Annual Mileage and BMS in Motor Pricing

Axel Wolfstein

Agenda

1. Pushed by J. Lemaire´s talk ASTIN 2013/Deregulation in EU as starting point
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5. Being part of a GLM model (company as well as market level)
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*German association of insurances

1. Pushed by J. Lemaire´s talk ASTIN 2013/Deregulation in EU as starting point

During ASTIN 2013 J. Lemaire held a talk on annual mileage for motor pricing in USA and Taiwan and referred to some issues

1. So far mileage wasn´t really in use due to manipulation/false reporting
2. On the other hand mileage turned out as the most important dimension
3. As in huge literature the BMS models were built separately from other criteria a double counting potential came up

Therefore I thought it could be worthwile to demonstrate the German experience

1. Pushed by J. Lemaire´s talk ASTIN 2013/Deregulation in EU as starting point

Motor tariff structure before deregulation in 1994:

1. BMS (22 classes)
2. Engine power in TPL* (12 classes)/type class in full comprehensive and fire+theft (31 classes each)
3. Territory (depending on big cities/rural areas and governmental employee yes/no)
4. Occupation (3 classes)

All this was part of a central recommendation provided by the German insurance association (GDV) in close relationship with the regulator (especially for TPL: background is the legal obligation to get a TPL insurance, otherwise you can´t register the car and on the other hand insurances are obliged to offer TPL insurance).

This was done as sort of a GLM.

*Third Party Liability

2. Introduction on company level

Motor tariff structure after deregulation in 1994 with new criteria:

1. Mileage
2. Houseownership
3. Parking location
4. Refined territory
5. Type class also for TPL
6. Extended BMS (29 classes, currently 39)
7. Age
8. Age of car
9. Age of car at purchase
10. Occupation (refined)
11. Payment
12. Sex (since Dec 2012 not more legal)
13. User of the car
14. …

More possible tariff cells than cars in Germany!

The central recommendation provided by the German insurance association (GDV) still existed but all add-ons where on company level

3. Becoming part of the GDV recommendation

Motor tariff structure after deregulation in 1994 with new criteria:

1. Driven by (new) possibilities of competition
2. Many other criteria were tried and checked like use of public transport
3. On the central GDV level also new structures were started: type class instead of engine power for TPL which was and is centrally managed on the basis of officially available information about all car types (classification of all car types by burning cost index taking other dimensions into account), refinement of regional level, extension of BMS to 29 classes
4. For the first time an UW cycle (rates went down; overall a reduction of 10% of premium) occurred as an indication for significantly increased competition
5. As competition went on the process of alignment of tariff structures came up to avoid negative selection issues
6. As a consequence the first two new criteria entered the central recommendation (no longer a competitive advantage for a company): parking location and mileage

3. Becoming part of the GDV recommendation

Motor tariff structure after deregulation in 1994 with new criteria:

1. Currently this process is mainly done resulting in significantly more tariff dimensions than before 1994 also involving more potential interactions

