Information Asymmetries and the Access Economy: The Impact of On-Demand Insurance on Competitive Insurance Market Equilibria

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Abstract

Access-based products and services are designed to target specific customer groups. Taking the example of on-demand insurance, which is generic for an intangible product with access-based design, we analyse market equilibria in competitive markets with asymmetric information. On-demand insurance is offered besides standard contracts and therefore stands in direct competition to them. Private information of customers comprise (1) their risk profile and (2) their frequency of usage of coverage. We find, that low frequency individuals can be attracted by the on-demand insurers’ offer as a result of an improvement of expected utility. However, high frequency individuals rather choose standard contracts. Overall, market entry of on-demand insurance companies is beneficial in the sense that market performance as well as utilitarian welfare increase. Our analyses show furthermore, that standard and on-demand markets coexist in a resulting equilibrium, which means that customers are distributed across both markets. In order to get those results, we use the optimization algorithm claimed by Miyazaki (1977) and extended by Spence (1978), and develop a proprietary optimization algorithm to meet the features of the market with two competing products.

Keywords: Access Economy · Information Asymmetries · Market Equilibrium · Adverse Selection · Digitalization
1 Introduction

The rise of technology and in particular everyone having a smartphone at hand enables demand for new kinds of services and products. Hence, pressure is put on existing business models in the commercial industry. Car- and Home-Sharing platfforms like ZipCar or AirBnB are continuously growing. The Rent-to-own market offers its customers objects like electronics on demand. Those companies satisfy specific needs of their customers. Bardhi and Eckhardt (2012) introduce the term access-based consumption, which describes the customers’ way of consuming goods. In contrast to sharing or ownership, access-based consumption entails neither transfer of ownership nor joint ownership by peers. Access to objects is often managed by a central authority and there usually is no interaction among customers. Key aspects, which describe access-based products and services are, according to Bardhi and Eckhardt (2012), the six dimensions temporality, anonymity, market mediation, consumer involvement, type of accessed object, and political consumerism. Demand for access-based products and services is driven by individuals with specific characteristics. Moeller and Wittkowski (2010) find possession importance, trend orientation and convenience orientation to be three traits, that have significant impact on the valuation of ownership.

The focus in our paper are access-based products in the insurance industry. More precisely, we put our attention to so-called “on-demand“ contracts. Customers with such a contract decide, which item they like to insure and can further switch on and off coverage, whenever needed. Insurance premiums, in this case, are only due during the time of active coverage, whereas there are no costs otherwise. Claims within an active period are covered as in a traditional insurance plan. A customer with a photo camera e.g. may therefore switch coverage on only in times when he uses it. A prominent example for an on-demand insurance company is trov \(^1\), a 2012 founded American InsurTech. It offers insurance e.g. for headphones, tablets, smartphones, wearables, and other items.

In our opinion, ownership is of minor importance with regard to insurance products. Aspects like convenience and trend orientation should definitely be relevant. This is aggravate by the customer’s perception of a fair payment plan, which only charges premiums for actual usage rather than for a predefined time frame that consists of many periods, in which the customer is not exposed to a certain risk (take e.g. a bike insurance in times when the bike is locked in the basement).

Various InsurTech companies tackle changing needs in order to gain market share and provide services to the customer which are not offered by incumbents. With having every information and desired action at ones fingertips, trends from other industries swap over to the insurance industry.

However, it is still not clear whether and how these contracts add value to the customer and the insurer\(^2\). On the one hand the usage-based design of on-demand insurance provides the freedom to flexibly choose coverage times, on the other hand, moral hazard will lead respectively to a higher premium. The on-demand model may therefore attract different types of customers: ones who less frequently use their insurance coverage than the average. Those may be better off by choosing the on-demand insurance plan over the standard plan and will therefore pay less premiums over all than if they would pay for a standard contract. Consequently, standard insurance might be left with all high frequency users. Moreover,

\(^1\)https://www.trov.com

\(^2\)https://home.kpmg.com/content/dam/kpmg/uk/pdf/2017/09/will-on-demand-insurance-become-mainstream.pdf
the on-demand insurer would have to take into account, that it only attracts low frequency users and
calculate the premiums accordingly.
In our paper we introduce a market that offers on-demand insurance products in competition to the
existing market of standard insurance contracts. More precisely, we investigate market equilibria, market
performance and utilitarian welfare to tackle the following key questions: Are there any benefits from
introducing on-demand contracts? Are on-demand insurance plans enough to describe a stable market
equilibrium or will market equilibrium still comprise standard insurance? What are the implications for
market performance and utilitarian welfare?
In this paper, we address these questions by introducing a stylized on-demand insurance policy. The
premium in this policy depends on the usage of coverage and may therefore differ for various customer
types. We analyze the effect of this contract regarding the second-best efficient insurance market equilib-
rium within the Wilson-Myazaki-Spence (WMS) framework and show the impact on utilitarian welfare.
Customers in our paper differ with regard to two dimensions: they either exhibit “high” or “low” risk
and are either “high” or “low” frequent users of their insurance coverage. Insurance companies, either
traditional or on-demand ones, have no information about the risk or frequency type of the customer
before the initiation of the contract.
The following Section 2 provides a brief overview of important related literature. In Section 3, we intro-
duce the model framework. Section 4 contains Equilibrium Analyses i.e. the description of new equilibria
as a result of the introduction of on-demand contracts. In Section 5, we discuss implications on utilitarian
welfare and market performance, and Section 6 concludes the paper and gives a brief outlook on future
research directions.

2 Related Literature

The model, which we establish in our paper, is built on the widely referenced study by Rothschild and
Stiglitz (1976). They analyze equilibria in a competitive insurance market with two customer types that
differ with regard to their probability of facing a loss. Insurance companies, however, are not able to
determine the risk type of customers and are therefore not able to offer targeted contracts for different
types. Though, revelation of risk types is only possible through self-selection, which means, that insurers
can offer contracts that are preferred by a specific type. Insurers act myopic, which means that they offer
contracts regardless of possible competitors’ reactions. Furthermore, they consider only contracts that
individually earn non-negative profits. They conclude that there does not exist a pooling equilibrium in
which both types choose the same contract. A separating, self-selecting equilibrium only exists, if the
fraction of high risk individuals exceeds a critical value. However, this equilibrium is not pareto optimal,
as low risk individuals do not receive full coverage.
Wilson (1977) modifies the definition of equilibrium in a way that insurers act nonmyopic. This means,
that insurance companies foresee possible reactions of other firms, which could drop unprofitable contracts
in consequence of own offered contracts. Dropped contracts release individuals that change over to their
most preferred contract left on the market, which potentially turns it unprofitable as well. This prop-
erty ensures the existence of an equilibrium that is independent of the fraction of high risk individuals.
If a separating equilibrium in the Wilsonian sense exists, it equals the one described by Rothschild and Stiglitz (1976). Otherwise, a pooling equilibrium is attained. This market equilibrium also is not efficient, since low risk individuals only receive partial coverage. The Wilsonian equilibrium analysis is extended by Miyazaki (1977) and Spence (1978) removing the non-negative profits constraint for single contracts and considering contract menus. This results in separating, cross-subsidizing, jointly non-negative profit making WMS contracts that are second-best efficient\(^3\).

