Risk sharing as a supplement to imperfect capitation in health insurance:

a tradeoff between selection and efficiency

Risicodeling als aanvulling op imperfecte normuitkeringen voor ziektekostenverzekeringen:

een afruil tussen selectie en doelmatigheid

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1. Introduction

Market-oriented health care reforms are high on the political agenda in many countries. The main purpose of many reforms is to increase the insurers' incentives for efficiency and their responsiveness to consumers' preferences. A common element is the introduction of capitation payments through which the insurers are (largely) financed by the regulator[1]. With these payments the insurers should provide or purchase a specified set of health care services for their members during a certain period, mostly one year. In some countries the capitation payments constitute the entire revenue of insurers, but in most countries the insurers are allowed to quote an additional premium to their members. In the latter case the regulator usually requires an insurer to quote the same additional premium to each member that chooses the same insurance modality. A common problem in all countries is the implementation of adequate capitation payments. Ideally the capitation payments should account for predictable variations in individual health care expenditures as far as these are caused by differences in health status while they should retain an insurer's incentives for efficiency. Currently employed capitation payments are mainly based on demographic variables which are relatively poor predictors of individual annual health care expenditures. Therefore, capitation payments based on demographic variables only, provide insurers with a strong incentive for preferred risk selection (Newhouse et al., 1989; Ash et al., 1990; Anderson et al., 1990; Van Vliet and Van de Ven, 1992). Preferred risk selection refers to an insurer's selection of those individuals that it expects to be profitable. It is also called cream skimming or cherry picking. In principle demographic capitation payments can be improved upon substantially by taking more and better risk factors into account. However, the implementation of such improved capitation payments does not appear to be straightforward. Currently the most promising risk

[1] Where this study uses the term 'insurer', it can be a sickness fund or so-called 'care insurer' as in Belgium, Germany, and the Netherlands, an integrated health plan such as health maintenance organizations in the United States or a (group of) health care providers such as General Practitioner-fundholders or Primary Care Groups in the United Kingdom. Commonly the regulator is the government but it may also be an employer or a group of employers.

adjusters are measures of prior costs and diagnostic information from either previous hospitalizations or previously prescribed drugs (Clark et al., 1995; Ellis et al., 1996; Lamers and Van Vliet, 1996; Weiner et al., 1996). However, it is unclear whether the application of such improved capitation payments will reduce insurers' incentives for selection to negligible levels. Some have argued that even with the application of near-perfect capitation payments, selection might remain highly profitable (Newhouse et al., 1989).
In case that - for whatever reason - crude capitation payments can not be improved in practice, several authors have suggested to pay the insurers partly on the basis of capitation payments and partly on the basis of actual costs (Gruenberg et al., 1986; Newhouse, 1986; Van de Ven and Van Vliet, 1992). Various names can be found for such payment systems: 'mixed payment systems', 'blended payment systems', 'partial capitation', '(outlier) pooling', and 'risk sharing'. In this study the latter term will be used. Risk sharing implies that the insurers are retrospectively reimbursed by the regulator for some of the expenditures of some of their members. Assuming budget-neutrality, it can be seen as a mandatory reinsurance program for the insurers, where the regulator acts as the reinsurer. With risk sharing the regulator might give up some of the insurers' incentives for efficiency in exchange for a reduction of their incentives for selection. As far as we know, a systematic analysis of the consequences of various forms of risk sharing in a regulated competitive individual health insurance market has not yet been performed.

> *Given this background the main purpose of this study is to compare the consequences of various forms of risk sharing as a supplement to demographic capitation payments in a regulated competitive individual health insurance market. In particular the focus is on the reduction of insurers' incentives for efficiency in exchange for a reduction of their incentives for selection. This tradeoff will be abbreviated as the tradeoff between selection and efficiency.*

The main contribution of this study is the development of a conceptual framework for optimizing the tradeoff between selection and efficiency and the empirical analyses of risk sharing as a supplement to demographic capitation

payments. It is interesting to compare the results of risk sharing with those that improving demographic capitation payments may yield. As a first step towards this type of research, this study also compares the consequences of risk sharing with the consequences of prior costs as an additional risk adjuster. In the latter case there is also a tradeoff between selection and efficiency. This chapter first describes the background to this study and the rationale for risk sharing more elaborately. Then the research questions are mentioned. Finally the international relevance is discussed as well as other ways to reduce the insurers' incentives for selection.

1.1 Regulated competition

In an unregulated market for health insurance, premiums per contract will be based on expected costs (equivalence principle). For individual health insurance this implies that the premium for an 80-year-old person would be on average about ten times the premium for a 20-year-old person, and that a chronically ill person would have to pay many times what a healthy person in the same age-group pays. Furthermore insurers might refuse to cover high-risk individuals for whom an appropriate premium can not be calculated and/or they might exclude pre-existing medical conditions from coverage. In most countries these consequences of the equivalence principle are considered unacceptable because of the serious access problems they would create. The purpose of much regulation in a competitive health insurance market is to guarantee access to coverage for high-risk individuals for an affordable price (premium). Such regulation should involve: the definition of a benefits package and rules with respect to enrolment and premiums.
This study assumes that the regulator specifies a benefits package that covers acute care such as short-term hospital care, physician services and prescribed drugs[2]. The insurers are allowed to offer different modalities of the benefits package provided that each modality covers all types of care specified in the

[2] For a study that analyzes capitation payments for various types of long-term care, see Van Barneveld et al. (1997).

benefits package. The insurance modalities of the specified benefits package may differ only with respect to the list of contracted providers of care and with respect to the conditions that have to be fulfilled in order to cover the costs. Such a condition could be that a referral card from a general practitioner is needed for the reimbursement of the costs of a consultation with a medical specialist in a hospital. The flexibility in the description of the specified benefits package should pave the way for setting up alternative health care insurance and delivery arrangements, such as health maintenance organizations and preferred provider organizations.
In most countries that currently apply capitation payments, it is mandatory for the consumers to buy a modality of the specified benefits package. However, this study is also relevant in the case of voluntary health insurance. In the latter case the capitation payments and the risk sharing apply only to those individuals that voluntarily buy a modality of the specified benefits package.
It is assumed that the regulator specifies a periodic open enrolment requirement. This means that each insurer has to accept anyone who wants to enrol for the specified benefits package during a certain enrolment period.

This study assumes that the insurers are largely financed via capitation payments. To calculate the capitation payments the regulator must have a practical definition of so-called 'acceptable expenditures' within the context of the specified benefits package. Such a definition is also necessary if capitation payments are supplemented with risk sharing.
A person's capitation payment equals the predicted costs within the risk group to which the person belongs (i.e. the normative costs of the person in question) minus e.g. a fixed amount or a certain percentage. The thus created deficit is closed by an additional premium that each person pays directly to the chosen insurer. Each insurer is free to set its own additional premium. Therefore, the level of the additional premiums is subject to competition and ultimately the insurer determines its own revenues. However, it is assumed that the regulator requires an insurer to quote the same premium to all members choosing the same insurance modality. The additional premiums reflect the difference between capitation payments and actual costs, thus creating incentives for the insurers to be efficient. An insurer is more efficient than a competitor if it is

able to serve the same population with the same quality of care for lower costs or with a higher quality of care for the same costs. Consequently, where this study uses the term 'efficiency', technical efficiency or so-called efficiency in production is meant, not allocative efficiency.

The consumers are free to choose from different insurers, choosing the insurance modality they like most. The premium paid will reflect the cost-generating behaviour of the contracted health care providers. It is expected that this will create an environment in which:
- consumers are being rewarded for choosing efficient insurers and choosing efficient providers;
- providers are being rewarded for efficient provision of care;
- insurers are stimulated to contract efficient providers and to be responsive to consumers' preferences (Van de Ven and Schut, 1994).

Besides preferred risk selection, another major potential problem in a regulated competitive individual health insurance market is quality skimping. Quality skimping or so-called stinting is the reduction of the quality of care to a level below the minimum level that is acceptable to society. Newhouse et al. (1997) propose risk sharing as a solution for the selection problem as well as the quality skimping problem. However, in the present study risk sharing will be analyzed as a potential solution for the selection problem only. The reason is that selection is caused by inadequate capitation payments whereas quality skimping may even emerge in the case of 'perfect' capitation payments.
Financial incentives for quality skimping are caused by insufficient pressure from consumers on insurers to contract good quality care when the consumers choose an insurance modality. Van de Ven and Schut (1994) have argued that with respect to most types of acute care, competing health insurers will have incentives to improve the quality of care if the selection problem is solved sufficiently. The authors mention two types of care for which the problem of quality skimping may be relevant even in the case of 'perfect' capitation payments: care that is often used by persons who do not have the mental ability to make a tradeoff between price and quality themselves; and care that most people are not interested in because they have a very low probability of needing

it during the next contract period. The present study assumes that the regulator uses a separate regulatory regime for such types of care (e.g. long-term care for demented elderly) apart from the competitive regulatory regime for acute care.

Inadequate capitation payments may lead to overcompensation and undercompensation of insurers. This 'fairness' problem arises if, for whatever reason, preferred risks are not distributed evenly among the insurers. In that case insurers with relatively many preferred risks are overpaid while others are underpaid, so there is not a 'level playing field' for all insurers. As a result efficient insurers might lose market share to inefficient insurers. The extent of this 'fairness' problem depends on the distribution of preferred risks among the insurers. If these are distributed evenly, then even if the capitation payment is the same for each individual ("flat capitation payments") there would be no overcompensation or undercompensation of insurers. However, the selection problem would be as great as possible. On the other hand, if the selection problem is solved sufficiently, it seems likely that the 'fairness' problem is also solved adequately.

This study focuses on preferred risk selection by insurers. A necessary condition for this type of selection to occur is that an insurer has an information surplus vis à vis the regulator. That is, an insurer has more information about the risks of individuals than the regulator uses in its payment system. Another type of selection is adverse selection. Adverse selection is caused by a consumer information surplus vis à vis the insurers, i.e. consumers have more information about their risks than the information that insurers (are allowed to) use for discerning risks groups and setting premiums (Pauly, 1984). Given demographic capitation payments and the premium rate restrictions, it is likely that risk sharing reduces both the insurers' incentives for preferred risk selection and the consumers' opportunities for adverse selection. Nevertheless, if the insurers' incentives for selection are reduced to such an extent that preferred risk selection is unprofitable, there may remain some consumers' opportunities for adverse selection, but their extent is unknown[3]. The distinction between

[3] These opportunities for adverse selection remain outside the scope of the present study.

preferred risk selection and adverse selection is vague when insurers try to attract preferred risks by offering different insurance modalities of the specified benefits package. However, besides offering different insurance modalities, insurers have several other tools for preferred risk selection at their disposal. The problem of preferred risk selection and potential solutions are discussed in chapter two.

1.2 Purpose of risk sharing

This study assumes that the regulator's purpose with risk sharing is to reduce insurers' incentives for selection while preserving their incentives for efficiency as much as possible. Of course the better the capitation payments, the less need for risk sharing. A crucial assumption in this study is that the capitation payments are calculated in the same way as in the situation without risk sharing. Furthermore it is assumed that the regulator requires risk sharing to be budget-neutral at the macro level and that it is mandatory for all insurers to contribute to the financing of the risk pool. The latter requirement is necessary because otherwise some insurers might not want to participate in the risk sharing arrangement. Various forms of risk sharing are possible. These will be described in detail in chapter three.

In related studies the purpose of risk sharing appears to be different or to include more aspects than the present study (Keeler et al., 1988; Beebe, 1992; Newhouse, 1992; Newhouse et al., 1997; Schokkaert et al., 1998; Keeler et al., 1998). In the present study it is *not* the purpose of risk sharing:

- To reduce the insurers' incentives for quality skimping.
Newhouse et al. (1997) have proposed risk sharing as a solution for the selection problem as well as for the problem of quality skimping. The present study assumes that it is the competition itself - not the payment system for the competing health insurers - that, in the long run, has to lead to the desired volume and quality of care.

- To reduce the insurers' financial risk.
An insurer's financial risk is related to the unpredictability of health care expenditures and the size of its portfolio. As a result of pure chance, the financial result of an insurer may vary over the years. Beebe (1992) has analyzed an outlier pool, which is one form of risk sharing, in the context of the capitation of at-risk health maintenance organizations in the Medicare program in the United States. The author concludes that an outlier pool could provide some protection against the risk of an *unpredictable* high proportion of high-cost users at a relatively modest cost. However, for relatively large insurers chance is not a problem at all and relatively small insurers can deal with this problem via voluntary risk-rated reinsurance techniques. There are two differences between risk sharing and such traditional reinsurance techniques: risk sharing is mandatory and the price for an insurer is not (fully) related to the risk of its members for whom some risk is shared, whereas traditional reinsurance is voluntary and risk-rated.

- To reduce the consumers' opportunities for adverse selection.
In the simulation of Keeler et al. (1998) an important outcome measure for each payment system is the so-called "payment fairness". This is the ratio of the payment to an insurer to the costs of providing the insurer's members with the care they would receive at the yardstick insurer. As the authors state: "to the degree this ratio falls short of 1.0, the insurer suffers from adverse selection, and premiums will include a surcharge for its risk mix (and conversely)". As mentioned before, the present study focuses on preferred risk selection by insurers. Any remaining opportunities for adverse selection after the problem of preferred risk selection has been solved adequately, remain outside the scope of the present study.

- To account for possible correlation between risk factors that should be included in the capitation formula (e.g. age, sex and indicators of health status) with variables that should not be included (e.g. regional overcapacity of hospitals and/or physi-cians or propensity to consume health care services).
Schokkaert et al. (1998) have argued in favour of risk sharing for this reason. The present study assumes that the capitation payments are based on an average

amount of health care supply and an average propensity to consume. The consequences of inefficiency should be reflected in an insurer's additional premium per insurance modality. Consumers with a preference for more than average health care use given their health status, may choose a more generous insurance modality while paying a higher additional premium.

- To average out pricing errors.
In the context of the capitation of health care providers, Newhouse (1992) assumes that hospital and physician prices will not equal those of a competitive equilibrium. Even if the intent were to approximate an optimal price, systems as the prospective payment system for paying hospitals in the United States[4] will make errors. In the light of such errors, the author argues that it will improve welfare to adopt a mixed mode of reimbursement. The present study assumes that it is the competition itself - not the payment system for the competing health insurers - that, in the long run, has to lead to good price signals.

In the context of the prospective payment system for paying hospitals in the United States, Keeler et al. (1988) have analyzed insurance aspects of diagnosis related groups outlier payments. Their paper characterizes the outlier payment formulae that minimize risk for hospitals under fixed constraints on the sum of outlier payments and minimum hospital coinsurance rate. They mention that in addition to reducing financial risk to hospitals, outlier payments have three other main goals: giving additional money to hospitals that treat sicker and more expensive patients than average; reducing access problems for patients who can be identified by hospitals as likely to need very expensive treatment; and, conditional on admission, reducing incentives to provide less care for the very sick than society would wish them to have. Therefore, in their study the purpose of risk sharing includes more aspects than the present study.

[4] The so-called prospective payment system for paying hospitals in the United States consists of normative payments for a certain admission given that the admission has occurred. In the context of the capitation of insurers, such a payment is commonly referred to as a retrospective capitation payment (see chapter two).

1.3 Research questions

The study is divided into two parts. In the *first* part a conceptual framework for optimizing the tradeoff between selection and efficiency will be developed. The *second* part contains empirical applications of the developed methodology.

In chapter two the problem of selection by insurers and the measurement of an insurer's incentives for selection will be discussed. Specifically the following research questions will be addressed:

1a. What tools can an insurer use for selection?
1b. What are the negative effects of selection?
1c. How can selection be prevented?
1d. What indicators can be used for measuring an insurer's incentives for selection?