2. Almost all criteria are part of the central recommendation and BMS was extended further to 39 classes

3. Each company is free to use this recommendation or deviate from it partly or completely

4. On GDV as well as on company level the evaluation of the tariff is subject to GLM (some details see below)

4. Stability and checks in comparison to other criteria incl market overview

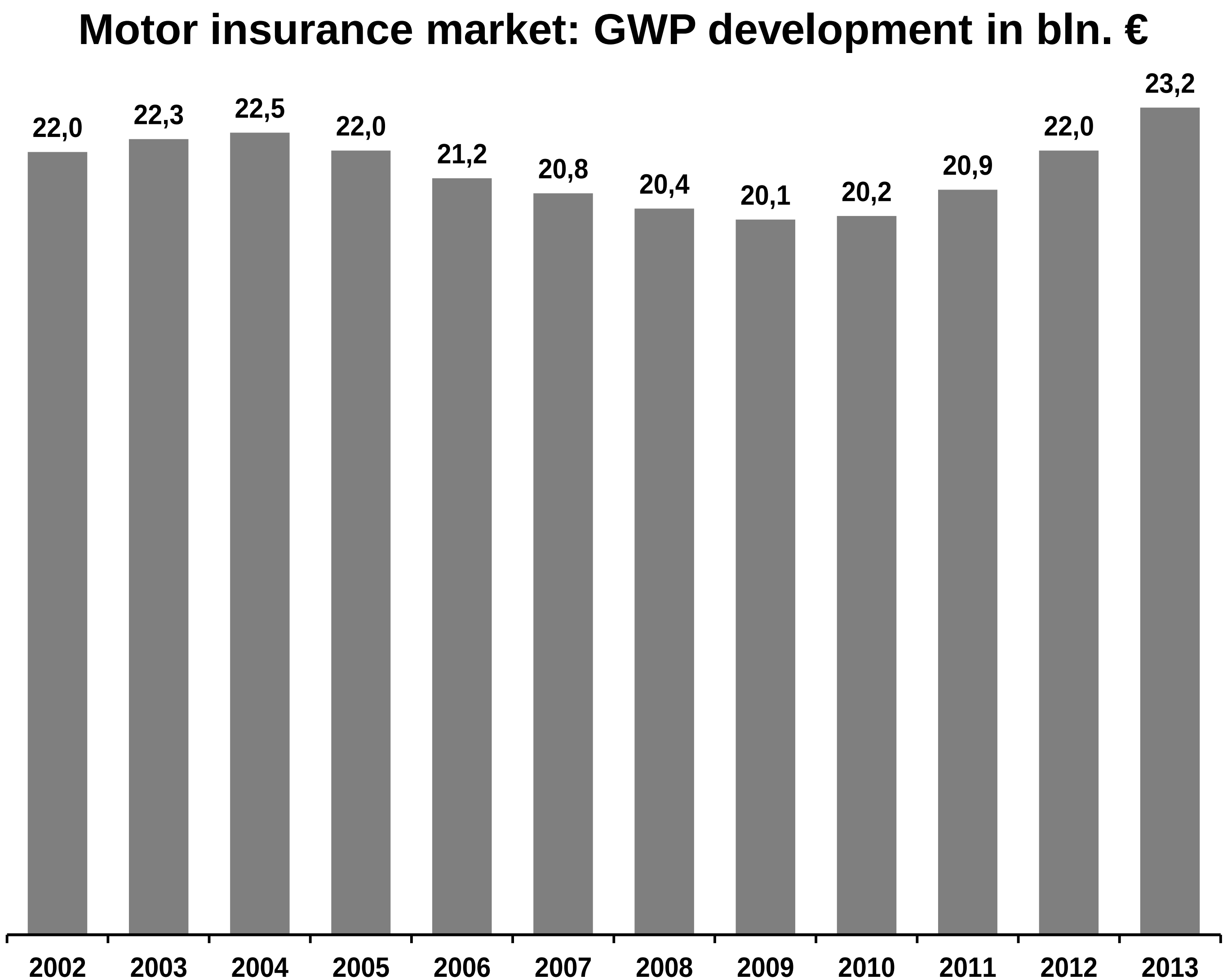
Some background information on the German motor insurance market to highlight/detail what was/is going on with certain tariff dimensions:

1. Still around 60% of the business are done by (classical) tied agent companies.
2. After 1994 some direct insurers started but were coming up significantly slower than forecasted and in other countries.
3. Also the customer behaviour was changing slower: aggregators are clearly growing but still on a lower level than in other countries.
4. In peoples minds data protection is a bigger issue than for example in the UK which had/has an impact on the very reluctant introduction of telematic based tariffs.
5. Since 1994 we faced two rounds of the UW cyle which were seriously oscillating between 20 bln€ and 23 bln€ premium by something like 10%.
6. Split of the German motor market and further information: see next slides
7. Policies have to be actively cancelled if customers want to switch to another insurance (automatic renewal).
8. Pricing is split by tariff generation within BoB* and especially between NB* and BoB

Summing up: The Germans seem to be rather conservative but the market also very competitive.

