Road pricing and congestion in the Netherlands

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Introduction

For years, the Netherlands have discussed road pricing; about both the systems and the prices. Besseling (2004) already researched prices, but did not sufficiently discuss the costs of congestion. This thesis will focus on the systems and the costs of congestion.

This thesis starts with a chapter about road pricing systems to give a small insight on the technical side. After that, three forms of road pricing are briefly discussed as introduction to the theme. Then, traffic models are discussed and those will be used to create a damage formula for congestion. With this damage function, a congestion toll is calculated. The chapter after that explains with an example that changes of road capacity, like in junction, can create damage as well. The last chapter discusses national versus regional implementation and the social basis for road pricing in the Netherlands.

I am grateful to Bauke Visser, my supervisor for this paper, for the helpful comments, to Karsten van Breugel for the fieldwork and to Wim van de Kulk of the KLPD.

Road Pricing Systems

Available systems

Wiggins (1994) discusses three possibilities for road pricing technologies. The described methods require a transponder and a communicator. The transponder, the part in the car, can be the size of a matchbox. The communicator can be above, beside or below the road.
The first method is called Automatic Vehicle Identification. This method uses the chip in the car to identify the vehicle and charges the owner later for the use of the road. The method is already being used on several British toll roads.
The second method is the Automatic Debiting System. Before a user uses the road, he has to purchase credit for his transponder. When the car passes the communicator, the transponder automatically deducts the amount of money owed for driving on that road. The money is put on the card via an assigned method, most probable gas stations, garages etc.
The third system is a Hybrid system. The user can choose between the two systems mentioned before. This requires a more expensive chip in the transponder.
Another possibility is licence plate recognition[1]. A communicator/camera records the vehicles passing and charges the owner later for the use of the road. Essentially, it works the same as the Automatic Vehicle Identification. This method is currently being used for track overspeed controls in the Netherlands.

System Requirements

The Ministry of Transport (1964) made a list of requirements for a road pricing system. I will list up the most important requirements:

1. The charges should be closely related to the amount of use made of the road.
2. The charges should be able to vary for different roads or areas, at different times, and different classes of vehicles
3. The charges should be stable, a road user should be able to calculate the price of his journey beforehand
4. The charging method should be easy for road users to understand
5. The equipment used for charging should be reliable and free from fraud and evasion
6. The method should also be applicable for foreign road users
7. The attention of the driver should not be diverted from the road by the system
8. The enforcement should be little extra work for the police

Comparison of the systems with the demands

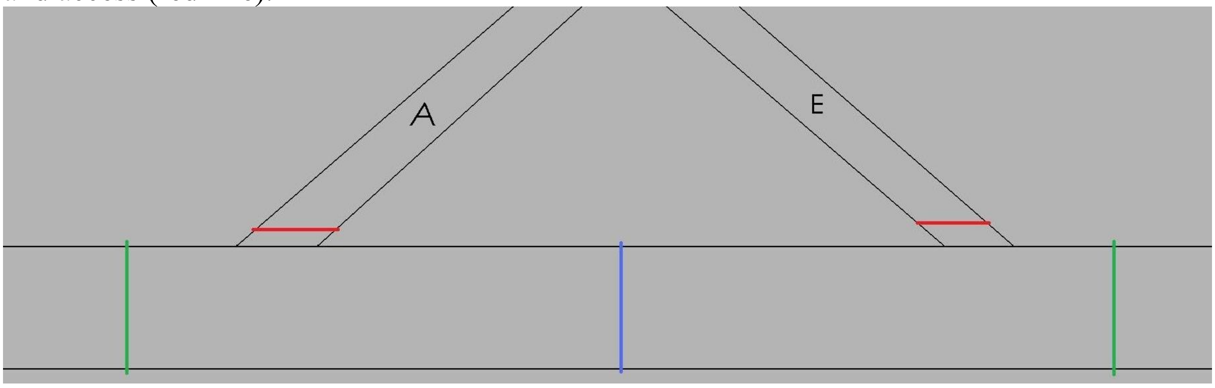
With regard to the first three requirements, no objection rise. The systems are designed for charges related to road use, charges can vary when so set in the communicator and with the internet, charges can always be requested for on a web page. The systems are not hard to understand, but should be explained to the public.
Fraud could pose a problem with the Automatic Debiting System and the Hybrid system. Fraudulent persons could try to forge a loading station or card. Evasion might be even more problematic, unless a method is used to identify chipless vehicles. Foreign road users are able to use the system, the transponders do not have to be installed, just have to be in the vehicle. Though the billing could pose a problem, since some foreign users are hard to identify[2]. For foreigners, the Automatic Debiting System would be ideal, since this is a prepaid system.