We extend the framework of aforementioned literature and introduce a second product besides the standard one. We also consider an additional dimension of customers' attributes by introducing usage frequency of coverage.

Ligon and Thistle (2008) introduce a model in which customers differ with regard to two dimensions, frequency and loss severity, and analyze demand for deductible and coinsurance. As they do not consider on-demand contracts, frequency in their context reflects the loss probability, severity concerns the loss distribution. In our paper, we use the term “frequency” to differentiate customers with regard to the fraction of a year they switch coverage on. For the other dimension of customer differentiation, we stick to the Rothschild-Stiglitz framework and consider “high” and “low” risk customers, which reflects differences in the probability to face a loss. Several further authors regard additional dimensions of customer heterogeneity. Wambach (2000) introduces wealth as second dimension to differentiate customers, whereas Crocker and Snow (2008) analyze the impact of background risk on existing market equilibria, market performance and social welfare. Smart (2000) introduces different levels of risk aversion alongside inherent risk as additional property of customers. In the three latter papers, the degree of risk aversion changes and the nature of the equilibrium changes slightly when compared with Rothschild and Stiglitz (1976). Frequency in our model has no impact on the degree of risk aversion.

There is also literature which is concerned with innovative insurance products within the WMS framework. Gemmo et al. (2017) analyze the impact of transparency aversion\(^4\) on existing market equilibria. Transparency aversion arises in the context of screening e.g. the customers health with wearables, which then leads to a decrease in utility but increase in market performance, as screened customers receive tailored contracts with full insurance coverage. Depending on the magnitude of transparency aversion, low risk customers choose to reveal their risk type, which results in an increase in utilitarian welfare. All of these papers tackle different features of insurance contracts. However, novelty of on-demand insurance leads to the fact, that there is still no research on the impact of such contracts on existing market equilibria, market performance and utilitarian welfare. Before-mentioned features may also play a role in the context of on-demand insurance, yet this paper tackles the basic question of the relevance of these contracts.

\(^3\)Harris and Townsend (1981) were first to define efficient allocations and mechanisms in environments with asymmetric information in contrast to full information allocations. Crocker and Snow (1985) apply this concept to competitive equilibria and efficient allocations in insurance markets with asymmetric information and establish the term “Second-best efficiency". They show, that the WMS equilibrium is second-best efficient for all values of \(\lambda\), which denotes the proportion of high risk individuals in the market.

\(^4\)i.e. the aversion to reveal private information.
3 Economic Environment

We consider a stylized model of an insurance market with focus on crucial features to be analyzed. Individuals in the market have fixed initial wealth of size \( W_0 \). There are two possible states for individuals. They either suffer a loss of size \( d \), and terminal wealth equals \( W_0 - d \), or wealth remains at \( W_0 \). Individuals can buy insurance in order to reduce potential loss. Individuals differ with respect to two dimensions: they are either “high” or “low” risk and either “high” or “low” frequency types. The former refers to differences in the probability of facing a loss, the latter refers to the fraction of time, the customer switches its insurance coverage on. That may be either driven by more need for coverage as well as a pure habit to use insurance more often. On the customer’s side, frequency also impacts the probability of risk.\(^5\)

Individual’s frequency is denoted by \( 0 < \nu^i < 1 \) with \( i \in \{l, h\} \) and the risk profile is denoted by \( 0 < p^i_j = p^i(\nu^j) < 1 \) with \( i, j \in \{l, h\} \). Both customer’s attributes are described by \( p^i_1 \). In contrast, a frequency close to 0 means, that the customer has sparse need for insurance. He would rarely switch his on-demand coverage on. A frequency close to 1 reflects almost permanent need for coverage. The proportion of type \( ij \) in the market is denoted by \( \lambda_{ij} \). Individuals are expected utility maximizers with a standard von Neumann-Morgenstern utility function over terminal wealth, \( u(\cdot) \), i.e. \( u'(\cdot) > 0 \) and \( u''(\cdot) < 0 \). Information about risk profile and frequency is private to each individual and cannot be observed by insurance companies, which means that information asymmetry prevails in this market.

There are two kinds of insurance companies operating on the market. \( s = (s_1, s_2) \) describes a standard insurance contract with premium \( s_1 \geq 0 \) and indemnification \( s_2 \geq 0 \). On-demand insurance contracts are described by \( s_{on} = (s_{on}^1, s_{on}^2) \) with equal implications for \( s_{on}^1 \) and \( s_{on}^2 \). In contrast to the former type of contracts, the latter is sensible to the frequency of usage of insurance coverage. \( s_1 \) reflects the actual payment to the insurance company opposed to \( s_{on}^1 \), which reflects a one year premium equivalent. To determine the actual payment, this value is multiplied by \( \nu \). Moral hazard will lead to \( s_{on}^1 > s_1 \) for the same risk and fairly priced contracts. For a more dense depiction of contracts in the environment, we introduce the triple \( s = (s_1, s_2, c) \). \( c \) defines the nature of the contract with \( c = 1 \) for standard contracts and \( c = 0 \) for on-demand contracts. We assume insurance companies to offer “price-quantity” contracts, which means that insurers set both dimensions in contrast to giving the customer the opportunity to freely choose the “quantity”, i.e. the deductible.\(^7\) These assumptions coincide with market observations in practice, when customers are limited in the choice of specific deductible levels.

As mentioned before, the “loss” and the “no-loss” state describe the terminal wealth of customers in the market, which is described by the tuple \( (W_0 - s_1, W_0 - s_1 - d + s_2) \) for standard insurance and \( (W_0 - \nu s_1, W_0 - \nu s_1 - d + s_2) \) for on-demand insurance.\(^8\)

In the next two sections we describe demand and supply functions of participants in the market.

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\(^{5}\)Intuitively, individuals that use their insurance coverage more often as they are more frequently exposed to risk, face a higher probability of loss.

