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Adverse selection and consumer inertia: empirical evidence from the Dutch health insurance market

Ramsis Croes[1] Erik Schut[2] Marco Varkevisser[3]

Abstract

This paper examines to what extent consumer inertia can reduce adverse selection in health insurance markets. To this end, we investigate consumer choice of deductible in the Dutch health insurance market over the period 2013-2018, using panel data based on a large random sample of all insured individuals in the Netherlands. The Dutch health insurance market offers a unique setting for studying adverse selection, because during annual open enrollment periods all adults are free to choose an extra deductible up to 500 euro per year. By focusing on deductible choices of those who do not switch health plans, we are able to examine the adverse selection effect in absence of distortions caused by other health plan attributes. Our dynamic logit model reveals clear evidence of adverse selection, but we also find that it is counteracted by a high level of consumer inertia.

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1. Introduction

The presence of adverse selection is a well-known impediment to an efficient health insurance market (Einav & Finkelstein 2011). Adverse selection occurs when enrollees choose health plans with more coverage because they have private information about being likely to incur high costs. Rothschild & Stiglitz (1976) show that adverse selection can result in the underinsurance of low-risk enrollees or even in a market with no equilibrium. However, as shown by Handel (2013) and Handel & Kolstad (2015), adverse selection may in practice be counteracted by individuals' suboptimal decision making. There is ample empirical evidence that optimal consumer choice in health insurance markets is hampered by "frictions" like inertia, search and switching cost, and a lack of knowledge ("health insurance literacy"); e.g., Samuelson & Zeckhauser (1988), Abaluck & Gruber (2011), Bhargava et al. (2017), Handel (2013), Handel & Kolstad (2015), Handel et al. (2019), Handel et al. (2020), Heiss et al. (2021), Ho et al. (2017), and Marzilli Ericson (2014).

Beforehand, it is not clear what is more important to market outcomes: adverse selection or frictions? The interaction between both potential market distortions is also unclear. As Pauly (1984) noticed already more than three decades ago: "One of the things that theory does say here is that only a little bit of adverse election may cause market equilibrium to unravel. But then only a little bit of consumer inertia is needed to reinstate it."

The interaction of adverse selection and consumer inertia has recently been studied in the context of US markets for health insurance (Handel 2013, Handel & Kolstad 2015, Polyakova 2016, Handel et al. 2019). Handel & Kolstad (2015) measure inertia as the implied monetary costs of switching plans when a default option is present. They identify inertia by comparing health plan choice of the same consumers over time in both clearly active and clearly passive choice environments. In the context of an employment-based insurance setting of a large US firm, they show that both adverse selection and inertia are important. Furthermore, they show that reducing frictions is welfare decreasing (increasing) when the mean and variance of surplus from risk protection compared to its costs are relatively low (high).

In this paper, we aim to empirically determine to what extent adverse selection is mitigated by consumer inertia. In our setting – the Dutch market for mandatory basic health insurance – the choice environment is stable, since we focus on individuals staying with the same health plan during the study period. These individuals, however, can each year freely adapt their choice of deductible (i.e., coverage level) resulting in a lower or higher premium. Hence, no health plan attributes other than the deductible level and its corresponding premium difference play a role in the consumer choices examined here. Given that only monetary trade-offs are involved in this choice setting, we are able to identify inertia precisely as defined by Handel (2013): the implied monetary costs of choice persistence. Using detailed data for a large random sample (6 million) of the total Dutch adult insured population (approx. 14 million), we constructed a study sample consisting of about 1.8 million individuals who in the period 2013-2018 (i) did not switch health plans, (ii) each year had either a zero or 500 euro deductible, and (iii) did not suffer from a severe mental illness. First, for these individuals we constructed 32 possible deductible choice paths to examine the relationship between health care costs and deductible choice. Second, we estimated a dynamic logit model using – for computational reasons – a smaller random subsample of people. The model estimates reveal to what extent individuals' previous and future health care costs impact their annual choice of deductible. Although we find clear evidence of adverse selection, we also find that the extent of it is strongly mitigated by the presence of substantial consumer inertia.

The remainder of this paper is organized as follows. In the next section, we briefly describe the context of the Dutch health insurance market in which people annually have free choice of deductible. Section 3 informs about the data and descriptive statistics. In section 4, 32 possible deductible choice paths are defined and analyzed. The empirical model is formulated in section 5, after which the estimation results are presented in section 6. Section 7 concludes.

