Damages after Deregulation - Dynamic Effects in the German Motor Vehicle Insurance Industry

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Abstract

Since 1994 the highly regulated German Insurance market have been deregulated. Insurers have been allowed to calculate their premiums and to offer contracts without regulation. Especially in the motor vehicle insurance several innovations were introduced: Age of car, garage, kilometres per year and so on are decisive to get rebates or additional premiums. According to the traditional literature about adverse selection the paper analyzes whether these tariff items are instruments to select better between low and high risks than before deregulation. Age of car and kilometres variables seems to have such selecting effects for one or two years.

Zusammenfassung

Seit 1994 ist der deutsche Versicherungsmarkt dereguliert, so daß die Versicherer die Freiheit bekommen haben, Tarife und Bedingungen nach eigener Wahl zu gestalten. Insbesondere in der Kraftfahrzeugversicherung gibt es Innovationen, wie Rabatte und Zuschläge in Abhängigkeit vom Alter des Fahrzeuges oder der Jahreskilometer. Entsprechend der theoretischen Literatur zu adverser Auslese würde man erwarten, daß diese neuartigen Tarifmerkmale die Möglichkeiten zur Risikoselektion gegenüber der Zeit vor der Deregulierung verbessern. Das Alter des Fahrzeuges und die gefahrenen Kilometer pro Jahr scheinen für ein oder zwei Jahre einen solchen Selektionseffekt auszuüben.

JEL-Klassifikation: G22, D82, L51

1 The Problem

Until the middle of 1994 the German insurance market was highly regulated (see *Deregulierungskommission* 1991, § 46), especially:

- The insurance firms were obliged to submit their policies to the Bundesaufsichtsamt für das Versicherungswesen (BAV = Federal Insurance Supervisory Office). The supervisory office discussed the firms' new contracts with other firms and with insurance pressure groups. The aims of the supervisory office were coming to complete, clearly arranged, and standardized insurance contract terms. Therefore, all firms had to use the same policies in the automobile insurance.
- The Federal Insurance Supervisory Office regulated the premiums. First, all firms had to demand an ex ante official authorization for using tariffs in the market. Secondly, in health care -, life -, and motor vehicle insurance the firms had to apply a given calculation scheme. The duty to use calculation schemes resulted in nearly uniform premiums. Price competition was only possible by offering premium repayments.
- In motor vehicle liability insurance and (in some German federal states) in fire insurance, firms had to accept any policyholder.

In accordance with European law the firms were furthermore regulated by a solvency monitoring, by a control of market entry, and by investment supervising.

In the first half of the nineties the European Union established insurance directives of the so-called third generation which abolished regulation of premiums and contracts. Since then the motor vehicle insurance firms have been free to calculate their tariffs and to formulate their contracts, if they were able to guarantee the payments for damages of third parties in liability insurance. The firms are now allowed to reject policy holders under special conditions (see for example *Müller* 1995).

In the deregulated German automobile insurance market the companies have used the new liberty by introducing new rating factors. Often employed rating factors are age, sex, or marital status of the drivers, the use of the car (private or commercial), garage, and the individual driving record. From the economic viewpoint it is possible that the

introduction of these rating factors has had consequences on the damages in this insurance section:

- If new tariffs will increase the premiums for high risks and decrease the premiums for low risks, high risks will expect an enlarged fiscal burden in case of an accident because of an higher malus. To have a collusion becomes more expensive. Therefore, the new, more risk-based tariffs may provide incentives to raise the drivers' carefulness; the problem of moral hazard in motor vehicle insurance market will be diminished. Looking on the German data, damages should be reduced if all other factors remain the same. Recognizing the new relative prices of having an accident needs probably time. Furthermore, bad risks may not immediately change their road traffic behavior. Summing up both effects I expect that decreasing damages can perhaps be noticed for several years after introducing new tariff items. Because my data set contains new tariff items introduced in 1997 at latest and damages are only given until 1999 it seems impossible to test the moral hazard effect today.
- The new tariffs can be used by insurers to select risks better than before. Accepting problems of adverse selection insurance companies are unable to determine the potential policy holders risks. Additional premiums and rebates may be an instrument to increase premiums for high risks and decrease for low risks; at the end the different motor vehicle policy holders have to pay premiums according to their expected damages. It cannot be expected that all new tariffs are good estimators for the car drivers' risk: Some new tariff items will represent the expected damages of a policy holder better than the premium calculation methods used before deregulation; and other tariffs have no correlation with risks and should be given up on the long run. In the following I will argue that insurance firms which introduced risk predicting new rating factors are well able to reduce their loss ratios in the short run. On the long run the competition process should enforce higher premiums for high risks and lower premiums for low risks; having high risks in a firm (= high damages) would be accompanied by higher premium revenues, lower revenues will follow successful attracting of low risks (= low damages). The aim of the paper is to test the effects on diminished adverse selection processes as a consequence of deregulation.

The second chapter contains the description of the rise and dissemination of new rating systems in the German automobile insurance market. The theoretical background for the introduction of the new rating factors and its consequences for damages is the subject of the third chapter. In the fourth chapter I am describing the used data set. Cross sectional estimations which are able to test the different hypotheses about the effects of using tariff items on the variation rates of loss ratios had been done. These results are given in chapter 5. Chapter 6 contains the conclusions.

2 New Rating Systems in the German Vehicle Insurance Market

The German consumer organization "Stiftung Warentest" reported on the 1st of January 1995, March, 1st 1996 and 1997 which new rating systems motor vehicle insurers had used at those points of time (1 = yes, 0 = no; see *Finanztest* 1995, 1996, 1997). Using these data I defined the following variables:

- New car rebates are cases in which an insurer diminishes the premium for new or very old vehicles.
- Policy holders which were the first owner of a car were given first user rebates.
- If a person used a garage or carport, it had been called garage rebate.
- Drivers with few kilometres were persons who drove not more than 9 000 (or 12 000) kilometres a year, for few insurance firms 20 000 kilometres per year.
- Woman-, single- and partner-rebates were given in cases in which only these persons drove the car.
- Ecological rebates were possible if the policy holder's car did not consume more than five litres per 100 kilometres or the policy holders owned a ticket for a local traffic provider.
- Special rebates were given to policy holders who were of middle age or police officers. Other characteristics were safety training or another insurance contract existing with the same firm.
- Additional premiums for old cars had to be paid if the car was seven or more years old.