*BoB: book of business, NB: new business

4. Stability and checks in comparison to other criteria incl market overview



Source: GDV

4. Stability and checks in comparison to other criteria incl market overview

Competitive environment 2013: 96 motor insurers

Allianz 3,2 bln. €	HUK Allg. 1,3 bln. €	AXA 1,2 bln. €	HUK A.G. 1,1 bln. €	VHV 1,1 bln €	

5 companies
7,8 bln. € GWP
34% market share

LVM 1,0 bln €	R+V 882 Mio. €	Zurich. 770 Mio. €	HDI 745 Mio. €	DEVK 689 Mio. €	Württembergische 658 Mio. €
Generali 651 Mio. €	ERGO 650 Mio. €	Kravag Logistik 537 Mio. €	AachenMünch. 507 Mio. €	HUK24. 497 Mio. €	Bay. Vers. Verb. 400 Mio. €

12 companies
8,0 bln. € GWP
34% market share

VGH. 388 Mio. €	Kravag Allg. 375 Mio. €	HDI Gerling Ind. 363 Mio. €	Prov. Rheinland 327 Mio. €	Westf. Prov. 327 Mio. €	Gothaer 294 Mio. €
Signal Iduna 284 Mio. €	DA 282 Mio. €	Itzehoer 241 Mio. €	**Direct Line 215 Mio. €**	Mecklenburg. 191 Mio. €	SV Sparkassen 185 Mio. €
Concordia 184 Mio. €	WGV 165 Mio. €	DEVK Bahn 164 Mio. €	Debeka 159 Mio. €	Prov. Nord 156 Mio. €	**+62 insurers**

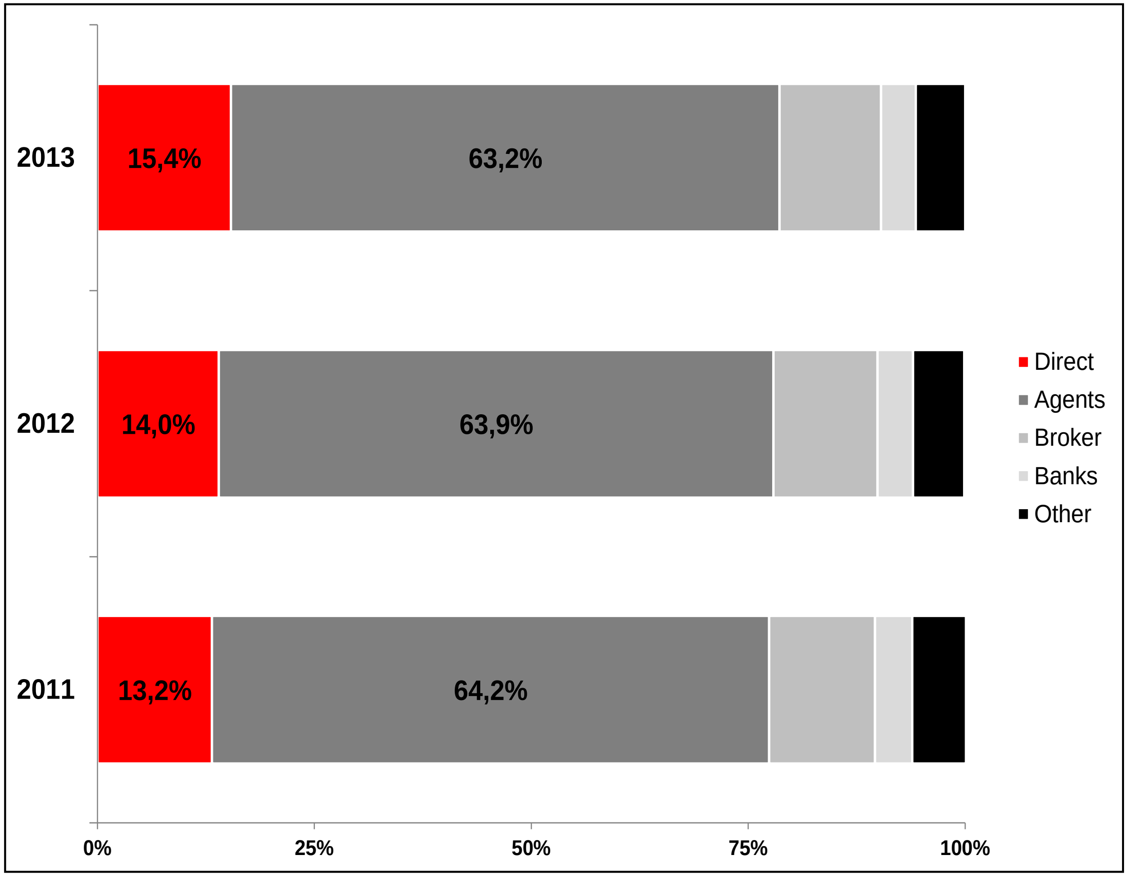
79 companies
7,4 bln. € GWP
32% market share