\(^{6}\)“l” and “h” stand for “low” and “high”.

\(^{7}\)Compare Rothschild and Stiglitz (1976) and Hellwig (1987).

\(^{8}\)We implicitly assume for on-demand insurance that coverage is always active, whenever risk is prevalent. If there is no risk, coverage is switched off. Therefore, customers never forget to switch on.
3.1 Demand for Insurance Contracts

Customers’ expected utility depends on the type of contract. The actual payment for an on-demand insurance contract depends on the frequency of usage $\nu$. In contrast, payments for standard insurance contracts are independent of $\nu$.

Hence, expected utility is defined by

$$ V(p^{ij}, s) := \mathbb{E}[u(W_1; p^{ij}, s)] = p^i(\nu^j)u(W_0 - s_1 - d + s_2) + (1 - p^i(\nu^j))u(W_0 - s_1) \quad (1) $$

for standard contracts and

$$ V(p^{ij}, s_{on}) := \mathbb{E}[u(W_1; p^{ij}, s_{on})] = p^i(\nu^j)u(W_0 - \nu^js_{1on} - d + s_{2on}) + (1 - p^i(\nu^j))u(W_0 - \nu^js_{1on}) \quad (2) $$

for on-demand contracts respectively. $W_1$ describes terminal wealth.

No Insurance

The simplest case, in which expected utilities can be considered is the “no insurance” case. Premiums $s_1$ and $s_{1on}$ as well as indemnifications $s_2$ and $s_{2on}$ equal 0. Utilities for both insurance types are the same and take on the value

$$ V(p^{ij}, (0, 0)) := \mathbb{E}[u(W_1; p^{ij}, (0, 0))] = p^i(\nu^j)u(W_0 - d) + (1 - p^i(\nu^j))u(W_0). $$

3.2 Supply of Insurance Contracts

The insurer’s expected profit depends on the contract type for the same reason given above. We assume insurance companies to be risk-neutral.

Expected profit is defined by

$$ \pi(p^{ij}, s) = p^i(\nu^j)(s_1 - s_2) + (1 - p^i(\nu^j))s_1 = s_1 - p^i(\nu^j)s_2 \quad (3) $$

for standard contracts and

$$ \pi(p^{ij}, s_{on}) = p^i(\nu^j)(\nu^js_{1on} - s_{2on}) + (1 - p^i(\nu^j))\nu^js_{1on} = \nu^js_{1on} - p^i(\nu^j)s_{2on} \quad (4) $$

for on-demand contracts respectively.

3.3 Definition of Equilibrium

In this paper we use the equilibrium definition established by Wilson (1977) and extended by Miyazaki (1977) and Spence (1978). Accordingly, a menu of policies is an equilibrium in the Wilson sense, if no firm can offer a different menu which (1) earns positive profits right away and (2) continues to be profitable after competitors have dropped all unprofitable policies in response to the firm’s original move.
This equilibrium concept assumes non-myopic insurance companies. We further assume that insurance companies offer exclusively either an on-demand contract or a standard contract, but not both. Customers that purchased/would purchase a dropped contract, change to the most preferred contract left on the market.

4 Equilibrium Analyses

Preliminaries
Before we begin with the analyses of the insurance market with on-demand insurance, we introduce important preliminary aspects of the model. As before-mentioned, we differ four customer types with two values of frequency ($\nu$) and two risk profiles ($p(\nu)$).

Definition 1. The index of $\nu$ and $p(\nu)$ imply value and order with regard to other values, i.e. $\nu^h > \nu^l$ and $p^h (\nu^j) \geq p^l (\nu^j)$.

Assumption 1. Insurance companies cannot observe risk profile and frequency of single individuals. They are only aware of the proportion $\lambda_{ij}$ in the market.

Assumption 1 follows the definition in preliminary studies of Rothschild and Stiglitz (1976), Wilson (1977), Miyazaki (1977), and Spence (1978). Insurance companies therefore cannot offer tailored contracts for specific individuals.

Assumption 2. Risk is non-decreasing in the frequency, i.e. $p^j (\nu^h) \geq p^j (\nu^l)$ for $j \in \{l, h\}$.

Assumption 2 follows the intuition that the individual with same risk profile but higher frequency does not have less probability of facing a loss.

Assumption 3. Under Assumption 2 it also holds that $p^j (\nu^h) < p^j (\nu^l)$ for reasonable $\nu^j \in [\underline{\nu}, \overline{\nu}]$.

Assumption 3 implies that the main risk is determined by the risk profile. Customers cannot change into another risk class simply by exhibiting different frequencies. Or, considered from another perspective: The main reason two risk groups are identified is, that they actually embody two different levels of risk even if they comprise different frequency types.

Assumption 4. Under Assumption 2 it further holds that $\nu^h \nu^l > p^j (\nu^h) p^j (\nu^l)$.

This implies that risk profiles are sluggish. A twice as high frequency does mean, that the risk is less than doubled\footnote{Using the example of motor insurance, frequency of usage (distance driven in one year) is one of several risk factor in the risk classification model, where usually a doubled distance does not mean doubling the risk because this fact comes along with more driving experience.} \footnote{See Figure 5 in Appendix 7.1 for a depiction of risk profiles with the afore-mentioned properties.}.

Characteristics of Indifference Curves
The slopes of the indifference curves are given by

$$
\sigma^{ij} (s_1, s_2) := \frac{ds_1}{ds_2} = -\frac{\frac{\partial V(p, s)}{\partial s_2}}{\frac{\partial V(p, s)}{\partial s_1}} = \frac{p^i (\nu^j) u' (W_0 - s_1 + s_2 - d)}{\frac{\partial V(p, s)}{\partial s_1}} = \frac{p^i (\nu^j) u' (W_0 - s_1 + s_2 - d)}{\frac{\partial V(p, s)}{\partial s_1}} + (1 - p^i (\nu^j)) u' (W_0 - s_1) \tag{5}
$$
for standard contracts and

$$\sigma^{ij} (s_{1n}^n, s_{2n}^n) := \frac{d s_{1n}^n}{d s_{2n}^n} = -\frac{\partial V(p, s_{1n}^n)}{\partial s_{2n}^n} \frac{\partial V(p, s_{1n}^n)}{\partial s_{1n}^n}$$

$$= \frac{1}{\nu^j \left( p^i \nu^j \right) u' \left( W_0 - \nu^j s_{1n}^n + s_{2n}^n - d \right)} - \frac{1}{\nu^j \left( p^i \nu^j \right) u' \left( W_0 - \nu^j s_{1n}^n + s_{2n}^n - d \right)}$$

for on-demand contracts respectively.