2. Context

In the Netherlands, universal mandatory health insurance is offered by competing private health insurers.[4] During our study period (2013-2018) the number of basic health plans (or health insurance policies) offered by insurers varies between 55 and 67. All Dutch citizens are required to buy a basic health plan and health insurers are required to accept all individuals applying for enrollment. The basic benefit package is comprehensive and standardized by law. Hence, each basic health plan covers the same benefits. In addition, health plan premiums must be community-rated. That is, all people enrolling in the same health plan face the same premium (except that, during the study period, in case of a group contract insurers are allowed to offer a premium discount up to 10%).[5] For all adult enrollees (18 years and older) there is a mandatory deductible. The level of this deductible is annually set by the government.[6] On top of this mandatory deductible, adults can opt for an extra deductible in return for a premium discount. The voluntary deductible levels are restricted by the government to zero, 100, 200, 300, 400 or 500 euro per year. For each deductible level, health insurers are free to determine a community-rated premium discount. Expenses on maternity care, district nursing and family care (provided by GPs) are exempted from both the mandatory and voluntary deductible.

Each year, individuals can switch health plans during the six-weeks annual open enrollment season (mid-November to December). Health plans differ from each other in terms of premium, service level, (preferred) provider network and premium discount for the various deductible levels. Enrollees can adjust the deductible level every year by notifying their health insurer during the open enrollment period. This typically requires only one phone call or ticking another box at the insurer's website. Changing deductible levels does not require

[4] For a more detailed description of the Dutch health insurance market and the system of regulated (or managed) competition, see Van de Ven & Schut (2008) and Douven et al. (2017).
[5] For each enrollee insurers receive a risk-adjusted premium subsidy from a risk-equalization fund that is filled with income-related contributions. This risk-adjusted premium subsidy is equal to the enrollee's predicted costs minus a fixed amount that is annually determined by the government (about 1,000 euro per year). Hence, to break even health insurers must at least charge a community-rated premium equal to this fixed amount (Van Kleef et al. 2018).
[6] During our study period the mandatory deductible was gradually raised from 350 euro in 2013 to 360 euro in 2014, 375 euro in 2015, and 385 euro from 2016 onwards.

changing health plans. Hence, after having increased the deductible level people can easily lower it again during the next open enrollment season if they have acquired a chronic disease or otherwise expect higher medical costs in the year(s) to come.

As mentioned in Section 1, depending on the specific market fundamentals, consumer inertia could be welfare increasing or decreasing (Handel et al. 2015). In the Netherlands, for instance, the potential welfare improving effect of consumer inertia counterbalancing adverse selection may be small, because adverse selection is effectively mitigated by a sophisticated system of risk equalization (Van Kleef et al. 2017). Nevertheless, even after sophisticated risk equalization those opting for the highest deductible level appear to be profitable to insurers at the prevailing discount levels (Croes et al. 2017). Hence, increasing the uptake of voluntary deductibles by reducing consumer inertia may well reduce profitability or increase premium discounts. In this paper, we aim to establish to what extent consumer inertia and adverse selection are indeed present in the Dutch health insurance market.

3. Data

We use individual level panel data, obtained from the Dutch Healthcare Authority (NZa), covering the entire Dutch adult population (approx. 14 million people) between 2013 and 2018. The dataset includes information on (i) each person's health care expenses, including out-of-pocket costs, for benefits covered by mandatory health insurance, and (ii) each person's choice of health plan and deductible level. In addition, we also obtained data from the NZa about the community-rated premium discount offered by each health plan in return for a higher deductible. Throughout the study period, the average premium discount for a 500 euro deductible was 232 euro (min. 150 euro, max. 324 euro).

As a start, we took a random sample of 6 million individuals that were in the dataset for the year 2018. Next, we excluded individuals that were not in the dataset the whole study period (2013-2018) and those younger than 18 years in any of these years, since these individuals did not face any deductible. We also excluded a small number of people with more than one health plan per year (e.g., because they enrolled in another group contract after changing jobs), and people with incomplete information on health expenses. Both groups comprise less than 1% of the total population. The remaining final study sample includes about 3.3 million individuals with data for each of the six years between 2013 and 2018.

For this balanced panel, Table 1 shows the distribution of individuals over the various deductible levels. The proportion of enrollees that opted for a voluntary deductible other than zero varied between 9% and 12%. In any year, the most frequently chosen non-zero deductible was 500 euro.