- Some firms charged additional premiums for a lot of kilometres if the policy holders drove more than 20 000 or 30 000 kilometres a year.
- Cars which were seen as special risks by the insurers were classified in special type classes.
- In some cases insurers only agreed to insure the car if the policy holder accepted an individual additional premium.
- Special additional premiums were charged if the policy holder drove more than 50 000 kilometres a year or to states in eastern Europe.

Some insurers combined different rebates and additional charges. I hereafter interpret every rating criterion as one single characteristic. It is too complex to introduce combined rebates and additional charges. Rating systems which were used before the deregulation of 1994 (rebates for handicapped persons, civil servants or employees of special firms) are not introduced in my analysis.

The frequencies of the 14 new rating systems at the three dates are given in table 1. In the beginning of the deregulation process the motor vehicle insurers used additional premiums for special classes intensively and they levied individual additional premiums. One year later, in 1996, the characteristics “special classes” and “individual” were almost completely abolished because the pressure group “Gesamtverband der Deutschen Versicherungswirtschaft (German Insurance Association)” recommended a new classification system by sorting the cars in special classes (“Typklassen” (type classes); see *von Schorlemer* 1996). 1996 some new tariff attributes became important: new car, old car, garage, and drivers with few kilometres. Looking at 1997 this trend was continued: The age of the car, the usage of garage, and drivers with few kilometres a year were often taken as characteristics by automobile insurers.

Table 1: New Rating Systems

		1995 (n: 96)	1996 (n: 106)	1997 (n: 105)
		existing?	existing?	existing?
Rebates		values in percent		
1	New car	3.1	69.8	72.4
2	First user	1.0	0.9	12.6
3	Garage etc.	3.1	34.0	65.7
4	Driver with few kilometres	3.1	34.9	64.8
5	Only women as driver	4.2	22.6	21.9
6	Only policy holder as driver (single rebate)	1.0	6.6	23.8
7	Only policy holder and partner/spouse as drivers (partner rebate)	4.2	4.7	35.2
8	Ecological rebate (cars with little gasoline consumption etc.)	1.0	1.9	3.8
9	Special (Age of policy holder, traffic experience, other insurance contracts, etc.)	11.5	24.5	31.4
Additional premium				
10	old car	9.4	49.1	56.2
11	Driver with a lot of kilometres (more than 20 000 or 30 000 km a year)	2.1	7.5	31.4
12	Special classes of cars	60.4	9.4	52.4
13	Individual	47.9	5.7	30.5
14	Special (age of driver, etc.)	5.2	4.7	2.9

Sources: Finanztest 1995, 1996, and 1997. Own calculations.

In table 2 I summarize descriptive values concerning the usage of new tariff systems in Germany. In the upper half of table 2 you find particular items to all rebates and premiums, to all rebates, and to all additional premiums chosen by insurance firms. In the beginning of 1995 more than 77 percent of the firms introduced one or more new tariff items. In 1996, it was 80 percent of the firms, and in 1997 it was nearly all firms. Looking at the mean values shows that the value of the new rating systems increases from 1.6 items in 1996 to 5 items in 1997. The usage of rebates has remarkably grown. The lower half of table 2 summarizes the results for aggregated rebates and additional premiums: age of car, kilometres a year, rebates for using restrictions, and special items. Comparing 1996 with the year before we can see that new rating systems got important. Particularly the age of cars was very often used to calculate premiums. In 1997, the importance of new tariff items increased further on: Three of four insures used kilometres a year and age of car for rebates or additional premiums.

Table 2: New Rating Systems - Descriptive Analysis

Sum of variables:	max.:	1995 (n: 96) one or more (in percent)	1995 mean	1995 standard deviation	1996 (n: 106) one or more (in percent)	1996 mean	1996 standard deviation	1997 (n=105) one or more (in percent)	1997 mean	1997 standard deviation
All rebates and additional premiums	14	77.1	1.6	1.3	80.2	2.8	2.2	99.0	5.1	2.4
All rebates	9	25.0	0.3	0.7	80.2	2.0	1.7	95.2	3.3	1.9
All additional premiums	5	76.0	1.3	1.0	56.6	0.8	0.8	94.3	1.7	0.9
Different classification:										
Age of car	2	11.5	0.1	0.4	71.7	1.2	0.9	76.2	1.3	0.8
Kilometres a year	2	5.2	0.1	0.2	34.9	0.4	0.6	64.8	1.0	0.8
Using restrictions: (woman-, single-, partner rebates)	3	7.3	0.1	0.4	26.4	0.4	0.6	45.7	0.8	1.0
Special rebates or additional premiums (Ecological rebates, special rating systems)	3	15.6	0.2	0.4	27.4	0.3	0.5	34.3	0.4	0.6

Own calculations.

By using the results of tables 2 I can relate the used characteristics to two different stages of competition:

- If less than fifty percent of the firms have used a new tariff characteristic, the usage of this item was classified as innovative competition.
- Imitative competition can be assumed in case of inclusion by half the insurance companies or more.

Table 3 represents the results given by these classification rules.

Table 3: Innovative and Imitative Competition in Germany

	1995	1996	1997
Age of car	Innovative (N)	Imitative (M)	Imitative (M)
Kilometres a year	Innovative (N)	Innovative (N)	Imitative (M)
Using restrictions: (woman-, single-, partner rebates)	Innovative (N)	Innovative (N)	Innovative (N)
Special rebates or additional premiums (Ecological rebates, special rating systems)	Innovative (N)	Innovative (N)	Innovative (N)
Garage	Innovative (N)	Innovative (N)	Imitative (M)

Own calculations; assessments based on tables 1 and 2.