96 companies
23,2 bln. € GWP

Source: GDV data 2013

4. Stability and checks in comparison to other criteria incl market overview

Market sales channel split for all motor contracts



Source GDV March 2014

4. Stability and checks in comparison to other criteria incl market overview

Let´s look at parking location and mileage in the recent years:

1. Meanwhile parking location lost all distinctive power whereas mileage is still on the same (high) level of differentiation as it started. Why?
2. Both criteria are depending on what the customer is saying.
3. But mileage is subject to potential checks: Customer are asked to tell their current mileage status which could be repeated later on and also in case of a claim to keep people away from lying.
4. If there is a „shift due to lies“ let´s say for one class only the name of the class is wrong, the differentiation stays ok.
5. Since Diesel fuel is cheaper than other fuel types but tax for Diesel cars is higher Diesel only makes sense when driving quite a lot which enables also a check/mistrust in case a Diesel car is said to have a low mileage (average mileage in Germany is between 15,000 and 20,000 km).

Summing up: The Germans seem to tell mainly the truth about their mileage.

4. Stability and checks in comparison to other criteria incl market overview

Let´s look at parking location and mileage in the recent years:

1. Currently 75% of the people are saying that they own a garage to park their car which can´t be true.
2. Therefore there might be quite a lot who do not park their car in a garage but saying this and consequently the distinction was shifted from yes/no to yes/mixture of yes and no and could mostly be neglected.
3. Background: Compared to their (rather) new direct competitors traditional tied agent insurers are located in the high rate area; therefore some 5%-discount for a garage could help out to keep the customer.
4. So a „flexible“ understanding of garage is an advantage for the tied agent who on the other hand might be the control level for customers of having a garage.
5. Therefore the increased occurence of garages might be mainly not driven from the customer or at least provides pricewise/persistency advantages for both sides involved in making the insurance contract.

Summing up: The distinction of this vanished due to an implicit agreement on advantages for the customer and the tied agent.

5. Being part of a GLM model (company as well as market level)

Let´s look at tariff dimensions in use:

1. Criteria used by GDV in TPL (see brief description of providing BMS by GDV below; number of classes in brackets): BMS (39), type class (16), regional class (12), mileage (8), occupation (3), flat/house ownership (2), user (2), age of user (16), car age at purchase(12) => above 23m possible tariff cells
2. Further criteria used by companies: car age, time of owning a car, young driver, payment frequency, payment mode, marital status, time of having a driving license => more tariff cells than cars

6. Brief description of BMS

Description GDV-Bonus/Malus-System

- Relativities/factors in terms of percentages (relative to a reference class) on the basis of market data with certain smoothing (GLM: Poisson distribution with log-link, different dimensions): in earlier time mainly by dividing burning costs for class x and class 1; now different (see below)

- Definition of downgrading in case of a claim with separate data due to more complex data needed: NCD* class from previous year and individual claim number in previous year (same GLM as above; see table below; now with some smoothing by regression)

- GDV model avoids disadvantage of non-entire frequencies on policy level (non-annual policies for example in case of car replacements) which one has to face if using a simple claim number distribution like the Poisson-Gamma approach which can be seen as a Bühlmann credibility model but using the Bühlmann/ Straub model enables the inclusion of weights
  GDV model also uses further dimensions which is a disadvantage of the simple Poisson-Gamma approach but this can also be avoided (see below)

- For all models (that is a general problem) a matrix of relativities would be more appropiate; reduction to a vector which is the practice implies some inhomogenity

•*NCD: no claims discount

6. Brief description of BMS: comparison old/new (recent extension) TPL factors, percentages, reference class (blue underlying)

