was fixed at an average rate of 12.4 cents/km, although the government originally calculated that 15 cents/km might be fair. To address environmental impacts, the toll rates were differentiated not only by km travelled but also by vehicle axles and emission categories. Current rate has been re-adjusted in January 2011 (see Table 3)[7].

Table 3. Category Classification by EURO Emission Limits[8]

Category	A	B	C	D
Euro Class	S5, EEV Class 1	S4, S3 with PMK 2-4	S3 w/o PMK S2 with PMK 1-4	S2 w/o PMK S1 and Vehicles Not Assigned to an Emission Class

(Toll Rates per Kilometer)

Category	Axles	From 1 Jan 2009	From 1 Jan 2011
A	Up to 3	0.141 €	0.140 €
	4 or more	0.155 €	0.154 €
B	Up to 3	0.169 €	0.168 €
	4 or more	0.183 €	0.182 €
C	Up to 3	0.190 €	0.210 €
	4 or more	0.204 €	0.224 €
D	Up to 3	0.274 €	0.273 €
	4 or more	0.288 €	0.287 €

(Source: GFMTBH, 2010, www.bmvbw.de)

The enforcement of the system was the responsibility of the Federal Office for Goods Transport (BAG) of the German government. Under the motto “No mercy for toll dodgers”, the BAG employed several enforcement methods: automated system on the autobahn with 300 gantries with DSRC and cameras, a mobile fleet of 300 vehicles with DSRC, and roadside stationary checks. In 2005 and 2006, the compliance rate amounted to 97% and 99% respectively (Kossak, 2007; Broaddus and Gertz, 2008).

As the accuracy of the toll system was stabilized, the availability of the automatic tolling system exceeded the required level of 99% in 2006 by recording 99.76%, a rapid improvement from the 72% rate at the beginning of the system in January 2005. Notably, the proportion of domestic and foreign vehicles equipped with OBU (On-Board Units) was 69% and 38% respectively in 2008.

One of the key achievements of the German HGV tolling may be the use of the automatic tolling system using a GPS (Global Positioning System) combined with OBU (on-board-unit). When a lorry/truck enters the autobahn, its location is detected via the mobile

[7] The calculation of initial toll rate was based on the guidance of the Directive 1999/62/EC, in which related toll rate calculation to ‘actual infrastructure costs’ covering ‘the costs of constructing, operating, and developing the infrastructure network concerned’. This means that the calculation of 15 cents/km did not reflect the social costs and thus a room for rate increase was made by the introduction of new Directive 2006 (2006/38/EC).

[8] For further information about EURO Emission Class, see Directive 2006/38/EC/ANNEX.

communication (GSM) between OBU and GPS system. As a result, the OBU begins to calculate the toll to be paid in accordance with the pre-declared number of axles and the emission class concerns. The data is then transmitted to prepare accurate billing. This automatic tolling system contributes to the savings of maintenance costs of the system[9].

1.10. Evaluations

As discussed, the aims of introducing HGVs tolling in Germany are two-fold: a) To generate revenue to build transportation infrastructure and b) To positively contribute to global climate change by reducing lorry traffic in motorways and thus facilitating modal shift to more environment-friendly transport modes (e.g. railway or waterways).

Judging from the outcomes revealed so far, the HGVs toll scheme seems to have produced positive results. First of all, it was reported that substantial additional revenue was generated for the federal government through HGVs charges. For the first year of introduction (2005), the gross toll revenues amounted to €2.86 billion and were increased to €3.08 billion in 2006. Revenues from 2006 were distributed as follows: 50% for road building and maintenance, 38% for upgrading the federal railway network, and 12% for inland waterways (Kossak, 2007).

With regards to achieving the second aim, it was reported that the introduction of the scheme contributed to the reduction of Green House Gas (GHG) significantly by affecting traffic patterns. Interestingly, the share of HGVs within the pollutant category S5 and EEV had risen remarkably from 1% in 2005 to 40% in 2008, while the proportionate mileage of HGVs in the categories S0, S1, and S2 had dropped from around 48% to less than 8% over the same period. In addition, a 13% decrease in the share of empty running large trucks on the autobahns had been observed in 2006. Concerning the modal shift, however, meaningful change has not been observed (Doll and Link, 2007; Broaddus and Gertz, 2008; Toll Collect, 2008).

