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Cost-benefit analysis of incentive systems rewarding compliance with speed limits

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ABSTRACT

The paper presents a cost-benefit analysis of schemes rewarding drivers for not speeding. The analysis is based on the findings of trials that have evaluated the effects of rewarding drivers for not speeding. For the purpose of cost-benefit analysis, three levels of the reward were defined: 20 Euros per year, 300 Euros per year and 1200 Euros per year (corresponds to 26, 396 and 1586 US dollars at June 2013 exchange rate). Based on the trials reported, it was estimated that these rewards would reduce the rate of speeding by 20 percent, 70 percent and 95 percent, respectively. To monitor compliance, each car would be equipped with a monitoring device recording speed. It was assumed that drivers would join a reward system voluntarily. Three groups of drivers were defined: one group, making up 50 percent of drivers with an annual per driver accident rate 20 percent below the average for all drivers; a second group, 40 percent of drivers, with a per driver accident rate 10 percent below the average, and a third group, 10 percent of drivers, with a per driver accident rate 140 percent above average (i.e. a relative accident rate of 2.4). It was assumed that the safest drivers would be the first to join the program; the least safe drivers would be the last. Official Norwegian monetary valuations of the prevention of traffic fatalities and injuries were applied. The prevention of a fatality was valued at 3.46 million Euros (2009-prices; equivalent to 4.8 million US dollars in 2009). Benefits were found to be smaller than costs for all versions of the reward system and all groups of drivers, except high-risk drivers in the system offering a 20 or 300 Euro annual reward for not speeding. If the reward is treated as a monetary transfer, not as a cost of the program, benefits clearly exceed costs in most versions of the program. It was, however, regarded as more appropriate to treat the rewards as a cost of the program, since it will not have an effect unless the rewards are actually paid.

Key words: speeding, rewards, selective recruitment, cost-benefit analysis

1 INTRODUCTION

Speeding remains an important road safety problem in most highly motorized countries (*1*). It is not realistic to expect conventional police enforcement or speed cameras to be deployed to such an extent as to eliminate or greatly reduce speeding. Modern technology has created another option for influencing speeding by rewarding drivers for complying with speed limits. To reward drivers, cars must be fitted with a device which records and stores data about speeding. A simple device recording speed once per second (as used in a Danish trial) would provide sufficiently precise data. The device can be a pure recording system; it does not have to force the driver to comply with speed limits, the way a mandatory ISA-system (ISA = Intelligent Speed Adaptation) would do. However, to earn the reward offered, drivers must abstain from speeding.

A limited number of trials (*2-6*) designed to reward drivers for not speeding (generally defined as exceeding the speed limit by at least 5 km/h) have been reported. These trials have been reviewed in another paper (*7*). The trials have a number of quite serious limitations. They are all based on small and self-selected samples of drivers. The drivers who volunteered for the trials cannot be regarded as representative of drivers in general. There are indications that the drivers who took part in the trials were less inclined to speed than the general population of drivers. Since these drivers already complied better with speed limits than a typical driver, complying even better with speed limits did not imply that they needed to change their driving behavior very much. Thus, in a Swedish trial, drivers had a violation rate of only some 14 percent (of driving time) before the trial, and reduced this rate to around 8 percent – hardly a major change in behavior (*4*).

Despite the limitations of the trials testing rewards, some of them had remarkable effects. In a Danish trial (*5*), the group assigned to a combination of information (given by a voice reminding drivers of the speed limit if they exceeded it) and incentives (in the form of a maximum reward of 700 Euros in case of no violations of speed limits) reduced their rate of speeding by nearly 80 percent. This shows that rewarding drivers can be very effective in reducing speeding.

The objective of this paper is to assess the costs and benefits of a system-wide introduction of a system rewarding drivers for not speeding. Since such a system, as far as is known, has not yet been introduced anywhere in the world, the analysis of its costs and benefits is hypothetical. It is only intended to probe whether the idea is viable, or likely to be too expensive to deserve serious consideration.

2 MAIN ELEMENTS OF COST-BENEFIT ANALYSIS

To perform a cost-benefit analysis of a system rewarding drivers for not speeding, a framework for analysis has been defined as follows:

1. The costs of the system consist of: (a) Installing speed monitoring devices in cars; (b) Collecting and analyzing speed data; (c) Payment of rewards earned by drivers. The latter item would normally not be treated as a cost, but as a monetary transfer, since it does not represent the use of a resource (labor or capital) for the purpose of production or consumption (*8*). A reward system,

however, can only be effective if rewards are actually paid; hence it is regarded as appropriate to treat the rewards paid as a cost of running the system.