Portfolio distribution

Relativities/factors

old

NCD classes

Ausprägungen des SF-Merkmals	Jahreseinheiten absolut	%-Ant.	kumul.	SF-Indizes Schadenbedarfe indiziert auf SF 1	untere SF-Index-grenze	obere SF-Index-grenze
1	2	3	4	5	6	7
M	6.133,2	0,04	0,04	246	219	274
0	30.288,0	0,19	0,23	230	214	247
S	42.491,4	0,27	0,50	157	147	169
SF 1/2	684.211,9	4,37	4,87	138	134	142
SF 1	731.547,3	4,67	9,54	100	97	103
SF 2	738.358,9	4,71	14,26	83	80	86
SF 3	747.989,6	4,78	19,04	71	68	73
SF 4	743.054,3	4,74	23,78	62	60	64
SF 5	703.109,9	4,49	28,27	57	55	59
SF 6	706.709,7	4,51	32,78	54	52	56
SF 7	718.317,4	4,59	37,37	51	49	53
SF 8	710.817,1	4,54	41,91	48	47	50
SF 9	678.374,4	4,33	46,24	46	44	47
SF 10	761.591,4	4,86	51,10	43	42	45
SF 11	764.530,5	4,88	55,99	43	41	44
SF 12	613.168,0	3,92	59,90	40	38	42
SF 13	542.042,5	3,46	63,36	39	37	41
SF 14	517.614,3	3,31	66,67	39	37	41
SF 15	554.533,7	3,54	70,21	38	36	39
SF 16	539.183,8	3,44	73,65	37	36	39
SF 17	435.829,3	2,78	76,43	36	34	38
SF 18	454.718,0	2,90	79,34	36	35	38
SF 19	389.710,9	2,49	81,83	34	33	36
SF 20	377.456,8	2,41	84,24	34	33	36
SF 21	368.357,3	2,35	86,59	33	32	35
SF 22	241.178,4	1,54	88,13	32	30	34
SF 23	210.891,3	1,35	89,48	32	30	34
SF 24	205.128,7	1,31	90,79	32	30	34
SF 25	1.443.015,2	9,21	100,00	29	28	30
Gesamt	15.660.353,2	100				

new

S/SF-Stufe	Statistikjahre 2008 - 2010: Jahreseinheiten Absolut	Anteil in %	Schadenbedarfs-Indizes auf gewichteten Mittelwert 1 indiziert	indiziert auf SF 1 = 100	Konfidenzintervall[1] (Intervallgrenzen: Schadenbedarfs-Index * (1 ± … %))
1	2	3	4	5	6
M	21.631	0,0	3,9554	221,8	6,66
0	116.401	0,1	2,7981	156,9	3,19
S	173.509	0,2	2,5168	141,1	2,98
SF 1/2	1.684.172	1,7	2,2177	124,3	1,04
SF 1	1.741.270	1,7	1,7837	100,0	1,13
SF 2	2.687.160	2,7	1,6462	92,3	0,98
SF 3	2.957.755	3,0	1,5318	85,9	0,99
SF 4	3.394.783	3,4	1,4351	80,5	0,96
SF 5	3.616.968	3,6	1,3523	75,8	0,96
SF 6	3.745.247	3,8	1,2806	71,8	0,96
SF 7	3.751.748	3,8	1,2179	68,3	1,00
SF 8	3.606.459	3,6	1,1627	65,2	1,04
SF 9	3.658.843	3,7	1,1136	62,4	1,07
SF 10	3.838.923	3,9	1,0697	60,0	1,05
SF 11	3.954.142	4,0	1,0302	57,8	1,03
SF 12	3.583.514	3,6	0,9945	55,8	1,13
SF 13	3.382.024	3,4	0,9620	53,9	1,18
SF 14	3.185.544	3,2	0,9324	52,3	1,26
SF 15	3.026.702	3,0	0,9053	50,8	1,31
SF 16	2.874.794	2,9	0,8803	49,4	1,35
SF 17	2.716.363	2,7	0,8573	48,1	1,39
SF 18	2.666.924	2,7	0,8360	46,9	1,43
SF 19	2.623.452	2,6	0,8162	45,8	1,42
SF 20	2.609.067	2,6	0,7978	44,7	1,42
SF 21	2.515.485	2,5	0,7806	43,8	1,50
SF 22	3.015.915	3,0	0,7645	42,9	1,37
SF 23	2.960.610	3,0	0,7494	42,0	1,37
SF 24	2.782.919	2,8	0,7353	41,2	1,44
SF 25	2.557.335	2,6	0,7219	40,5	1,51
SF 26	2.380.773	2,4	0,7094	39,8	1,59
SF 27	2.300.295	2,3	0,6975	39,1	1,64
SF 28	2.149.080	2,2	0,6863	38,5	1,66
SF 29	1.926.993	1,9	0,6757	37,9	1,79
SF 30	1.663.672	1,7	0,6656	37,3	1,96
SF 31	1.339.134	1,3	0,6560	36,8	2,19
SF 32	1.290.774	1,3	0,6469	36,3	2,26
SF 33	1.057.201	1,1	0,6383	35,8	2,48
SF 34	896.098	0,9	0,6300	35,3	2,77
SF 35	5.089.021	5,1	0,5842	32,8	1,21
	99.542.693	100,0			