Table 1: Distribution of enrollees over the voluntary deductible levels

	2013	2014	2015	2016	2017	2018
0 euro	91%	90%	88%	89%	89%	90%
100 euro	1%	1%	1%	1%	1%	0%
200 euro	1%	1%	1%	1%	1%	1%
300 euro	1%	1%	1%	1%	1%	1%
400 euro	0%	0%	0%	0%	0%	0%
500 euro	5%	7%	8%	8%	8%	8%

In our dataset, 38% of all enrollees who changed their deductible, also switched health plans. The decision to switch health plans depends on multiple factors (Boonen et al. 2016). Since these factors may be correlated with the choice of deductible, we restrict our analysis to those enrollees that did *not* switch health plans during the study period (but who might have changed their choice of deductible). For this subsample, it is most likely that choices for another deductible level are driven by past or anticipated health care expenses. Furthermore, to keep the analysis concise we also excluded the small minority of people (2-4%) who chose intermediary deductible levels (100-400 euro). Lastly, we also excluded individuals with severe mental illness since they are unlikely to make deliberate choices concerning their health insurance.[7]

The final sample consists of about 1.8 million individuals who in the period 2013-2018 (i) did not switch health plans, (ii) each year had either a zero or a 500 euro deductible, and (iii) did not suffer from a severe mental illness.

In our regression, we use people's health care expenses in previous years for explaining their deductible choice in year *t*. Therefore, we lose one year of deductible choices (2013) in our analyses. For this reason, we limit the descriptive analyses to the years 2014-2018. Given this 5-year study period and the two deductible choice options considered (0 or 500 euro), 32 possible deductible choice paths can be distinguished. These paths will be discussed in more detail below.

When calculating people's health care costs, we excluded the costs of GP-care, district nursing and maternity care because these are exempted from the deductible. Since the distribution of individual health care costs is highly skewed, we transformed the cost data by taking the natural logarithm of one plus the costs, i.e., *log*(*cost+1*). Figure 1 shows that the resulting log transformed distribution has the familiar bimodal shape, with local maxima at 0-0.5 (≈ 0 euro) and 6.5-7 (≈ 900 euro).

[7] These individuals are identified by their use of medicines for mental illnesses, based on whether they were classified in a relevant Pharmaceutical Cost Group. These PCGs are used as risk adjusters in the Dutch system of risk equalization.

Figure 1: Distribution of *log(cost+1)* transformed individual health care expenses