In the third chapter forms of risk sharing will be described. The questions guiding chapter three are:

2a. Which forms of risk sharing have been suggested in the literature?
2b. What are the results of previous empirical studies on risk sharing?
2c. Which conceptual framework can be used to describe forms of risk sharing?
2d. What is the difference between risk sharing and capitation?

Chapter four describes the tools that an insurer can use to improve the efficiency of care and the savings that could be achieved. Moreover, it discusses the measurement of an insurer's incentives for efficiency.

3a. What tools can an insurer use to improve efficiency?
3b. What are the savings that could be achieved by an insurer?
3c. What indicators can be used for measuring an insurer's incentives for efficiency?

The purpose of chapter five is to combine the elements of the preceding chapters into a conceptual framework for optimizing the tradeoff between selection and efficiency. The question addressed in chapter five is therefore:

4. Which conceptual framework can be used for optimizing the tradeoff between selection and efficiency?

The *second* part of the study consists of empirical illustrations. Given a demographic capitation formula, the consequences of various main forms of risk sharing will be analyzed. After a description of the data, the methods and the incentives for selection under demographic capitation payments in chapter six, chapter seven addresses the following questions:

5a. What are the consequences of several variants of the main forms of risk sharing for an insurer's incentives for selection and efficiency?
5b. Which form of risk sharing yields the best tradeoff between selection and efficiency?

Chapter eight analyzes capitation payments that are, besides demographic variables, based on prior costs. The results are compared with those of risk sharing in chapter seven.

6a. What are the consequences of several variants of prior costs as an additional risk adjuster for an insurer's incentives for selection and efficiency?
6b. Do prior costs as an additional risk adjuster yield a better tradeoff between selection and efficiency than risk sharing as a supplement to demographic capitation payments?

For the empirical analyses a stratified data set is available with information at individual level for several consecutive years of about 47,000 Dutch sickness fund members ("Zorg en Zekerheid"). The data set contains administrative information on background variables of the insureds (like their age and sex) as well as their annual health care expenditures for several types of acute care (like short-term hospital care, physician services and prescribed drugs) and the

diagnoses from their hospital admissions in the form of the relevant code from the International Classification of Diseases, 9th Edition, Clinical Modification. For a subset of about 10,500 members, health survey data are also available. Although the data set is not very large, it contains the necessary detailed information for a thorough analysis of risk sharing as a supplement to demographic capitation payments in a regulated competitive individual health insurance market.

1.4 International relevance

This study is relevant for at least ten countries that are implementing or considering to implement competitive health care reforms that include similar regulations as those that are assumed in this study. In the late 1990s competing sickness funds or so-called 'care insurers' receive capitation payments in:
- Belgium (Schokkaert et al., 1998);
- the Czech Republic (McCarthy et al., 1995);
- Germany (Files and Murray, 1995);
- the Netherlands (Van de Ven et al., 1994);
- Ireland;
- Israel (Chinitz, 1994);
- Switzerland (McCarthy et al., 1995).

In Russia some experiments with capitation payments have been conducted (Sheiman, 1994; Isakova et al., 1995).

In the Medicare program in the United States competing at-risk health maintenance organizations have been receiving capitation payments since the early 1980s. The capitation payments are based on the Average Adjusted Per Capita Costs formula. In 1997 this formula was still based on age, sex, welfare status and institutional status only (Newhouse et al., 1997).
Risk sharing as a supplement to capitation payments is also relevant for the Medicaid program and for private (group) health insurance in the United States (Cutler and Zeckhauser, 1998).

Risk sharing is also relevant for a competitive provider market, in which competing (groups of) providers receive a capitation payment to provide or purchase a specified set of services for a group of members, such as the system of fundholding for general practitioners in the United Kingdom in the 1990s (Matsaganis and Glennester, 1994; Sheldon et al., 1994).

All countries mentioned use a rather crude capitation formula, mostly based on demographic variables only, combined with flat-rate additional premiums. Besides trying to improve their capitation formula, these countries might consider to implement some form of risk sharing. In fact, some countries have already implemented a form of risk sharing (e.g. Belgium, the Netherlands, the United Kingdom). Such countries might consider to change their specific form of risk sharing if other forms are shown to yield a better tradeoff between selection and efficiency.

Of course there are also several important differences between the health care reforms in the countries mentioned above. For instance, differences in the population that is included (all ages or the elderly); the exact types of care covered in the benefits package (including or excluding types of long-term care) and the contract period (one year or one month). The present study focuses on a regulated competitive health insurance market that covers a general population for types of acute care only. Furthermore the study focuses on a contract-period of one year.

1.5 Other solutions

Within the context of this study, the problem of selection by insurers can be addressed via procompetitive regulation, improving the capitation payments, and introducing risk sharing as a supplement to the capitation payments. Other solutions are mentioned in this section, but they are outside the context of this study.

Financial incentives for selection can be removed by providing full reimburse-

ment of an insurer's expenditures or by refraining from any regulation. In the first case an insurer would have nothing to gain by selection but it would also have nothing to gain by improving efficiency. Because the main reason for market-oriented health care reforms is to increase the insurers' incentives for efficiency, this option is outside the context of this study.
Because incentives for selection are (mainly) caused by regulation (Pauly, 1984), refraining from regulation removes (most) incentives for selection. However, without regulation, a free competitive individual health insurance market with its associated access problems will arise. For the latter case Van de Ven et al. (1999) concluded that risk-adjusted subsidies may be an effective tool to increase access to coverage for high-risk individuals without having the adverse effects of (regulation-induced) selection. As long as the subsidies are imperfectly risk-adjusted, risk sharing could then be used as a tool to reduce access problems. However, the present study only considers a regulated competitive individual health insurance market with capitation payments and flat-rate additional premiums. Consequently, the present study focuses on risk sharing as a tool to reduce the selection problem.

Preferred risk selection can be mitigated by relaxing the premium rate restrictions to some extent, by standardizing the benefits package and by stimulating group insurance. The premium rate restrictions could be changed by allowing an insurer to quote a premium per insurance modality that varies between a certain minimum and a certain maximum value. In that case an insurer can use (a part of) its information surplus vis à vis the regulator for premium differentiation which will lower its incentives for selection.
A mandatory insurance for a fully standardized benefits package would imply refraining from different insurance modalities and from selective contracting. As a result, an insurer would not be able to attract preferred risks by the design of different insurance modalities. However, an insurer could also use other tools for selection and a fully standardized benefits package may be hard to implement. Even if fully standardized benefits could be implemented, it may have several adverse effects: a reduction of an insurer's tools for efficiency, a reduction of an insurer's possibilities to be responsive to consumers' preferences and - depending on the generosity of the fully standardized benefits package - it

may increase moral hazard. On the other hand, standardizing the benefits package could have the advantage of making the market more transparent and reducing consumers' search costs. The present study assumes a specified benefits package that can be offered in different insurance modalities provided that such a modality covers all types of care specified in the benefits package. It can either be mandatory for the consumers to buy a modality of the specified benefits package or they may buy such a modality on a voluntary basis.
Stimulating group insurance may create possibilities for consumers to realize cross-subsidies between low-risk and high-risk individuals within a group, thereby lowering insurers' incentives to select. However, cross-subsidies between consumers that participate in group insurance arrangements and consumers that have individual health insurance can not be realized in this way.

Part one:

Conceptual framework

2. Selection

In this study selection refers to an insurer's selection of those individuals that it expects to be profitable. This chapter first describes the tools that an insurer can use for selection (section 2.1) and the negative effects of selection to society (section 2.2). The third section places risk sharing between the insurers and the regulator in the context of alternative strategies that the regulator can follow to prevent selection. Previous research mainly focused on one strategy to prevent selection: improving (demographic) capitation payments by adding more and better cost predictors. Recent studies on risk adjusting capitation payments will be summarized and discussed. Section 2.4 focuses on the measurement of an insurer's incentives for selection. In order to study the tradeoff between selection and efficiency, it is necessary to have good indicators of an insurer's incentives for selection. Section 2.5 contains the conclusions.

2.1 Tools for selection

Several studies have described tools that an insurer can use for selection despite an open enrolment requirement (e.g. Newhouse, 1982; Luft and Miller, 1988; Van de Ven and Van Vliet, 1992; Newhouse, 1994). Generally a distinction is made between selection at enrolment of new members and selection at disenrollment of members.

At enrolment selection can take place as follows:
- An insurer can contract with a specialty mix of different quality and reputation, for instance good paediatricians and obstetricians and less well trained cardiologists, oncologists or diabetes-specialists. An insurer can also contract with providers who have no interpreters, who practice in 'healthy' districts, and whose facilities have no disabled access.
- An insurer can attract preferred risks by design of insurance modalities. For instance, an insurer could offer a modality with a low premium that offers reimbursement of the costs of care provided by a small group of selectively con-

tracted health care providers that are subject to strict utilization management and a modality with a high premium that unconditionally reimburses the costs of care provided by any provider.
- A third possibility is the design of supplemental health insurance policies. For example extensive maternity benefits might attract relatively healthy families. Dental benefits might attract profitable persons if it is found that those who still have their teeth use less hospital care than those with dentures.
- An insurer can attract preferred risks by offering (a package deal of health insurance and) other forms of insurance bought mostly by relatively healthy people, such as travel insurances.
- If an insurer uses a sales agent, this person can advise relatively healthy people to buy health insurance from the insurer in question and relatively unhealthy people to join another insurer.
- An insurer can attract preferred risks by selective advertising and direct mailing.
- An insurer can attract preferred risks by offering group-contracts to (large) employers with relatively healthy employees.

At disenrollment selection can take place as follows:
- The contracted health care providers can make members leave an insurer. Health care providers, who have a contract with an insurer that contains elements of financial risk sharing, have similar financial incentives for selection as the insurer has. On the one hand providers may have more opportunities for selection than insurers because they probably have better information about the health status of their patients and because they can use more subtle tools, such as keeping a patient in uncertainty about the correct diagnosis, making a patient wait for an appointment or in the office, being discourteous or advising a patient to consult another provider because that is the one with the best reputation of treating the disease involved. On the other hand providers may be more reluctant than an insurer to perform selection activities because of more powerful ethical restraints.
- An insurer can encourage non-preferred risks to leave by providing them with poor service such as delayed payments of reimbursement.
- An insurer can give their non-preferred risks a 'golden hand shake'. Both an

insurer and a member who forms a non-preferred risk might come up with the proposal that the member receives a part of the expected future losses from the insurer if it chooses another insurer during the next open enrolment period.

Summarizing an insurer can use several (subtle) tools for selection. The negative effects of selection are described in the next section.

2.2 Negative effects of selection

The adverse effects of selection to society are threefold. First an insurer has a disincentive to be responsive to the preferences of non-preferred risks. As a result it may give poor service to chronically ill people and may prefer not to contract with providers of care who have the best reputation of treating chronic illnesses. This situation gives providers a disincentive for acquiring the reputation of being the best provider for treating certain chronic illnesses. In the case of any risk sharing between an insurer and its contracted health care providers, the latter also have financial incentives to attract profitable patients and deter patients who generate predictable losses. This may lead to poor provider service and poor care for chronically ill people. Thus one possible outcome is poor service and poor care for chronically ill. Because insurers are allowed to quote a flat-rate additional premium per insurance modality, another outcome is also possible. An insurer that specializes in good care for chronically ill has to quote a high additional premium. So the other possible outcome is that chronically ill have to pay a high additional premium for good care and good service.

Second selection might be more profitable than improving the efficiency of care. So at least in the short run, when an insurer has a restricted amount of resources available to invest in cost-reducing activities, it may prefer to invest in selection rather than in improving efficiency. In the long run, of course, improving efficiency is always rewarding, independent of the level of selection. Efficient insurers who, for whatever reason, are reluctant to perform selection activities, might lose market share to inefficient insurers that are successful in selection.

Third while an individual insurer can gain by selection, for society as a whole, selection is a zero-sum game. Therefore any resources used in performing selection activities can be seen as social welfare losses.

In sum if selection occurs, it is counterproductive with respect to supposedly positive effects of competition, that is, improving the efficiency of care and becoming more responsive to consumers' preferences. Therefore it is necessary to prevent selection in a regulated competitive individual health insurance market. The next section places risk sharing between the insurers and the regulator in the context of alternative strategies to prevent selection.

2.3 Prevention of selection

The regulator may follow three strategies to prevent selection in a regulated competitive health insurance market with capitation payments that are mainly based on demographic variables and with flat-rate additional premiums:
(1) Using procompetitive regulation.
(2) Improving the capitation payments.
(3) Introducing risk sharing between the insurers and the regulator.
This section discusses the first and second strategy to prevent selection. In the remainder of this study, the third strategy is analyzed.

2.3.1 Procompetitive regulation

Procompetitive regulation may limit an insurer's tools for selection. Such regulation may include the qualification of insurance contracts, ethical codes for insurers and monitoring systems.

Qualification of insurance contracts

The capitation payments may be given to insurers for qualified insurance contracts only. The requirements for qualification of contracts between an insurer and its members may relate to the quality of the contracted health care providers, the location and accessibility of contracted facilities, procedures for making and handling complaints, the contract language and the pricing and

selling of contracts. The last point could mean that marketing and enrolment efforts should be approved by the regulator. One can imagine the following requirements:
- Health insurance modalities are not allowed to be sold tied-in with supplemental health insurance policies, other types of insurance or other products.
- Direct interaction between an insurer's sales representative and a potential member in the enrolment period is not allowed.
- Members that want to switch from one insurer to another deal with a special agency that notifies the insurers of those who have (dis)enroled for the coming contract-period. This may prevent efforts such as signing up enrolees at dances for seniors.

Ethical codes for insurers
Based on government-regulation or self-regulation, ethical codes for insurers could be developed. Such codes could relate to similar issues as the qualification of insurance contracts. Another example could be an agreement on the undesirability of 'golden hand shakes' as a way to disenrol high-risk persons.

Monitoring systems
The regulator might set up monitoring systems that could signal undesirable developments. For instance, the health care use and costs of those who switch from one insurer to another could be analyzed. In addition, these people can be asked why they switched, how they felt about their former insurer and its contracted health care providers.

The effects of procompetitive regulation are hard to evaluate. Especially because an insurer can use such subtle tools for selection, procompetitive regulation by itself can not be considered to be a promising strategy to prevent selection.

2.3.2 Improving the capitation payments
Previous research mainly focused on improving the capitation payments as a way to prevent selection. This subsection first lists the desirable properties of (additional) risk adjusters. Second the difference between prospective and retro-

spective risk adjustment is described. Third recent empirical studies on improving demographic capitation payments are summarized and discussed.

Desirable properties of risk adjusters

Epstein and Cumella (1988) have described desirable properties of risk adjusters. These properties are:

- validity: the risk adjusters should predict differences in individual (annual) health care expenditures that are caused by differences in health status;
- reliability: the risk adjusters should be measured without measurement errors;
- manipulation: the risk adjusters should not be subject to manipulation by insurers, providers or consumers;
- feasibility: obtaining the risk adjusters should be administratively feasible without undue expenditure of time or money;
- (perverse) incentives: the risk adjusters together with the estimated weights should not provide incentives for inefficiency;
- privacy: the risk adjusters should not conflict with the right of privacy of providers and consumers.

Prospective versus retrospective risk adjusters

Commonly the term risk adjustment refers to prospective risk adjustment, but Luft (1986) and Enthoven (1988) have suggested that risk adjustments may also be done retrospectively. Prospective risk adjustment means that only information that is available at the beginning of the contract period is used to calculate the capitation payments. Retrospective risk adjustment means that information from the contract period is used also, for instance, whether someone died. (Van Vliet and Lamers, 1999). Both methods have in common that the resulting capitation payment for an individual is independent of the actual costs of that individual in the contract period. The last two decades much research has focused on prospective risk adjustment. The reason for focusing on prospective and not on retrospective risk adjustment is that capitation payments can be seen as (partly) premium-replacing payments and premiums are calculated ex-ante.