For the usage of new tariff items in motor vehicle insurance in 1999 table 4 is relevant. Rating systems concerning the age of the car, garage, or few kilometres were still important as in the years before.

Table 4: Rating systems/Spring 1999 - values in percent (99 firms)

	existing?
New car	27.2
Age of the car	87.9
Garage	73.7
Woman/driver alone	31.3
Driver: policyholder or partner only	11.1
Driver: policyholder or spouse	3.0
Driver: family only	1.0
Restricted drivers	53.5
Drivers with few kilometres a year	73.7
Safety training	3.0
Discount for handicapped persons	6.1
Contract in other insurance line	35.4

Source: Plus (1999, pp 40-42). Own calculations.

3 Theoretical Background

Following the famous paper of *Rothschild/Stiglitz* (1976) rating systems are instruments to classify policy holders in groups with high risks and low risks (see also *Chiappori/Salanie* (2000), and *Wein* 2001, pp 39-61). Assuming that regulation before 1994 had prevented the use of good classifying rating systems we had to expect more risk-based premiums after deregulation. It was especially possible that the rebates and additional premiums generated such effects.

Additional premiums or rebates have two effects:

- An insurer who uses these new tariff items can expect to get different damage values. For example, attracting good risks by rebates probably generate a lower mean damage as before.
- Using additional premiums or rebates have effects on the firms' premium revenues. Additional premiums which are levied to "old" policy holders rise the firms' revenues.

To measure these effects it is necessary to analyze the loss ratio of time t:

$$LR_t = \frac{\text{sum of claims}_t}{\text{sum of gross premiums}_t} \cdot 100 = \frac{L_t}{P_t}$$

Looking at the beginning of the deregulation process it is obvious that insurers had different loss ratios. These differences might have been consequences of varying business strategies chosen by firms in the past. One strategy could be to attract high risk policy holders with high premium revenues; in this case the firm had accepted a high loss ratio. Another strategy could have been attracting low risks with the result of a low loss ratio. Furthermore, it can be assumed that new firms suffered high loss ratios because they had to learn selecting good policy holders or charging sufficient premiums. To assess the effects of new tariff items empirically it is necessary to include the loss ratios of the past. I will take this effect into account when I use the variation rate of loss ratios

$$VR_T = VR_{t+1/t} = \frac{LR_{t+1} - LR_t}{LR_t} \cdot 100.$$

The expected sign of variation rate depends on several conditions which will be presented in the following:

- Because of using rebates initially an insurer is able to attract low risks. Initially using means that the special rebate was used by less than 50 percent of all competitors. The special rebate is part of innovative competition (*case 1*).
- Introducing a special rebate may be a reaction of the former use of this item by another competitor. The insurers will do this to prevent low risks from wandering away. We have an example of imitative competition (*case 2*).
- Firms which are implementing additional premiums at first can push away high risks. Such innovative competition will be analyzed as *case 3*.
- Additional premiums may be also the reaction of innovative behavior of other firms. This imitative competition may be necessary to hinder high risks from contracting the firm (*case 4*).

Case 1: If an insurer introduces rebates its low risks will have to pay less premiums; the premium revenues go down compared to the year before ($-\triangle P$). Because of attracting good risks premium revenues ($+P^N$) rise and damages also increase ($+L^N$). Hence, one year later the insurer have got the new loss ratio t+1:

$$LR_{t+1} = \frac{L_t + L^N}{P_t - \Delta P + P^N}$$

To decide about the expected sign of the variation rate VR_T it is necessary to compare LR_t and LR_{t+1}. If LR_{t+1} is smaller than LR_t,

$$\frac{L_t + L^N}{P_t - \Delta P + P^N} < \frac{L_t}{P_t},$$

VR_t will be negative. Rearranging the last equation the following will be given:

$$\frac{L^N}{P^N - \Delta P} < \frac{L_t}{P_t}.$$

Therefore, a negative variation rate can be expected, if L^N is very small or P^N -△P becomes very high. A small L^N may be the result of successful attracting good risks. For simplicity I assume that such a scenario is given. A great difference between P^N and $\triangle P$ can be the result of two different effects. On the one hand, the additional premium income P^N which are received from the new good risks can be very important. On the other hand, the premium revenue losses △P which are the result of giving rebates to old policy holders are perhaps neglectable. It seems possible that a rebate which is only given from one firm or from few firms can be small. In this case the additional premium earnings (P^N) will be high and the premium revenue losses (△P) will be low. Hence, the probability of a negative variation rate will be high if rebates are given as a result of innovative competition. With increasing competition (more imitative activities) the market forces higher rebates. We expect that imitative competition enforces a zero or positive variation rate of loss ratio.

Case 2: Introducing a special rebate as an answer of past innovative behavior of other firms (imitative competition) has the aim to prevent the outgoing of own low risks to competitors which are supplying this rebate. The imitative firm has the problem that under such circumstances the damages remain constant and the revenues decrease. The loss ratio of the following year can be written as:

$$LR_{t+1} = \frac{L_t}{P_t - \Delta P}$$

Hence, the denominator decreases, and LR_{t+1} increases. The variation rate VR_T is positive with certainty. In other words: If we have an imitative competition with rebates we will expect a positive sign of the variation rate of loss ratio.

Case 3: Innovators which are using additional premiums are able to create incentives to high risks to leave their firm.[1] As one consequence it is obvious that the damages which have to be paid by the innovative firm decreases ($-L^M$). The other consequence will be declining premium revenues ($-P^M$). Hence, the loss ratio of t+1 can be calculated by

$$\mathrm{LR}_{t+1} = \frac{\mathrm{L}_t - L^M}{\mathrm{P}_t - P^M}.$$

The variation rate VR_T will be negative if LR_{t-1} is smaller than LR_t. Written as an equation this means:

$$\frac{L_t - L^M}{P_t - P^M} < \frac{L_t}{P_t}.$$

Rearranging the last equation we will get:

$$\frac{L^M}{P^M} > \frac{L_t}{P_t}.$$

The result means that a negative variation rate appears, if the loss ratio of the leaving policy holder is higher than the loss ratio in the pre-deregulation period. We have assumed that before deregulation market forces had not enforced risk-based premiums and new additional premiums may be one way to more risk-based premiums. Hence, we must expect that the last equation is given. Therefore, we expect a negative variation rate as a result of innovative competition with introducing additional premiums.