[1] This system is not mentioned in the paper by Wiggins and only briefly in the book by the *Ministry of Transport*
[2] With the current European system, it is possible to recognize license plates from other European countries and bill them, though some countries do not yet work with that system.

None of the systems require the immediate attention of the driver, though the Hybrid system can be switched on different charging modes. This will not pose major problems, since most drivers decide what system to use before they start driving.

Charging methods

Charging can be done in two ways, with an open and a closed system. An open system is basically one communicator on a single stretch of road. In practice, this means that the communicator must be located either between the exit and the access (blue line) or between the access and the next exit (green line). A closed system is one communicator on the start of the road and another one at the end. This would mean placing communicators at every exit and access (red line).



Discussion

License plate recognition is an ideal form of identifying vehicles. If the Dutch borders were closed, this would be the ideal system for road pricing. But because foreign vehicles often cannot be identified or billed, it is far from perfect. The Automatic Vehicle Identification can be employed just like the licence plate recognition for the Dutch vehicles. The system can be installed to employ the Automatic Debiting System for the foreign vehicles simultaneously. The government should make clear to foreigners travelling to the Netherlands that a tag is obligatory and should make tags widely obtainable both in the Netherlands and abroad. To reduce the possibilities of fraud, Dutch cars should not be allowed to drive with the prepaid chip. A dual system of two different vehicle identification tags could be possible, this could be especially helpful for business drivers, but this is not a priority. The most important issue is the detection of drivers evading toll. Special devices should be produced to identify tagless vehicles.

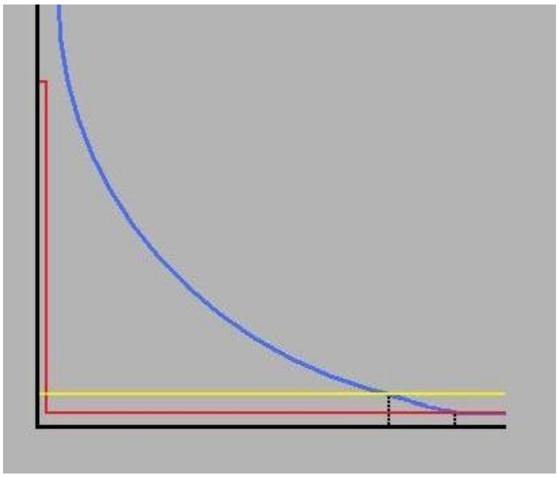
An open charging system would be the best system to have. With a broken communicator, this system does not harm the consumer; a closed system could charge a consumer for an indefinite amount of kilometres. But the open system might be very expensive, since this requires many communications. One option could be a closed system with a checkpoint every several exits.

Road pricing forms

Road pricing can have three forms. The first and most simple form only covers the material costs of the road, like maintenance. The second form covers both the material costs and the costs of time loss. The third form covers material costs, cost of time loss and externalities of emission, sound and safety. The externalities of emission, sound and safety have already been discussed elaborately in the "Economische toets op de Nota Mobiliteit" of Besseling in 2004. Therefore, I will not discuss this further on.

The current form used in the Netherlands is also a form that covers the material costs, but this form charges a fixed amount for the ownership of a vehicle[3]. There is also a small part of the costs covered by petrol tax, but this tax has other goals as well[4]. By charging an amount per kilometer, the road user will drive less kilometers. The graph below will clarify this.

The y-axis registers monetary value, the x-axis the number of kilometers. The blue line indicates the value of kilometers, from high value to low value. The red line shows the current form and the yellow one shows the form that covers material costs in a variable way. Every extra kilometer driven is worth less than the one before, but the first few kilometers are very valuable. The red line starts high, because with the first kilometer driven, the ownership tax has to be paid. The remaining costs are the fuel taxes. As seen in the graph, the number of driven kilometers is reduced.



The second form incorporates the costs made driver towards other drivers. Because every extra driver slows down traffic, they burden other drivers. To correct this externality, a Pigouvian tax can be implemented[5].