2. The benefits of the system consist of the reduction in the number of accidents, fatalities and injuries attributable to reduced speed, converted to monetary terms. To the extent travel time increases, a monetary valuation of additional travel time is not included as a negative benefit, because savings in travel time obtained by speeding are illegal and therefore not regarded as a societal benefit (*9*).
3. By speeding less, drivers may pay fewer traffic tickets for speeding. These savings are not counted as a societal benefit, since traffic tickets are only monetary transfers, not payment for the use of a material resource.
4. The effects of a reward system on speeding are modeled as a function of two factors: (a) Characteristics of the drivers who elect to join the system. It will be assumed that any reward system is voluntary and that the success of the system depends on drivers opting to join it. The rewards could, for example, take the form of insurance rebates. Offering the rewards as insurance rebates would provide a test of the commercial viability of the idea (*10*). (b) The nature and size of the reward. It will be assumed that the reward is monetary and that its size depends on driver compliance with speed limits. For the purpose of the analysis, models have been developed to describe: (a) Propitious selection of drivers joining the system. Propitious selection is the opposite of adverse selection, i.e. it means that the safest drivers will be the first to join the system. (b) The dose-response relationship between the size of the reward offered and the size of its effect on speeding. All else equal, one would expect a large reward to have a greater effect than a small reward.

In the following sections, these elements of analysis will be developed. Norwegian data were applied in the cost-benefit analysis. The benefits in terms of a reduced number of fatalities or injuries were valued by relying on a recent Norwegian valuation study, see section 6.

3 PROPITIOUS SELECTION TO A REWARD SYSTEM

There are clear indications from the trials reported (*2-6*) that the drivers who volunteered to take part in these trials were much less inclined to speed than drivers in general. Swedish drivers taking part in the trial were speeding about 13 percent of the time. At the same time, about 55 percent of all traffic in Sweden violated speed limits. In the Danish trial, the mean speed of participating drivers before the start of the trial was 6-9 km/h lower in 80 km/h zones than the mean speed of traffic. In 50 km/h zones, it was 4-5 km/h lower than the mean speed of traffic. In the Australian trial, the mean rate of speeding for drivers taking part in it was about 12 percent (of driving distance). Representative data collected by means of GPS indicated that a little more than 20 percent of traffic was speeding in 50 km/h zones in Sydney (*11*). Thus, the studies suggest that the drivers who took part in the reward trials were less inclined to speed than drivers in general.

The only study that reports the effects of the rewarding system for drivers with different initial rates of speeding is the Australian study. The data from that study were re-analyzed by grouping the data in bands of 5 percentage points (0-4.9, 5-9.9, etc). The mean rate of speeding before and after was estimated in each group. Figure 1 shows the results.

A second degree polynomial best fits the data points. The form of this function is consistent with the idea that drivers with a high rate of speeding may be less inclined to change behavior than drivers with a low rate of speeding (the function becomes flatter as the rate of speeding increases). However, if the function is extrapolated outside the range of the data in Figure 1, it makes no sense. It reaches a turning point when speeding is about 35 percent of the distance driven, and drops below zero if the rate of speeding is above 70 percent.

While it is reasonable to expect habitual speeders to be more resistant to change than other drivers, it is not reasonable to expect them to react to the prospect of earning a reward by speeding even more. It is therefore concluded that the function fitted in Figure 1 cannot serve as the basis for describing how the effects of a reward system will vary between drivers with different rates of speeding.

Another approach has therefore been taken in order to describe the effects of selective driver recruitment to a reward system. Based on a recent study of the typical distribution of the long-term expected number of accidents in a population of drivers (*12*), it has been assumed that 50 percent of drivers are 20 percent safer than the average for all drivers, 40 percent are 10 percent safer than the overall average and 10 percent are 2.4 times less safe than the overall average. These assumptions are intended as an approximate description of the typical distribution of accidents in a population of drivers who have a mean annual number of accidents of around 0.10-0.15, which is the number of insurance-reported accidents per driver per year in Norway. It can then be calculated that the safest 50 percent of drivers will be involved in 40 percent of all accidents, the middle 40 percent will be involved in 36 percent of all accidents, and the most risky 10 percent will be involved in 24 percent of all accidents. It is further assumed that the 50 safest percent join a reward program first and that the most risky 10 percent join it last.

4 EFFECT OF SIZE OF REWARD

The trials offered drivers very different maximum rewards. The largest reward was offered in the Danish trial, 700 Euros (about 1020 US dollars in 2008). To earn the entire reward, a driver had to avoid any speeding. In one of the experimental groups, drivers reduced speeding by close to 80 percent. If the assumption is made that the amount paid to drivers is proportional to the reduction of speeding, drivers reducing their speeding by close to 80 percent would be rewarded by about 553 Euros. Similar estimates of the effective reward paid to drivers were made for the other trials quoted above. The results are presented in Figure 2.

There is a very clear dose-response pattern, which makes sense according to economic theory. A logarithmic function fits the data very well. This is consistent with the frequently made assumption that the utility of income (the reward adds to the income of a driver) is logarithmic (*13*). The function will therefore be applied to estimate the effects of rewards of different sizes.