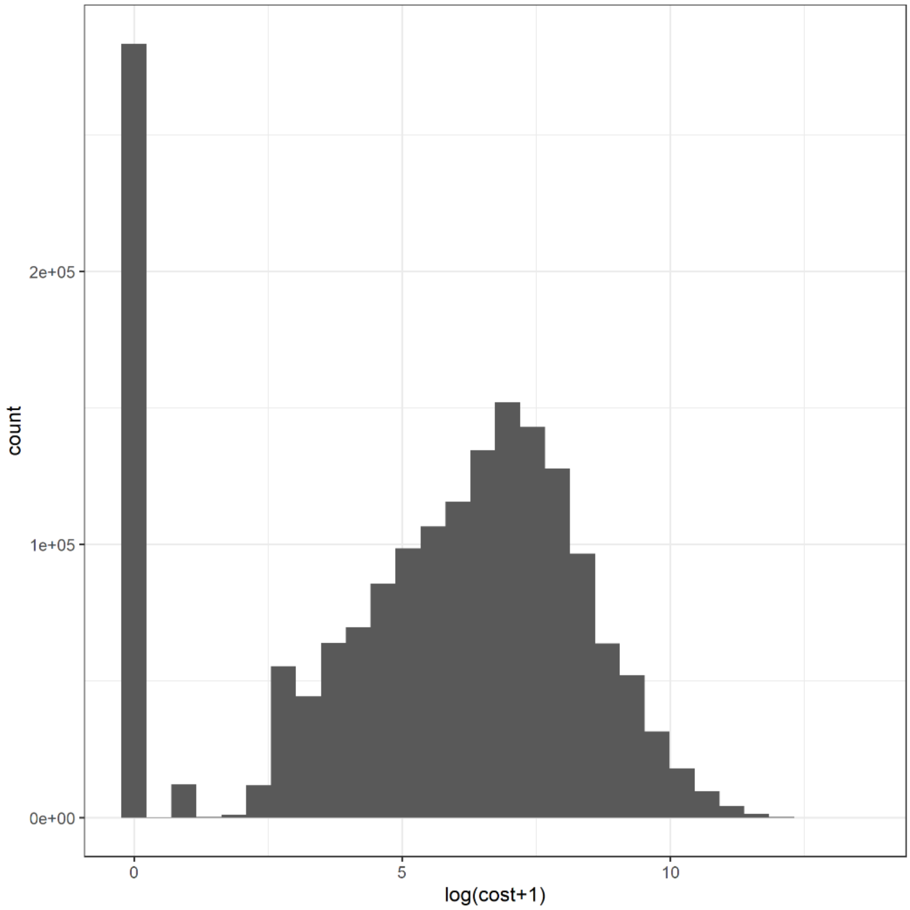

Table 2 displays the proportion of people with either a zero or 500 euro deductible in 2018 for 6 different cost categories. As expected, the share of people opting for the highest deductible in 2018 is negatively related to their health care expenses in the current year. In the lowest cost category 12.7% of the individuals opted for a 500 euro deductible, whereas this deductible was chosen by only 0.8% of the individuals in the highest cost category. However, even among those in the lowest cost category more than 87% of the individuals preferred not to opt for a voluntary deductible.

Table 2: People with a zero or 500 euro deductible in 2018 per cost category

log(*cost+1*)	People with deductible 0 euro	People with deductible 500 euro	People (%) with deductible 500 euro
[0,2]	259,047	37,673	12.7%
(2,4]	165,525	18,153	9.9%
(4,6]	374,538	23,923	6.0%
(6,8]	582,151	13,753	2.3%
(8,10]	274,449	2,712	1.0%
(10,15]	33,679	256	0.8%

The high percentage of people with low costs choosing a zero deductible indicates that many people may not make a (financially) optimal deductible choice. Indeed, as showed by Van Winssen et al. (2015) an uptake of a 500 euro deductible would have been retrospectively financially profitable for 48% of the Dutch insured population in 2014, whereas only about 11% actually did so.[8] In another study, using data for the years 2006-2013, Douven et al. (2016) found that almost half of the people without a 500 euro deductible would have financially benefited if they had opted for this. They also found that for 80-90% of the people with a 500 euro deductible this was ex-post profitable. Similar results are presented by Handel et al. (2020). They found that in 2015 about 52% of all Dutch consumers would have been better off with a 500 euro voluntary deductible, while this was taken by less than 7%.[9] Of course, an *ex-post* non-profitable deductible choice does not necessarily mean this choice is also non-profitable *ex-ante*, because the ex-ante profitability depends on the distribution of risk as well as people's risk preferences.[10]

For each of the deductible choice paths, we examined the relation between healthcare costs and deductible choice more closely. More specifically, for each choice path we calculated the aggregate annual median healthcare costs. In Table 3, the resulting median cost patterns are presented in a heatmap.

[8] Handel et al. (2019) find similar differences in a US employment-based insurance context. Based on ex post spending, 60% of employees would have been better off financially in a high deductible health plan though only 15% of employees actually chose such a plan.
[9] Based on their study, only 54% of the Dutch population chose the cost-minimizing deductible leaving on average 66 euro per individual on the table.
[10] Note that the rationale of insurance is that ex-post the 'lucky' majority of the insured make a personal loss because their premiums are used to pay the claims of the 'unlucky' minority.

Table 3: Choice paths and annual median costs

	Voluntary deductible level (€)			Annual median costs (€)					
	2014_2015_2016_2017_2018	**N**	**%**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1	000_000_000_000_000	1,663,338	93.14%	377	400	358	411	421	488
2	000_000_000_000_500	5,262	0.29%	69	63	49	44	36	38
3	000_000_000_500_000	865	0.05%	142	126	111	78	263	434
4	000_000_000_500_500	5,585	0.31%	57	54	42	35	32	40
5	000_000_500_000_000	748	0.04%	187	166	106	468	485	357
6	000_000_500_000_500	93	0.01%	94	91	78	77	233	69
7	000_000_500_500_000	637	0.04%	137	117	74	87	334	394
8	000_000_500_500_500	4,831	0.27%	55	49	35	30	31	39
9	000_500_000_000_000	1,384	0.08%	158	155	350	512	352	344
10	000_500_000_000_500	106	0.01%	114	160	110	452	119	58
11	000_500_000_500_000	44	0.00%	166	147	106	537	167	782
12	000_500_000_500_500	155	0.01%	120	78	81	280	45	64
13	000_500_500_000_000	1,072	0.06%	130	115	99	404	508	301
14	000_500_500_000_500	183	0.01%	114	84	53	131	440	77
15	000_500_500_500_000	961	0.05%	114	87	57	92	363	511
16	000_500_500_500_500	8,761	0.49%	45	40	24	29	29	36
17	500_000_000_000_000	5,609	0.31%	125	478	451	338	299	313
18	500_000_000_000_500	184	0.01%	78	255	464	131	87	68
19	500_000_000_500_000	80	0.00%	106	305	430	197	544	724
20	500_000_000_500_500	301	0.02%	84	153	487	130	38	81
21	500_000_500_000_000	104	0.01%	120	313	562	550	888	471
22	500_000_500_000_500	30	0.00%	76	44	656	99	438	48
23	500_000_500_500_000	100	0.01%	72	145	374	59	450	778
24	500_000_500_500_500	623	0.03%	46	92	411	39	48	56
25	500_500_000_000_000	4,977	0.28%	72	99	389	479	274	268
26	500_500_000_000_500	296	0.02%	33	64	259	508	143	80
27	500_500_000_500_000	150	0.01%	70	73	125	393	207	594
28	500_500_000_500_500	759	0.04%	39	45	108	513	37	54
29	500_500_500_000_000	4,508	0.25%	59	66	85	539	489	302
30	500_500_500_000_500	778	0.04%	50	45	48	149	552	74
31	500_500_500_500_000	4,812	0.27%	45	44	44	63	375	521
32	500_500_500_500_500	68,523	3.84%	26	26	16	16	17	23
		1,785,859	**100%**						