Ellis et al. (1996) compared prospective with retrospective risk adjustment models. Both types of models appeared to be equally powerful in predicting health care expenditures for subgroups based on health care utilization in the

previous years. Thus both types reduce incentives for selection equally well. However, retrospective models establish poorer incentives for diagnostic coding and appropriate provision of medical care than prospective models. Payment weights are generally larger in retrospective models, providing greater incentives for inappropriate coding of diagnoses. Moreover the higher payment weights are attached to acute medical conditions, which could potentially be harder to audit and verify than chronic conditions. Also certain potentially avoidable, but very high-cost, acute diagnoses that are sometimes indicators of poor quality of care are paid more in a retrospective model. In short the authors concluded that retrospective models may be less appropriate as payment models, but particularly useful where payment incentives are of less concern, such as physician profiling. Finally one may argue that if a retrospective risk adjustment system can be developed and applied in practice, it should be possible to change this system into a prospective one. The only requirement seems to be the availability of the necessary data for two consecutive years instead of one year only. Based on these findings and arguments, the present study does not consider retrospective risk adjustment.

Recent empirical studies

Recent empirical studies have focused on various risk adjusters that could be used in addition to demographic variables. These risk adjusters can be classified as follows: measures of prior costs, diagnostic information from either previous hospitalizations, previous outpatient care or previously prescribed drugs, health survey information and mortality. Next the focus is on the predictive power of models that include such risk adjusters in addition to demographic variables in comparison with models based on demographic variables only.

- *Prior costs*

Van Vliet and Van de Ven (1992) analyzed a panel data set of some 35,000 Dutch privately insured individuals of all ages. The R^2-value of their capitation formula based on age, gender and region was 0.024. Including prior costs as a continuous variable as an additional risk adjuster yielded an R^2-value of 0.072.

Van Vliet and Van de Ven (1993) also estimated a prior cost model where prior costs is included as a continuous variable. They used data on some 200,000 Dutch privately insured individuals of all ages. The prior cost model had a R^2-value of 0.117 which was substantially higher than the R^2-value of their demographic model (R^2=0.032).

Lamers and Van Vliet (1996) estimated a so-called high prior cost model in which prior costs are included as a continuous variable, as far as these costs exceed a certain high threshold. They used a panel data set of some 50,000 Dutch sickness fund members. The threshold was chosen as the 99th percentile of the empirical distribution of the health care expenditures. This yielded a threshold value of about Dfl. 20,000[5]. The high prior cost model yielded an R^2-value of 0.093 whereas the demographic model yielded 0.031 only.

- *Diagnostic information from prior hospitalizations*

Van Vliet and Van de Ven (1993) compared various alternative capitation formulae based, among others, on diagnostic information from previous hospitalizations. They estimated models that are related as closely as possible to the diagnostic cost group model suggested by Ash et al. (1989), and the payment amount for capitation systems model suggested by Anderson et al. (1990). Although the latter model had a higher R^2-value (0.083 versus 0.066), the authors prefer the first model because both clinical and economical criteria are employed in their development.

Ellis and Ash (1995) examined a number of extensions and refinements to the basic diagnostic cost group model developed by Ash et al. (1989). They showed, among other things, that although discretionary hospitalizations ideally should not be considered, their exclusion reduced the predictive power of the model substantially. Therefore, efforts should be made to select carefully which diagnoses are excluded. Depending on the exact definition of high-discretion diagnoses, the R^2-value may drop, for instance, from 0.052 to 0.038.

[5] In 1999 one Dutch florin (or guilder) was worth about 0.45 Euro and about 0.5 U.S. dollar.

Ellis et al. (1996) developed, estimated and evaluated risk-adjustment models that utilize diagnostic information from both inpatient and ambulatory claims to calculate capitation payments. Hierarchical coexisting condition models achieved greater explanatory power than diagnostic cost group models by taking account of multiple coexisting conditions. All models predicted medical costs far more accurately than the current Adjusted Average Per Capita Costs formula. The R^2-values varied between 0.055 and 0.090 in comparison with 0.010 for the Adjusted Average Per Capita Costs formula.

Lamers and Van Vliet (1996) examined whether the incorporation of inpatient diagnostic information over a multi-year period can increase the accuracy of a demographic capitation formula. They showed that the longer the period over which diagnostic information (in the form of diagnostic cost groups) is used for calculating capitation payments, the better is the predictive accuracy. For example the R^2-value of the one-year diagnostic cost group model was 0.064, the two-year diagnostic cost group model yielded a value of 0.070, and the three-year diagnostic cost group model yielded 0.077.

- *Diagnostic information of prescribed drugs*

Clark et al. (1995) developed a revised version of the chronic disease score, covering a wider range of medication than the original chronic disease score developed by Von Korff et al. (1992). The chronic disease score is a set of dummy variables that indicate a pharmacy prescription during a six month period for a medication or medication class representing particular chronic diseases. The revised chronic disease score model predicted 10% of the variance in total health care expenditures of adults (18 years or older) enroled in a health maintenance organiza-
tion in the next six month period. Age and gender alone predicted 3%. The authors also estimated an ambulatory diagnostic group model using clusters of ambulatory diagnostic codes formed on the basis of expected resource use. This model yielded a R^2-value comparable with the revised chronic disease score model.

Lamers (1999a) also used the revised chronic disease score to incorporate the use of prescribed drugs in a capitation formula. The author used a panel data set of about 56,000 Dutch sickness fund members and compared the predictive accuracy of a demographic model and a so-called pharmacy cost group model. The demographic model yielded an R^2-value of about 0.04 and the pharmacy cost group model about 0.09. She concluded that information on chronic conditions derived from claims of prescribed drugs is a promising option for improving the capitation payments.

- *Health survey information*

Hornbrook and Goodman (1995) examined whether a relatively brief (36 items) self-administrated social survey instrument can usefully forecast future real per capita health expense using several dimensions of perceived and functional health status. The R^2-value of their simplified survey/demographic model was 0.046 whereas the demographic model on its own yielded an R^2-value of 0.012. The most elaborate survey/demographic model yielded an R^2-value of 0.049. The authors concluded that self-reported health status is a useful and powerful risk measure for adults.

Gruenberg et al. (1996) used data from the Medicare Current Beneficiary Survey to compare several models predicting Medicare costs. A demographic model yielded an R^2-value of 0.007. A comprehensive model incorporating demographic, diagnostic, perceived-health and disability variables fitted the data well for a variety of beneficiary subgroups defined by their health and functional status ($R^2 \approx 0.060$).

- *Mortality*

Van Vliet and Lamers (1999) showed that mortality as additional risk adjuster would improve the capitation payments at best marginally. This conclusion holds irrespective of the various ways of employing mortality as a risk adjuster: at the individual or at the insurer level, prospective or retrospective. This finding and practical problems of employing mortality in this context led the authors to conclude that further research could better be directed at other risk adjusters.

Ellis and Ash (1995) showed that mortality rates are highly correlated with diagnostic cost groups, with substantially higher rates in higher numbered groups. The diagnostic cost group classification thus is picking up a substantial proportion of the costs of members who are dying in a given year without directly making adjustments based upon death.

- *Combinations of promising risk adjusters*

Van Vliet and Van de Ven (1993) estimated a combination of their diagnostic cost group model (R^2=0.066) and prior costs model (R^2=0.117). The combination yielded an R^2-value of 0.12. This finding suggests that diagnostic cost groups and prior costs largely capture the same portion of predictable variance in health care expenditures. However, looking at the predictable profits and losses for different subgroups, the authors concluded that both models are inadequate on their own and that diagnostic cost groups as well as prior costs seem indispensable for determining adequate capitation payments, provided of course that no other predictive information becomes available.

Clark et al. (1995) showed that the combination of their revised chronic disease score model and their ambulatory diagnostic group model has only marginally greater predictive power than either one alone. This suggested that the information on prescribed drugs used in the chronic disease score and the ambulatory diagnoses capture the same part of the predictable variations in future health care expenditures.

Lamers and Van Vliet (1996) estimated a combination of their diagnostic cost group model (R^2=0.064) and their high prior cost model (R^2=0.093). The combination yielded an R^2-value of 0.105 which again suggests that diagnostic cost groups and prior costs largely capture the same part of predictable variance.

Weiner et al. (1996) integrated two diagnostic risk adjustment systems. The first is the ambulatory care group case-mix measure for use among the non-elderly population (Weiner et al., 1991; Starfield et al., 1991). This measure is based on ambulatory diagnostic groups. The second is the payment amount for

capitated sy-stems, an inpatient-oriented risk adjuster for the Medicare aged population (Anderson et al., 1990). The authors developed two new methods to calculate capitation payments. Both methods predicted expenditures far better than the Adjusted Average Per Capita Costs formula. Their so-called ADG-MDC model predicted 6.3 percent of total variance at the individual level and their so-called ADG-Hosdom model predicted 5.5 percent. The latter model included a binary variable (hospital dominance) indicating the presence of one or more codes that are serious enough to usually be treated on an inpatient basis. The Adjusted Average Per Capita Costs formula predicts 1.0 percent only.

Maximum R^2

Newhouse et al. (1989) and Van Vliet (1992) have estimated that about 20 percent of the variance in individual annual health care expenditures is predictable by means of factors reflected in past spending. Insurers could potentially predict somewhat more than the 20 percent, but how much more is unclear. It should be noted that, according to the assumptions in the present study, this figure is calculated for a general population that is covered for types of acute care. However, they are based on data of the 1970s and 1980s. The maximum R^2-value may have increased since then. More recently, using the same method as Van Vliet (1992), Lamers (1999b) found a maximum predictable R^2-value of 0.33.

Conclusion

Based on the results with respect to the predictive power, it can be concluded that currently the most promising risk adjusters are (high) prior costs and diagnostic information from either previous hospitalizations or previously prescribed drugs.

Implementing capitation payments that are partly based on such risk adjusters will substantially increase the predictive power of a demographic capitation formula. However, it will still be considerably lower than the estimates of the maximum predictive power that could be achieved. Therefore, it is unclear whether the application of such improved capitation formulae will reduce the insurer's incentives for selection to negligible levels.

Discussion
Although demographic capitation payments may be improved substantially, in many countries it appears to be very difficult to implement such improved capitation payments in practice. The only exception is the United States where some programs have implemented diagnosis-based risk adjustment and where the Medicare program will implement diagnosis-based risk adjustment as of January, 2000 to pay at-risk health maintenance organizations for their members. An explanation is that in many countries risk adjustment is in a very early stage of development and that the most pathbreaking research results are recent. Another explanation is the difficulty to obtain the relevant data in practice. Nonetheless it can be expected that (recent) research results will be implemented in the future. However, there is a growing consensus in the literature that, given the crude capitation formulae that are currently applied in practice and the awareness that it will be very complex and expensive to calculate close to perfect capitation payments, any capitation formula should be accompanied by some form of risk sharing between the insurers and the regulator. Before describing forms of risk sharing in the next chapter, the next section describes indicators of an insurer's incentives for selection.

2.4 Measuring incentives for selection

Section 2.4.1 presents overall indicators of an insurer's incentives for selection. These indicators summarize its incentives for selection into one figure and are useful under the assumption that an insurer tries to attract all (highly) preferred risks and to deter all (highly) non-preferred risks. In section 2.4.2 it is assumed that an insurer tries to attract or deter specific subgroups. In that situation for each relevant subgroup an indication of an insurer's incentives to select may be appropriate.

2.4.1 Overall indicators
In the literature various overall indicators of selection have been used: R^2-values, Grouped R^2-values, the mean absolute result and the mean absolute predicted result.

Most studies on risk adjustment report R^2-values of different capitation formulae. Let AC be the actual costs of a member, E(AC) the mean actual costs and PC_{REG} the predicted costs by the regulator (i.e. the normative costs). In empirical studies usually the mean normative costs equal the mean actual costs. An R^2-value equals the proportion of predicted variance in health care costs at the individual level[6]:

(2.1) $R^2 = 1 - SS(model)/SS(total)$,

where SS(model) is $\Sigma(PC_{REG} - AC)^2$ and SS(total) is $\Sigma(AC - E(AC))^2$.

A reason that most studies report R^2-values is that they can be compared with an estimate of the maximum predictable variance in individual health care expenditures. A disadvantage of R^2-values is that they are a *quadratic* function of actual profits and losses. Thus large profits and losses are weighted more heavily than small profits and losses. However, it is by no means clear that insurers weight different values of profits and losses this way. Therefore, a better starting point seems to express incentives for selection as a *linear* function of profits and losses.
Where this study reports R^2-values, it is mainly for comparison with other studies.

Ellis and Ash (1995) as well as Rosenkranz and Luft (1997) use so-called Grouped R^2-values as an indicator of an insurer's incentives for selection. The Grouped R^2-value is an analog of conventional R^2-values. The purpose of this indicator is to summarize the predictive power of a capitation formula in terms of its ability to predict the costs of *groups* of enrolees. The Grouped R^2 for a partition of a population into k subgroups is defined as:

(2.2) Grouped $R^2 = 1$ - GSS(model)/GSS(total),

where GSS(model) is $\Sigma_{j=1}^{k} n_j*(PC_{REG,j} - AC_j)^2$, n_j is the number of members in

[6] To simplify the notation a subscript i for each member is omitted.

subgroup j, and $PC_{REG,j}$ and AC_j are the mean normative costs and the mean actual costs of subgroup j respectively. GSS(total) is $\Sigma_{j=1}^{k} n_j*(AC_j-E(AC))^2$. The prime motivation for this indicator given by Ellis and Ash (1995) is that in practice health maintenance organizations receive reimbursement for entire groups of enrolees. Rosenkranz and Luft (1997) state that assessing models in terms of their ability to predict individual expenditures is inappropriate if one needs to measure risk differences only among employers. However, in an *individual* health insurance market, as is assumed in the present study, the capitation payments are tied to individuals because enrolment takes place at individual level. Therefore the present study does not report any Grouped R^2-values.

Ettner et al. (1998) use the mean absolute result as an indicator of incentives for selection.

$$(2.3)\ MAR = (1/n) * \Sigma|PC_{REG}-AC|.$$

The mean absolute result is a linear function of *actual* profits and losses whereas *predictable* profits and losses are of interest. As far as we know, a lower bound for the mean absolute result has not been estimated. Therefore it is difficult to compare and interpret the mean absolute result for different capitation formulae. Where this study presents mean absolute result values, it is mainly for comparison with other studies.

A more useful measure is the mean absolute predicted result. Let PC_{INS} be the predicted costs by the insurer for a member. Given the costs predictions of the insurer and the regulator, preferred risks can be defined as those for whom the predicted costs by the insurer are lower than the predicted costs by the regulator. Others are non-preferred risks. The mean absolute predicted result equals:

$$(2.4)\ MAPR = (1/n) * \Sigma|PC_{REG}-PC_{INS}|.$$

It is assumed that an insurer tries to improve its own cost prediction as much as possible. Unless stated otherwise, the predicted costs by the insurer are based

on various predictors of health care expenditures that are not included in the calculation of the costs predictions of the regulator together with the predictors that are included.

The mean absolute predicted result takes into account *all* predictable profits and losses for an insurer. It could be argued that small predictable profits and losses are irrelevant for an insurer because of its costs of selection and the (statistical) uncertainties about the net benefits of selection. If this assumption is right, small predictable profits and losses could be ignored. Ignoring small predictable profits and losses in the calculation of the mean absolute predicted result yields a so-called weighted mean absolute predicted result.