Confidence intervals

Factors relative to reference class (deliberate choice)

New best percentage higher than old highest percentage: Difficult to communicate towards customer (background: more dimensions taken into account), issue is solved by change of reference class to class 0 and/or change of setting reference class percentage from 100 to a lower value

6. Brief description of BMS: comparison old/new TPL downgrade

old

SF- Merkmal im Schadenjahr	RÜCKSTUFUNG bei ... nach ... 1 Schaden	2 Schäden
1	2	3
SF 25	SF 11	SF 4
SF 24	SF 11	SF 4
SF 23	SF 10	SF 4
SF 22	SF 10	SF 4
SF 21	SF 10	SF 4
SF 20	SF 9	SF 3
SF 19	SF 9	SF 3
SF 18	SF 7	SF 3
SF 17	SF 7	SF 2
SF 16	SF 6	SF 2
SF 15	SF 6	SF 2
SF 14	SF 6	SF 2
SF 13	SF 5	SF 2
SF 12	SF 5	SF 1
SF 11	SF 5	SF 1
SF 10	SF 4	SF 1
SF 9	SF 4	SF 1
SF 8	SF 4	SF 1
SF 7	SF 3	SF 1/2
SF 6	SF 3	SF 1/2
SF 5	SF 2	SF 1/2
SF 4	SF 2	SF 1/2
SF 3	SF 1	S
SF 2	SF 1/2	S
SF 1	S	M
SF 1/2	S	M
S	M	M
0	M	M
M	M	M

new

SF-Merkmal im Schadenjahr	RÜCKSTUFUNG bei ... nach ... 1 Schaden	2 Schäden
1	2	3
SF 35	SF 20	SF 8
SF 34	SF 17	SF 7
SF 33	SF 16	SF 7
SF 32	SF 16	SF 6
SF 31	SF 15	SF 6
SF 30	SF 15	SF 6
SF 29	SF 14	SF 6
SF 28	SF 14	SF 5
SF 27	SF 13	SF 5
SF 26	SF 13	SF 5
SF 25	SF 12	SF 4
SF 24	SF 12	SF 4
SF 23	SF 11	SF 4
SF 22	SF 11	SF 4
SF 21	SF 10	SF 3
SF 20	SF 10	SF 3
SF 19	SF 9	SF 3
SF 18	SF 9	SF 2
SF 17	SF 8	SF 2
SF 16	SF 8	SF 2
SF 15	SF 7	SF 1
SF 14	SF 6	SF 1
SF 13	SF 6	SF 1
SF 12	SF 5	SF 1
SF 11	SF 5	SF 1
SF 10	SF 4	SF 1/2
SF 9	SF 3	SF 1/2
SF 8	SF 3	SF 1/2
SF 7	SF 2	SF 1/2
SF 6	SF 2	S
SF 5	SF 1	S
SF 4	SF 1	0
SF 3	SF 1	0
SF 2	SF 1/2	0
SF 1	SF 1/2	0
SF 1/2	0	M
S	0	M
0	M	M
M	M	M

For example:

1 claim in NCD 25 gives downgrade to NCD 11 (old) and NCD12 (new)

6. Brief description of BMS: principle definition of downgrade

Burning costs current year by NCD class previous year and claim number previous year (0, 1 or 2)