[1] I assume that all high risks leave the innovative insurer.

Case 4: The insurer introduces additional premiums as a consequence of the behavior of other firms which have already introduced additional premiums. The aim of this imitative strategy is to prevent high risks from entering the firm. Assuming that this strategy is successful the new loss ratio is:

$$LR_{t+1} = \frac{L_t}{P_t}.$$

The variation rate of loss ratio remains constant in this case of imitative competition.

If I sum up the four cases two effects can be extracted:

- Additional premiums or rebates which are offered as a part of innovative competition are leading to negative variation rates of loss ratios.
- Constant or positive variation rates of loss ratios can be expected as the result of imitative competition which were based on the tariff items.

Using rebates and additional premiums as instruments of innovative competition we expect the decrease of loss ratios needs time on the one hand. Lower loss ratios would not only be relevant in the period in which the insurer uses the new rating system. It needs time until low risks move to the firms with new rebates and additional premiums and bad risks leave these firms. Therefore, I expect that the rating system in t does not only have consequences on the loss ratio in t, but also in t+1, t+2 and so on. On the other hand it is theoretically certain that after a given period all risks have chosen their optimal insurer. At the end the selection effect of rating system is finished, and the loss ratios remain stable over time, an equilibrium is reached. Hence, the variation rate of loss ratios should be zero after several periods of introduction. It is impossible from the theoretical point of view to determine how many years the selection process will require. One hypothesis can be made: The longer before the innovative tariff item was introduced, the lower is the probability of a negative variation rate and a constant variation rate can be expected.

At the end of the theoretical part I would like to bring in mind another hypothesis. In the beginning I assumed that the additional premiums and rebates are good

instruments to select between low and high risks. But this assumption may be wrong. Insurers have difficulties to know which rebates and additional premiums are good predictors of the policy holders' risk. If some of the new tariffs do not improve the selection process which the used criteria before deregulation had done the following effects will occur:

- A "wrong" rebate given to "old" policy holders has no influence on the damages but decreases the premium revenues. The loss ratio in the following goes up and the variation rate becomes positive.
- A "wrong" additional premium creates incentives for "old" policy holders who are good risks to leave the firm. Analogous to case 3 mentioned above we can expect that the loss ratios of the leaving policy holders are lower than of the remaining clients. Hence, the new loss ratio increases and variation rate has a positive sign.

"Wrong" new tariffs should have the effect of increasing variation rates. As in the case of innovative competition with "right" tariffs it seems plausible that the reaction on false additional premiums needs time. Therefore, the variation rate may be positive in t, in t+1, t+2 and so on.

Not only using new tariff items can have an influence on the variation rate of loss ratios. Following facts may influence the variation rate, too:

- If motor vehicle insurers had restricted their local working area they would perhaps have been able to reach lower claims than unrestricted firms, due to an attraction of low risk policy holders. A restricted firm would have lower loss ratios, and if a local restriction has influence in every period their variation rate will be negative.
- Insurers who only take out a policy on special groups (for example civil servants) hope that the selected group causes lower damages. As with the local restriction the personal restriction should imply lower loss ratios and a negative variation rate on loss ratios.
- The influence of insurers which are selling their insurance contracts by own agents can have two opposite effects. On the one hand, if the own agents are interested in selecting low risks and able to do so, the firms with an own field service have lower damages than firms without own agents. Assuming that this effect is working in every period this kind of insurer has a lower loss ratio in the following year and a

negative variation rate of loss ratios. On the other hand, agents who are interested in maximizing provisions and therefore the number of contracts may also accept bad risks. Such a maximizing strategy must lead to higher loss ratios and positive variation rates of loss ratios if this incentive exists in every period.

4 The data set

For analyzing the influence of the new rating systems on firm specific damages I created an own data set which I have called “motor vehicle insurance market” (see also *Wein* 2001). The information about using new rebates and additional premiums was described in the second chapter of this paper. *Tillinghast Towers Perrin* (2001) collected loss ratios from nearly all motor vehicle insurers which are active in business in Germany. I used these ratios from 1991 to 1999, the last recorded year at the moment. The descriptive values about the loss ratios in my data set are given by table 5. The medians and the means have nearly the same values. But in 1997 we have got an exception because one new firm has a very high value. Minimum, maximum, standard deviation and numbers of collected firms are also reproduced in table 5.

Table 5: Loss Ratios - Data Set “Motor Vehicle Insurance Market”

		1991	1992	1993	1994	1995	1996	1997	1998	1999
Mean:	%	0.924	0.979	0.945	0.846	0.837	0.846	0.934	0.918	0.935
Median:		0.909	0.950	0.928	0.832	0.818	0.827	0.855	0.916	0.942
Minimum:		0.309	0.781	0.658	0.544	0.590	0.564	0.623	0.121	0.590
Maximum:		1.176	2.467	1.447	1.137	2.536	1.801	8.372	1.405	1.209
Standard-deviation:		0.1	0.179	0.106	0.071	0.180	0.138	699	0.135	0.106
n:		107	109	111	111	112	117	119	111	111

Source: Data Set “motor vehicle insurance market”.

Following the theoretical considerations it is necessary to regard the variation rates of loss ratios in order to investigate the connection between new rating systems and damages. In table 6 I calculated the variation rate of loss ratios in my data set. The values for means and medians show conformably that the German motor vehicle insurers typically had decreasing loss ratios between 1992 and 1995. Form 1995 to 1996 they were nearly constant and they increased in later periods.