(2.5) $WMAPR = (1/n) * \Sigma\ w * |PC_{REG} - PC_{INS}|$,

where w equals one for those individuals for whom the predictable profit or loss can not be ignored and w equals zero for others. The weighted mean absolute predicted result seems an appropriate refinement of the mean absolute predicted result under the assumption that an insurer tries to attract *highly* preferred risks and to deter *highly* non-preferred risks.

In a theoretical analysis, Newhouse et al. (1989) have shown that there is a nonlinear relation between the predicted variance by the regulator and the mean absolute predicted result. Based on this finding, Newhouse (1996) concludes that: 'the formula for adjusting for heterogeneity must be close to perfect to reduce greatly the incentives to select'. The appendix of this chapter extends the theoretical analyses of Newhouse et al. (1989) by deriving a relation between the R^2 of the regulator and the *weighted* mean absolute predicted result. Then it presents an application for a general population. The results suggest that, without ignoring small predictable profits and losses, the problem of selection is overestimated, especially under relatively good capitation formulae. An empirical analysis supported this conclusion (see also chapter eight of this study, and Van Barneveld et al., 1999a).

An alternative way to calculate the mean absolute predicted result is given in Equation (2.6):

$$(2.6)\ MAPR = f_1*|MPR_1| + f_2*|MPR_2|,$$

where f_1 is the fraction preferred risks, f_2 is the fraction non-preferred risks and MPR_1 is the mean predicted result for the preferred risks and MPR_2 is the mean result for the non-preferred risks.
In the case that the mean predicted result for both subgroups equal the mean actual result, this may be written as:

$$(2.7)\ MAPR = f_1*|MR_1| + f_2*|MR_2|,$$

where f_1 and f_2 are defined similar as above and MR_1 (MR_2) is the mean actual result for the group of preferred (non-preferred) risks. If risk sharing is used as a supplement to capitation payments, calculating the mean absolute predicted result is not straightforward. As an overall indicator for an insurer's incentives for selection we will then use Equation (2.7). Ignoring small predictable profits and losses in the case of risk sharing can be done by dividing the members into *highly* preferred risks, *highly* non-preferred risks and others. Subsequently, the index one applies to the group of highly preferred risks and the index two to the group of highly non-preferred risks.

2.4.2 Specific indicators

The selection activities of an insurer may focus on various subgroups. Subgroups with a good socio-economic status might be attracted via the design of (supplemental) health insurance policies, a package deal of health insurance and other products, selective advertising and direct mailing. Therefore it seems relevant to distinguish some subgroups based on socio-economic variables such as education, profession, income, family composition and nationality. Furthermore it seems relevant to distinguish subgroups on the basis of indicators of 'prior use' and 'prior costs' which are likely to be available in the administrative data of an insurer. Based on this kind of information, an insurer and/or its contracted health care providers may provide non-preferred risks with poor

quality/service, thereby encouraging them to disenrol. For other non-preferred individuals enrolment can be discouraged by the quality/reputation of the insurer and/or its contracted health care providers.
In several studies so-called predictive ratios (PR) are used as an indicator of an insurer's incentives for selection with respect to various subgroups (e.g. Ellis et al., 1996; Weiner et al., 1996). The predictive ratio equals the mean normative costs of a subgroup divided by the mean actual costs of this subgroup. A predictive ratio greater than one means that the subgroup constitutes preferred risks because the normative costs are higher than the actual costs.

(2.8) $PR_j = PC_{REG,j}/AC_j$.

Similarly, a predictive ratio smaller than one means that the subgroup constitutes non-preferred risks. Other studies used so-called cost ratios (CR) as indicators of incentives for selection. A cost ratio equals the inverse of the predictive ratio (e.g. Van Vliet and Van de Ven, 1992; Lamers and Van Vliet, 1996).

(2.9) $CR_j = AC_j/PC_{REG,j}$.

Because the normative costs now appear in the denominator of the ratio, it is difficult to interpret the results when comparing different capitation formulae.

The present study simply uses the mean result for relevant subgroups (MR_j) as indicator of an insurer's incentives to select:

(2.10) $MR_j = AC_j - PC_{REG,j}$.

In the case of risk sharing, the normative costs are replaced by the normative costs plus the insurer's risk sharing reimbursement minus the insurer's price of the risk sharing.

An interesting question is: how does the regulator value an overall reduction of predictable profits and losses versus a selective reduction of certain predictable

profits and/or losses? Looking at the negative effects of selection, one could argue that it is more important to reduce the relatively high predictable losses for the relatively small group of non-preferred risks than to reduce the relatively small predictable profits for the relatively large group of preferred risks. Given relatively high predictable losses, an insurer has strong disincentives to improve efficiency for types of care that are often used by chronically ill and to be responsive to their preferences. Because all insurers have this disincentive, the purpose of market-oriented health care reforms is endangered directly.
Given relatively small predictable profits, an insurer has incentives to attract healthy individuals and to provide them with good service. It is mainly the social welfare losses that is the negative effect in this situation. This effect only indirectly endangers the purpose of market-oriented health care reforms. Therefore, a selective reduction of the largest predictable losses might be more important from the regulator's point of view than an overall reduction of all predictable profits and losses.

2.5 Conclusions

This chapter has focused on the problem of preferred risk selection in a regulated competitive individual health insurance market. The following issues have been addressed: an insurer's tools for selection; the adverse effects of selection to society; the regulator's options to prevent selection and the measurement of an insurer's incentives for selection.

An insurer can use many (subtle) tools for selection at enrolment of new members as well as at disenrollment of members. Tools for selection include: the service of an insurer, the quality, reputation and service of its contracted health care providers, the design of insurance modalities as well as of supplemental health insurance policies, selective advertising and direct mailing.

The adverse effects of selection to society are threefold. First for chronically ill, the access to good health care may be hindered. Second efficient insurers might lose market share to inefficient insurers. Third any resources used in perform-

ing selection can be seen as social welfare losses. Therefore the prevention of selection is critical to the success of a regulated competitive individual health insurance market.

The regulator may follow three strategies to prevent selection if the capitation payments are based on demographic variables only and the additional premiums are required to be the same for each member that chooses the same insurance modality. First the regulator may use forms of procompetitive regulation such as the qualification of insurance contracts, developing ethical codes for insurers and developing monitoring systems that could signal undesirable developments. Given the many (subtle) tools that an insurer can use for selection, one may wonder whether procompetitive regulation on its own is a promising strategy to prevent selection.
Second the regulator can try to improve the demographic capitation formula. Many (recent) studies have shown that demographic capitation payments can be improved substantially. However, the implementation of such improved capitation payments appears to be very difficult. Recent empirical studies showed that currently the most promising risk adjusters are: measures of prior costs and diagnostic information from either previous hospitalizations or previously prescribed drugs. Although the application of capitation formulae that are partly based on this type of information may reduce an insurer's incentives for selection substantially in comparison with a demographic capitation formula, there is a growing consensus in the literature that any capitation formula should be accompanied by some form of risk sharing.
Finally the regulator may introduce risk sharing between the insurers and the regulator as a supplement to the capitation payments. In the present study this approach will be analyzed. The next chapter focuses on the description of various forms of risk sharing.

In the literature various overall indicators of incentives for selection have been used: R^2-values, Grouped R^2-values, the mean absolute result and the mean absolute predicted result. It has been argued that the latter indicator is more useful than the others. Because the Grouped R^2-value was developed for situations that involve group insurance, this indicator will not be used in the

present study. R^2-values and the mean absolute result are used mainly for comparison with other studies. As a refinement of the mean absolute predicted result, it was suggested to ignore the small predictable profits and losses. These may be irrelevant for an insurer because it has to take into account its costs of selection and the (statistical) uncertainties about the net benefits of selection. If this is right, the so-called weighted mean absolute predicted result is a better indicator than the mean absolute predicted result.

Newhouse et al. (1989) have shown that there is a nonlinear relation between the R^2-value and the mean absolute predicted result and that the nonlinearity is in the wrong direction from the regulator's point of view. Based on this theoretical finding, Newhouse (1996) concluded: 'the formula for adjusting for heterogeneity must be close to perfect to reduce greatly the incentives to select'. In the appendix of this chapter, the theoretical analysis has been extended to a relation between the R^2 and the weighted mean absolute predicted result. An application to a general population suggested that, without ignoring small predictable profits and losses, the problem of selection is overestimated, especially in the case of relatively good capitation formulae. Thus different assumptions about the relevance of small predictable profits and losses are likely to lead to different judgements of relatively good capitation formulae, such as those partly based on prior costs, on diagnostic information from previous hospitalizations or on diagnostic information from previously prescribed drugs. The analysis also suggested that this is not the case for relatively crude capitation formulae such as those based on demographic variables only. For such capitation formulae the incentives for selection are large irrespective of the relevance of small predictable profits and losses for selection.

Besides overall indicators of an insurer's incentives for selection, the present study uses the mean result for various subgroups as an indicator of an insurer's incentives to select such subgroups.

All indicators of an insurer's incentives for selection are based on the gross potential benefits of selection. Of course, the actual selection activities may also be influenced by other factors such as: the market share and working area of an insurer, the level of competition in the health insurance market and the market for health care provision, the monitoring activities of the regulator and the role of employers.

Appendix chapter 2

Suppose that the regulator and an insurer use equation (A.2.1) and (A.2.2) respectively to calculate a cost prediction for each individual:

(A.2.1) $\log(AC) = X_1*\beta_1+\epsilon_1$
(A.2.2) $\log(AC) = X_1*\beta_1+X_2*\beta_2+\epsilon_2$

where AC is lognormally distributed health care expenditures, X_1 contains the risk adjusters included in the capitation formula by the regulator, X_2 represents additional risk factors used by the insurer, and ϵ_1 and ϵ_2 are normally distributed error terms with mean zero. The vectors X_1 and X_2 are assumed to be orthogonal and $X_1*\beta_1$ and $X_2*\beta_2$ have means μ_1 and 0 and standard deviations σ_1 and σ_2 respectively. Define $\sigma^2 = \sigma_1^2+\sigma_2^2+\sigma_3^2$ (σ_3^2 is the variance of ϵ_2).

The unconditional expectation of the actual costs equals:

(A.2.3) $E(AC) = \exp(\mu_1+0,5*\sigma^2)$.

The predicted costs for an individual with characteristics X_1 and X_2 equal (A.2.4) for the regulator and (A.2.5) for the insurer respectively.

(A.2.4) $PC_{REG} = E(AC|X_1) = \exp(X_1*\beta_1+0,5*(\sigma_2^2 + \sigma_3^2))$.
(A.2.5) $PC_{INS} = E(AC|X_1; X_2) = \exp(X_1*\beta_1+X_2*\beta_2+0,5*\sigma_3^2)$.

Given the fraction of predicted variance of both equations at the *linear* level (R^2_{REG}, R^2_{INS}), and the coefficient of variation (cv), Van Vliet (1994) showed that σ_2^2 can be calculated as:

(A.2.6) $\sigma_2^2 = \log[(R^2_{INS}*cv^2+1)/(R^2_{REG}*cv^2+1)]$.

The insurer expects a profit for a certain individual of more than α_1% of its

predicted costs (PC_{INS}) if[7]:

$(PC_{REG} - PC_{INS})/PC_{INS} > \alpha_1/100$, where $\alpha_1 >= 0$.

Thus: $[E(AC|X_1) - E(AC|X_1; X_2)]/E(AC|X_1; X_2) > \alpha_1/100$, which implies:

$E(AC|X_1;X_2) < E(AC|X_1)*\delta_1$, where $\delta_1 = 100/(100+\alpha_1)$.

Using equation (A.2.4) and (A.2.5), this implies:

$X_2*\beta_2 < 0.5*\sigma_2^2 + \log(\delta_1)$.

The proportion of individuals for whom the insurer expects a profit of more than α_1% of their predicted costs (PC_{INS}) is therefore given by:

(A.2.7) $PPROF(R^2_{INS};R^2_{REG};\alpha_1) = P(X_2*\beta_2 < 0.5*\sigma_2^2 + \log(\delta_1)) =$

$$P((X_2*\beta_2)/\sigma_2 < 0.5*\sigma_2 + \log(\delta_1)/\sigma_2) = \Phi(0.5*\sigma_2 + \log(\delta_1)/\sigma_2).$$

The expected costs (given X_1 and X_2) for these profitable individuals can be calculated as:

$E(\exp(X_1*\beta_1 + X_2*\beta_2 + 0.5*\sigma_3^2 | X_2*\beta_2 < 0.5*\sigma_2^2 + \log(\delta_1)/\sigma_2) =$

$$\exp(\mu_1 + 0.5*(\sigma_1^2 + \sigma_3^2))*E(\exp(X_2*\beta_2 | (X_2*\beta_2)/\sigma_2 < 0.5*\sigma_2 + \log(\delta_1)/\sigma_2) =$$

$$\exp(\mu_1 + 0.5*(\sigma_1^2 + \sigma_3^2))*\exp(0.5*\sigma_2^2)*$$
$$\Phi(-0.5*\sigma_2 + \log(\delta_1)/\sigma_2)/\Phi(0.5*\sigma_2 + \log(\delta_1)/\sigma_2) =$$

$$E(AC)*\Phi(-0.5*\sigma_2 + \log(\delta_1)/\sigma_2)/\Phi(0.5*\sigma_2 + \log(\delta_1)/\sigma_2).$$

[7] For the special case that α_1 and α_2 both are zero, this analysis has been presented by Van Vliet in the appendix of Van de Ven et al. (1994).

The second equal-sign is based on the formula for expectations of truncated lognormals (Johnson and Kotz, 1970, p. 129).

The mean predictable profit per individual of this subgroup equals:

(A.2.8) $MPP(R^2_{INS};R^2_{REG};\alpha_1) =$

$$E(AC)*[1-\Phi(-0.5*\sigma_2+\log(\delta_1)/\sigma_2)/\Phi(0.5*\sigma_2+\log(\delta_1)/\sigma_2)]$$

because the average normative costs for this group equals the mean actual costs. This is due to the assumption that X_1 and X_2 are orthogonal, thus the profitable individuals constitute a representative sample of the total population with respect to the variables included in X_1.

In a similar way the following formulae with respect to those individuals for whom the insurer expects a loss of more than α_2% of their predicted costs (PC_{INS}) can be derived:

$(PC_{INS}-PC_{REG})/PC_{INS} > \alpha_2/100$ where $0 <= \alpha_2 < 100$,

$[E(AC|X_1;X_2)-E(AC|X_1)]/E(AC|X_1;X_2) > \alpha_2/100$ which implies:

$E(AC|X_1;X_2) > E(AC|X_1)*\delta_2$, where $\delta_2 = 100/(100-\alpha_2)$.