The graph below shows monetary value on the y-axis, kilometers driven on the x-axis, the marginal value of an extra kilometer, represented by the blue line and the material and fuel costs depicted by the yellow line. The red line represents the marginal social cost, the externalities of the kilometers driven by the consumer, incurred by other drivers, plus the value depicted by the yellow line. When no additional tax is levied, next to the tax that covers material costs, the driver will choose point + for number of kilometers to drive. This gives him a value of areas 1, 2 and 3[6], but the driver damages society for 2, 3 and 4. When the driver drives only * kilometers, value to him is 1 and 2, and societal damage is only 2. To

[3] In Dutch, motorrijtuigenbelasting

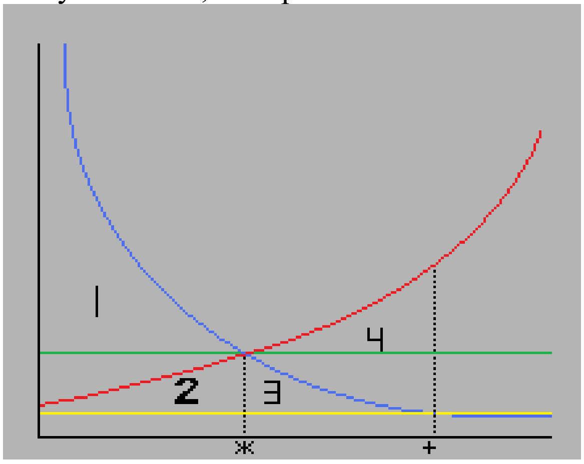
[4] The petrol tax is divided into gasoline tax (€0.71 p/l), diesel (€0.42 p/l) and LPG (€0.07 p/l). Diesel tax is lower because it is mainly used by business vehicles, mostly trucks. To support the industry, this tax is lower. Diesel in normal cars has a lower mileage, so this creates an environmental reason. LPG, liquid petroleum gas, has a poor mileage, but is it by far the cleanest fuel available.

Beleidsinformatie 2009 A. belastingtarieven *ministerie van financiën* 2008

[5] Public Finance *H. S. Rosen T. Gayer* 2008

[6] Areas 1 and 4 are not split by the green line; areas are marked by the red, blue and black lines.

make the driver drive only * kilometers, a Pigouvian tax is levied of value between the green and yellow line, as depicted below.



Traffic models
To determine the congestion tax, a model is needed to analyze traffic. Gerlough (1975) discusses three main traffic analysis models. Many other models are based on these models. Greenshields developed an easy to use linear model. Several investigators have found a good correlation between this model and field data. Greenberg made a logarithmic model, especially designed for congested flows, but this model deteriorates for less congested flows. Underwood created a model for low concentrations, but this model did not give satisfactory results for high concentrations. Because I intend to use both congested and less congested flows, I will stick to the Greenshield model.
Greenshields model is the following:

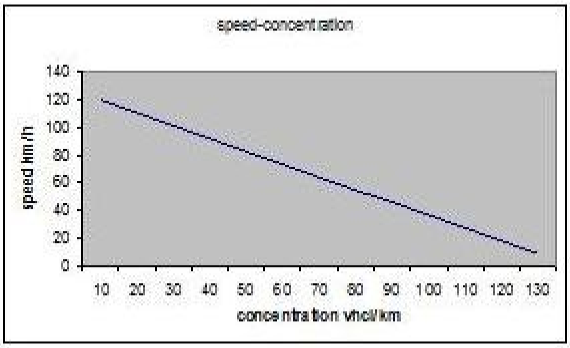
(1) $s=sf*(1-k/kj)$

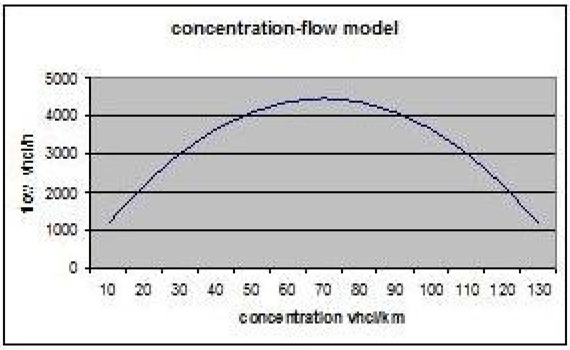
(2) $q=k*s$

In words, speed (s) equals free flow speed (sf) times one minus concentration (k) divided by the jam concentration (kj). The formula basically says that the speed goes down when the concentration rises. The second one is a general formula; flow (q) equals concentration times speed. Speed is measured in kilometers per hour, concentration in vehicles per kilometer and flow in vehicles per hour. Free flow speed is recorded when concentrations are very low and jam concentration is measured when traffic is at a full stop.
The free flow speed and the jam concentration are not mentioned in books or papers, so I have measured these. For the free flow speed, I have stationed myself along the A4 near Halsteren. The measurement was for half an hour and recorded 126 [7] cars. The average speed was 128 km/h. This is 6,6% above the speed limit of 120 km/h. The jam concentration was measured along the A29 near the Haringvlietbrug. When this bridge opens, the traffic is brought to a halt for about ten minutes. A total of 21 parts of a hundred meters was measured; the concentration was 14 vehicles per 100 meters, so 140 vhcl/km for one lane. In this number, trucks count as two vehicles; they have been found to be twice as long as other vehicles. When the data above is substituted into formula (1):

(3) $s=128*(1-k/140)$

The graphs below show the relation between speed and concentration, and between concentration and flow.





[7] Trucks and caravans have been excluded from measurement, 13 in total.

Pricing model

When deciding what tax to levy, one must find out what the damage to society is. Very few good models can be found to estimate the damage, so I have created the following formula:

(4) $D=Vt*(1/s-1/ss)*k$

The D is for damage and Vt is the valuation of time. ss is the standard speed in kilometers per hour. This is the speed where externalities arise. One divided by a speed is the time it takes to travel one kilometer. The middle part is the loss in time.

Besseling (2004) has investigated what the value of time is for different road users. They have found the following:

Motive	Valuation of 1 hour	Frequency	Adj. frequency[8]
Lorry traffic	€19.70	13%	23%
Commuter traffic	€8.00	28%	24.8%
Business traffic	€27.00	20%	17.7%
Other traffic	€5.50	39%	34.5%

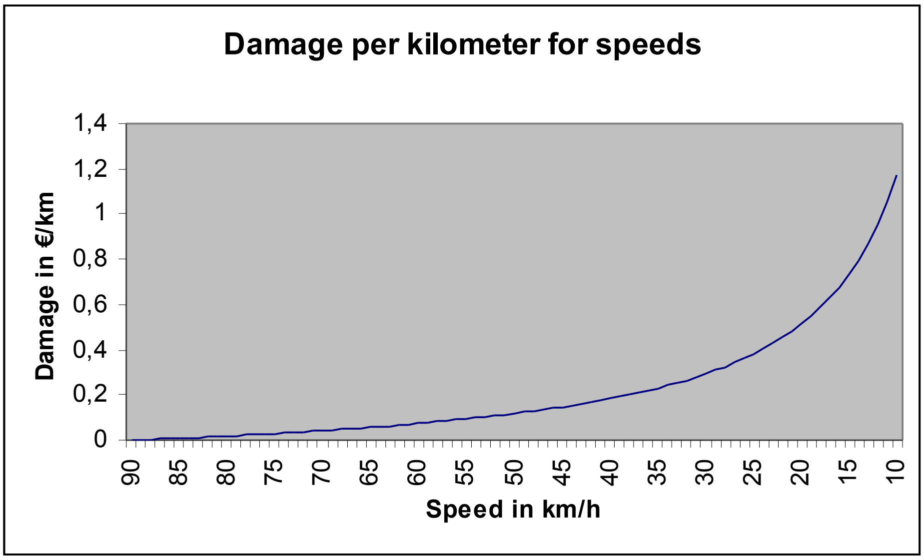
The frequencies have to be adjusted, because trucks count as two vehicles in concentration figures in this paper, as mentioned above. Therefore is the valuation of the truckers time halved. The weighted average of the valuation is:

$$0.23*€19.70+0.248*€8.00+0.177*€27.00+0.345*€5.50=€13.19$$

The standard speed is set arbitrarily. I fix the speed at 90 km/h. This is because then all users receive damage from slower traffic. When formula (4) and (1) fuse, the other variables filled in, and divided by the users, the following arises:

(5) $D=13.19*\{(1/128[1-k/140])-1/90)\}$

The results are visible in the graph below. The lowest speed recorded in this graph is 10 km/h at a price of €1.17. This damage function displays the value of the externalities mentioned on page five and six. When this damage is incorporated in the Pigouvian tax, people can be discouraged to take the very busy roads.