In summary, the km-based charge for trucks on the German motorways seems to have worked well. Its scheme structure is seen to be rational and fair, while the enforcement system is productive with considerable revenue. The operation and application of technologies are also seen to be customer-friendly with few system errors.
Nevertheless, it should be noted that the German HGVs tolling scheme is not free from the debate of ‘double partiality’; that is, ‘tolls only on some roads and only for some vehicles’. The grounds for tolling only HGVs may be fragile in that in most countries, the contribution of private cars for congestion and pollutant emissions is as great as that of trucks. Also, the application of the scheme only in motorways could bring few returns for trucks that can divert their travel onto other roads and create little difference in terms of GHG emissions.

2. IMPLICATIONS FOR KOREA

The road pricing policies of the UK and Germany as examined is significant in that they

[9] This automatic tolling system is used for frequent users. Occasional users can use manual system in which trips are reserved and payment is made before travel through internet, point of sale, or a call center (Nash et al., 2005, p.10).

represent the first organized and coordinated attempts for practicing the concept of road pricing in real context. It is generally viewed that the London's congestion charge scheme contributed to the reduction of congestion by and large, while Germany's Km-based charge for HGVs succeeded in generating revenues for infrastructure improvement as well as reducing green house gas emissions. Based on the examination of these two European systems, the following will look at key implications for road pricing in Korea.

2.1 Awareness of Global Warming and Emergence of Road Pricing

The road system of Korea is comprised of seven different layers in a hierarchical order: Motorways (national expressways), National highways, (special) Metropolitan roads, Provincial roads, city roads, County roads, and District roads. Among them, only motorways and national highways (16%) are maintained by the central government, while the rest (84%) by their local government authorities (see Table 4).

Table 4. Korean Yearly Road Statistics Based on Road Types Areas

(km, 2007)	Motorways	Nat'l Highways	Metropolitan Roads	Provincial Roads	Others
Length	3,368	13,832	18,109	18,174	49,536
Ratio	3%	13%	18%	18%	48%

(Source: MLTM, 2008, Yearly Road Statistics)

In general, road pricing has not been a familiar concept in Korean society until recently. Roads have been construed as the public property and, thus, should be constructed and maintained at the expense of Korean government. The Korean Constitution (Article 123) proclaims that fostering balanced developments among the regions of Korea belongs to the duty of Korean government and also declares achieving efficient and balanced utilization, development, and preservation of the land of the nation is the key responsibility of the government (Article 122). Hence, it may be no wonder to know that the use of roads in Korea is provided for free in principle and open to all. The only exception to this is motorways[10]. However, even motorways fall under strict conditions that should be met in order to be admitted as tolled roads. For example, the existence of alternative free highway or local road is legally required.

This social consensus, however, has begun to change. With the emergence of global warming and other environmental concerns, road pricing is becoming a hotly debated subject in the Korean transportation sector. The current government which took office in February 2008 established a presidential committee on low-carbon society in August 2008 and presented an ambitious target for reduction of national greenhouse gas emissions of 27% to 30%. It also founded the 'Global Green Growth Institute (GGI)' in June 2010 which aims to support economic development combined with environmental sustainability. A series of legislative actions have also followed. In June 2009, the 'Urban Traffic Improvement Promotion Act' was passed in Assembly, in which a legal definition of 'congestion' and 'congestion charge' were first given and formally opened the way to levy congestion charges by road authorities in urban areas. In May 2010, the 'Framework Act

[10] The reason to this notable exception is not revealed clearly so far. Some researchers claim that the construction of the first motorways in Korea during the early 1970s was financed mainly by foreign debt and government bond, which made the then government difficult to accept free motorways.

on Low Carbon Green Growth' was published[11]. It prescribed the overall responsibility of the government to curb greenhouse gas emission with specific goals [12] (http://www.greengrowth.go.kr/english/en_about/en_ introduction/ introduction.cms).