(A.2.9) $PUNPROF(R^2_{INS};R^2_{REG};\alpha_2) = \Phi(-0.5*\sigma_2-\log(\delta_2)/\sigma_2)$

(A.2.10) $MPL(R^2_{INS};R^2_{REG};\alpha_2) =$

$$E(AC)*[\Phi(0.5*\sigma_2-\log(\delta_2)/\sigma_2)/\Phi(-0.5*\sigma_2-\log(\delta_2)/\sigma_2)-1]$$

Given R^2_{INS}, R^2_{REG}, α_1 and α_2, the weighted mean absolute predicted result equals:

(A.2.11) $WMAPR(R^2_{INS};R^2_{REG};\alpha_1;\alpha_2) =$

$$\{PPROF(R^2_{INS};R^2_{REG};\alpha_1)*MPP(R^2_{INS};R^2_{REG};\alpha_1) + PUNPROF(R^2_{INS};R^2_{REG};\alpha_2)*MPL(R^2_{INS};R^2_{REG};\alpha_2)\} =$$

$$\{E(AC)*[\Phi(0.5*\sigma_2+\log(\delta_1)/\sigma_2) + \Phi(0.5*\sigma_2-\log(\delta_1)/\sigma_2) - 1] + E(AC)*[\Phi(0.5*\sigma_2+\log(\delta_2)/\sigma_2) + \Phi(0.5*\sigma_2-\log(\delta_2)/\sigma_2) - 1]\} =$$

$$E(AC) * \{[\Phi(0.5*\sigma_2+\log(\delta_1)/\sigma_2) + \Phi(0.5*\sigma_2-\log(\delta_1)/\sigma_2) + \Phi(0.5*\sigma_2+\log(\delta_2)/\sigma_2) + \Phi(0.5*\sigma_2-\log(\delta_2)/\sigma_2) - 2]\}.$$

The mean absolute predicted result equals:

(A.2.12) $MAPR(R^2_{INS};R^2_{REG}) = WMAPR(R^2_{INS};R^2_{REG};0;0) =$

$$E(AC)*\{4*\Phi(0,5*\sigma_2)-2\}.$$

An application of this theoretical analysis is presented in Figure A.2.1. In this example the mean costs are Dfl. 2,000 which is about the mean cost per member in the Dutch public health insurance market. The coefficient of variation is four, which value has been found in datasets containing health care expenditures of Dutch sickness fund members (Lamers and Van Vliet, 1996, Van Barneveld et al., 1996). The R^2-value of the insurer is assumed to be 0.20. The R^2-value of the regulator is varied between 0 and 0.20[8]. By changing the relevant parameters in the analysis, one can apply it to other settings. The mean, the coefficient of variation and the predictability of health care expenditures may depend heavily on the benefits package, the population that is included, and the contract period. Figure A.2.1 presents the (weighted) mean absolute result as a function of the R^2-value of the regulator. The relation is nonlinear and the nonlinearity is in the wrong direction from the regulator's point of view (Newhouse, 1994). The first improvements in the capitation

[8] This analysis has also been performed with the R^2-value of the insurer equal to 0.25. This sensivity analysis yielded similar results.

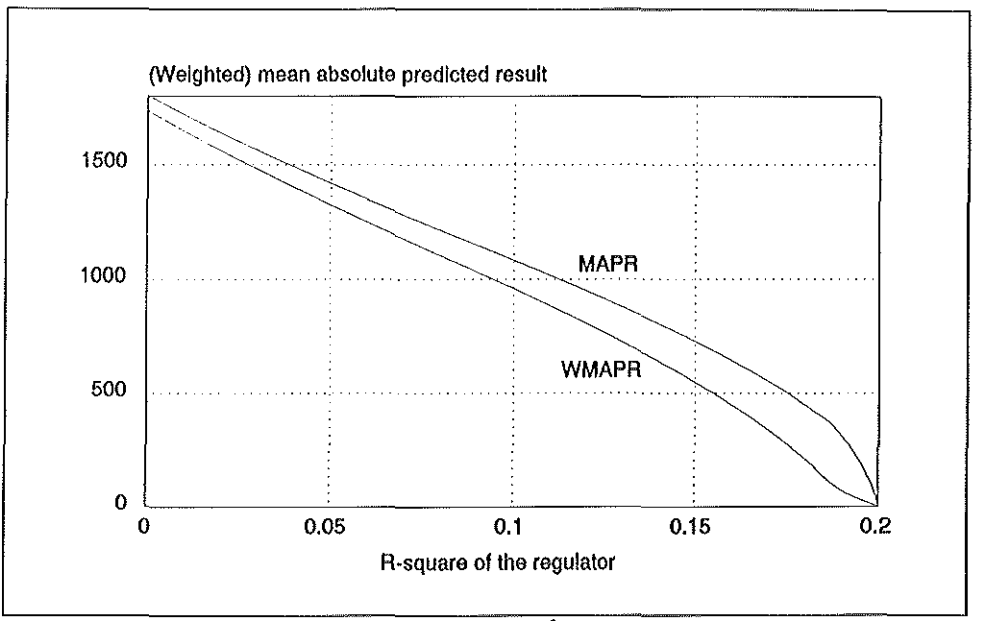

Figure A.2.1. The relation between the R^2-value of the regulator and the (weighted) mean absolute predicted result ($R^2_{INS}=0.2$)

formula lead to relatively small reductions in the mean absolute predicted result whereas later improvements lead to relatively large reductions. For example, the first five percentage points increase in the R^2-value of the regulator lead to a reduction of the mean absolute predicted result from about Dfl. 1,800 to about Dfl. 1,440, whereas the last five percentage points increase in R^2-value lead to a reduction from about Dfl. 720 to Dfl. 0. Of course, from the regulator's point of view, the opposite would be preferable.

If the regulator uses a capitation formula based on demographic variables only, the fraction predicted variance will be about 0.03 [Van Vliet and Van de Ven 1993; Lamers and Van Vliet 1996]. This leads to a reduction of the mean absolute predicted result to about Dfl. 1,530 only. Globally speaking, in comparison with flat capitation payments, demographic capitation payments reduce incentives for cream skimming by 15%. Thus Figure A.2.1 confirms that demographic capitation formulae leave ample room for selection.

Adding diagnostic information from hospitalizations in the previous year as a

risk adjuster generally doubles the R^2-value [Van Vliet and Van de Ven 1993; Lamers and Van Vliet 1996]. However, because of the nonlinearity, the reduction of the mean absolute predicted result is not twice as much. Including diagnostic information from hospitalizations of the previous year ($R^2 \approx 0.06$) leads to a reduction of the mean absolute predicted result to about Dfl. 1,350.
Addition of the risk adjuster '(high) prior costs' next to demographic variables could increase the fraction of explained variance of the capitation formula to about 0.1 [Van Vliet and Van de Ven 1993; Lamers and Van Vliet 1996]. In Figure A.2.1, this leads to a reduction of the mean absolute predicted result to about Dfl. 1,100.
Because of the nonlinearity, even with the application of 'near-perfect' capitation payments, the gross revenues of selection might still be high. In Figure A.2.1, the application of a capitation formula with an R^2-value of, say, 0.18 leads to a reduction of the mean absolute predicted result to about Dfl. 360. This has led Newhouse [1996] to conclude that: 'the formula for adjusting for heterogeneity must be close to 'perfect' to reduce greatly the incentives to select'.
Figure A.2.1 also presents the weighted mean absolute predicted result with α_1 and α_2 both 33%. The Figure shows that the relation between the R^2-value of the regulator and the weighted mean absolute predicted result is less nonlinear than the relationship between the R^2-value of the regulator and the mean absolute predicted result[9]. Given the choice that α_1 and α_2 are both equal to 33%, the relation does not start in the point (0; 1,800) but in the point (0; 1,700). About four percent of the predictable profits and losses are ignored. Then an increase in the R^2-value of the regulator further reduces the weighted mean absolute predicted result and, in this example, the relation is almost linear. It follows that with the mean absolute predicted result, the extent of the selection problem might be overestimated, especially in the case of relatively high values of the fraction predicted variance by the regulator. For instance, if the R^2-value of the regulator would be 0.15, then under this example, the

[9] In an additional analysis not presented here, the change in the form of the relationship appeared to be mainly caused by the introduction of α_2. That is the fact that small predictable losses for non-preferred risks are ignored.

weighted mean absolute predicted result is reduced to about Dfl. 540 whereas the mean absolute predicted result reduces to Dfl. 720 only. If the first value is right, the mean absolute predicted result yields an overestimation of more than 30%.

Of course, it is not exactly clear what the best choices for α_1 and α_2 are. However, the nonlinearity that Newhouse [1996] mentions, is based on the assumption that α_1 and α_2 both are zero. This choice appears to lead to an overestimation of the selection problem especially in the case of capitation formula with high R^2-values.

Although this theoretical analysis is useful to get a quick indication of the (weighted) mean absolute predicted result under different capitation formulae, it also has some drawbacks. First, given the assumptions, there is a unique relationship between the (weighted) mean absolute predicted result and the R^2-value of the regulator. In practice, the assumptions may not hold. In particular the assumption of normally distributed error terms in equations (A.2.1) and (A.2.2) may be violated. Second, large predictable profits or losses can only be defined in relative terms (i.e those predictable profits or losses that exceed a certain percentage of the predicted costs by the insurer). It is not possible to define large predictable profits or losses in absolute terms. These drawbacks have motivated us to perform an empirical analysis as well. The results of this empirical analysis supported the conclusion of the theoretical analysis (see chapter eight of this study, and Van Barneveld et al., 1999a).

3. Forms of risk sharing

The previous chapter argued that the combination of demographic capitation payments and flat-rate additional premiums is likely to lead to selection problems. If - for whatever reason - improving demographic capitation payments is impossible, another way to reduce the insurer's incentives for selection is to supplement such capitation payments with a form of risk sharing between the insurers and the regulator. Risk sharing implies that the insurers are retrospectively reimbursed by the regulator for some expenditures of some of their members. This chapter first describes forms of risk sharing that have been suggested in the literature and two studies that have analyzed a certain form of risk sharing empirically. Then a conceptual framework for the description of forms of risk sharing is developed. The third section presents four forms of risk sharing that will be analyzed further in this study. This is followed by a brief description of the differences between risk sharing and capitation. Finally some conclusions are drawn.

3.1 Previous studies

3.1.1 Suggested forms of risk sharing

Newhouse (1986) and Newhouse et al. (1989) argued that besides trying to improve capitation formulae, consideration should be given to a blend of capitation with actual costs. For example, an insurer might receive three-quarters of its normative costs while one-quarter of its payments might be based on its actual costs. The author left for future research the topic of determining optimal weights in this blend. This topic is addressed in chapter five of the present study.

As a refinement the author(s) suggested that the weight on actual costs may vary between the members of an insurer. For example a higher weight on actual costs for those members in risk-groups with higher variances in health care expenditures.

In a recent paper Newhouse (1996) argues that the essence of the selection-efficiency tradeoff is captured by the costs the insurer bears at the time of use or the so-called amount of 'supply-side cost sharing'. In its simplest form supply-side cost sharing is a linear combination of fee-for-service ('no supplier cost sharing') and capitation pricing ('full supplier cost sharing'), but non-linear schemes are possible too. The author argues that neither corner solution is likely to be optimal.

Gruenberg et al. (1986) described various pricing strategies for capitated delivery systems. One option they mentioned is to introduce an amount of risk sharing between the at-risk health maintenance organizations and the Health Care Financing Administration. The latter can be seen as the regulator. Some forms of risk sharing deal directly with the aggregate costs of insurers. In the reinsurance literature such a mechanism is known as stop-loss (Bovbjerg, 1992). An alternative is the use of an individual stop-loss approach. Insurers would be at risk for a small percentage of those expenditures that exceed the threshold, in order to maintain some incentives for efficiency. In the reinsurance literature an individual stop-loss arrangement is known as excess-of-loss (Bovbjerg, 1992).

Wallack et al. (1988) elaborated on a so-called risk-corridor approach and an individual outlier approach. The risk corridor concept is quite flexible. It would modify payments to an insurer by an amount that depends upon whether aggregate costs (for all ór for a subset of services) lie outside a specified corridor. The size of the corridor and the division of profits and losses both inside and outside the corridor can be varied. An extreme example of the risk corridor approach would be achieved when the size of the corridor is brought to zero, in which case all profits and losses are shared according to some specified formula. The establishment of a risk corridor for hospital service costs and paying for other services prospectively was presented as a prototype of this form of risk sharing.
The outlier approach would reimburse insurers for some portion of individuals' costs above a cost outlier threshold, or after a specified medical event (for instance a stroke). The latter example would create a so-called 'condition-

specific' risk sharing arrangement[10]. As a prototype of their outlier approach, the authors presented the following variant: pay 80 percent of an individual's costs for hospital care that exceed $5,000 (or about ten hospital days) per year. Other services and administrative functions would remain under capitation.

Van de Ven and Van Vliet (1992) suggested to let an insurer itself decide - within certain boundaries - for which members, or for which types of care, or to what extent it wants to share the risk with the regulator. According to the authors, the refusals of potential high risk members and the exclusions of pre-existing medical conditions, as occurring in a free market for health insurance, can be simulated by allowing an insurer to decide himself which risks it wants to insure and to what extent.

Van de Ven et al. (1994) took up the suggestion to let an insurer itself decide for which members it wants to share the risk with the regulator. They described a system of risk sharing for high-risks, called "mandatory community-rated high-risk pooling". Under this system each insurer would be allowed to share all (or some) expenditures of a specified fraction of its members with the regulator. To finance the arrangement, a contribution should be paid that depends only on the number of members. In advance of each year the insurers inform the regulator which of their members will be designated for risk sharing that year. This group of members may change every year. The payments that an insurer receives for these members may take several forms. It could apply to certain costs above a threshold, or to a certain percentage of those costs.
An alternative suggestion was to share all (or some) expenditures for, say, the one percent members with the highest costs.

The conclusion is that various forms of risk sharing have been suggested for quite some time now, and that risk sharing can take many forms.

[10] Condition-specific risk sharing differs slightly from retrospective capitation payments (see chapter two).

3.1.2 Empirical results

Beebe (1992) examined a payment system that combines the Adjusted Average Per Capita Costs-formula with an individual outlier payment mechanism as suggested by Gruenberg et al. (1986)[11]. The outlier risk sharing proposal would establish a risk pool funded by an amount equal to two percent of the current payments. This would be the cost equivalent of raising payments from 95 percent of the Adjusted Average Per Capita Costs to 97 percent. Thus the proposal is not budget-neutral from the regulator's point of view. The regulator would pay 45 percent of the cost in excess of $50,000 for each enrolee whose costs exceed that amount. The remaining 55 percent of the costs above $50,000 would be borne by the health maintenance organization so that there would remain an incentive for efficiency. All other aspects of the current system would remain unchanged. The author simulated the effect of this specific proposal and variations of it on program costs relative to the current costs. It was concluded that an outlier risk sharing method for health maintenance organizations could provide some protection against the risk of an *unexpectedly* high proportion of high-cost users at a relatively modest cost. Unfortunately an indication of the reduction of the incentives for selection was not given. A problem mentioned is that health maintenance organizations would have to install systems that would assign costs to ambulatory care, inpatient physician care, and, possibly, to hospital care in some cases. To alleviate data problems it is suggested to share the risk of specific services for which data are more readily available, such as hospital stays. These could be covered at something greater than the 45 percent rate and provide the same overall degree of protection.

Van Barneveld et al. (1996) analyzed a system of risk sharing for high-risks as suggested by Van de Ven et al. (1994). We investigated two aspects of the addition of this form of risk sharing to age/sex-based capitation payments. First we calculated the percentage of the total costs that would be shared between the

[11] More recently Ellis et al. (1996) and Weiner et al. (1996) have also analyzed outlier risk sharing. However, the main focus of these studies was on diagnosis-based risk adjustment (see chapter two).

insurers and the regulator. The higher this percentage, the lower the incentives for efficiency in general. Second we investigated to what extent the addition of risk sharing for high-risks reduces predictable profits and losses for various non-random subgroups. This gave an indication as to what extent it reduces the incentives for selection. We concluded that sharing the risk of less than 4% of the members would be most meaningful. Such a level of risk sharing for high-risks as a supplement to age/sex-based capitation payments may substantially reduce the incentives for selection. Without risk sharing for high-risks, the maximum predictable losses per member for the analyzed subgroups with at least 1% of the members was about Dfl. 14,000. Risk sharing for high-risks for 2% and 4% of the members reduced this loss by 67% and 80% respectively. An important question is whether the reduction of the incentives for selection comes at the expense of substantially reduced incentives for efficiency. It seems that this is not the case, because an insurer remains at risk for the costs of those persons with unpredictable high expenditures - which comprise the majority of all high costs - and because the group of members for whom the risk is shared is relatively small. In our analysis, the insurers remained fully at risk for at least 75% of their expenditures on average. Based on these findings we concluded that risk sharing for high-risks is a promising supplement to capitation payments.