As revealed by Table 3, the vast majority (93%) of all enrollees included in the dataset sticks with the default option of a zero deductible during the entire period. The second largest subgroup (almost 4%) consists of enrollees who stick with a once chosen 500 euro deductible. The remaining 3% changed their deductible at least once during the study period.

The heatmap presented in Table 3 confirms our initial expectations. Enrollees in path 32 (500_500_500_500_500) consistently have the lowest annual median costs. In contrast, enrollees in path 1 (000_000_000_000_000) have consistently (one of) the highest median costs compared to the other deductible choice paths. These median cost patterns are consistent with the presence of adverse selection: high (low) risks seem to sort themselves into low (high) deductible plans.

Of particular interest are the choice paths of enrollees who experience a substantial increase in health care expenses over the years. In the heatmap, these are the paths with a profound change of color between years. For many choice paths in which enrollees experience a strong increase in costs – e.g., paths 29 and 31 – we observe that the cost jump is followed by a change in deductible from 500 to zero in the next year. This is consistent with the presence of an adverse selection effect. Enrollees following choice path 22, 24, 28, and 30 substituted a zero for a 500 euro deductible in the only year(s) they had higher health care cost and immediately changed back to a zero deductible in the next year if their health care costs had returned to a low level. This is consistent with both adverse selection (choosing a zero deductible in anticipation of health care expenses) and moral hazard (a zero deductible resulting in higher health care expenses). Choice paths 2, 4, and 8 show that enrollees with a zero deductible who are experiencing stable low health care costs over the entire period eventually opted for a 500 euro deductible. This demonstrates that adverse selection does not necessarily take place immediately because over time consumers may learn more about their health risk, and the corresponding health care expenses, as well as about the available deductible choice options.

In sum, all the possible choice paths seem to have cost patterns that are, at least to some extent, consistent with the presence of adverse selection. The patterns also suggest that (i) adverse selection may take time to arise, and (ii) some healthy people are able to effectively anticipate an increase in next year's health care costs.

4. Empirical model

Using the individual level data over the period 2013-2018, we estimate a dynamic logit model to examine how deductible choice in year *t* is affected by health care costs and deductible choice in year *t-1*. With this model, we explicitly consider two types of confounding that are relevant for our analysis. First, we control for unobserved time-invariant individual heterogeneity. Second, for all individuals we use information about their drug consumption in the past to capture any chronic diseases and illnesses to control for the confounding of people's health status. As a result, the effect of the lagged cost variable provides evidence for adverse selection, whereas the effect of the lagged deductible choice variable captures choice persistence and thus consumer inertia.

Our dynamic logit model specifies the probability μ_i that individual *i* (*i*=1,..,*I*) chooses a 500 euro deductible in year *t* as:

$$\pi_{it} = \frac{exp(\mu_{it})}{1 + exp(\mu_{it})}$$

where μ_i denotes the set of relevant characteristics for individual *i*, which can be specified as follows:

$$\mu_{i,t} = c_i + \beta deductible_{i,t-1} + \sum_{k=1}^{2} \rho_k cost_{k,i,t-1} + \pi chronic_{i,t-1} + \sum_{k=1}^{2} \varphi_k cost_{k,i,t}\, chronic_{i,t-1} + \tau discount_{it} + \epsilon_{it}$$

The main variables of interest in our model are $cost_{t-1}$ and the state dependence parameter $deductible_{t-1}$. We expect that having a 500 euro deductible in *t-1* has a positive impact on the probability of choosing a 500 euro deductible in *t*. If adverse selection is present, we expect to find a negative relationship between the uptake of a 500 euro deductible in *t* and health care cost in *t-1*.