Indifference curves in the \((s_1, s_2)\)-space take different forms depending on the market in which they are considered. In the standard market, a higher risk profile as well as a higher frequency leads to a steeper indifference curve. Rearranging Equation 5 to Equation 7 clarifies this fact.

$$\sigma^{ij} (s_1, s_2) = \left( 1 + \frac{1 - p^i \left( \nu^j \right)}{p^i \left( \nu^j \right) u' \left( W_0 - s_1 \right)} \frac{u' \left( W_0 - s_1 \right)}{u' \left( W_0 - s_1 + s_2 - d \right)} \right)^{-1}$$

In the on-demand market, these characteristics are more ambiguous. In case of a higher risk profile, the indifference curve becomes steeper as well, whereas in case of an increasing frequency, we cannot draw these conclusions. By reference to Equation 8, we can show this ambiguity.

$$\sigma^{ij} (s_{1n}^n, s_{2n}^n) = \frac{1}{\nu^j \left( p^i \nu^j \right) u' \left( W_0 - \nu^j s_{1n}^n + s_{2n}^n - d \right)}$$

Expression 1 is decreasing in \(\nu^j\). Term 2 is decreasing in \(\nu^j\) as well, which causes the value of the parentheses to increase. For expression 3, the effect depends on the specification of the utility function.

**Characteristics of Zero-profit Lines**

In this section, we describe the characteristics of zero-profit lines in both markets. Competition in the market usually forces firms to offer contracts on these lines. Again, different products cause zero-profit lines to be different (see Figure 1). The slope of zero-profit lines is given by \(p^i \left( \nu^j \right)\) in the standard market and \(p^i \left( \nu^j \right)\) in the on-demand market.

We can further conclude the following:

- In contrast to the standard market, the zero-profit line of high risk, low frequency individuals is above the one of high risk, high frequency individuals in the on-demand market. The reason for that is lower premium incomes due to less frequent coverage usage, which outweighs the effect of smaller risk\(^{11}\).
- Zero-profit lines in the on-demand market are strictly steeper than in the standard market as premium cash flows only take place in on-times.

Consequently, the order of zero-profit lines switches according to the market.

\(^{11}\)This effect is a consequence of Assumption 4.
Illustration of the Market

In the following part, we introduce the illustration of the market in the \((s_1,s_2)\)-space (see Figure 2). We therefore consider one customer in order to keep the example simple (in particular, we consider the high risk, high frequency customer), and further focus on the standard market, since there are only minor differences in the depiction of the two markets\(^{12}\). All relevant contracts have positive premium \((s_1)\) and indemnification \((s_2)\). Line \(z_{\text{ph}}\) reflects the zero-profit line, which comprises all contracts that provide zero expected profits for the insurance company. \(U_{\text{hh}}\) is one example of an isouility curve, which contains contracts that provide the same expected utility for type \(\text{hh}\).

With contracts above \(z_{\text{ph}}\), the insurance company earns positive profits, whereas on ones below, the company loses money in expectation. Customers obtain higher(lower) expected utility for contracts below(above) \(U_{\text{hh}}\). The origin reflects the situation in which the customer does not have any insurance (i.e. \(s_1, s_2 = 0\)). \(U_{\text{min}}\) represents the isouility curve through the origin.

Feasible contracts are given by the set of contracts in the grey area. Letter (A) describes the set of contracts that would lead to negative consumption in the loss-state. Negative consumption in both states is obtained for contracts in area (B). (C) comprises contracts, for which customers are overinsured, i.e. the compensation in the loss-state is higher than the loss itself\(^{13}\). Finally, (D) describes those contracts, that deliver less expected utility than if the customer had no insurance. The customer would therefore

\(^{12}\)See Appendix 7.2.

\(^{13}\)This case is problematic in the sense, that it creates incentives for moral hazard.
just do nothing and stay uninsured instead of buying such contracts. Formally, we can describe the sets as in Equation 9.

\[
A = \{ (s_1, s_2) \in \mathbb{R}^2 : W_0 - s_1 - d + s_2 < 0 \}
\]

\[
A \cup B = \{ (s_1, s_2) \in \mathbb{R}^2 : W_0 - s_1 - d + s_2 < 0 \text{ or } W_0 - s_1 < 0 \}
\]

\[
C = \{ (s_1, s_2) \in \mathbb{R}^2 : s_2 > d \}
\]

\[
D = \{ (s_1, s_2) \in \mathbb{R}^2 : V(p, (s_1, s_2)) < U_{\text{min}} \}
\]

(9)

**Homogeneous Customers**

Firstly, we evaluate the market in the presence of homogeneous individuals. The potential to attract customers by on-demand insurance is described in the following Proposition.

**Proposition 1.** *In a competitive market with homogeneous individuals, i.e. \( p^{ij} = p \), on-demand insurance can at most offer a contract \( s_{\text{on}} \), which provides the same expected utility to the customer as the respective standard contract \( s \).*
Proof. Let $s^*$ be the equilibrium contract in the standard market in the moment of market entrance of the on-demand insurance and $s_{\text{on}}$ the rivaling on-demand contract. Further, as the insurance operates in a competitive market, the break-even condition $\pi(p, s_{\text{on}}) = 0$ holds true. For $V(p, s_{\text{on}})$ we can conclude:

\[
V(p, s_{\text{on}}) = pu(W_0 - \nu s_{\text{on}}^1 - d + s_{\text{on}}^2) + (1 - p) u(W_0 - \nu s_{\text{on}}^1) \\
\leq u(W_0 - p d - \nu s_{\text{on}}^1 + p s_{\text{on}}^2) \\
\leq u(W_0 - p d) = V(p, s^*). \tag{10}
\]

However, there is only potential to attract customers if $V(p, s_{\text{on}}) > V(p, s^*)$. Furthermore, it can be shown, that the on-demand insurance can offer contracts that at least break even in expected utility.\(^{14}\)

Note, that with both contracts, customers receive full coverage for an actuarially fair premium. Consequently, respective contracts lead to the same expected utility. Graphically (see Figure 2), the slope of the indifference curve is equal to the slope of the zero-profit line (i.e. $\frac{d\nu_i}{ds_1^1} = p$ and $\frac{d\nu_i}{ds_2^1} = \frac{p}{2}$ respectively). In fact, individuals are indifferent between both contracts\(^{15}\).