5 THE RELATIONSHIP BETWEEN LEVELS OF COMPLIANCE, MEAN SPEED AND THE NUMBER OF FATALITIES AND INJURIES

To estimate costs and benefits of alternative schemes for rewarding drivers for complying with speed limits, Norwegian data on the rate of speed violations have been applied. These data refer to 2006. More recent data are available on mean speeds, but not on speed dispersion, which must be known to estimate both the overall rate of violations and the specific rate of violations that are, e.g. 10-20 km/h above speed limits, 20-30 km/h above, and so on.

Table 1 presents the current rate of violations of different speed limits in Norway. The mean violation rate for all speed limits (weighted by vehicle kilometers of travel) is 49 percent. Three levels of improved compliance have been defined:

1. Reducing the violation rate to 40 percent. This represents, roughly speaking, a 20 percent reduction in the rate of speeding.
2. Reducing the violation rate to 15 percent. This represents a 70 percent reduction of the rate of speeding.
3. Reducing the violation rate to 2.3 percent, which is equivalent to assuming that all drivers up to and including two standard deviations above current mean speed will comply with speed limits. This corresponds to a 95 percent reduction in the rate of speeding and is intended to show nearly perfect compliance with speed limits.

Figure 3 illustrates how the effect on the mean speed of traffic of changes in the violation rate has been estimated. It was assumed that speed is normally distributed around the mean and that the entire speed distribution is contained within plus or minus 3 standard deviations from the mean. Figure 3 shows cumulative speed distributions for the current violation rate and for three levels of reduced violation rates. Strictly speaking, it is only the distribution referring to the current violation rate which is normal. This distribution is shown by the blue curve to the right in Figure 3. It was assumed that drivers who already comply with speed limits will not be influenced. The upper half of the cumulative speed distribution shifts to the left as violation rate declines; the leftmost curve in Figure 3 shows the distribution when compliance is 97.7 percent. This level of compliance corresponds, roughly speaking, to a reduction of violation rate by 95 percent (in the example used in Figure 3 from 53.6 to 2.3 percent).

The speed distribution was divided into 12 ranges; the first was from 3 to 2.5 standard deviations below the mean; the next from 2.5 to 2 standard deviations below the mean, and so on. The mean speed of traffic was estimated in each range and the overall mean speed of traffic was a weighted mean of the mean speeds in each range, using the share of traffic in each range as weight. Table 2 illustrates this procedure.

Based on the function presented in Figure 2, it has been assumed that an effective reward of 20 Euros would bring about a reduction of the violation rate to 40 percent;

an effective reward of 300 Euros would reduce violation rate to 15 percent, and an effective reward of 1200 Euros would reduce violation rate to 2.3 percent.

When estimating the changes in the mean speed of traffic associated with these changes in the rate of speeding, it has been assumed that drivers who currently comply with speed limits will not change their speed; only those currently exceeding speed limits will reduce speed. As can be seen from Table 1, mean speeds are reduced when compliance improves; the more so the larger the improvement in compliance.

Changes in mean speed will influence the number of fatalities and injured road users. The effects of changes in speed on the number of fatalities and injuries have been estimated by applying exponential functions as discussed by Elvik (*14*). According to these functions, changes in the number of fatalities or injured road users can be modeled in terms of exponential functions of the following form:

Change in fatalities or injuries = $\alpha \cdot e^{\beta \cdot x}$ (1)

In equation 1, e denotes the exponential function, x is the speed of traffic (km/h) and α and β are parameters that are estimated. The parameter β is of principal interest, as it shows how sensitive the number of fatalities or injured road users is to changes in speed.

The parameter β has been estimated to values of 0.068 for fatalities, 0.062 for serious injuries and 0.039 for slight injuries. All these estimates are statistically highly significant and associated with small standard errors. The value of the parameter α was, respectively, 0.167, 0.302 and 2.617 (all statistically significant at the 5 percent level). Changes in the number of fatalities and injured road users were estimated based on average values for Norway for 2009 and 2010. The mean annual number of fatalities for these two years was 210. This was estimated to be reduced to 202 at the 40 percent violation rate, 170 at the 15 percent violation rate and 157 at the 2.3 percent violation rate. The corresponding annual numbers of seriously injured road users were, respectively, 755, 727, 625 and 582. For slightly injured road users, the numbers were 8105 (current), 7891 (40 percent violation rate), 7197 (15 percent violation rate) and 6897 (2.3 percent violation rate).

6 COST-BENEFIT ANALYSIS

The elements required to perform a cost-benefit analysis have now been defined. There are three levels of driver recruitment to the reward program:

1. The 50 percent safest drivers, involved in 40 percent of accidents, join the program.
2. Another 40 percent of drivers, involved in 36 percent of accidents, join the program. Its penetration will then be 90 percent of drivers and 76 percent of accidents.
3. The last 10 percent of drivers, involved in 24 percent of accidents, join the program. Penetration is now 100 percent of drivers and 100 percent of accidents.