For each individual, we categorized the health care cost in *t*, given by $cost_{i,t-1}$, in three different groups (k = 0,..,2): [0, 385) , [385,885) and [885,+) euro. These groups reflect the situations in which health care costs are below the mandatory deductible, above the mandatory deductible but below the maximum total deductible, and above the maximum total deductible, respectively.[11] In the model, the cost groups are included as dummy variables with the [0, 385] group as reference group. To check if our estimation results are sensitive to this categorization of costs, we also estimate a model with *log(cost+1)* in year *t-1* as predictor.

To control for the confounding of an individual's health status, we included a dummy variable equal to one if the enrollee had a chronic illness in year *t-1* and zero otherwise. In addition, to control for the potential impact of price, we include for each individual the community rated premium *discount* offered by his insurer for choosing a 500 euro deductible.

Ideally, we would like to estimate our dynamic logit model with individual time-invariant effects to control for unobserved time-invariant individual heterogeneity. However, we cannot estimate the model like the unconditional fixed effects maximum likelihood estimator with a dummy variable for each individual. Next to being computational costly, this will also be an inconsistent estimator due to the incidental parameters problem (Stammann et al. 2016). This refers to the following inference problem: as the number of individuals goes to infinity, the number of c_i's (called incidental variables) also goes to infinity. As a result, the incidental variables will be inconsistently estimated, which contaminates the estimation of the other variables (Neyman & Scott 1948). There are several model specific solutions (i.e. estimation

[11] We took the 2016 mandatory deductible (385 euro) as uniform cutoff point for all years. Although the mandatory deductible in 2013, 2014 and 2015 was slightly lower (350-375 euro) the difference was very small.

methods) to the incidental parameters problem, but not a unified one (Cameron & Trivedi 2005).

Note that in linear models, we could easily estimate a panel model with individual fixed effects by means of first differencing or using a within transformation (where the c_i's are eliminated). However, since the binary outcome panel model is nonlinear, this does not work here. Furthermore, estimating a fixed effects model in our case is biased due to the incidental parameters problem mentioned above.

There are several bias corrections available to reduce the bias due to the incidental parameters and methods for reducing the computational costs (e.g., Greene 2004; Hahn & Newey 2004). However, bias correction methods could be computational costly. For our estimation, we therefore used a recently developed estimation technique: the pseudo conditional maximum likelihood (PCLM) estimator developed by Bartolucci & Nigro (2012). The PCLM estimator approximates the dynamic logit model through a quadratic exponential model. It follows a similar approximation approach as Bartolucci & Nigro (2010). Using this estimator, the incidental parameters problem is solved by conditioning on sufficient statistics for the individual intercepts, which are based on the sums of the response variable on the individual level.

Bartolucci & Nigro (2012) performed simulations to determine the finite sample properties of their pseudo estimator. Their simulations showed that the estimator has a has a very low bias for the covariates and the state dependence, indicating that it performs well. Furthermore, they showed that their estimator, compared to alternative estimators, usually has a smaller bias and a greater efficiency.

5. Estimation results

As explained above, we used the PCLM estimator (Bartolucci & Nigro 2012) for estimating our dynamic logit model. For computational reasons, we took a random sample of 500,000 individuals from our study sample. Subsequently, we selected individuals who are (i) 18 years and older, (ii) did not switch health plan and (iii) did not have a chronical mental illness.[12] This selection reduced our final sample to 265,629 individuals. For these individuals three specifications of our model were estimated. In the first specification health care costs are included as *log(cost+1)*, while in the second and third specification costs are included as dummy variables based on the maximum (mandatory and voluntary) deductible people have to pay out-of-pocket; i.e., people with healthcare cost in one of the [0, 385), [385,885) and [885,+) euro groups. Additionally, in the third specification, we also included interactions between these cost groups and the lagged dummy variable for being chronically ill ($chronic_{i,t-1}$). Table 4 gives the estimated coefficients for each of these three model specifications.

[12] These ilnesses are psychosis, chronic mood disorder, substance use disorder, bipolar disorder, and attention deficit hyperactivity disorder.