Summarizing two forms of risk sharing have been analyzed empirically. Beebe (1992) has analyzed outlier risk sharing in the context of the Medicare program in the United States. Van Barneveld et al. (1996) have analyzed risk sharing for high-risks in the context of the Dutch public health insurance market. A systematic comparison of the consequences of various forms of risk sharing in a regulated competitive individual health insurance market has not yet been performed. The next section describes potential forms risk sharing.

3.2. Potential forms of risk sharing

The purpose of this section is to highlight the essential elements of risk sharing and the choices that can be made. Because risk sharing can be seen as a

mandatory reinsurance program for the insurers in which the regulator acts as the reinsurer, the essential elements of risk sharing are similar to those of a reinsurance contract (see e.g. Carter, 1979). Let us assume that the period to which the risk sharing applies is one year for all members for whom some risk is shared. Besides this period, Table 3.1 presents four other essential elements (Van Barneveld et al., 1999b).

Table 3.1 Four essential elements of a form of risk sharing

(1) The group of members for whom some risk is shared
(2) The types of care for which the risk is shared
(3) The extent of the risk that is shared
(4) The price that insurers have to pay to share some risk

3.2.1 The members

If the members for whom some risk is shared are known in advance of the contract year, we can speak of *prospective* risk sharing. If these members become known during the contract year, the risk sharing can be called *retrospective*. An extreme case is risk sharing for all members. Then the distinction between prospective risk sharing and retrospective risk sharing is irrelevant.

In the case of prospective risk sharing, the regulator may stipulate for which members some risk will be shared, for instance members with a certain medical condition (AIDS patients, cancer patients, transplantation patients) or with high prior costs. This can be called prospective *condition-specific* risk sharing. Under this form of risk sharing the percentage of members for whom some risk is shared will probably not be the same for all insurers. Another possibility is that an insurer is free to select a fixed percentage of its members whose costs then are (partially) shared. This form of risk sharing will be referred to as *risk sharing for high-risks (RSHR)*. With risk sharing for high-risks, the fraction of members for whom some risk is shared may be set the same for each insurer or it may vary over the insurers (Van Barneveld et al., 1996). In the latter case, the percentage would depend, preferably, on the risk that an insurer represents as far as this risk is not reflected in the capitation payments. However, the

option of varying percentages of designated members will not be explored in the empirical analysis because the present study focuses on the insurers' incentives for selection and not on the consequences of risk sharing at insurer level. Moreover it seems likely that the question of how to differentiate the percentages of members that insurers are allowed to designate will be difficult to answer.

An alternative for prospective risk sharing can be retrospective risk sharing. As with prospective risk sharing, the regulator may stipulate which members are eligible for risk sharing, for instance members that have ór develop a certain (medical) condition in the contract year [(new) AIDS patients, (new) cancer patients, (new) transplantation patients] or members who died during the year. This can be called a retrospective condition-specific risk sharing. Again the regulator can also leave it up to the insurers to select a fixed percentage of their members for risk sharing. This type of retrospective risk sharing will be called *risk sharing for high-costs (RSHC)*. As with risk sharing for high-risks, it is possible to differentiate the percentage of members for whom some risk is shared per insurer which could improve the effects of risk sharing at insurer level. However, for the same reasons as mentioned above with respect to risk sharing for high-risks, this form of risk sharing for high-costs will not be explored in the empirical analysis.
Condition-specific risk sharing, whether prospective or retrospective, requires a list of (medical) conditions that make members eligible for risk sharing. It is likely that such forms of risk sharing create discussions over which (medical) conditions make members eligible for risk sharing (Swartz, 1995). Condition-specific risk sharing could conflict with privacy rights of members and there may be a possibility of manipulation, namely by 'inflating' diagnoses to make members eligible for risk sharing (Swartz, 1995). The extent of the latter problem can be mitigated by using only (medical) conditions with relatively low discretion as well as a good monitoring system[12].
Risk sharing for high-risks and risk sharing for high-costs can be seen as

[12] Discussions on condition-specific risk sharing are similar to those on diagnosis-based risk adjustment.

alternatives for prospective and retrospective condition-specific risk sharing respectively. Under risk sharing for high-risks and for high-costs, it is up to the insurers themselves to decide for which of their members they want to share some risk, so discussions over eligibility can be avoided. The regulator only has to specify the percentage of members that each insurer is allowed to designate for risk sharing. Given a certain average percentage of designated members per insurer, it could be that the group of members for whom some risk is shared under risk sharing for high-risks is similar to the group of members under prospective condition-specific risk sharing. In that case the insurers' incentives for selection as well as for efficiency will be similar. The same holds for risk sharing for high-costs in comparison with retrospective condition-specific risk sharing.
For the reasons mentioned above, it can be concluded that risk sharing for high-risks and risk sharing for high-costs have better administrative feasibility and are less vulnerable to manipulation than condition-specific risk sharing, while the consequences for the insurers' incentives for selection and efficiency can be similar. Therefore condition-specific risk sharing will not be analyzed empirically in the second part of the study.

3.2.2 The types of care

The types of care for which the risk is shared could be set the same for each member that is designated or it could vary between these members (Wallack et al., 1988). In the latter case, the regulator has to stipulate which types of care can be distinguished in the risk sharing and the insurers have to register their (designated) members' expenditures per type of care. Furthermore the regulator will have to determine the price of risk sharing that an insurer has to pay, for each of these different types of care.

If insurers would be allowed to decide themselves for which types of care the risk is shared, prospective risk sharing might simulate - to some extent - the exclusion of pre-existing medical conditions. However, a distinction between several types of care within the specified benefits package does not seem to go well with a flexible description of the benefits package. This is a major element of many competitive health care reforms and should provide insurers with tools

for cost-effective substitution of care. A form of risk sharing that makes a distinction between several types of care might stimulate undesirable substitution of care. This could happen if the risk for relatively expensive types of care is shared and the risk for relatively inexpensive types of care is not. Furthermore such a form of risk sharing might be 'gamed' by the insurers if they register health care expenditures of one type of care (for which expenditures are shared) under another type of care (for which expenditures are not shared). In sum risk sharing with a distinction between several types of care within the specified benefits package may provide perverse incentives to insurers, and will be rather difficult to register and to monitor. For these reasons the remainder of this study assumes that the risk sharing applies to all types of care within the specified benefits package[13]. If the risk for all types of care within the specified benefits package is shared, risk sharing for high-risks might simulate - to a certain extent - the refusals to sell insurance to high-risk applicants for whom an appropriate premium (capitation payment) can not be calculated.

3.2.3 The extent

The extent of risk sharing may be the same for all members that are designated for it or it may vary between these members (Newhouse, 1986). In the latter case it may be the regulator that decides the extent of risk sharing or it can be left to the insurers themselves. Such flexible forms of risk sharing would require that the regulator determines a price for every possible extent of risk sharing. This might be a difficult task. For this reason it is assumed that the extent of risk sharing is the same for all members for whom some risk is shared.

The risk sharing applies to an individual level and not to an aggregate level (Gruenberg et al., 1986). Risk sharing on an aggregate level could resemble stop-loss reinsurance. This form of risk sharing would primarily concern the aggregate financial result of insurers. Because the present study focuses on tradeoffs between incentives for selection and efficiency and not on the conse-

[13] An argument in favor of risk sharing for specific types of care within the specified benefits package is that in some circumstances, insurers have no tools to improve efficiency for certain types of care. For this reason in the Netherlands the sickness funds have been given little financial responsibility for production-independent hospital costs since 1996.

quences of risk sharing at insurer level, this form of risk sharing will not be analyzed empirically. In the present study risk sharing reimbursements will be based on the actual costs of individual members for whom some risk is shared. Then the risk sharing may apply to all costs of a designated member, may be limited to the member's costs above his normative costs, or may be limited to the costs above a certain threshold. In each of these variants risk sharing may apply to a certain percentage of the cost involved. Of course it is possible to use more than one threshold in combination with different percentages of the costs involved. However, to avoid unnecessary complications, the empirical analyses are restricted to only one preset threshold (if any) together with one percentage of the costs involved. If the risk sharing applies to all members and all expenditures above a certain threshold are shared, the risk sharing is called *outlier risk sharing (ORS)*. It resembles excess-of-loss reinsurance (Bovbjerg, 1992). If the risk sharing applies to all members and a certain percentage of all expenditures is shared, the risk sharing is called *proportional risk sharing (PRS)*. This form of risk sharing resembles quota-share reinsurance (Bovbjerg, 1992).

3.2.4 The price

The financing of a risk sharing arrangement can take several forms. Risk sharing may be financed externally, internally or via a combination of both. External financing means that there is some flow of money towards the whole payment system, for instance from the government. For example Beebe's (1992) outlier pool was assumed to be financed this way. With such a flow of money, risk sharing is not budget-neutral from the regulator's point of view. However, in this study it is assumed that the regulator requires risk sharing to be budget-neutral at the macro-level. This can be achieved by using an internal financing mechanism i.e. the risk sharing is financed via mandatory contributions from all insurers in the market. This way the risk sharing only shifts (limited) amounts of money from some insurers to others. In practice the price that an insurer has to pay to the regulator can be calculated at the end of the year, when the proportion shared expenditures is known. In the empirical analyses it will be assumed that the normative costs, on which the capitation payments are based, are reduced proportionally to finance the risk sharing. A disadvantage of this financing method is that it is not necessarily budget-neutral

for each of the risk groups that are distinguished in the capitation formula. This may create some new selection problems. However, for limited extents of risk sharing, there is no reason to assume that a refinement of the financing method would alter the conclusions of this study (see chapter seven).

3.3. Four forms of risk sharing

This section first summarizes the choices that have been made with respect to the essential elements of risk sharing. Then four forms of risk sharing are presented more formally by introducing some parameters. An important aspect of risk sharing is the proportion shared expenditures. This is the proportion of all expenditures that is retrospectively paid for by the regulator. The higher this proportion, the lower an insurer's incentives for efficiency. Based on an assumption with respect to the distribution of individual health care expenditures, an indication of the relation between the parameter(s) of the forms of risk sharing and the resulting proportion shared expenditures is presented. Finally some implementation issues of the four forms of risk sharing are discussed.

3.3.1 Summary of choices

For the empirical analyses in the second part of the study, the following choices have been made:

(1) Each insurer is allowed to select itself a given percentage of its members; if the members have to be designated before the start of the year, it is called risk sharing for high-risks. If the members can be designated at the end of the year, it is called risk sharing for high-costs. The fraction of members is set by the regulator. A special case is risk sharing for all members.

(2) The risk sharing applies to all types of care within the specified benefits package.

(3) Insurers are entitled to a certain percentage of the costs of a designated member as far as these costs are above a certain threshold.

(4) The risk sharing is budget-neutral from the regulator's point of view and it is mandatory for each insurer to contribute to the financing of the risk sharing. The risk sharing is financed via a proportional reduction of the normative costs.

For a brief description of the forms of risk sharing, the next subsection introduces four parameters.

3.3.2 Risk sharing parameters

Given the choices of the previous subsection, the forms of risk sharing studied here can be described by four parameters (Van Vliet, 1997):

p: The fraction of members that an insurer is allowed to designate for risk sharing. Of course, this fraction varies between zero and one. A special case is a fraction of one, when the risk sharing applies to all members.

D: Dummy variable that indicates whether the designation of members whose expenditures are (partly) paid by the regulator, can be done at the start of a year (D=0) or at the end of the year (D=1).

T: The threshold above which the costs of designated members are (partially) reimbursed. Of course, the threshold is greater than or equal to zero. A special case is a threshold of zero, when the risk sharing applies to all costs of the designated members.

a: The fraction of the costs of designated members - possibly above a threshold - that is reimbursed. Of course this fraction varies between zero and one. A special case is a fraction of one, when all costs of designated members - possibly above a threshold - are shared.

The following values of three parameters imply no risk sharing at all: p equals zero; and/or T is infinite; and/or a equals zero. The influence of the three parameters is roughly as follows: the higher p or a and the lower T, the more extensive the risk sharing. If p equals one, T equals zero and a equals one, the most extensive form of risk sharing arises, i.e. the situation of full cost reimbursement. Further limiting the possibilities such that each form of risk sharing has essentially one parameter only, yields four main forms of risk sharing. Table 3.2 presents these four forms. By choosing different parameter values for a certain form of risk sharing, one may get different variants of this form.

Table 3.2. Description of four forms of risk sharing

Name	p	D	T	a
Risk sharing for high-risks (RSHR)	p	0	0	1
Risk sharing for high-costs (RSHC)	p	1	0	1
Outlier risk sharing (ORS)	1	1	T	1
Proportional risk sharing (PRS)	1	1	0	a

Slight modifications would be: risk sharing for high-risks ór high-costs with proportional cost based payments ($0<a<1$); outlier-cost based payments ($0<T<\infty$); or with proportional outlier-cost based payments ($0<T<\infty$; $0<a<1$). Outlier risk sharing ór proportional risk sharing may be combined to get proportional outlier-cost based payments ($0<T<\infty$; $0<a<1$). Of course, other combinations of the four main forms are possible as well.

Because risk sharing for high-risks is a prospective form of risk sharing, for this form it is clear that the usefulness of risk sharing strongly depends on the capitation formula employed. The question is whether insurers are able to identify members for whom they expect to be underpaid given the capitation formula. Given a demographic capitation formula, insurers can easily do this by using the claims history of their members. The proportion shared expenditures then provides a clear indication to the regulator of how bad its capitation formula really is. If in the future, the regulator is able to improve its capitation formula, it will become more difficult for the insurers to select members for whom they expect to be underpaid and their costs will decrease. Therefore, given the fraction of members for whom some risk is shared, an improvement of the capitation formula will lead to a reduction of the proportion shared expenditures under risk sharing for high risks. Under the three retrospective forms of risk sharing, an improvement of the capitation formula will not lead to a reduction of the proportion shared expenditures.

3.3.3 Proportion shared expenditures

An important aspect of risk sharing is the proportion shared expenditures. In the case of proportional risk sharing, the proportion shared expenditures equals the weight on the actual costs. Under risk sharing for high-risks ór high-costs, the

proportion shared expenditures equals the costs incurred by the designated members expressed as a fraction of the costs of all members. In the case of outlier risk sharing, the proportion shared expenditures equals the costs incurred above the threshold expressed as a fraction of the total costs.
Under the assumption that the probability density function of individual health care expenditures consists of a combination of an alternative distribution (yes/no costs) and a lognormal distribution (with parameters μ and σ) for those members with positive costs, Van Vliet (1997) derived the following formulae for the proportion shared expenditures (PSE)[14]:

(3.1) RSHR: $PSE = 1-\Phi(\Phi^{-1}(1-p)-\rho*\sigma)$.
(3.2) RSHC: $PSE = 1-\Phi(\Phi^{-1}(1-p/\pi)-\sigma)$.
(3.3) ORS: $PSE = (1-\Phi(c-\sigma)) - T*\pi*(1-\Phi(c))$ with $c=(\log(T)-\mu)/\sigma$.

The parameters μ and σ of the lognormal distribution can be calculated with equation (3.4) and (3.5) given the mean costs (E(AC)), the probability of positive costs (π) and the coefficient of variation (cv).

(3.4) $E(AC) = \pi*\exp(\mu+0.5*\sigma^2)$ and
(3.5) $\sigma^2 = \log[\pi*(cv^2+1)]$.