There are three levels of effective rewarding:

1. Drivers are effectively rewarded 20 Euros per year. Compliance with speed limits will then increase from the current 51 percent to 60 percent.
2. Drivers are effectively rewarded 300 Euros per year. Compliance with speed limits will then increase from 51 percent to 85 percent.
3. Drivers are effectively rewarded 1200 Euros per year. Compliance with speed limits will then increase from 51 percent to 97.7 percent.

By combining the three levels of driver participation and the three levels of rewarding, a total of nine options are created. Three types of cost are associated with the program:

1. Costs of installing speed monitoring devices in cars. Based on experience gained in ISA-trials in Denmark (*15*) and Great Britain (*16*) the cost of installing the monitoring device in a car has been set to 150 Euros.
2. Annual costs of collecting and analyzing data from the speed monitoring devices. These costs are assumed to be 10 Euros per car per year.
3. Costs of rewarding drivers. These costs are 20, 300 or 1200 Euros per year per driver who has joined the system (recall that these are "effective rewards", or average amounts – not all drivers will actually be rewarded).

The costs of installing speed monitoring devices are one-time investment costs. The other costs are recurring annual costs. To make all costs comparable, the costs of installing the speed monitoring devices have been converted to an annual cost. The annual cost is an annuity for 10 years based on an annual discount rate of 4 percent, the currently recommended discount rate for cost-benefit analyses in Norway (*17*). It was assumed that devices will be used for an average period of 10 years in each car. With 100 percent penetration, the devices will need to be installed in 2.9 million cars (at the end of 2010).

Results of a recent valuation study (*18*) were applied to convert the savings in the number of fatalities and injured road users to monetary terms. Analyses of this study are still going on, possibly leading to revised valuations (*19*), but the valuations that were originally published have been used in this analysis. These valuations were (2009-prices):

Preventing 1 fatality =30,220,000 NOK = 3.46 million Euros (4.80 million US dollars in 2009).

Preventing 1 serious injury = 10,590,000 NOK = 1.21 million Euros.

Preventing 1 slight injury = 614,000 NOK = 0.07 million Euros.

The estimated reductions in the number of fatalities and injured road users were converted to annual monetary benefits for comparison with program costs. The results are presented in Table 3.

Benefits are smaller than costs for all versions of the program. The only exception from this rule is that the marginal benefits of the 10 percent most risky drivers joining the program are greater than the marginal costs at the two lowest rewards (20 and 300 Euros). Unfortunately, these drivers may be less inclined to join a reward program than other drivers.

Rewards are often thought to be more effective in influencing behavior than punishments. The success of at least some of the trials in which drivers have been rewarded shows that rewards may be very effective and reduce speeding by up to 80 percent. On the other hand, the rewards offered to obtain such large effects are sizable. A maximum reward of 700 Euros, which was offered in the Danish trial, corresponds to 1020 US dollars at the 2008 exchange rate. This is not a trivial amount. Moreover, if extended to the general population of drivers, rewards would be paid to a large number of drivers who normally comply with speed limits and would do so even if not rewarded.

7 DISCUSSION

Can drivers be motivated to comply better with speed limits if they are rewarded for doing so? A limited number of trials in which drivers were rewarded for complying with speed limits suggest that the answer is yes. Moreover, when the results of these trials are synthesized, they show a clear dose-response relationship between the size of the reward and the size of the effect on speed compliance. In the most successful trial, speeding was reduced by almost 80 percent. Since the costs of setting up and administering the reward systems are small, one would expect them to be very cost-effective.

This is indeed also the case when only the cost of equipping cars with speed monitoring devices and running the system are included. However, the costs of rewarding drivers are huge. Although one might argue that the rewards are only monetary transfers, not a cost of running the system, it stands to reason that the system would be ineffective if the rewards were not paid. It therefore seems appropriate to treat the rewards as a real cost and enter them on the cost side of a cost-benefit analysis. It then turns out that the cost of rewarding drivers dwarfs all other costs of a reward system – unless the rewards offered are quite small (20 Euros per year). Small rewards have small effects; therefore reward systems are not cost-effective even when rewards are kept to a minimum.

This result is perhaps a bit surprising. Reward systems are attractive from many points of view. They do not compel the driver to comply with speed limits; a driver can still exceed speed limits without cost. The only thing the driver loses is the reward. However, nobody rewards drivers for not speeding today. Hence, if reward systems became commonplace, drivers could in principle continue speeding as they do now without noticing any difference at all – provided police enforcement stayed the same.

It turns out that really effective rewards must be sizable – in the order of 1000 to 1500 dollars per year. Paying rewards of this size greatly inflates the costs of a reward system and makes it less cost-effective than other technological options for influencing speed. Indeed, it may be regarded as ethically problematic to reward people for lawful behavior and it is doubtful if offering rewards can be used as a means of law enforcement in general. It is at the very least impractical to start rewarding people for not vandalizing property, abstaining from smuggling, not committing rape, etc. Paying for behavior that conforms to social norms may undermine the legitimacy of those norms (*20*); the main problem is that there is no strong social norm condemning speeding.