[8] Adjusted frequency is frequency divided by 113, except with lorries, their adjusted frequency is 26 divided by 113

Junctions

Queues usually start around junctions. In this chapter, I will give an example of one of the Netherlands main junctions, Kleinpolderplein, near Rotterdam. This is the junction of the A20 with the A13. Coming from the A13, a choice is presented between going into Rotterdam, and going onto the A20, either west or eastbound. Most traffic chooses the last option. The turn westbound is a one lane wide light bend, the turn eastbound a two lane wide bend. These turns can each serve approximately 75 cars a minute[9]. I assume approximately 20 cars a minute enter Rotterdam[10]. During off-peak hours, the junction can handle the traffic stream. But at rush hour, the A13 reaches its maximum capacity. The A13 is a three lane highway with permanent tracking overspeed control set at 80 km/h. The maximum traffic flow is 4200 vehicles per hour per lane[11], 210 per minute in total for three lanes. I assume the rush hour is 60 minutes, and after the rush hour, the traffic flow reduces by 30 cars a minute[12].

Gerlough (1981) discussed the following model for duration of the queue and the delay caused:

(6) $t=r*(qm-f)/(f-qn)$

(7) $T=[r*(qm-f)*(r+t)]/2$

Clarifying, t is the duration of the queue after the rush hour has ended, r is the number of minutes rush hour, qm is the arrival of traffic during rush hour, f is the maximum flow the junction can handle, qn is the arrival of traffic during off-peak hours and T is the total delay caused by the queue in minutes. This gives:

$t=60*(210-195)/(195-180)=60$

$T=[60*(210-195)*(60+60)]/2=54000$

According to the model, the queue on the A13 should last an hour after rush hour, and costs 900 hours. Multiplying this by the costs calculated before brings the costs of one queue to €11871,00.

The numbers used in this example may prove to be slightly too bright, figures for serving traffic in the bends might be a little high, rush hour might well be longer, and the reduction of traffic flow might prove to be high.

This example shows that not every traffic jam is caused solely by traffic, but also by poorly designed junction.

[9] Estimation, based on observation

[10] Based on Inweva report 2006. 10 % of the vehicles on the A13 entered Rotterdam

[11] Maximum concentration per lane at 80 km/h is: (3) 80=128*(1-k/140) gives k=52.5, flow based on these figures is: (2) 52.5*80=4200

[12] Estimation

Implementation issues

Congestion problems arise mainly in the “Randstad[13]”and near the axis Eindhoven-Arnhem.[14]

[15]

This poses the question whether to implement road pricing only in those areas or also in the rest of the country. The installation of the communicators might prove to be quite costly, while revenue in the less congested provinces can be disappointing. Only installing communicators in the congested areas may boost economic activities on other places. This can create a reduction in transport activities in the busier parts of the country. However, this will encounter fierce opposition from industries native to the congested areas and will see this as unfair competition. Furthermore, when the first excluded provinces become more congested, these will also have to pay for road use. The problem then arises whether the industries settled in those areas will move away again. Next is the problem when to call an area congested. This might cause heavy lobbyism to mark roads as non-congested. Last is a fairness problem. How should people from non-congested areas pay for their road use? Not paying is not an option, because they still use the road, and thus cause maintenance costs. And for people living in non-congested areas working in or regularly driving through congested areas it is not fair to levy also a fixed amount as road tax. In my opinion, it is best to implement the road pricing system across the land and levy only a small maintenance fee in the less congested areas[16].

The social basis for road pricing is very low. Verhoef (1997) found that only 25 % of the road users supported road pricing. But many areas currently working with road pricing, including London, first did non support the idea of road pricing. Goodwin (1989) and Jones (1991) found that public support increases when the government spends the revenue well. Goodwin introduces the “rule of three”. This says that the revenues should be used to build and maintain roads, to improve public transport, and to cut vehicle related taxes. Verhoef found support for Goodwins rule among the Dutch population.