Table 4: Estimation results dynamic logit model

	Dependent variable: *500 euro deductible (1=yes/0=no)*		
	(1)	(2)	(3)
deductible$_{t-1}$	4.286** (0.091)	4.279** (0.091)	4.290** (0.091)
$\log(cost_{i,t-1} + 1)$	-0.152** (0.008)		
$cost_{i,t-1}[385{,}885)$		-0.406** (0.063)	-0.426** (0.067)
$cost_{i,t-1}[885,+)$		-1.266** (0.060)	-1.139** (0.063)
$chronic_{i,t-1}$			-0.315 (0.184)
$cost_{i,t-1}[385{,}885) chronic_{i,t-1}$			0.021 (0.213)
$cost_{i,t-1}[885,+) chronic_{i,t-1}$			-0.844** (0.212)
$discount_{it}$	0.319** (0.055)	0.300** (0.055)	0.293** (0.055)

Note: ** = p<0.01, * = p<0.05 *and standard error in parentheses*

As expected, the coefficients for the lagged health care costs – ($cost_{k,i,t-1}$) in specifications 2 and 3 or $log\left(cost_{i,t-1} + 1\right)$ in specification 1 – are negative. Hence, higher costs in year *t-1* lower the probability of having a 500 euro deductible in year *t*, all else equal. The coefficient for having a 500 euro deductible in year *t-1* ($deductible_{i,t-1}$) is positive. This implies that, as expected, already having a deductible of 500 euro increases the probability to choose it again, all else equal. It also implies that having no voluntary deductible in year *t-1* lowers the probability of choosing a deductible of 500 euro instead next year.

The premium discount ($discount_{it}$) also has a positive coefficient, which implies that, as expected, people are more likely to choose a 500 euro deductible if they get a higher premium discount from the insurer. In model 3 we explicitly controlled for each individual's health status by inlcluding the dummy variable capturing chronic diseases ($chronic_{i,t-1}$) as well as its interactions with the cost categories ($cost_{k,i,t}\ chronic_{i,t-1}$). Also conform to expectations, we find that people with a chronic disease are less likely to choose a 500 euro deductible. The coefficients for our main variables of interest ($cost_{t-1}$ and $deductible_{t-1}$) do not change and thus seem to be robust.

To obtain a better indication of the effects of the explanatory variables included in our model, we use the Average Partial Effect (APE). This measures the change in the expected outcome (i.e. response probability) due to a small change in a covariate. However, if the number of periods is fixed, the APE of some covariate is generally biased. This is due to the incidental parameters problem since the estimation of the individual effects is biased, which also has an effect on the slope parameters (Bartolucci & Pigini 2019).

As a solution, Bartolucci & Pigini (2019) proposed an APE estimator that does still has asymptotic bias but performs well in finite samples, even when I (number of individuals) is much larger than T (number of periods). Moreover, the bias corrected estimate of the unobserved heterogeneity entails a substantial improvement over the standard ML estimate with short T. Let vector $\boldsymbol{w}_{itk}$ collect all model variables. Following Bartolucci & Pigini (2019), the partial effect of covariate k for individual i at period t is defined as

$$v_{itk}(c_i, \boldsymbol{\theta}, \boldsymbol{w}_{it}) = \begin{cases} p(\pi_{it} = 1|c_i, \boldsymbol{w}_{it})[1 - p(\pi_{it} = 1|c_i, \boldsymbol{w}_{it})]\delta_{k,} \\ \textit{with } w_{itk} \textit{ continuous} \\ p\left(\pi_{it} = 1\middle|c_i, \boldsymbol{w}_{it,-k,} w_{itk} = 1\right) - \left(\pi_{it} = 1\middle|c_i, \boldsymbol{w}_{it,-k,} w_{itk} = 0\right), \\ \textit{with } w_{itk} \textit{ discrete} \end{cases}$$

where $\boldsymbol{w}_{it,-k}$ denotes the vector with $\boldsymbol{w}_{it}$ excluding $\boldsymbol{w}_{itk}$, and vector $\boldsymbol{\theta}$ collects all model coeficients.

The APE of covariate k can be estimated by

$$\tilde{v}_k = \frac{1}{nT} \sum_{i=1}^{I} \sum_{t=1}^{T} v_{itk}\left(\tilde{c}_i(\tilde{\boldsymbol{\theta}}), \tilde{\boldsymbol{\theta}}, \boldsymbol{w}_{it}\right),$$

where $\tilde{\boldsymbol{\theta}}$ are the above estimated coeficients and Bartolucci & Pigini (2019) uses the modified score function by Firth (1993) to estimate $\tilde{c}_i(\tilde{\boldsymbol{\theta}})$. See Bartolucci & Pigini (2019) for the calculation of the standard errors for $\tilde{v}_k$.[13]

Table 5 presents, for each model specification, the estimated APEs including the standard errors. From these effects it can be concluded that having chosen a 500 euro deductible in year $t-1$ increases the probability to choose this deductible in year t with approximately 70 percentage points in all three model specifications. This indicates the presence of a large choice persistence effect.