Nevertheless, it may be fair to say that these initial efforts led by government do not guarantee the easy acceptance and quick spread of road pricing schemes in Korean society. For road pricing schemes to be successfully introduced and settled, it seems that there are some pre-conditions to be met beforehand. The following will discuss these pre-conditions and tries to suggest possible solutions.

2.2 Pre-conditions and Possible Solutions

Firstly, two different streams of road pricing have been observed: urban road pricing and inter-urban road pricing. Urban road pricing focuses on the reduction of traffic inflow into a city center mainly in order to reduce traffic volume and GHG. Inter-urban road pricing tries more to generate revenue to cover road construction and maintenance costs. At the time of writing this paper, no debates or agreements have been made regarding the selection of specific road pricing schemes. In that context, setting up clear goals for the introduction of road pricing and selecting proper schemes with a careful selection of points or areas of road pricing may be a starting point for Korean society to complete in the future.

Secondly, road-related laws should be re-examined as to see if there are any possible conflicts by the introduction of road pricing schemes. If necessary, further legal revisions should be made to secure road pricing schemes. For instance, with regards to the operation of Korean expressways (the only tolled road), three different laws are being enforced: the 'Motorway Act', the 'Toll Road Act', and the 'Korean Expressway Corporation (KEC) Act'. Nevertheless, all these acts do not assume the same situations of introducing congestion charges or Km-based tolls related to GHG. Hence, it is required to reconsider the related articles of these Acts and, if necessary, to find or create legal grounds for road pricing.

Thirdly, the scope of external costs should be agreed in advance. As shown in the 2006 EU Directive (2006/38/EC), road pricing can be understood as the function of internalizing all types of external traffic-related costs which, in theory, include traffic congestion, GHG-related costs, noise pollution, and traffic-related accidents. Since each society has developed idiosyncratic formal and informal institutions through their history, the scope of tolerance for the inclusion of external costs can be vastly different depending on each society's context. For example, the congestion charge scheme of London mainly focuses on the internalization of GHG-related costs and congestion costs, while the German Km-based HGVs charge mainly considers emission influences. In that sense, public opinion should be routinely polled or surveyed when introducing road pricing in Korea.
Lastly and most importantly, it will be worthwhile to note how to increase public acceptance level for road pricing. Although Korean motorways have been operated as toll roads from the beginning (since 1969), the Korean people, industries, and mass media have expressed negative attitudes to toll collection on motorways. Immersed in the

[11] According to Korean government, 'Low Carbon Green Growth' refers to the activities of promoting economic growth and development while also reducing carbon emissions, increasing sustainability, and strengthening climate resilience (http://www.gggi.org/About/About_01.php).
[12] Since road sector is responsible for nearly a third of total green house emission of Korea, this attention may not be surprising.

rationale of seeing roads as public property, they claim that tolling roads should be understood as an exceptional measure, and further expansion might be against legal and social spirit. In that context, if the Korean government tries to introduce road pricing without enough consultation with the public, it will cause public anger and resentment. Thus, before discussing the introduction of road pricing in Korea, it may be mandatory to inform and influence the general public to understand the concept, necessity, and benefits of road pricing.

CONCLUSION

This study has reviewed the road pricing policies of Europe by looking at the UK's congestion charge scheme and Germany's Km-charge for HGVs. Considering the increasing attention towards global warming and the calls for international cooperation, road pricing policies seem to be a central issue for debates in the forthcoming decades in the area of transportation.

As seen above, the Korean government has recognized its significance and has embarked upon its own energetic legislative programs as proved by the legislation of 'Urban Traffic Improvement Promotion Act' (June 2009) and 'Framework Act on Low Carbon Green Growth (May, 2010).

Nevertheless, it may need a long time for road pricing policies to be settled in Korea. Many barriers should be resolved for the successful introduction of road pricing policies in Korea. These barriers can be resolved by a) setting clear goals that are coherent between road-related laws, b) decision-making on these topics and how to increase public acceptance levels and c) the examination of the scope of external costs. To achieve this, further collaborative research may be required in diverse disciplines which include legal, managerial, economic, and transportation policy studies.

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