Table 6: Variation Rate of Loss Ratios - Data Set “Motor Vehicle Insurance Market

		91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Mean:	%	5.474	-3.049	-10.08	-2.562	1.521	2.975	5.303	6.936
Median:		3.737	-1.314	-8.829	-2.099	0.860	4.174	5.755	1.963
Minimum:		-17.61	-57.07	-29.44	-29.76	-51.77	-44.32	-8758	-30.56
Maximum:		187.4	22.41	4.41	46.51	55.67	43.11	7367	538.3
Standard deviation:		19.14	9.994	5.824	9.633	12.21	12.129	17.69	52.46
n:		107	109	110	111	112	115	111	109

Source: Data Set “motor vehicle insurance market”.

In the data set “motor vehicle insurance market” I have one information for every firm about local restriction or not (1 = yes, 0 = no;). Personal restriction and the question about having an own field service with own agents or not are also given as dummy variables (see *Versicherungsreport* 1996, 1997 and *Wein* 2001).

5 Cross sectional analysis

Using the theoretical considerations deduced two chapters before I estimated this equation for the variation rates VR_T:

$$VR_T = b_0 + \underbrace{b_1 N_t}_{-} + \underbrace{b_2 N_{t-1}}_{-} + \ldots \underbrace{b_3 M_t}_{+} + \underbrace{b_4 M_{t-1}}_{+} + \ldots$$
$$+ \underbrace{b_5 Service}_{+-} + \underbrace{b_6 Local}_{-} + \underbrace{b_7 Personal}_{-} + m_i$$

To specify this general cross sectional equation I make use of my data about new rating systems in two ways:

S A new rating system can be measured as defined groups “garage, age of car, kilometres driven a year, using restrictions and special items” (see chapter 2). According to table 3 I subsumed the groups age of cars$_{95}$, kilometres a year$_{95, 96}$ using restrictions$_{95, 96, 97}$, special rebates or additional premiums$_{95, 96, 97}$ and garage$_{95, 96}$ as innovative variables $N_{95, 96, 97}$. Age of cars$_{96,97,}$ kilometres a year$_{97,}$ and garage$_{95, 96}$ were classified as imitative variable $M_{96, 97.}$ Because the variation rates VR_T are given in the data set for the years 95/94, 96/95, 97/96, 98/97, and 99/98 I am able to estimate the explaining variables out of 1995 for 95+4 years, variables out of 1996 for 96+3 years, variables out of 1997 for 97+2 years.

- The number of rebates and additional premiums can be counted whether they are used as innovative or imitative variables defined like table 3. Innovative competition can be tested from 1995 until 1999 at maximum. From 1996 to 1999 estimations are possible concerning the influence of imitative competition on variation rates.

All cross sectional estimations used the Ordinary Least Square (OLS-)-method (see *Gujarati* 1995 or *Hill/Griffiths/Judge* 1997). Furthermore, I conducted a normality-test after Jarque-Bera and a homoscedasticity-test after White to check for important assumptions of the OLS-method (see *Greene* 1997, *Gujarati* 1995, and *Kawakatsu* 1998). The used statistical software package had been EViews 4.0.

Do rebates and additional premiums which are given in the year t have influence on the variation rate of the same year? Table 7 presents the estimation results to this question. Model 1 analyzed the effects of new tariff items used at the beginning of 1995 to the loss ratios of 1995. All used rebates and additional premiums are innovative action of the insurers; therefore, we should expect a negative sign for the variation rate 1995. Looking at the 5 innovative variables, age of car is the only one which has the expected negative and significant sign: Insurers which had used age of car tariffs were able to diminish their loss ratio round about 9 percent compared to 1994. This coefficient is significant on the 1-percent-level. All other variables, including the dummies for own field service, locally, and personally restricted have no significant signs. But Model 1 should be carefully interpreted because the adjusted R^2 is small (7 percent), the whole model is only significant on the 10-percent-level and the assumption of normal distributed residue must be rejected.

Table 7: Rebates and Additional Premiums$_t$ and Variation Rate of Loss Ratio$_T$[1]

	model 1 1995	model 2 1996	model 3 1997[3]
Age of car rebates and additional premiums in 1995^N / 1996^M / 1997^M (one or more=1)	-8.828*** (-3.152)	0.753 (0.320)	-1.862 (-0.666)
Kilometre rebates and additional premiums in 1995^N / 1996^N / 1997^M (one or more=1)	-2.708 (-0.585)	-8.386** (-2.161)	7.352* (1,899)
Using restricted rebates in 1995^N / 1996^N / 1997^N (one or more=1)	-2.385 (-0.618)	4.287 (1.525)	-2.524 (-0,928)
Special rebates and additional premiums in 1995^N / 1996^N / 1997^N (one or more=1)	-1.795 (-0.682)	0.627 (0.294)	-5.970** (-2.364)
Garage rebate in 1995^N / 1996^N / 1997^M (Yes=1)	0.938 (0.184)	3.496 (0.999)	-1.498 (-0.441)
Own field service (Yes=1)	0.446 (0.211)	0.974 (0.440)	3.553 (1,176)
Locally restricted (Yes=1)	-0.264 (-0.276)	-1.089 (-1.038)	-0.127 (-0.150)
Personally restricted (Yes=1)	0.180 (0.057)	5.065 (1.389)	-5.051* (-1.954)
constant	-1.754 (-0.936)	0.708 (0.280)	2.378 (0.884)
R^2 (adjusted)	0.068	0.015	0.069
F-value (p-value)	1.779* (0.094)	1.174 (0.324)	1.889* (0.072)
n:	87	95	97
test of normality after Jarque/Bera[2]	H_0^{na} (0.406)	H_0^{a***} (0.004)	H_0^{a***} (0.000)
test of homoscedasticity after White[2]	H_0^{na} (0.991)	H_0^{na} (0.929)	H_0^{a***} (0.000)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_o^a: null hypothesis could be rejected, H_o^{na}: null hypothesis could not be rejected; p-values in parantheses.
[3] Heteroskedastie-consistent-OLS-Estimation after White.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

The influence of used new tariff systems in the year 1996 was estimated with model 2. Rebates and additional premiums concerning kilometres per year which had been applied at the beginning of 1996 were part of the innovative competition. Therefore, we must expect a negative sign of the coefficient. Model 2 shows that this sign was estimated significantly (5-percent-level). The t-values of all other variables are not significant. For the whole model we have the problems that the adjusted R^2 is very small and the model is insignificant. But normality-test and homoscedasticity-test do not indicate estimation difficulties.