Customers differ w.r.t. Frequency

Now we consider two types of customers who differentiate according to their frequency only, i.e. $p^i(\nu^j) = p(\nu^j)$ and $\nu^i \neq \nu^j$ for $i \neq j$, $\nu^h > \nu^l$. Moreover, we assume on-demand insurers to enter an existing market, on which standard contracts are offered. We can therefore track the dynamics of the establishment of a new market equilibrium more realistically. Following Rothschild and Stiglitz (1976), Wilson (1977), Miyazaki (1977) and Spence (1978), the market equilibrium takes on two forms. If the fraction of high risk individuals, i.e. high frequency individuals here, exceeds a critical value $\lambda_{WMS}$, the standard market equilibrium is described as in Rothschild and Stiglitz (1976)\(^{16}\). For $\lambda < \lambda_{WMS}$ the market equilibrium is described by a WMS-equilibrium\(^{17,18}\).

We consider following cases.

- $\lambda \geq \lambda_{WMS}$

  The market equilibrium in the standard market contains two separating contracts which provide full coverage for an actuarially fair premium to high frequency individuals and partial coverage to low frequency individuals (also for an actuarially fair premium). On condition of zero-profits, full coverage provides maximum utility to high frequency individuals. However, as seen in Figure 1, the order of riskiness changes if we consider zero-profit lines in the on-demand market. This leads us to the following Proposition.

\(^{14}\)For more details, see Appendix 7.3.

\(^{15}\)We are aware of the possibility, that other influencing factors may decide customers’ demand for specific contracts, as convenience of use. These are not considered deliberately.

\(^{16}\)In this case, high risk or, in the sense of this analysis, high frequency customers receive full coverage, whereas low frequency individuals receive partial coverage for an actuarially fair premium.

\(^{17}\)High frequency customers obtain full coverage and are cross-subsidized by low frequency customers, who receive partial coverage.

\(^{18}\)Rothschild and Stiglitz (1976) use an equilibrium definition, which is different from the one of Wilson (1977), Miyazaki (1977) and Spence (1978). Hence, the value of the critical proportion $\lambda$ changes between those authors. See Crocker and Snow (1985) for more information. A brief depiction is provided in Appendix 7.4.
Proposition 2. Let the fraction of high frequency individuals be \( \lambda \geq \lambda_{WMS} \) and the market equilibrium in the standard market be described by a RS-equilibrium. Then (1) there exists an on-demand contract \( s_{on} \), which provides more expected utility to low frequency individuals than the corresponding standard contract, on which the insurance company earns zero expected profits. Furthermore, (2) the resulting equilibrium is given by two separating contracts with the high frequency individuals receiving standard insurance and low frequency individuals receiving on-demand insurance.

Proof. The equilibrium contracts in the standard market are denoted by \( HH = (s_{1HH}, s_{2HH}, c = 1) \) and \( HL = (s_{1HL}, s_{2HL}, c = 1) \) with \( s_{1HH} = p^h (\nu^h) d \) and \( s_{2HH} = d \).

Utilities for individuals are defined by

\[
V(p_{hh}, HH) = u(W_0 - p^h (\nu^h) d)
\]

for high frequency types and

\[
V(p_{hl}, HL) = (1 - p^h (\nu^l)) u(W_0 - s_{1HL}^H) + p^h (\nu^l) u(W_0 - s_{1HL}^H - d - s_{2HL}^H)
\]

for low frequency types.

Firstly, we will show statement (1) of Proposition 2, that an on-demand insurance can attract low frequency individuals by offering full coverage with a premium equal to the expected loss, i.e. \( s_{2HL, on} = d, \nu s_{1HL, on} = p^h (\nu^l) d \Rightarrow s_{1HL, on} = \frac{p^h (\nu^l) d}{\nu^l} \). Let this contract be denoted by \( HL_{on} \).

On these conditions, expected utility of low frequency individuals for \( HL_{on} \) is higher than for the RS-equilibrium contract. Self-selection requirements of an equilibrium demand high frequency customers not to be attracted by \( HL_{on} \), i.e. \( V(p_{hh}, HH) \leq V(p_{hh}, HL_{on}) \). In fact, it holds true that

\[
V(p_{hh}, HL_{on}) = (1 - p^h (\nu^h)) u(W_0 - \nu p^h s_{1HL, on}^H) + p^h (\nu^h) u(W_0 - \nu p^h s_{1HL, on}^H - d + s_{2HL, on}^H)
\]

\[
= (1 - p^h (\nu^h)) u(W_0 - \nu^h p^h (\nu^l) d) + p^h (\nu^h) u(W_0 - \nu^h p^h (\nu^l) d)
\]

\[
= u(W_0 - \nu^h p^h (\nu^l) d) \geq u(W_0 - p^h (\nu^l) d)
\]

\[
\Leftrightarrow \frac{\nu^h}{\nu^l} \geq \frac{p^h (\nu^h)}{p^h (\nu^l)}.
\]

The final expression holds true because of Assumption 4. It remains to show (2) of Proposition 2, which states the persistent relevance of the standard contract. Therefore, we assume, that only on-demand insurance contracts are sold on the market. If the level of welfare should be retained,
contracts for high frequency customers have to provide full coverage for an actuarially fair premium. However, this contract in return will attract low frequency individuals as

\[ V(p^H, s_{on}^{HH}) = (1 - p^H \nu^l) u \left( W_0 - \nu^l s_1^{HH, on} \right) + p^H \nu^l \left( W_0 - \nu^l s_1^{H, on} - d + s_2^{H, on} \right) \]

\[ = u \left( W_0 - \frac{\nu^l}{\nu^H} p^H d \right) > u \left( W_0 - p^H \nu^l d \right) = V(p^H, s_{on}^{HL}). \]  

(14)

Where we used Assumption 4.

On-demand insurance can attract low frequency customers from an existing standard market RS-equilibrium. In the end, expected utility of low frequency customers increases. The standard insurance contract for high frequency customers persists as it earns non-negative profits even in the presence of on-demand insurance and provides maximum utility. However, on-demand insurance cannot make high frequency individuals better off by still gaining non-negative profits. The resulting market equilibrium is described by two separating contracts, which provide full coverage to each customer for an actuarially fair premium.

- $\lambda < \lambda^{WMS}$

The market equilibrium in the standard market is described by a cross-subsidizing equilibrium of separating contracts. High (low) frequency customers receive a contract, which provides full (partial) coverage for a lower (higher) than actuarially fair premium. The situation is shown in the first row of Figure 3\textsuperscript{19}. On the left, the starting situation in the standard market is shown. The chart on the right shows the initial position of the on-demand market. Blue lines indicate isoultility curves for the equilibrium contracts in the standard market (denoted by $U_{st}^{hh}$ and $U_{st}^{hl}$).