[13] The area around Rotterdam, Den Haag, Amsterdam and Utrecht

[14] Source: Ministerie van Verkeer en Waterstaat, Adviesdienst Geo-informatie en ICT

[15] Legenda is in Dutch, it indicates the travel time in congested periods.

[16] This maintenance fee varies from €0.002 for cars to €0.04 for lorries per kilometer (Besseling 2004)

Conclusion

In the fall 2009, the "Raad van State[17]" will pronounce a sentence in the road pricing case in the Netherlands on the maximum toll. This verdict will provide the maximum price for the road. It also provides a new question, what effect will this price have, and what would have been different if the prices mentioned in this paper would have been instated. Junctions will remain a problem, even with congestion pricing. Further investigation is needed to find ways to ease the queuing problems, not only at junctions but also at sites of lane reduction.

The damage model formulated in this thesis is one of few and has not been tested with empirical data. No research in this thesis has been done towards a political basis on road pricing. Some political parties worry that high road price like mentioned in my thesis are not affordable for some groups, or worry that industry might suffer. These secondary effects of road pricing deserve more attention.

[17] This council advises the Dutch government about legislation

Literature

Ahn, K. (2009) *Road Pricing and Bus Service Policies* Journal of transport economics and policy

Besseling, P. Groot, W. Verrips, A. (2004) *Economische toets op de Nota Mobiliteit* Centraal Planbureau

Bonsall, P. (2000) *Legislating for modal shift: background to the UK's new transport act* Transport policy

Centraal Bureau voor de Statistiek (1998) *kerncijfers verkeer en vervoer 1998*

Ceuster, M. J. G. de, Immers, L. H. (2001) *Verkeersindices voor het gebruik van het autosnelwegennet in België* Ministerie van Verkeer en Infrastructuur

Eliasson, J. Mattsonn, L. G. (2001) *Transport and Location Effects of Road Pricing: A Simulation Approach* Journal of transport economics and policy

Gerlough, D. L. Matthew, J. H. (1975) *Traffic flow theory A monograph special report 165* Transportation Research Board

Glaister, S. (1981) *Fundamentals of transport economics* Basil Blackwell

Goodwin, P. B. (1989)*The rule of three: a possible solution to the political problem of competing objectives for road pricing* Traffic engineering and control

Hacken. V. ten (2005) *Decision-making about road pricing in the Netherlands: Actors, their viewpoints and their position in the network* Bijdrage aan het Colloquium Vervoersplanologisch Speurwerk 2005

Hall, F. L. Allen, B. L. Gunter, M. A. (1986) *Empirical analysis of freeway flow-density relationships* Transportation research part A

Jones, P. M. (1991) *Gaining public support for road pricing through a package approach* Traffic engineering and control

Jordan, W. J. (1983) *Capacity costs, heterogeneous users, and peak-load pricing* Quarterly journal of economics

Kamnitzer, D. (1994) A *road pricing strategy for greater Vancouver*

Keeler, T. E. Small, K. A. (1977) *Optimal peak load pricing, investment, and service levels on urban expressways* Journal of Political economy

May, A. D. (1992) *Road pricing, an international perspective* Transportation 19

Ministerie van Financiën (2008) B*eleidsinformatie 2009* www.minfin.nl/ejb2009

Ministry of Transport (1964) *Road pricing: the economic and technical possibilities* Her Majesty’s Stationary Office

Mohring, H. D. (1970)*The Peak Load Problem with Increasing Returns and Pricing Constraints* American Economic Review

Mohring, H. D. (1975) *Pricing and Transportation capacity* Better use of existing transportation facilities Transportation Research Board

Newbery, D.M. (1988) *Charging for roads* The International Bank for Reconstruction and Development/The World Bank

Newbery, D.M. (1990) *Pricing and Congestion: economic principles relevant to pricing roads* Oxford review of economic policy

Palma, A. de, Lindsey, R. Wu, F. (2008) *Private Operators and Time-of-Day Tolling on a Congested Road Network* Journal of transport economics and policy

Rijkswaterstaat Adviesdienst Verkeer en Vervoer (2005) *Filemonitor 2005*

Rijkswaterstaat Adviesdienst Verkeer en Vervoer (2006) *Profiel van de spitsrijder Wie rijdt er in de spits?*