NCD classes previous year

Evaluation of GDV downgrade for full comprehensive (original process: now with smoothing by regression, same principle also for TPL); constant downgrade in multiplicative sense due to claim number of previous year as independent dimension

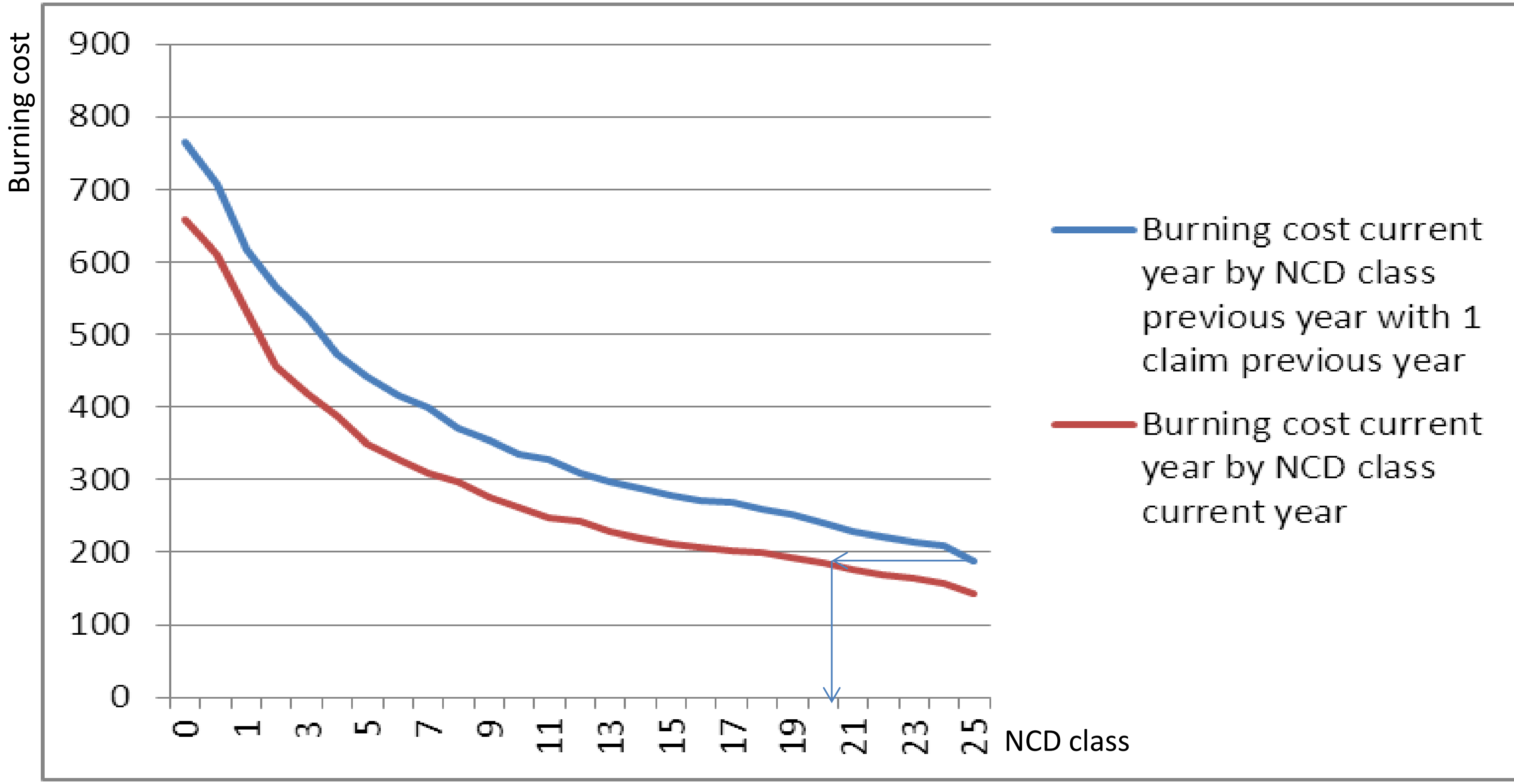
Ausprägung des SF-Merkmals im VJ	Schadenbedarfe der Risiken im SJ mit genau ... Schäden im VJ: 0 Schäden	1 Schaden	2 Schäden	Schadenbedarfe des SF-Merkmals im SJ: Bedarf	Ausprägung
1	2	3	4	5	6
M				853	M
0	567	765	1.049	659	0
SF 1/2	525	708	971	610	SF 1/2
SF 1	457	617	846	532	SF 1
SF 2	418	565	774	457	SF 2
SF 3	387	522	716	418	SF 3
SF 4	350	473	648	387	SF 4
SF 5	328	442	606	350	SF 5
SF 6	309	417	572	328	SF 6
SF 7	296	399	547	309	SF 7
SF 8	275	371	508	296	SF 8
SF 9	261	353	484	275	SF 9
SF 10	248	335	459	261	SF 10
SF 11	242	327	448	248	SF 11
SF 12	228	308	422	242	SF 12
SF 13	219	296	406	228	SF 13
SF 14	212	287	393	219	SF 14
SF 15	206	278	381	212	SF 15
SF 16	201	271	372	206	SF 16
SF 17	199	268	368	201	SF 17
SF 18	193	260	356	199	SF 18
SF 19	186	251	344	193	SF 19
SF 20	177	239	328	186	SF 20
SF 21	169	228	313	177	SF 21
SF 22	163	220	301	169	SF 22
SF 23	158	213	292	163	SF 23
SF 24	155	210	287	158	SF 24
SF 25	140	189	259	142	SF 25