The position of $U_{st}^{hl}$ above the zero-profit line $zp_{hl}$ indicates the on-demand insurers’ potential to sell a contract, which provides more expected utility to low frequency individuals. This contract comprises full coverage and is actuarially fair priced. As low frequency customers leave the standard market, there is no more potential for cross-subsidization between both types\textsuperscript{20}. We formulate the following Proposition (without proof).

**Proposition 3.** Let the fraction of high frequency individuals be $\lambda < \lambda^{WMS}$ and the market equilibrium in the standard market be described by a cross-subsidizing WMS-equilibrium. Then (1) there exists an on-demand contract $s_{on}$, which provides more expected utility to low frequency individuals than the corresponding standard contract, on which the insurance company earns zero expected profits. Furthermore, (2) the resulting equilibrium is given by two separating contracts with the high frequency individuals receiving standard insurance and low frequency individuals receiving on-demand insurance.

The new equilibrium is described by separating contracts which both provide full coverage. These equilibrium contracts, $HH$ and $HL$, are depicted in the second row of Figure 3. Note, that the

\textsuperscript{19}Specifications of this numerical example are shown in Appendix 7.5.

\textsuperscript{20}This is due to the fact, that firms operate exclusively in one of both market. Zero-profit constraints therefore hold true for each of those firms.
equilibrium shown here is equal to the full information equilibrium. However, in contrast to a market without on-demand insurers, high frequency customers have to forfeit utility.

Both findings above show, that on-demand insurance can attract low frequency individuals and sell contracts with full insurance coverage for an actuarially fair premium. However, standard insurance remains relevant for high frequency individuals. It follows coexistence of standard and on-demand insurance companies.

**Customers differ w.r.t. Frequency and Risk Profile**

We now assume individuals to differ w.r.t. to frequency as well as their risk profile. Therefore, four different types are present in the market. Considering the existence of only one of both markets, Spence
Spence (1978) defines an optimization problem in order to solve for the solution of the market equilibrium\(^{21}\). The algorithm is given in Equation 15.

Let \( p' > p' \), for \( i < j \).

\[
\begin{align*}
   i &= 1: \\
   \bar{w}_1 &= \max_{s_2} V(p', s') \\
   \text{Subject to} \\
   s_1^i &= p's_2^i \\
   2 \leq i \leq n: \\
   \bar{w}_i &= \max_{s^k, k \in \{1, \ldots, i\}} V(p', s^i) \\
   \text{Subject to} \\
   V(p^k, s^k) &\geq \bar{w}_k, \quad \forall k < i \\
   V(p^i, s^i) &\geq V(p^i, s^{i+1}), \quad \forall k < i \\
   \sum_{k=1}^{i} \lambda^k \pi(p^k, s^k) &= 0 (15)
\end{align*}
\]

In the following, we give an optimization algorithm to derive an equilibrium in the combined market, beginning with an RS-equilibrium\(^{22}\).

First, we introduce the following notation:

\( \Phi_{st}^k \) - Set of types in the standard market in step \( k \)\(^{23}\).

\( \Phi_{on}^0 \) - Set of types in the on-demand market in step \( k \)\(^{24}\).

\( s_{ij}^* \) - Contracts in the standard market equilibrium of remaining types \( ij \in \Phi_{st}^k \setminus \{\text{type}_k\} \) in the standard market\(^{25}\). For \( ij \in \Phi_{on}^k \) this defines the contracts of the attracted types from step \( k - 1 \).

\( s_{\text{type}_k}^* \) - Contract of type \( k \) in the market equilibrium of types \( \Phi_{st}^k \) in the standard market.

\(^{21}\)Spence (1978) extends the algorithm of Miyazaki (1977) to the n-group case and applies the labor market model to the insurance market.

\(^{22}\)Note, that even if we consider more than two types, we speak of an RS-equilibrium if each type receives actuarially fair priced contracts.

\(^{23}\)\( \Phi_{st}^0 = \{hh, hl, lh, ll\} \), where the first letter stands for the risk profile (“h” for “high” and “l” for “low”) and the second letter for the frequency.

\(^{24}\)\( \Phi_{on}^0 = \emptyset \).

\(^{25}\)This equilibrium can be determined by Spence’s Algorithm (see Equation 15).
The sequential optimization problem for \( n \) types\(^{26} \) is defined as follows:

\[
\begin{align*}
1 \leq k \leq n: \\
\text{max} & \quad V \left( p_{type_k}, s_{type_k} \right) \\
\text{Subject to} & \\
V \left( p_{type_k}, s_{type_k} \right) & \geq V \left( p_{type_k}, s_{type_k}^* \right) \\
V \left( p_{ij}, s_{ij}^* \right) & \geq V \left( p_{ij}, s_{type_k} \right), \quad \forall ij \in \Phi_{st} \setminus \{type_k\} \\
V \left( p_{ij}, s_{ij}^* \right) & \geq V \left( p_{ij}, s_{kl} \right), \quad \forall ij \in \Phi_{st} \setminus \{type_k\}, \ kl \in \Phi_{on} \\
\sum_{ij \in \Phi_{on} \cup \{type_k\}} \lambda_{ij} \pi \left( p_{ij}, s_{ij} \right) & = 0
\end{align*}
\]

In every single step of this algorithm, \( \Phi_{on}^k \) and \( \Phi_{st}^k \) are updated. It is possible, that there exists no solution to the optimization problem in a certain step. Intuitively, this means that the regarded type cannot be attracted by on-demand insurance and he remains in the standard market. Consequently, we define \( \Phi_{on}^k = \Phi_{on}^{k-1} \) and \( \Phi_{st}^k = \Phi_{st}^{k-1} \). Else, there is a solution to the optimization problem, which implies, that on-demand insurance can attract individual \( k \). Hence, we define \( \Phi_{on}^k = \Phi_{on}^{k-1} \cup \{type_k\} \) and \( \Phi_{st}^k = \Phi_{st}^{k-1} \setminus \{type_k\} \). Constraints (16) - (19) are the self-selection criteria. Constraint (16) ensures, that the optimized contract provides at least the same utility as the respective equilibrium contract in the standard market. That customers in the standard market are not attracted by the optimized contract is described by constraint (17). Constraint (18) guarantees, that already attracted customers in the on-demand market are provided at least the same utility as before. With a view to the new potential standard market equilibrium, constraint (19) makes sure, that these customers are not attracted by the on-demand contracts. Constraint (20) formalizes the fact, that on-demand contracts are determined by the optimization problem and constraint (21) is the resource constraint for the on-demand market\(^{27} \).