Under the assumption that the average costs are Dfl 2,000, the coefficient of variation is 4 and the probability of positive costs is 0.8 and the correlation between the costs in two consecutive years is 0.3, Figure 3.1 gives an indication of the proportion shared expenditures under risk sharing for high-risks and for high-costs for various fractions of designated members. The higher the fraction of designated members, the higher the proportion shared expenditures. The Figure shows that, given a certain fraction of designated members, risk sharing for high-risks yields a smaller proportion shared expenditures than risk sharing for high-costs. For instance, with 2% designated members, risk sharing for high-risks yields a proportion shared expenditures of about 5% whereas risk

[14] Under risk sharing for high risks it is assumed that an insurer designates those members with the highest costs in the previous year and ρ is the first-order autocorrelation of the costs.

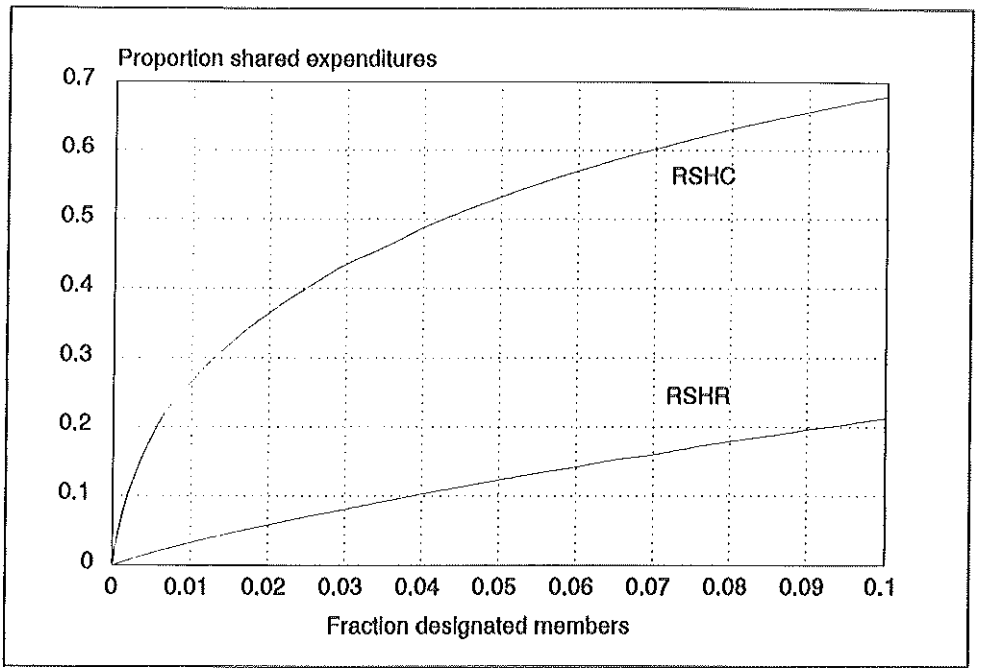

Figure 3.1 The proportion shared expenditures under RSHR and RSHC given the fraction of designated members (E(AC)=Dfl. 2,000; cv=4; π=0.8 and ρ=0.3)

sharing for high-costs yields a proportion shared expenditures of about 35%. The reason is that under risk sharing for high-risks, members are designated in advance of the year whereas under risk sharing for high-costs this is done at the end of the year.
Figure 3.2 gives an indication of the proportion shared expenditures under outlier risk sharing given various threshold amounts. The higher the threshold, the lower the proportion shared expenditures.

For instance, a threshold of Dfl. 10,000 yields a proportion shared expenditures of about 0.3, a threshold of Dfl. 35,000 yields a proportion of about 0.1.
Figure 3.3 gives an indication of the fraction of members whose costs exceed a certain threshold in a year. Under outlier risk sharing, these persons are the designated members. The higher the threshold, the lower is the fraction of

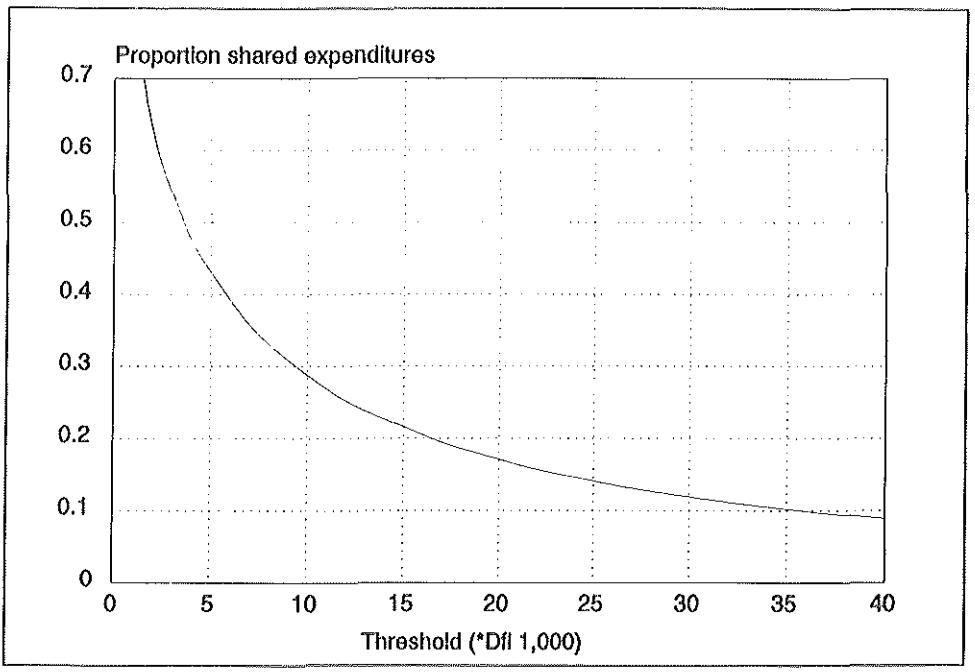

Figure 3.2 The proportion shared expenditures under outlier risk sharing given the threshold (E(AC)=Dfl. 2,000; cv=4; π=0.8)

designated members. About 5% of the members have health care expenditures above Dfl. 10,000. About 2% of the members exceed the threshold of Dfl. 20,000 and about 1% exceed Dfl. 30,000.

The proportion shared expenditures provides a rough measure of the reduction of an insurer's incentives for efficiency caused by the addition of risk sharing. The higher the proportion shared expenditures, the lower an insurer's incentives for efficiency in general. However, given a certain proportion shared expenditures, the different forms of risk sharing may have different effects on an insurer's incentives for efficiency. Therefore the measurement of an insurer's incentives for efficiency under risk sharing will be further investigated in the next chapter.

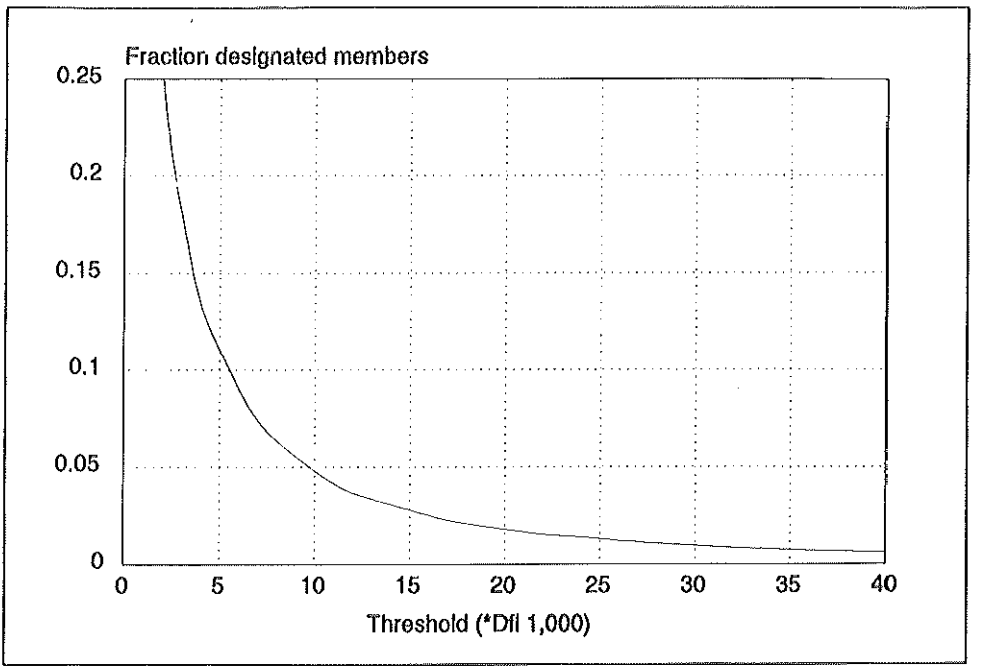

Figure 3.3 The fraction of designated members under outlier risk sharing given the threshold (E(AC)=Dfl. 2,000; cv=4; π=0.8)

3.3.4 Implementation issues

This subsection describes some implementation issues of the four forms of risk sharing.

With respect to the money flows between insured members, insurers and the regulator, risk sharing can be implemented as follows:

- All members that choose the same insurance modality pay the same additional premium directly to the insurer of choice.
- The regulator calculates the capitation payments as in the situation without risk sharing. The insurers receive these capitation payments as in the situation without risk sharing.
- At the end of the year each insurer informs the regulator about the costs of its members designated for risk sharing. The regulator calculates for each insurer

its gross risk sharing reimbursement. Furthermore the regulator calculates for each insurer the price that it has to pay to finance the risk pool. The net risk sharing reimbursement for an insurer is calculated as gross risk sharing reimbursement minus this price. An insurer with positive net risk sharing reimbursement receives this amount from the regulator and vice versa.

In comparison with the situation without risk sharing, each insurer has to make a list of its designated members. Furthermore each insurer must provide, depending on the exact form of the risk sharing reimbursements and the price of risk sharing: the costs of individual designated members ór the total costs of the group of designated members.

Implementing *risk sharing for high-risks* requires rules of how to deal with enrolment and disenrolment during the year whereas with the other forms of risk sharing this is not necessary. Several options are possible.
(1) The most simple option would be that at the start of the year each insurer designates the percentage of its members for whom it is allowed to share the risk. Members who switch to another insurer during the year keep their status of designated or non-designated member. The same holds for those members who die during the year.
In the second and third option insurers will be able to designate (a fraction of) members who enrol during the year and who form a predictable loss.
(2) A second option would be that designated members who switch to another insurer or die during the year can be replaced by new members only. Because only newly enroling members can still be designated for risk sharing, it is not possible that insurers designate those members with (almost certain) high costs in the year, without being able to predict this at the start of the year.
(3) A third option would be to allow designation for risk sharing on the contract renewal date which can be any day of the year. Members that are designated for risk sharing are designated for one year. This option requires that the regulator registers the starting date of the risk sharing per designated member. In comparison with the other two options, it will be more difficult to keep track of the percentage of designated members per insurer and their costs.
If an insurer has designated more members than it is allowed to - this is only

possible in the second and third option - this can be corrected for by lowering the costs of its designated members pro rata.
With respect to (dis)enrolment during the year, it should be noted that if the contract renewal date is the same for each member, the potential implementation problems of risk sharing for high-risks are greatly reduced.

Risk sharing requires that each insurer registers the costs of individual members. In some circumstances this may pose difficulties because such cost data are not readily available for all types of care within the specified benefits package. Beebe (1992) suggested to base risk sharing on those types of care for which cost data are already available, but the present study assumes that risk sharing does not make a distinction between several types of care within the specified benefits package. Implementation problems caused by the omission of necessary cost data may be alleviated by the use of standard prices in conjunction with utilization data.

3.4 Risk sharing versus capitation

The following classification of payments to insurers might be helpful to understand the difference between risk sharing and capitation. Assume a contract period of one year and assume that the capitation payments as well as the risk sharing apply to this year.

With prospective capitation, the payments to an insurer depend on cost predictions. These cost predictions are based on variables whose values are known at the start of the year. The cost predictions depend on the way these variables are incorporated in the capitation formula and on their estimated weights. For a specific member with a medical problem that needs treatment during the year, any treatment savings will increase the insurer's profit in that year. Depending on the exact form of the capitation formula, the capitation payment for the member involved in the next year might be 'high'. However, the member's insurer can not be sure that next year it will receive this 'high' payment, because he might switch to another insurer or might die. With risk sharing, the

reimbursement of an insurer is not based on predicted costs but on the actual costs of its designated members. For a designated member with a medical problem that needs treatment during the year, any treatment savings will lower the insurer's reimbursement for that year. Therefore, risk sharing lowers the insurers' incentives for efficiency.

Table 3.3. Risk sharing versus capitation

	For members known at the start of the year	For members known at the end of the year
Payments independent of actual costs in the year	Prospective capitation	Retrospective capitation
Payments based on actual costs in the year	Prospective risk sharing	Retrospective risk sharing

With prospective risk sharing an insurer knows at the start of the year which members are designated that year. With retrospective risk sharing, this becomes known during the year or at the end.

An interesting example of capitation is capitation payments that are (partly) based on prior costs. Such capitation payments are still different from risk sharing because risk sharing reimbursements are based on actual costs in the present year. However, an important similarity is that in both cases, a selection-efficiency tradeoff takes place. Then the question arises: which method will yield the best tradeoff? Newhouse (1994) has put forward that - with the exception of those who die or change plans - prior use and actual use do not markedly differ in their incentive effects. For instance, prior costs with an estimated weight of 0.3 in the capitation formula would establish similar incentive effects as proportional risk sharing with a weight of 0.3 on actual costs. Chapter eight of the present study contains an empirical analysis that addresses the question whether this premise is true if both incentives for selection and efficiency are taken into account. Moreover chapter eight com-

pares prior costs as an additional risk adjuster with the other forms of risk sharing.

3.5. Conclusions

This chapter summarized forms of risk sharing as well as previous empirical studies on risk sharing as a supplement to capitation payments. It was concluded that risk sharing can take many forms and that a systematic comparison of various forms of risk sharing as a supplement to capitation payments in a regulated competitive individual health insurance market has not yet been performed. Potential forms of risk sharing were described. Because all forms of risk sharing are reinsurance-like mechanisms in which the regulator acts as the reinsurer, the essential elements of risk sharing are similar to those of a reinsurance contract. Besides the period to which the risk sharing applies (usually one year), a description of risk sharing should include at least the following four topics: the group of members for whom some risk is shared; the types of care for which the risk is shared; the extent of the risk that is shared; the price that insurers have to pay to share some risk.

For the empirical analyses in the second part of this study, the following choices are made:
- An insurer is allowed to select itself a certain percentage of its members for risk sharing either at the start of a year ór at the end of a year. A special case is risk sharing for all members.
- Risk sharing applies to all types of care within the specified benefits package.
- An insurer is entitled to receive a certain percentage of the costs of a designated member as far as these costs are above a certain threshold.
- It is mandatory for an insurer to contribute to the financing of the risk pool.

It is assumed that the normative costs are reduced proportionally to finance the risk pool. The size of the reduction is set afterwards such that the risk sharing is budget-neutral from the regulator's point of view.

Two forms of risk sharing that apply to all members of an insurer are outlier

risk sharing and proportional risk sharing. Under outlier risk sharing insurers are fully reimbursed for a member's costs above a threshold. In the reinsurance industry this is called excess-of-loss. Under proportional risk sharing an insurer receives at the end of the year a% of the difference between the total actual costs it has incurred and the total normative costs of its members. Because it is assumed that the risk sharing is financed via a percentage of the normative costs per member, proportional risk sharing equals a blended payment system as proposed by Newhouse (1986).