Regarding model 3 three coefficients are significant and have the expected signs. Kilometres rebates and additional premiums which are implemented at the beginning of 1997 were used by more of half of the insurance companies. Hence, they can be classified as instruments of imitative competition and we predict an increasing loss

ratio in 1997 compared to 1996 (positive variation rate). The coefficient indicates that the loss ratios increase with round about 7 percent, but the certainty of this results is only given on the 10-percent-level. Special rebates and additional premiums are not very often applied in the early months of 1997; they can be seen as a kind of innovative competition. Therefore decreasing loss ratio in 1997 were expected. The empirical evidence is not able to reject this hypothesis (significant on the 5-percent-level). All other variables have no significant coefficients. Firms which do not insure all clients have a declining loss ratio in 1997 as expected. Model 3 is able to explain nearly 7 percent of the variance in the explained variable, is significant on the 10-percent-level, and normality and homoscedasticity distribution seems to be given. Summing up model 3 it cannot reject hypotheses about the expected sign in 4 cases, all other variables have no influence, and the whole model is econometrically acceptable, although on a low level.

If we restrict our investigation on the effects in the same year we will receive the expected signs of variables. But we have also a lot of coefficients which are not significant, that could be the result of wrong tariffs used to classify policy holders better than before.

New tariffs which are given in the year before (t-1) may also have influence on variation rate of loss ratio T. Looking at table 8 it is possible to find the estimation results to this question. Model 4 and model 5 shows that in two cases innovative behavior coincides with the expected negative sign. Applying age of car in 1995 significantly diminishes the loss ratios in 1996, and special tariff items at the beginning of 1996 reduce the loss ratios one year later. All other variables are not significant. The whole models should be carefully interpreted because the statistical tests do not allow to accept the OLS-method. Accepting the counter-arguments “many insignificant coefficients” and “bad model characteristics” we receive results which are in line with the theoretical arguments. As mentioned above insignificant coefficients can be explained by the unsuitability of these premium as classifying instruments.

Table 8: Rebates and Additional Premiums$_{t-1}$ and Variation Rate of Loss Ratio$_T$[1]

	model 4 1996	model 5[3] 1997	model 6 1998
Age of car rebates and additional premiums in 1995^N / 1996^M / 1997^M (one or more=1)	-4.759*** (-1.540)	-0.675 (-0.334)	5.902 (0.841)
Kilometre rebates and additional premiums in 1995^N / 1996^N / 1997^M (one or more=1)	-3.431 (-0.672)	7.335 (1.344)	-1.466 (-0.329)
Using restricted rebates in 1995^N / 1996^N / 1997^N (one or more=1)	5.016 (1.178)	-2.924 (-0.737)	-2.817 (-0.688)
Special rebates and additional premiums in 1995^N / 1996^N / 1997^N (one or more=1)	6.675 (2.299)	-6.583** (-2.476)	-2.608 (-0.682)
Garage rebate in 1995^N / 1996^N / 1997^M (Yes=1)	-4.775 (-0.849)	-4.606 (-0.913)	-0.350 (-0.085)
Own field service (Yes=1)	1.795 (0.770)	1.272 (0.414)	-4.196 (-1.230)
Locally restricted (Yes=1)	-1.697 (-1.612)	-0.077 (-0.813)	-1.269 (-0.695)
Personally restricted (Yes=1)	5.999 (1.704)	-1.129 (-0.528)	4.504 (1.276)
constant	-0.170 (-0.082)	4.482 (2.164)	6.000 (1.198)
R^2 (adjusted)	0.053	0.037	-0.040
F-value (p-value)	1.601 (0.138)	1.470 (0.179)	0.559 (0.808)
n:	87	99	92
test of normality after Jarque/Bera[2]	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
test of homoscedasticity after White[2]	H_0^{na} (0.985)	H_0^{a***} (0.000)	H_0^{na} (0.441)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_o^a: null hypothesis could be rejected, H_o^{na}: null hypothesis could not be rejected; p-values in parantheses.
[3] Heteroskedastie-consistent-OLS-Estimation after White.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

The use of rebates and additional premiums two years ago could be important for the actual development of loss ratios. *The variation rate of loss ratio in T can be influenced by new rating systems used in the year t-2* (see table 9). Models 8 and 9 must not intensively be interpreted because any coefficient is significant and the whole models cannot be accepted from the econometric viewpoint. Model 7 indicates that the innovative use of age of car or kilometre rebates and additional premiums in 1995 increases the loss ratios in 1997 compared to 1996; age of car variable is significant on the 10 percent level and kilometre based premiums are significant on the 5 percent level. But model 7 is not significant at all and cannot explain a lot of the variance.