Figure 4 illustrates the mechanics of the algorithm. In the beginning, there exists a market equilibrium in the standard market, which is determined by Spence’s algorithm. Respective isouility curves of standard market equilibrium contracts are shown as blue lines in the upper right chart of Figure 4. As can be seen, type hl’s isouility curve is above the one for an actuarially fair priced, full coverage contract. Moreover, this contract would not attract type hh, as its corresponding isouility line lies below. Attraction of type hl by an on-demand contract leads to the allocation shown in the second row of Figure 4.

However, the second step of the algorithm has no solution. Type hh cannot be attracted as there are no break-even contracts that grant higher utility to this type and less or equal utility for type hl to maintain self-selection.

The final individual to be attracted by on-demand insurance is type ll. The third row of Figure 4 shows the final equilibrium. Like type hh, type lh remains in the standard market.

\(^{26}\)In the most sophisticated case in this paper it holds \( n = 4 \).

\(^{27}\)Spence’s algorithm ensures that the resource constraint holds true in the standard market.
We conclude this Section with the following Proposition (without proof):

**Proposition 4.** Beginning with an RS-equilibrium, on-demand insurance can attract specific customer groups to form a new market equilibrium across both markets.

However, as shown in Figure 4, standard contracts remain relevant for some types, which leads to coexistence of both markets. The on-demand market cannot replace the standard market entirely.
Figure 4: Evolution of the equilibrium in the combined market. The upper row shows the starting position with equilibrium contracts in the standard market (left chart) and corresponding isoutility curves of these contracts in the on-demand market (right chart). The middle row shows the allocation with respective contracts in the standard (left chart) and on-demand market (right chart) after the first step of the algorithm. The lower row shows the final equilibrium with the respective contracts in the standard (left chart) and on-demand market (right chart), which result from the third step of the optimization algorithm.
5 Welfare Analyses and Market Performance

In this section, we analyze the utilitarian welfare as well as market performance for the combined market. Utilitarian welfare is the weighted expected utility of the whole market. Market performance describes the level of coverage. The best market performance would be achieved, if all customers receive full insurance coverage.

In our analysis, we use the chronology of the previous section.

Homogeneous Customers

**Proposition 5.** If there is only one type of individuals in the market, market entrance of on-demand insurance companies has no effect on utilitarian welfare and market performance.

*Proof.* The break-even constraint would force on-demand insurance to supply the actuarially fair priced contract with full coverage. Expected utilities remain the same for customers independent from the contract’s type. Coverage levels remain constant at full coverage.

In fact, no matter which contract individuals choose here, there is no change in utilitarian welfare and market performance.

Customers differ w.r.t. Frequency

As in the section before, we distinguish two cases based on the fraction of high frequency individuals in the market, which determines the kind of equilibrium in the standard market.

- \( \lambda \geq \lambda^{WMS} \)

**Proposition 6.** If there are two different types of individuals in the market with the same risk profile and different frequencies and if for the fraction of high frequency individuals it holds \( \lambda \geq \lambda^{WMS} \). Then, market entrance of on-demand insurers results in an increase in utilitarian welfare and market performance in the market equilibrium.

*Proof.* In the RS-equilibrium, high frequency customers already receive full coverage for an actuarially fair premium. This coincides with the contract in the combined-market equilibrium. Low frequency types switch their fair contract, which provides partial coverage, to an actuarially fair on-demand contract with full coverage. This leads to an increase in utility. Consequently, the increase in expected utility and a higher coverage level on side of low frequency customers causes utilitarian welfare and market performance to raise.

- \( \lambda < \lambda^{WMS} \)

**Proposition 7.** If there are two different types of individuals in the market with the same risk profile and different frequencies and if for the fraction of high frequency individuals it holds \( \lambda < \lambda^{WMS} \). Then, market entrance of on-demand insurers results in an increase in utilitarian welfare and market performance in the market equilibrium.

\(^{28}\)Utilitarian welfare subsumes both, customers’ expected utilities and firms’ expected profits.
Proof. In this case, the standard market equilibrium is described by a cross-subsidizing jointly zero-profit WMS-equilibrium. Though high frequency individuals suffer a decrease in utility in the combined-market equilibrium, utilitarian welfare increases due to the fact, that an allocation accrues, which provides full coverage for an actuarially fair premium for both types. Spence (1978) shows, that this allocation is the one with highest utilitarian welfare in competitive markets. Market performance raises simply by the increase of coverage for low frequency customers.

Proposition 6 and 7 show, that on-demand insurance in addition to standard insurance is beneficial for the market.

Customers differ w.r.t. Frequency and Risk Profile

Proposition 8. If there are four different types of individuals in the market with high/low risk profile as well as high/low frequencies and if the market equilibrium in the standard market is of RS-type. Then, market entrance of on-demand insurers results in an increase of utilitarian welfare and market performance in a resulting market equilibrium.

Proof. Conclusions with regard to welfare and market performance follow analogously to those in Proposition 6. Market entry of on-demand insurance increases coverage level as well as expected utility of hl-types. In consequence, types, that bear less risk in the standard market (lh and ll) receive more advantageous contracts, since negative externalities of the hl-types vanish. The same holds true for type ll individuals, whose attraction further reduces negative externalities in the standard market. Likewise, level of coverage as well as expected utility raises for type ll. Overall, the combined-market equilibrium grants at least the same utility and coverage level for each individual.

Proposition 8 shows, that the market entry of on-demand insurance proofs to be beneficial.

6 Conclusion and Outlook

Basing our model on preliminary studies of Rothschild and Stiglitz (1976), extended by Wilson (1977), Miyazaki (1977), and Spence (1978), we introduce an access-based insurance contract, a so-called “on-demand“ contract, which enters the market besides classical one-year contracts. As generic example for access-based consumption, it stands for arising new business models in today’s world.

Further, we consider heterogeneous individuals with two important attributes: the frequency of usage of their coverage/insurance and their risk profile. This information is private to the individuals. Our analysis shows that those products have the potential to attract specific types, particularly those, who are low frequent users. As long as we observe individuals, who exhibit different levels of frequency, market equilibrium is split into contracts for individuals, who prefer a standard contract and ones for individuals, who prefer an on-demand contract. Therefore, we observe coexistence of the two markets.