Rosen, H. S. Gayer, T. *Public Finance* McGraw-Hill

Sar, J. van der, Baggen, J (2005) *Prijsbeleid op de weg in Nederland Een historisch overzicht* Paper voor het Colloquium Vervoersplanologisch Speurwerk 2005

Sorensen, P. A. Taylor, B. D. (2005) *Review and Synthesis of Road-Use Metering and Charging Systems* Transportation Research Board of the National Academies
Verhoef, E. T. Nijkamp, P. Rietveld, P. (1997) *The social feasability of road pricing A case study for the Randstad area* Journal of transport economics and policy
Wee, B. van (2004) *Grote infrastructuurprojecten: de kwaliteit van kostenschattingen en vervoersprognoses. Een literatuuroverzicht* Bijdrage aan het Colloquium Vervoersplanologisch Speurwerk 2004
Wiggins, A. E. (1994) *A review of cashless electronic toll collection technology*
Willumsen, L. G. (2005) *London congestion charging and urban tolling in Chile: contrasts and lessons of fairness and project finance* PIARC Seminar on Road Pricing with emphasis on Financing, Regulation and Equity

appendix

concentration-flow-damage table

k	q	D
0	0	0
1	127,0857	0
2	252,3429	0
3	375,7714	0
4	497,3714	0
5	617,1429	0
6	735,0857	0
7	851,2	0
8	965,4857	0
9	1077,943	0
10	1188,571	0
11	1297,371	0
12	1404,343	0
13	1509,486	0
14	1612,8	0
15	1714,286	0
16	1813,943	0
17	1911,771	0
18	2007,771	0
19	2101,943	0
20	2194,286	0
21	2284,8	0
22	2373,486	0
23	2460,343	0
24	2545,371	0
25	2628,571	0
26	2709,943	0
27	2789,486	0
28	2867,2	0
29	2943,086	0
30	3017,143	0
31	3089,371	0
32	3159,771	0
33	3228,343	0
34	3295,086	0
35	3360	0
36	3423,086	0
37	3484,343	0
38	3543,771	0
39	3601,371	0
40	3657,143	0
41	3711,086	0
42	3763,2	0,000654
43	3813,486	0,002172
44	3861,943	0,003721
45	3908,571	0,005303
46	3953,371	0,006919
47	3996,343	0,008569
48	4037,486	0,010255
49	4076,8	0,011978
50	4114,286	0,01374
51	4149,943	0,015541
52	4183,771	0,017383
53	4215,771	0,019267
54	4245,943	0,021195
55	4274,286	0,023169
56	4300,8	0,025189
57	4325,486	0,027258
58	4348,343	0,029378
59	4369,371	0,03155
60	4388,571	0,033776
61	4405,943	0,036059
62	4421,486	0,0384
63	4435,2	0,040802
64	4447,086	0,043268
65	4457,143	0,045799
66	4465,371	0,048398
67	4471,771	0,051069
68	4476,343	0,053813
69	4479,086	0,056635
70	4480	0,059538
71	4479,086	0,062525
72	4476,343	0,0656
73	4471,771	0,068766
74	4465,371	0,072029
75	4457,143	0,075392
76	4447,086	0,078859
77	4435,2	0,082438
78	4421,486	0,086131
79	4405,943	0,089945
80	4388,571	0,093887
81	4369,371	0,097962
82	4348,343	0,102178
83	4325,486	0,106542
84	4300,8	0,111062
85	4274,286	0,115746
86	4245,943	0,120603
87	4215,771	0,125644
88	4183,771	0,130878
89	4149,943	0,136318
90	4114,286	0,141976
91	4076,8	0,147864
92	4037,486	0,153998
93	3996,343	0,160393
94	3953,371	0,167065
95	3908,571	0,174035
96	3861,943	0,181321
97	3813,486	0,188946
98	3763,2	0,196934
99	3711,086	0,205312
100	3657,143	0,214109
101	3601,371	0,223356
102	3543,771	0,233091
103	3484,343	0,243352
104	3423,086	0,254182
105	3360	0,265632
106	3295,086	0,277755
107	3228,343	0,290613
108	3159,771	0,304275
109	3089,371	0,318817
110	3017,143	0,33433
111	2943,086	0,350912
112	2867,2	0,368679
113	2789,486	0,387762
114	2709,943	0,408312
115	2628,571	0,430507
116	2545,371	0,454551
117	2460,343	0,480686
118	2373,486	0,509197
119	2284,8	0,540424
120	2194,286	0,574773
121	2101,943	0,612737
122	2007,771	0,65492
123	1911,771	0,702066
124	1813,943	0,755105
125	1714,286	0,815215
126	1612,8	0,883913
127	1509,486	0,96318
128	1404,343	1,055658
129	1297,371	1,16495
130	1188,571	1,296101
131	1077,943	1,456396
132	965,4857	1,656765
133	851,2	1,914382
134	735,0857	2,257872
135	617,1429	2,738757
136	497,3714	3,460085
137	375,7714	4,662299
138	252,3429	7,066726
139	127,0857	14,28001
140	0	