Table 9: Rebates and Additional Premiums$_{t-2}$ and Variation Rate of Loss Ratio$_T$[1]

	model 7 1997	model 8 1998	model 9 1999
Age of car rebates and additional premiums in 1995^N / 1996^M / 1997^M (one or more=1)	6.068* (1.918)	5.553 (1.502)	8.961 (0.555)
Kilometre rebates and additional premiums in 1995^N / 1996^N / 1997^M (one or more=1)	11.604** (2.108)	-3.132 (-0.523)	-5.144 (-0.273)
Using restricted rebates in 1995^N / 1996^N / 1997^N (one or more=1)	-5.161 (-1.172)	-1.341 (-0.304)	-1.336 (-0.086)
Special rebates and additional premiums in 1995^N / 1996^N / 1997^N (one or more=1)	-3.262 (-1.154)	-1.308 (-0.397)	-9.239 (-0.671)
Garage rebate in 1995^N / 1996^N / 1997^M (Yes=1)	2.582 (0.379)	4.334 (0.806)	-15.605 (-0.869)
Own field service (Yes=1)	-0.635 (-0.272)	-3.764 (-1.105)	3.633 (0.254)
Locally restricted (Yes=1)	1.555 (1.447)	-1.442 (-0.912)	5.837 (0.860)
Personally restricted (Yes=1)	-3.728 (-1.042)	6.509 (1.164)	-9.132 (-0.406)
constant	3.581* (1.736)	4.014 (1.017)	15.433 (0.764)
R^2 (adjusted)	0.043	-0.03	-0.053
F-value (p-value)	1.499 (0.170)	0.659 (0.726)	0.443 (0.891)
n:	90	94	90
test of normality after Jarque/Bera[2]	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a***} (0.000)
test of homoscedasticity after White[2]	H_0^{na} (0.914)	H_0^{na} (0.649)	H_0^{na} (0.518)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_o^a: null hypothesis could be rejected, H_o^{na}: null hypothesis could not be rejected; p-values in parantheses.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

The given data set allows to test whether *rebates and additional premiums in the year t-3 have influence in the year t on the variation rates of loss ratios* (see table 10). Models 10 + 11 which tried to test the influence from 1995 to 1998 or from 1996 to 1999 have no significant coefficients and lead to insignificant whole models. These results can be explained in two ways: On the one hand, the theoretical model which interprets new tariff items as methods to classify risks is correct because after three years a significant influence cannot be expected. On the other hand, the theoretical model must be rejected because rebates and additional premiums are not useful to select between low and high risks.

Table 10: Rebates and Additional Premiums$_{t-3}$ and Variation Rate of Loss Ratio$_T$[1]

	model 10 1998	model 11 1999
Age of car rebates and additional premiums in 1995^N / 1996^M (one or more=1)	3.180 (0.857)	-24.766 (-1.553)
Kilometre rebates and additional premiums in 1995^N / 1996^N (one or more=1)	-5.232 (-0.832)	-5.422 (-0.208)
Using restricted rebates in 1995^N / 1996^N (one or more=1)	3.347 (0.619)	7.594 (0.407)
Special rebates and additional premiums in 1995^N / 1996^N (one or more=1)	3.092 (0.975)	-0.130 (-0,009)
Garage rebate in 1995^N / 1996^N (Yes=1)	-8.760 (-1.149)	-0.064 (-0.003)
Own field service (Yes=1)	-2.975 (-1.127)	9.619 (0.677)
Locally restricted (Yes=1)	-0,617 (-0.513)	3.673 (0.558)
Personally restricted (Yes=1)	1.094 (0.273)	-21.920 (-0.936)
constant	7.661 (3.308)	21.264 (1.282)
R^2 (adjusted)	-0.045	-0.053
F-value (p-value)	0.547 (0.817)	0.429 (0.900)
n:	86	92
test of normality after Jarque/Bera[2]	H_0^{a**} (0.017)	H_0^{a***} (0.000)
test of homoscedasticity after White[2]	H_0^{na} (0.358)	H_0^{na} (0.547)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_o^a: null hypothesis could be rejected, H_o^{na}: null hypothesis could not be rejected; p-values in parantheses.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

It is possible, but not very probable that the *use of using new tariff items needs 4 years until the loss ratio changes*. Table 11 reports the possible estimation about this hypothesis. The results are identical to table 10. Hence, the economic interpretation is the same: On the one hand, long run effects do not occur as expected, on the other hand, additional premiums and rebates are not good risk classifying instruments.

Table 11: Rebates and Additional Premiums$_{t-4}$ and Variation Rate of Loss Ratio$_T$[1]

	model 12 1999
Age of car rebates and additional premiums in 1995^N (one or more=1)	2.464 (0.644)
Kilometre rebates and additional premiums in 1995^N (one or more=1)	-0.820 (-0.127)
Using restricted rebates in 1995^N (one or more=1)	-6.977 (-1.252)
Special rebates and additional premiums in 1995^N (one or more=1)	-1.232 (-0.377)
Garage rebate in 1995^N (Yes=1)	-5.524 (-0.704)
Own field service (Yes=1)	-1.715 (-0.629)
Locally restricted (Yes=1)	0.115 (0.093)
Personally restricted (Yes=1)	1.860 (0.450)
constant	4.902** (2.055)
R^2 (adjusted)	-0.054
F-value (p-value)	0.465 (0.877)
n:	85
test of normality after Jarque/Bera[2]	H_0^a*** (0.000)
test of homoscedasticity after White[2]	H_0^{na} (0.990)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_o^a: null hypothesis could be rejected, H_o^{na}: null hypothesis could not be rejected; p-values in parantheses.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

Table 12 summarizes the influence of the number of innovative additional premiums and rebates used in the years 1995 to 1997 and the number of imitative new rating systems (given in the years 1996 and 1997) on the variation rates of loss ratios VR_T. The estimation can be done with variation rates from 1995 to 1999 at maximum. The results are as follows:

- Model 13 cannot reject the hypothesis that innovative behavior in 1995 has a negative effect on the variation rate of the same year (significant on the 1 percent level).
- Model 14 shows that innovative or imitative actions done by the insurers in 1996 and 1997 have no significant influence on the variation rate of 1996
- Explaining the variation rate of loss rate 1997 the number of innovative and imitative tariff items are significant, but they have the wrong sign as theoretically predicted (model 15).
- Model 16 shows no influence of the new rating systems on the loss rations in 1998.

- **S** The number of innovative behavior in 1996 leads to significant increasing loss ratios in 1999 (model 17). This result could not be explained by our theoretical framework. Imitative behavior in 1997 has the expected sign: Loss ratios in 1999 increases significantly.