factor = 1.35

Burning costs by NCD class current year: see column claim free previous year allocated to one class upwards

Example:
NCD 25 in previous year with 1 claim in previous year
has burning cost of 189;
next to this value is NCD 20
w/o claim in previous year with burning cost of 186
=> resulting rule:
downgrade for 1 claim from NCD 25 to NCD 20

6. Brief description of BMS: principle definition of downgrade



Rule for downgrade definition: From a burning cost value of a certain NCD class with claim previous year (blue curve) go left until hitting the red curve (description above), then go down to find the NCD class belonging to that value (see example in the graph above): alignment of risks with claim to claim free risks with same burning cost

7. Interaction of annual mileage with other criteria especially BMS

Let´s look at interactions:

1. On GDV level with type class (currently not any more)
2. No interaction with BMS*
3. On distribution or mix side with gender (partial substitution in unisex case): women drive less than men
4. Interaction with fuel type: Higher mileage for Diesel cars
5. Interactions to be checked and identified during GLM evaluation process

Summing up: Overseeable interactions without problems for pricing

* Both being part of a GLM but even in case of using Poisson-Gamma for BMS and GLM for other criteria one can avoid double counting: Poisson-Gamma could be seen as credibility model which can be combined with GLM to one single algorithm (see E. Ohlsson/B. Johansson: Non-Life Insurance Pricing with Generalized Linear Models, 2010)

8. Ranking of most important criteria: annual mileage being TOP 4 but not No 1

Let´s look at distinctive power of the most important tariff dimensions for TPL (in terms of multiplicative distance between minimal and maximal factor):

1. Type class: distance = 8.68
2. BMS: distance = 6.77
3. Age of user: distance = 2.63
4. Mileage: distance = 1.69

(GDV level)

9. Outlook/Telematics

1. Mileage with stable outlook in terms of distinctive power
2. Compared to other European countries telematic is mainly not in use for pricing
3. Telematic devices are used for offering assistance; eCall (emergency call) will be obligatory by EU in near future for new car types (not new cars)
4. There was a telematic pilot for young drivers brought to the market by one company but did not go life at the end (technical issues?)
   A recent pilot generates more criticism in the public than positive feedback
5. Given the existing range of differentiation in motor tariffs you could expect that there might be only small differences in rates (normal vs telematic) for something like 75% of the risks; this should be different for high risk areas like young drivers or luxury cars (theft).
6. Data protection is a bigger issue in Germany than in other countries („glass clear car driver“).

Summing up: The distinction of mileage will stay; mileage would be also important for telematic based pricing but this is not yet started.

Many thanks for your attention!
Questions?

Axel Wolfstein
Member of the Executive Committee
Actuary (DAV)
Direct Line Versicherung AG
Rheinstraße 7A
14513 Teltow
Germany

Phone: +49 3328 449 - 391
Axel.Wolfstein@directline.de
www.directline.de