Market entry of on-demand insurance also increases utilitarian welfare as well as market performance.

\[\text{29} \text{see first row of Figure 3 (left).}\]

\[\text{30} \text{As seen in Figure 4, we carried out a numerical example. Specifications are shown in Appendix 7.5.}\]
Overall, introduction of on-demand insurance is beneficial for the market. Insurance companies, which offer standard policies only, might therefore consider to extend their product line. Access-based services could either be deployed in order to complement the current offer or to offer a distinctive alternative to the existing product line.

The short track record of access-based products, in particular in the insurance industry, aggravates a conclusive evaluation of this business model. We see either on-demand insurers to grow and assert themselves against incumbents or incumbents to extend their product portfolio by on-demand contracts.
7 Appendix

7.1 Risk Profiles

In this section, we show one example of potential risk profiles. Properties are as mentioned in Assumptions 2 to 4 and therefore it holds $p' (\cdot) < 1$. The risk profiles, which we used in this paper are depicted in Figure 5. It shows, that the risk profile of high risk types is above the one of low risk types for all frequencies. Note, that for Assumption 3 to hold, it requires to choose appropriate frequencies.

![Exemplary risk profiles](image)

Figure 5: Exemplary risk profiles.

7.2 Illustration of the On-Demand Market

Akin to the depiction of the standard market (see Figure 2), Figure 6 shows combinations of premiums $s_1$ and indemnifications $s_2$ in the on-demand market. Zero-profit lines are steeper and the shape of isouitlity curves also differs. The areas (A) - (D) reflect similar kind of contracts as defined in Section 4. Note, that the line, that limits the space of feasible contracts (black line starting at $(0, \frac{W_0-d}{\nu})$) depends on the customer’s type, which leads to different values for the intercept.
7.3 Proof of Equation 10

For on-demand insurance to attract individuals, following two conditions have to hold: $V(p, s_{on}) > V(p, s^*)$ and $\pi^{on} \geq 0$. We can see that

$$V(p, s_{on}) = p \cdot u(W_0 - \nu s_1^{on} - d + s_2^{on}) + (1 - p) \cdot u(W_0 - \nu s_1^{on})$$

$$\leq u(W_0 - p d - \nu s_1^{on} + p s_2^{on})$$

$$= u(W_0 - \nu s_1^{on} + p (s_2^{on} - d))$$

$$= u(W_0 - p d - \nu s_1^{on} + p s_2^{on})$$

$$\leq u(W_0 - p d) = V(p, s^*).$$

The first inequality holds true because of the concavity of the utility function. The second one results from $u(\cdot)$ being an increasing function.
7.4 Comparison of Critical Values in RS and WMS

The equilibrium notion of Rothschild and Stiglitz (1976), which means that insurance companies act myopic, results in a comparably lower critical value $\lambda$ for the proportion of high risk individuals. This implies the existence of values for this fraction, for which the market equilibrium is described by a separating equilibrium in the RS-sense on one side, and a cross-subsidizing equilibrium in the WMS-sense on the other side. Figure 7 shows the different natures of the market equilibrium depending on those aspects.

Figure 7: Critical values for the fraction of high risk individuals and corresponding nature of the market equilibrium in the RS- or WMS-sense.

7.5 Specification of the Numerical Analysis and Results

The following section comprises the calibration and results of our numerical analysis, which we conducted in order to generate figures in this paper as well as derive concrete numbers to evaluate change in utilitarian welfare and market performance.

We set initial wealth $W_0 = 10$ for each individual. Individuals face a loss of $d = 9$ in case of an accident with a probability, which depends on risk profile and frequency. We also assign weights to those types, i.e. the proportion in the market. Probabilities and weights are shown in Table 1.

<table>
<thead>
<tr>
<th>type</th>
<th>frequency</th>
<th>probability</th>
<th>weight (two types)</th>
<th>weight (four types)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hh</td>
<td>0.7</td>
<td>0.4595</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>hl</td>
<td>0.5</td>
<td>0.3493</td>
<td>0.5</td>
<td>0.09</td>
</tr>
<tr>
<td>lh</td>
<td>0.7</td>
<td>0.3285</td>
<td>-</td>
<td>0.009</td>
</tr>
<tr>
<td>ll</td>
<td>0.5</td>
<td>0.2451</td>
<td>-</td>
<td>0.0009</td>
</tr>
</tbody>
</table>

Weights do not necessarily add up to 1. This does not cause any problems, as this can be achieved by dividing them by the sum of all weights. In the analysis of four types, weights are set to ensure the establishment of a Rothschild-Stiglitz equilibrium in the standard market. This requires the weight of higher risk individuals to be substantially higher in comparison to weights of subsequent, lower risky
individuals.

We use an isoelastic utility function (see Equation 22), which fulfills the von Neumann-Morgenstern property for risk averse individuals with $u(\cdot) > 0$, $u'(\cdot) > 0$ and $u''(\cdot) < 0$.

$$u(x) = \begin{cases} \frac{x^{1-\eta}-1}{1-\eta} & \eta > 0, \eta \neq 1 \\ \ln x & \eta = 1 \end{cases}$$

(22)

For the analysis, we chose $\eta = 2$. The results for market performance and utilitarian welfare are as follows:

**Two types with WMS-equilibrium as starting situation:**

Utilitarian welfare increases slightly from 0.8417 in the standard market equilibrium to 0.8419 in the combined-market equilibrium. Type hh’s coverage stays the same at 9, whereas coverage for type hl increases by 1.52 (from 7.48 to 9). This indicates, that market performance rises as well.

**Four types:**

Utilitarian welfare and market performance increase in this case. Both, utility and coverage for all types are depicted in Table 2. Differences are not substantially in absolute as well as in relative terms. The reason for that is the flat slope of the utility function. However, a marginal effect can be observed in both cases shown above.

<table>
<thead>
<tr>
<th>type</th>
<th>utility (standard)</th>
<th>utility (combined)</th>
<th>coverage (standard)</th>
<th>coverage (combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hh</td>
<td>0.8295</td>
<td>0.8295</td>
<td>9.0000</td>
<td>9.0000</td>
</tr>
<tr>
<td>hl</td>
<td>0.8412</td>
<td>0.8543</td>
<td>5.2142</td>
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</tr>
<tr>
<td>lh</td>
<td>0.8434</td>
<td>0.8440</td>
<td>4.9030</td>
<td>4.9705</td>
</tr>
<tr>
<td>ll</td>
<td>0.8550</td>
<td>0.8634</td>
<td>3.9704</td>
<td>5.1482</td>
</tr>
<tr>
<td>All</td>
<td>0.8307</td>
<td>0.8319</td>
<td>-</td>
<td>-</td>
</tr>
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References