Furthermore, model 17 indicates that an own field service is a functioning instrument to reduce loss ratios.

Table 12: Innovative and Imitative Behavior and Variation Rates of Loss Ratio$_T$[1]

		model 13 1995	model 14 1996	model 15 1997	model 16 1998	model 17 1999
Number of innovative additional premiums and rebates in 1995		-1.805*** (-2.505)	0.648 (0.792)	0.797 (0.938)	0.767 (0.780)	-0.986 (-1.077)
Number of innovative additional premiums and rebates...	... in 1996	-	-0.666 (-0.580)	0.523 (0.447)	0.597 (0.439)	3.594*** (2.842)
	... in 1997	-	-	1.670** (2.562)	0.164 (0.212)	-0.812 (-1.113)
Number of imitative additional premiums and rebates...	... in 1996	-	-0.284 (-0.307)	0.719 (0.693)	-0.331 (-0,277)	-1.222 (-1.097)
	... in 1997	-	-	-1.961* (-1.796)	-0.785 (-0.597)	2.830** (2.296)
Own field service (Yes=1)		-0.820 (-0.400)	2.282 (0.958)	1.193 (0.491)	-2.045 (-0.724)	-4.385* (-1.668)
Locally restricted (Yes=1)		0.186 (0.195)	-1.274 (-1.174)	0.597 (0.546)	-0.568 (-0.458)	0.965 (0.836)
Personally restricted (Yes=1)		0.091 (0.028)	4.375 (1.169)	-2.762 (-0.734)	0.952 (0.223)	6.827* (1.720)
constant		0.182 (0.084)	0.310 (0.111)	-2.297 (-0.715)	6.301* (1.692)	2.093 (0.602)
R^2 (adjusted)		0.029	-0.017	0.022	-0.075	0.105
F-value (p-value)		1.637 (0.173)	0.756 (0.607)	1.239 (0.289)	0.305 (0.962)	2.162** (0.041)
n:		87	87	85	81	80
test of normality after Jarque/Bera[2]		H_0^{a*} (0.073)	H_0^{a***} (0.000)	H_0^{a***} (0.000)	H_0^{a*} (0.084)	H_0^{na} (0.158)
test of homoscedasticity after White[2]		H_0^{na} (0.969)	H_0^{na} (0.963)	H_0^{na} (0.957)	H_0^{na} (0.597)	H_0^{na} (0.995)

[1] OLS-estimation; significant on 10 %-, 5 %-, and 1 %-level: *, ** and ***; t-values in parantheses.
[2] H_0^a: null hypothesis could be rejected, H_0^{na}: null hypothesis could not be rejected; p-values in parantheses.
Data set “motor vehicle insurance market; estimated with "EViews 4.0".

All models given in table 12 are not significant. Additionally, not all significant results have the expected signs. Hence, we should be careful to use the models in table 12. , It is especially possible that the aggregation process used in table 12 cannot explain the influence on loss ratios: The counting of the numbers of innovative and imitative tariff items can be the wrong way; to find suitable rebates and additional premiums is much more decisive than to maximize the new tariff items.

6 Conclusions

Since the middle of 1994 the German motor vehicle insurers have had the possibility to calculate their tariffs and to develop their contracts without being authorized by the Federal Insurance Supervisory Office. Moreover, they are now able to reject potential policy holders under special conditions. The firms have already used these new freedom to develop and apply new rating factors. Beginning in 1995 they have been using tariff items which concern the age of the car, driven kilometres a year, or restrictions on particular drivers (woman, single, partner) very often. The aim of the paper was to explain whether the new rating systems are a useful instrument to differ between low and high risks.

Summarizing the results of this paper the following points should be mentioned:

- Applying age of car rebates and additional premiums under innovative circumstances seems to be a successful method to classify policy holders: In the same year and one year later the loss ratios decline as expected. Two years later the effect seems to run out and loss ratios increase again. Kilometres based rating systems during innovative competition create negative variation rates in the same year and two years later. Kilometres based tariffs as an answer to the behavior of other firms are combined with increasing loss ratios in the same year as theoretically expected. Special rebates or additional premiums given as an innovative action decrease the loss ratios one year later - according to the hypothesis of less adverse selection as a result of new rating systems. Age of car may be a good instrument to classify instruments because low risks probably do not use old cars. Driven kilometres per year are a good indicator for riskiness because with less kilometres per year the risk of having a collusion decrease.
- All other new rebates and additional premiums have no significant effects on the loss ratios. Hence, it is possible that these instruments are not useful to classify between low and high risks. Or in other words: The classifying instruments used before deregulation were successful, more instruments are not necessary. Accepting this interpretation we have to look after other arguments why insurance companies innovate or imitate these additional premiums or rebates. One

hypothesis could be that these instruments are good arguments to catch new policy holders without causing high costs.

- The hypothesis that on the long run the new rating systems have no influence cannot be rejected. With the exception of the estimations reported in table 12 which counted the variables of innovative or imitative behavior we have no influence on the long run.
- All estimations about the variation rates of loss ratios cannot explain most of the variance of these variables. We lack information about the firm-specific factors which influence the variation rate of loss ratios. Using the data set as a panel could perhaps explain better these factors. Further research should investigate these questions.
- The theoretical considerations about the dynamic effects of new rating systems are very uncertain. To differentiate between innovative and imitative behavior is difficult. Furthermore, the determination of the short run and the long run aspects is always artificial. Hence, looking at the empirical result we have very often two possible results. One the one hand the empirical results reject the hypotheses. On the other hand the wide-spreading theory is able to explain all possible effects and cannot be rejected.

The paper shows that it is difficult to model dynamic processes and to estimate the models. But if we would like to know whether deregulation in the German insurance market has the effect of applying more risk based premiums, this difficult task had to be done. Accepting the empirical results it seems that age of car or kilometres based premiums have done better their job to differentiate between low and high risks. In other words: Deregulation was helpful to diminish the problem of adverse selection in the German motor vehicle insurance market.

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