It cannot be ruled out that drivers would adapt behavior when rewarded for not speeding. The reward would add to their income; this would effectively reduce the cost of crashes. On the other hand, crashes would be less likely to occur if speed was reduced. Drivers might, however, spend the extra money on driving more, which, all else equal, would be associated with an increased number of accidents.

There are at least three other technological solutions that are likely to be more cost-effective than rewarding drivers. One option is a purely informative ISA. This is a speed monitoring device, sometimes referred to as speed alert, which gives the driver a message, either on the instrument panel or in the form of a voice message (or both) when the speed limit is exceeded. The Danish trial (*5*) found that a purely informative ISA was associated with reduced speeding. It had a smaller effect than the most effective combination of information and rewards. On the other hand, costs were also considerably smaller, since no rewards were paid.

The second option is mandatory ISA. This is a system that makes it impossible to exceed speed limits, by cutting fuel supply if a driver tries to accelerate above the speed limit. According to a British cost-benefit analysis (*16*), the benefits of such a system exceed the costs. The system will ensure perfect, or nearly perfect, compliance with speed limits, but costs less than a reward system, because drivers will not be rewarded for complying with speed limits. A mandatory ISA-device costs more than a simple speed monitoring device, but considerably less than the most expensive rewards that were tested in the trials discussed in this paper.

The third option would be to introduce road pricing, combined with equipping cars with computers that recorded details about driving, including speed (*21*). In principle, speeding could then be priced and drivers would pay for speeding, rather than getting rewarded for not doing so. While an advanced system of road pricing is expensive, it does have the attraction that when in force for some time, it may generate or reinforce social norms that make speeding unacceptable.

8 CONCLUSIONS

The main conclusions of the study presented in this paper can be summarized as follows:

1. Trials have found that rewarding drivers for not speeding can be very effective in reducing speeding. In the most successful trial speeding was reduced by nearly 80 percent.
2. There is a dose-response pattern between the size of a reward and the size of the effect on speeding. The dose-response curve is subject to declining marginal effect and becomes flatter as the size of the reward increases.
3. There is evidence of strong self-selection bias among drivers who volunteered to take part in trials rewarding drivers for not speeding. If voluntary reward systems are introduced on a wider scale, it is therefore reasonable to expect the systems to be subject to propitious selection, i.e. the safest drivers will be the first to join the systems.

4. A cost-benefit analysis was made of a system for rewarding drivers for not speeding with three levels of reward: 20 Euros per year, 300 Euros per year and 1200 Euros per year. Costs and benefits were estimated for three groups of drivers: the safest 50 percent, the next-to-safest 40 percent and the most high-risk 10 percent.
5. Benefits were found to be smaller than costs for all versions of the reward system, except for the system offering the smallest rewards (20 or 300 Euros) to high-risk drivers.
6. Informative or mandatory ISA systems are likely to be more cost-effective than rewarding drivers for not speeding.
7. The study has a number of limitations: (a) It is based on a small number of trials; (b) The long-term effects of reward systems are not known; (c) The likelihood of behavioral adaptation to reward systems is unknown and was not included in the analysis; (d) The possibility of targeting the system to high-risk drivers was not addressed.

ACKNOWLEDGEMENTS

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LIST OF FIGURES AND TABLES

Figure 1:

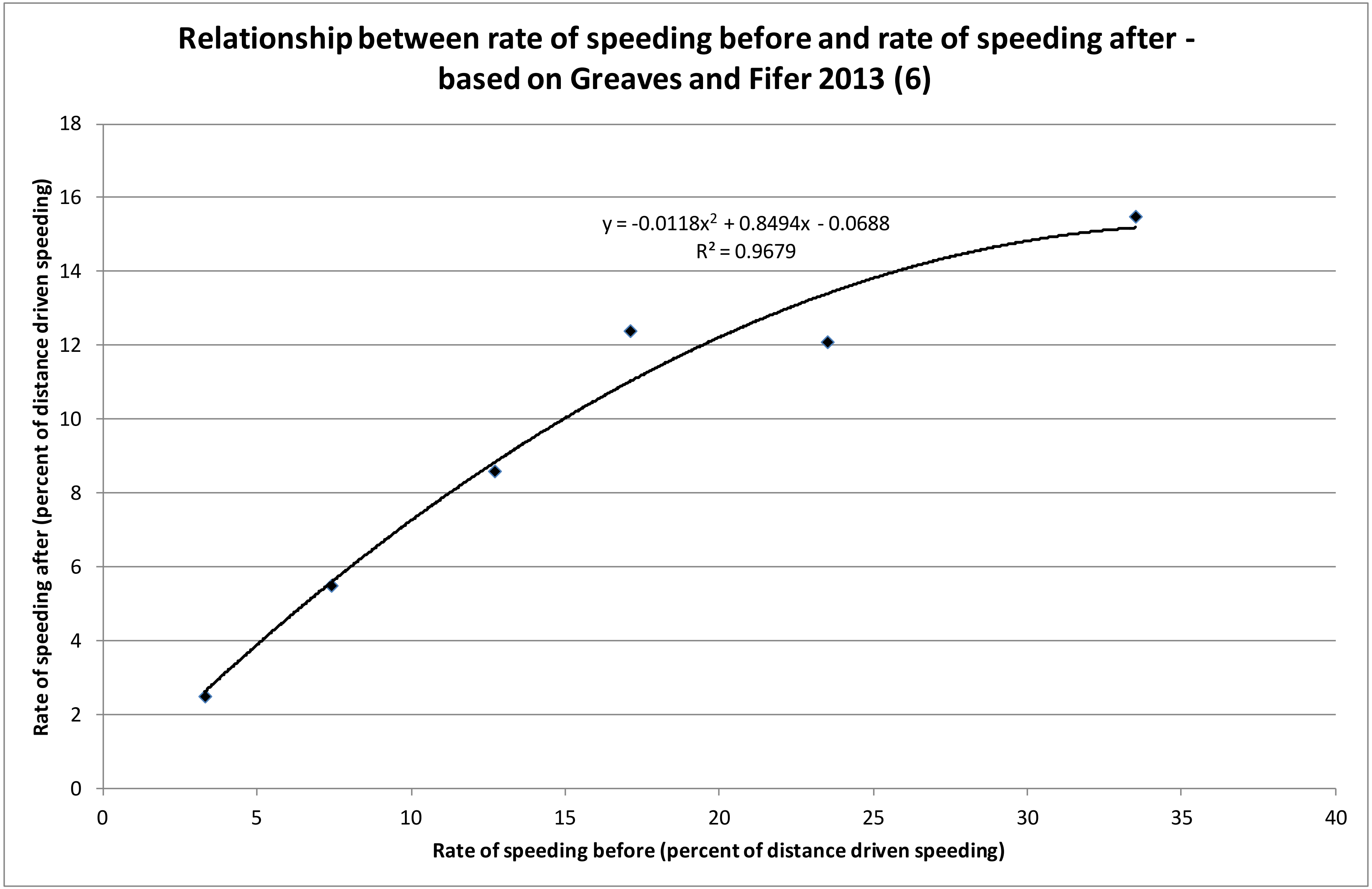
Relationship between rate of speeding before and rate of speeding after - based on Greaves and Fifer 2013 (6)
y = -0.0118x² + 0.8494x - 0.0688
R² = 0.9679
Rate of speeding after (percent of distance driven speeding)
Rate of speeding before (percent of distance driven speeding)
0
2
4
6
8
10
12
14
16
18
0
5
10
15
20
25
30
35
40

Figure 2:

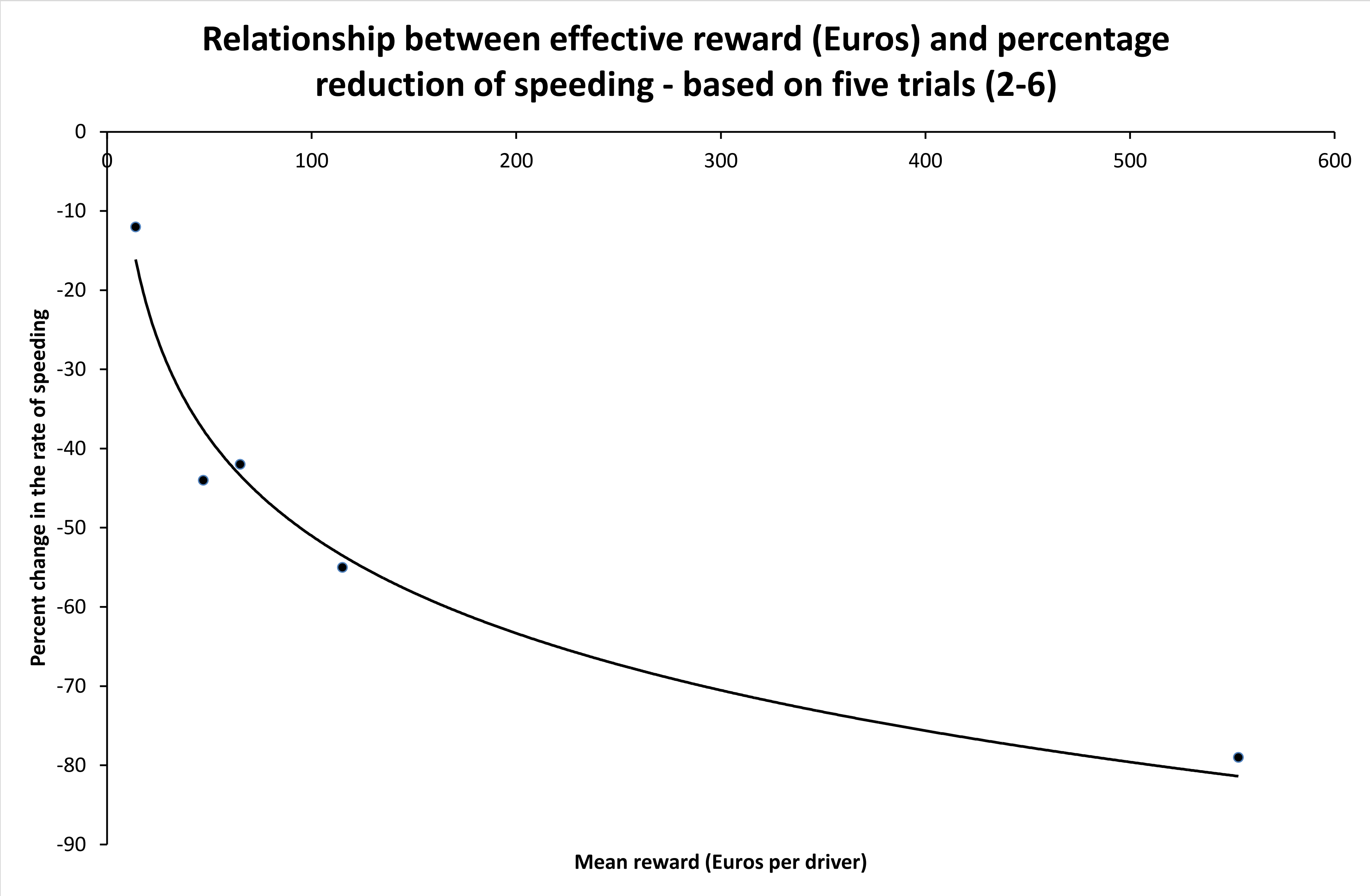
Relationship between effective reward (Euros) and percentage reduction of speeding - based on five trials (2-6)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
100
200
300
400
500
600
Percent change in the rate of speeding
Mean reward (Euros per driver)

Figure 3:

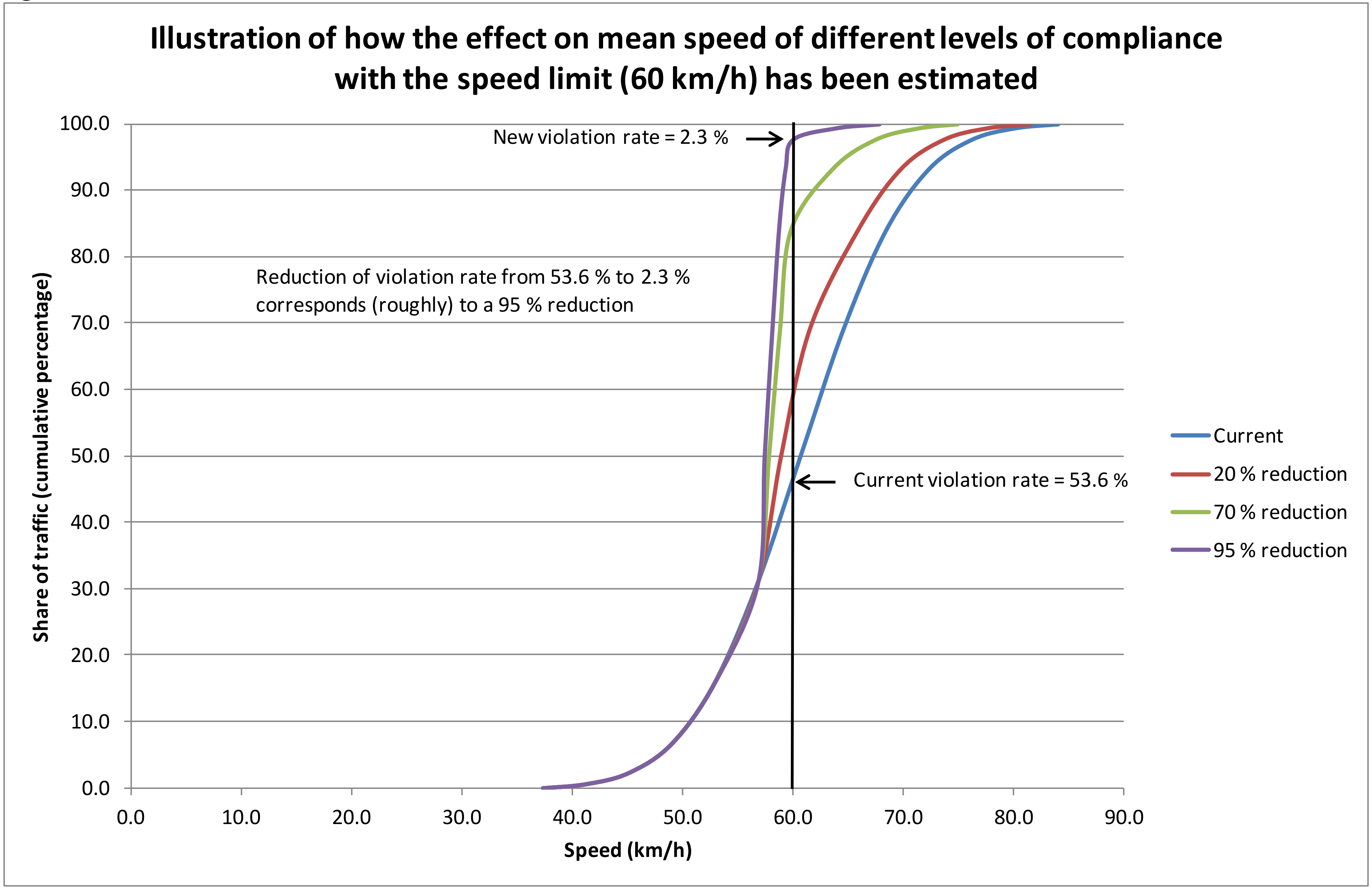
Illustration of how the effect on mean speed of different levels of compliance with the speed limit (60 km/h) has been estimated
New violation rate = 2.3 %
Reduction of violation rate from 53.6 % to 2.3 % corresponds (roughly) to a 95 % reduction
Current violation rate = 53.6 %
Share of traffic (cumulative percentage)
Speed (km/h)
Current
20 % reduction
70 % reduction
95 % reduction
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0