[13] Bartolucci & Pigini graciously provided the authors the *R*-code that calculates the APEs.

Table 5: Average Partial Effects (APEs)

	Dependent variable: 500 euro deductible (1=yes/0=no)		
	(1)	(2)	(3)
$deductible_{t-1}$	0.702** (0.006)	0.707** (0.006)	0.708** (0.013)
$\log(cost_{i,t-1}+1)$	-0.019** (0.001)		
$cost_{i,t-1}[385{,}885)$		-0.051** (0.008)	-0.053** (0.008)
$cost_{i,t-1}[885,+)$		-0.157** (0.007)	-0.142** (0.008)
$chronic_{i,t-1}$			-0.040 (0.023)
$cost_{i,t-1}[385{,}885)chronic_{i,t-1}$			0.003 (0.027)
$cost_{i,t-1}[885,+)chronic_{i,t-1}$			-0.105** (0.026)
$discount_{it}$	0.040** (0.007)	0.038** (0.007)	0.037** (0.007)
*Note: ** = p<0.01, * = p<0.05 and standard error in parentheses*			

In model specification 1, an increase of 10% in *log(cost+1)* in year *t-1* reduces the probability of of choosing a 500 euro deductible in year *t* with 1.9 percentage points. As an illustration, a 10% increase in log health care costs for example reflects an increase from exp(6) = 403 euro to exp(6.6) = 735 euro.

In model specification 2, people in *cost_cat[385,885)* in year *t−1* have in year *t* a 5 percentage points lower probability to choose a 500 deductible when compared to people in the reference cost group *cost_cat[0,385)*. For people in *cost_cat[885,+)* this decrease in probability is 15.7 percentage points.

Looking at the interactions in model specification 3, only the interaction between having expenses in *cost_cat[885,+)* in *t−1* seems relevant. Having expenses in the highest cost category and having a chronic illness in *t−1* gives in *t* an additional reduction in the probability of choosing a 500 euro deductible of 11 percentage points on top of the 14 percentage points decrease when having high cost without having a chronic illness in *t−1*.

This suggests that people are much more likely to opt for a lower deductible when high costs are associated with a chronic illness than when high costs caused by non-chronic diseases.

Overall, from our estimation results we conclude that in all model specifications our estimated APE indicates large choice persistence. However, we also find evidence of substantial adverse selection since significant number of people incurring high healthcare expenses and/or a chronical condition in year *t-1* are likely to reduce their 500 euro deductible to zero in year *t*.

6. Conclusion and discussion

We used the unique context of the Dutch health insurance market, where people can annually choose for an extra voluntary deductible varying from 0 to 500 euro without having to change health plans, for quantifying the opposing effects of consumer inertia and adverse selection. Using data for a large random sample (6 million) of the total Dutch adult insured population (approx. 14 million), we constructed a study sample consisting of about 1.8 million individuals who in the period 2013-2018 did not switch health plans and each year had a zero or 500 euro deductible.

For these people, we first examined the 32 possible deductible choice paths. This reveals that all choice paths have cost patterns that are consistent with the presence of adverse selection. The patterns also suggest that adverse selection may take time to arise since it can take several years before people with low health care cost substitute a 500 euro for a zero deductible. In addition, the choice paths show that on average healthy people can anticipate effectively next year's health care costs. Next, using a smaller random subsample, we estimated a dynamic logit model for examining to what extent the individual choice of deductible in year *t* can be explained by their deductible choice in year *t-1* as well as health care costs in year *t-1*. We find clear evidence of adverse selection, as people with higher previous health care costs are substantially less likely to take up or keep a 500 euro deductible. However, we also find clear evidence of high consumer inertia as the average partial effect of already having a deductible in year *t-1* is much larger than the average partial effect of changes in health care costs. The substantial degree of choice persistence is remarkable, given the very low transaction costs for enrollees involved in adjusting their deductible level and the implied monetary costs of choice persistence. The missed premium discount equals approximately 200 euros per person per year. By counteracting adverse selection, a certain degree of consumer inertia may be welfare increasing. Future research could assess whether in the Dutch health care system, with sophisticated but still imperfect risk equalization, stimulating the uptake of voluntary deductibles would increase or decrease welfare.

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