appendix
speed-flow-damage table

0	0		54	4370,625	0,097704	108	2362,5	0
1	138,9063	13,04344	55	4391,406	0,093263	109	2265,156	0
2	275,625	6,448444	56	4410	0,08898	110	2165,625	0
3	410,1563	4,250111	57	4426,406	0,084848	111	2063,906	0
4	542,5	3,150944	58	4440,625	0,080858	112	1960	0
5	672,6563	2,491444	59	4452,656	0,077004	113	1853,906	0
6	800,625	2,051778	60	4462,5	0,073278	114	1745,625	0
7	926,4063	1,73773	61	4470,156	0,069674	115	1635,156	0
8	1050	1,502194	62	4475,625	0,066186	116	1522,5	0
9	1171,406	1,319	63	4478,906	0,06281	117	1407,656	0
10	1290,625	1,172444	64	4480	0,059538	118	1290,625	0
11	1407,656	1,052535	65	4478,906	0,056368	119	1171,406	0
12	1522,5	0,952611	66	4475,625	0,053293	120	1050	0
13	1635,156	0,86806	67	4470,156	0,05031	121	926,4063	0
14	1745,625	0,795587	68	4462,5	0,047415	122	800,625	0
15	1853,906	0,732778	69	4452,656	0,044604	123	672,6563	0
16	1960	0,677819	70	4440,625	0,041873	124	542,5	0
17	2063,906	0,629327	71	4426,406	0,039219	125	410,1563	0
18	2165,625	0,586222	72	4410	0,036639	126	275,625	0
19	2265,156	0,547655	73	4391,406	0,034129	127	138,9063	0
20	2362,5	0,512944	74	4370,625	0,031688	128	0	0
21	2457,656	0,48154	75	4347,656	0,029311			
22	2550,625	0,45299	76	4322,5	0,026997			
23	2641,406	0,426923	77	4295,156	0,024743			
24	2730	0,403028	78	4265,625	0,022547			
25	2816,406	0,381044	79	4233,906	0,020406			
26	2900,625	0,360752	80	4200	0,018319			
27	2982,656	0,341963	81	4163,906	0,016284			
28	3062,5	0,324516	82	4125,625	0,014298			
29	3140,156	0,308272	83	4085,156	0,01236			
30	3215,625	0,293111	84	4042,5	0,010468			
31	3288,906	0,278928	85	3997,656	0,008621			
32	3360	0,265632	86	3950,625	0,006817			
33	3428,906	0,253141	87	3901,406	0,005054			
34	3495,625	0,241386	88	3850	0,003331			
35	3560,156	0,230302	89	3796,406	0,001647			
36	3622,5	0,219833	90	3740,625	0			
37	3682,656	0,209931	91	3682,656	0			
38	3740,625	0,20055	92	3622,5	0			
39	3796,406	0,19165	93	3560,156	0			
40	3850	0,183194	94	3495,625	0			
41	3901,406	0,175152	95	3428,906	0			
42	3950,625	0,167492	96	3360	0			
43	3997,656	0,160189	97	3288,906	0			
44	4042,5	0,153217	98	3215,625	0			
45	4085,156	0,146556	99	3140,156	0			
46	4125,625	0,140184	100	3062,5	0			
47	4163,906	0,134083	101	2982,656	0			
48	4200	0,128236	102	2900,625	0			
49	4233,906	0,122628	103	2816,406	0			
50	4265,625	0,117244	104	2730	0			
51	4295,156	0,112072	105	2641,406	0			
52	4322,5	0,107098	106	2550,625	0			
53	4347,656	0,102312	107	2457,656	0			