Table 1:

Speed limit (km/h)	Current mean speed (km/h)	Current violation rate (%)	Mean speed at violation rate of 40 % (km/h)	Mean speed at violation rate of 15 % (km/h)	Mean speed at violation rate of 2.3 % (km/h)
50	49.2	45.5	48.7	46.6	45.7
60	60.7	53.6	59.2	57.1	56.2
70	70.0	50.0	68.9	66.5	65.5
80	78.4	42.8	78.1	75.3	73.9
90 two lane	87.8	38.6	87.8	85.5	84.2
90 multi lane	89.9	49.5	88.7	86.7	85.4
100	99.8	49.2	99.0	95.7	94.3
All speed limits		49.0			

Table 2:

Range of distribution (standard deviations from mean)	Share of traffic in range (proportion)	Mean speed of traffic in km/h in each range of the speed distribution			
		Current situation	20 % lower violation rate	70 % lower violation rate	95 % lower violation rate
-3.0 to -2.5	0.006	39.3	39.3	39.3	39.3
-2.5 to -2.0	0.017	43.2	43.2	43.2	43.2
-2.0 to -1.5	0.044	47.0	47.0	47.0	47.0
-1.5 to -1.0	0.092	50.9	50.9	50.9	50.9
-1.0 to -0.5	0.150	54.9	54.9	54.9	54.9
-0.5 to 0.0	0.191	58.8	57.9	57.3	57.1
0.0 to 0.5	0.191	62.7	60.2	58.3	57.8
0.5 to 1.0	0.150	66.6	63.7	59.3	58.4
1.0 to 1.5	0.092	70.5	67.9	61.7	59.1
1.5 to 2.0	0.044	74.4	71.8	65.6	59.7
2.0 to 2.5	0.017	78.3	75.7	69.5	62.0
2.5 to 3.0	0.006	82.2	79.6	73.2	65.9
Weighted mean speed	1.000	60.7	59.2	57.1	56.2

Table 3:

Share of drivers joining system (%)	Effective reward per driver (Euros)	Number of cars equipped with speed monitoring device	Total cost of installing monitoring devices (million Euros)	Installation cost converted to annuity (10 years; 4 % discount rate)	Annual costs of collecting and analyzing speed data (million Euros)	Annual costs of rewards paid to drivers (million Euros)	Total annual costs (million Euros)	Total annual benefits (million Euros)	Marginal costs (million Euros)	Marginal benefits (million Euros)
50	20	1450000	217.50	26.82	14.50	29.00	70.32	30.99		
90	20	2610000	391.50	48.27	26.10	32.00	106.37	58.88	36.05	27.89
100	20	2900000	435.00	53.63	29.00	32.00	114.63	77.48	8.26	18.60
50	300	1450000	217.50	26.82	14.50	435.00	476.32	144.13		
90	300	2610000	391.50	48.27	26.10	741.00	815.37	273.86	339.05	129.73
100	300	2900000	435.00	53.63	29.00	741.00	823.63	360.34	8.26	86.48
50	1200	1450000	217.50	26.82	14.50	1740.00	1781.32	191.89		
90	1200	2610000	391.50	48.27	26.10	3132.00	3206.37	364.59	1425.05	172.70
100	1200	2900000	435.00	53.63	29.00	3296.00	3478.63	479.72	272.26	115.13