Given the choices that were made with respect to the essential elements of risk sharing, four forms of risk sharing were distinguished: risk sharing for high-risks, risk sharing for high-costs, outlier risk sharing and proportional risk sharing. These forms of risk sharing can be described formally with four parameters:

- p: The fraction of members that an insurer is allowed to designate for risk sharing.
- D: Dummy variable that indicates whether the designation of members for risk sharing is done at the start of a year (D=0) or at the end (D=1).
- T: The threshold above which the costs of designated members are (partially) reimbursed.
- a: The fraction of the costs of designated members - possibly above a threshold - that is reimbursed.

The following values imply no risk sharing at all: p equals zero, T is infinite, a equals zero. The higher p and a and the lower T, the more extensive the risk sharing. If p equals one, T equals zero and a equals one, the most extensive form of risk sharing arises, i.e. the situation of full cost reimbursement.

By choosing different parameter values, one may get different variants of a specific form of risk sharing. Optimizing the tradeoff between selection and efficiency not only includes the determination of the optimal form of risk sharing, but may also deal with determining the optimal variant of a certain form of risk sharing.

Important aspects of the four forms of risk sharing are that the designated members pay the same premium as others and typically would be unaware that their insurer has designated them for risk sharing.

Risk sharing implies payments to insurers based on the actual costs of their designated members. Therefore risk sharing differs from capitation which implies payments to insurers that are independent of the actual costs of their members. As capitation payments can be prospective and retrospective, risk sharing can also be prospective (risk sharing for high-risks) and retrospective (risk sharing for high-costs). Under outlier risk sharing or proportional risk sharing, this difference is irrelevant because for all members some risk is shared.

Risk sharing implies a reduction of an insurer's incentives for efficiency. A rough measure of this reduction is given by the proportion shared expenditures. The higher this proportion, the lower an insurer's incentives for efficiency. But given a certain proportion shared expenditures, different forms of risk sharing may have different effects on an insurer's incentives for efficiency. Therefore the next chapter develops better indicators of (the reduction of) an insurer's incentives for efficiency under risk sharing.

4. Efficiency

A negative effect of risk sharing is that it reduces an insurer's incentives for efficiency. Remember that in this study efficiency refers to efficiency in production or so-called technical efficiency. That is an insurer is more efficient than a competitor if it is able to serve the same population with the same quality of care for lower costs ór with a higher quality of care for the same costs. Because the potential problem of quality skimping is outside the context of this study, an insurer's incentives for efficiency will be measured by its incentives for cost containment. If the capitation payment is the same for each individual, an insurer keeps the entire revenue of cost reducing activities itself. Thus flat capitation payments maximize an insurer's incentives for efficiency. For the same reason an insurer's incentives for efficiency are as great as possible under demographic capitation payments. Previous empirical studies on risk sharing did not quantify an insurer's incentives for efficiency (Beebe, 1992) or used the proportion shared expenditures as a rough measure of the reduction of an insurer's incentives for efficiency (Van Barneveld et al., 1996). The main purpose of this chapter is to develop better indicators of an insurer's incentives for efficiency under risk sharing.
Section 4.1 and 4.2 argue that an insurer can use several tools for improving efficiency and that the application of such tools may yield large savings. Section 4.3 proposes some methods to measure an insurer's incentives for efficiency given a certain form of risk sharing or given prior costs as an additional risk adjuster. Section 4.4 summarizes the conclusions.

4.1 Tools to improve efficiency

Hillman (1991) distinguished two basic mechanisms - rules and incentives - to shape physicians' practice patterns in managed care. According to the author clinical rules have assumed various names as managed care evolved: treatment protocols or algorithms, regulations, administrative constraints, practice guidelines or parameters, prospective utilization review, utilization management,

'cookbook' medicine, and simply 'controls'. Nevertheless all embody the same basic concept: direct instruction on how a physician should or should not act in specific clinical circumstances. In addition to rules regarding clinical decisions, other rules, including new legal and ethical constraints on referral behaviour, and ownership of medical facilities, have altered physicians' behaviour.
The use of incentives is seen as a more subtle approach to influencing physicians' clinical decisions. Incentives are generally financial in nature and expose physicians to some risk or reward for certain patterns of behaviour.
Other approaches to influencing physicians' clinical decisions in managed care are also mentioned, such as feedback to physicians about their prescribing behaviour compared to a norm followed by education to change their prescribing.

Weiner and de Lissovoy (1993) reviewed past and current trends in the United States market for nontraditional health benefit plans. They concluded that complete consensus on the use of the term 'managed care' does not exist. Nevertheless they mentioned several methods used to manage the patient's care. These include preadmission certification, mandatory second opinion before surgery, certification of treatment plans for discretionary nonemergency services, primary care physician gatekeepers and nonphysician case managers to monitor the care of particular patients.

Enthoven (1994) described a normative model for the market structure for third-party purchasing of health care. In his model an important role is played by so-called accountable health plans. These are organizations that contract to pay for and deliver a uniform list of comprehensive health services, and to participate in a national system of uniform health outcomes reporting. The author mentioned that an accountable health plan can do a great deal to improve quality and cut costs. Among other things:
- It can seek to align the incentives of doctors, and others, and the interest of patients in high quality economical care. Its management can use judgment and various indicators of performance, to seek best to reward effectiveness and useful effort, how best to pay different types of doctors for different activities.
- It can gather data on diagnoses, treatments, outcomes and resource use, study

variation in practice patterns, and inform and advise its doctors about cost-effective practices.
- It can match numbers and types of doctors to the needs of the enroled population, to assure good access to primary care, a rational referral process, and busy, proficient specialists.
- It can manage processes of care with a view to minimizing total system costs.

Miller and Luft (1994) performed an extensive literature analysis to compare the health care utilization, expenditure, quality of care, and satisfaction since 1980 of enrolees in managed care and indemnity plans. According to the authors, plans differ greatly in physician practice management features such as provider selection, information feedback techniques, utilization management procedures, provider reimbursement and risk-sharing methods, and physician organization. Furthermore the extent of integration of the intermediary with delivery system providers varies greatly.

According to Armstrong (1997) there are quality and cost benefits to be gained by the application of disease management to an increasing list of predominantly chronic conditions. In the case of these specific, high-cost diseases, it seems reasonable to assume that the introduction of education, better preventive care and improved self medication might serve to reduce emergency treatment and hospital admission and so substantially reduce costs. Within the United States this appears to be the case with asthma and diabetes. Other conditions for which disease management principles are already being successfully applied, include congestive heart failure, depression, breast cancer, low back pain, arthritis, headache, gallstones and AIDS.

These studies show that health insurers can use many tools to improve the efficiency of care. To give an indication which tools are actually being used by managed care plans in the United States and to which extent, two studies are summarized that have addressed this question.

Langwell (1990) mentioned that health maintenance organizations combine utilization management, provider selection and financial incentives to control

provider behaviour. However, the many diverse types of these organizations and the mixture of these elements of managed care systems make it difficult to disentangle the effects of utilization management methods, provider selection and financial incentives to determine which specific mechanisms are most effective.
Commonly used utilization management methods by health maintenance organiza-tions include: primary care gatekeepers (93%); concurrent utilization review (94%); retrospective utilization review (89%); prior authorization for inpatient care (88%).
Preferred provider organizations recruit and offer a network of preferred providers who are selected on the basis of practice style and willingness to follow the utilization management and review requirements of the organization. Their utilization management activities include: preadmission certification (78%); concurrent utilization review (51%); retrospective utilization review (55%); mandatory second surgical opinion (44%); discharge planning (31%).

Gold et al. (1995) conducted a national survey of the arrangements managed-care plans make with physicians in the United States. Of the 108 plans that responded, 29 were group-model or staff-model health maintenance organizations, 50 were network or independent-practice-association health maintenance organizations, and 29 were preferred provider organizations. Respondents from all three types of plans said they emphasized careful selection of physicians, although the group or staff health maintenance organizations tended to have more demanding requirements, such as board certification. Sixty-one percent of the plans responded that physicians' previous patterns of costs or utilization of resources had little influence on their selection; 26 percent said these factors had a moderate influence; and 13 percent said they had a large influence.
Some risk sharing with physicians was typical in the health maintenance organiza-tions but rare in the preferred provider organizations. Fifty-six percent of the network or independent-practice-association health maintenance organizations used capitation as the predominant method of paying primary care physicians, as compared with 34 percent of the group or staff health maintenance organizations and 7 percent of the preferred provider organizations.
Ninety-two percent of the network or independent-practice-association health

maintenance organizations and 61 percent of the group or staff health maintenance organizations required their patients to select a primary care physician who was responsible for most referrals to specialists. About three quarters of the health maintenance organizations and 31 percent of the preferred provider organizations reported using studies of the outcomes of medical care as a part of their quality-improvement programs.
The authors concluded that managed-care plans, particularly health maintenance organizations, have complex systems for selecting, paying, and monitoring their physicians. Hybrid forms are common and the differences between several types of health maintenance organizations are less than is commonly assumed.

Summarizing an insurer can use many tools to improve the efficiency of care. The most important tools seem to be:
- Utilization management techniques.
- Disease and (high-cost) case management techniques.
- Selective contracting with physicians and pharmacists.
- Financial incentives to share some risk with providers of care.
- Negotiating lower fees than those officially approved.
- Offering different insurance modalities.

An insurer can be expected to use several combinations of the tools mentioned above. Such a combination might focus on:
- All expenditures within the specified benefits package.
- Expenditures for specific types of care ór specific groups of members.

The next section describes evidence on potential savings when tools to improve efficiency are applied.

4.2 Potential savings

Various studies indicate that tools to improve the efficiency of care can be applied successfully. These studies are mainly based on experiences with managed care in the United States. First the potential savings that can be achieved for all types of care within the specified benefits package will be discussed. This is followed by some evidence of savings for hospital care and

for specific groups of members.

4.2.1 Overall savings

Manning et al. (1984) investigated whether a prepaid group practice delivers less care than the fee-for-service system when both serve comparable populations with comparable benefits. To answer this question they randomly assigned a group of 1,580 persons to receive care free of charge from either a fee-for-service physician of their own choice (431 persons) or the Group Health Cooperative of Puget Sound (1,149 persons). In addition, 733 prior enrolees of the Cooperative were studied as a control group. The rate of hospital admissions in both groups at the Cooperative was about 40% less than in the fee-for-service group ($p<0.01$), although ambulatory visit rates were similar. The calculated expenditure rate for all services was about 25% less in the two Cooperative groups ($p<0.01$ for the experimental group; $p<0,05$ for the control group). The number of preventive visits was higher in the prepaid groups, but this difference does not explain reduced hospitalization.
The lower rate of use along with comparable reductions found in non-controlled studies by others, suggested that the style of medicine at prepaid group practices is markedly less 'hospital-intensive' and, consequently, less expensive. According to the authors it is very unlikely that prepaid group practices have a substantial negative effect on the health status of (some of) their members.

Kirkmann-Liff and Van de Ven (1989) described a variety of efforts that have been launched in the Netherlands to achieve a more effective use of limited resources. Among these innovations are improved systems for the monitoring of utilization and cost of medical care providers, demonstrations of incentives for cost-effective care, the development of community care projects, and efforts to improve the coordination of care. They mentioned that the estimated inefficiency in the Dutch health care system was about 15% of total health care expenditures.

On the basis of an extensive review of the literature, Miller and Luft (1994) concluded that, compared with indemnity plans, health maintenance organizations have somewhat lower hospital admission rates, 1% to 20% shorter

hospital length of stay, the same or more physician office visits per enrolee, less use of expensive procedures and tests, greater use of preventive services, mixed results on outcomes, and somewhat lower enrolee satisfaction with services but higher satisfaction with costs. There were few or no results for key summary measures of performance, including total health plan and system-level expenditures, out-of-pocket costs per enrolee, and the level and rate of growth of premiums.

Enthoven and Singer (1996) presented evidence from California of a broad decline in health care costs for employment groups adopting managed care and managed competition. The premium for some groups were reduced by about 10 percent in comparison with the previous year(s). Many of the employees involved are enroled in a health maintenance organization. Lower premiums may not imply reductions in total spending, because benefit changes and selection may increase overall spending. For the purchasers they examined, however, benefits have been fairly standard. Also, in general, benefits have not been manipulated to reduce premiums. In addition, the decreases in weighted average premiums probably did not reflect favourable risk selection.

4.2.2 Savings for hospital care

Siu et al. (1988) investigated whether health maintenance organizations selectively avoid discretionary hospitalizations. Medical records were reviewed from the same randomized trial as used by Manning et al. (1984). Physicians who were blinded to the system reviewed 244 medical records and judged the appropriateness of both the hospital setting and the medical indications for hospitalization. The rate of discretionary surgery was lower in the health maintenance organization, while the rate of nondiscretionary surgery was equivalent in the two systems. For medical admissions, rates of discretionary and nondiscretionary admissions were lower in the health maintenance organization. There were no observable adverse effects on health from the lower rates of nondiscretionary hospitalization, either because the net effect on health was small or because the health maintenance organization substituted appropriate ambulatory services. The authors concluded that the health maintenance organization's reductions in hospitalization rates do not occur 'across the

board'. Discretionary surgery is selectively avoided.

Mennemeyer and Olinger (1989) examined the financial consequences when California implemented selective contracting for Medicaid services. They concluded that selective contracting halted a long history of hospital price inflation and won significant price concessions for the state (about 19%). While the state might have tried to get the cheapest possible care from the worst possible providers, their evidence showed that the state secured price concessions from mainstream hospitals that provided accessible, good-quality care. Furthermore length of stay remained virtually unchanged and growth of volume remained within expected ranges. Faced with a credible danger of loss of business, hospitals were able to make price concessions and find approaches to more economical operation.

Melnick et al. (1992) investigated prices obtained in different types of markets by the largest preferred provider organization in California. Their results indicated that prices paid to hospitals in the Blue Cross of California preferred provider organization network, after controlling for hospital product differences, are strongly influenced by the competitive structure of the hospital market. Greater hospital competition leads to lower prices. Furthermore as the importance of a hospital to the preferred provider organization in an area increases, the price rises substantially.

Khandker and Manning (1992) examined the performance of a utilization review program with data of one insurer. They compared the group of costumers involved with a representative sample of the costumers which had no utilization review during the study period. The program included precertification and concurrent review for each medical and surgical admission. The precertification covered both the necessity of the admission and the length of stay. The data suggested that utilization review reduced inpatient expenses by 8.1% (and overall medical expenses by 4.4%) after a year of experience, largely by reducing length of stay. The savings of the program outweighed the extra administration costs of the program. Therefore the authors concluded that utilization review offers some promise as a cost control strategy. However, they

also mentioned several limitations in their data and they note that their study has not looked at the possibility that the utilization review program may have impacts on the health status of the population.

4.2.3 Savings for specific groups of members

According to Enthoven and Singer (1996) clinical improvements will be the main source of continued savings in the health care system in the future. They give several examples of such improvements. For instance, one hospital introduced clinical case management for congestive heart failure. This reduced the overall costs per patient by 39 percent. Satisfaction levels for patients with congestive heart failure with clinical case management were higher than those for patients without case management. In addition, the readmission rate for congestive heart failure fell 33 percent to 7.1 percent. Another example is a hospital that reduced the inpatient stay for hip replacement surgery from 8 days to 3.4 days and cut costs by $4,500 per patient.

Armstrong (1997) gave examples of successfully applied disease management programs. By utilizing an asthma disease management program it is reported that the Harvard Community Health Plan's admission rate for paediatric asthma admissions dropped by 25%. For adults the admission rate dropped 10%. Leading health maintenance organizations in the United States are targeting diabetes for disease management. It is believed by these organizations that although diabetes afflicts only 3% of their members it accounts for about 13% of their overall costs. It is estimated that diabetes disease management programs are already producing cost savings of 15-35%.

Summarizing various forms of managed care may improve efficiency compared with indemnity insurance. However, introducing risk sharing ór prior costs as an additional risk adjuster will reduce an insurer's potential benefits of improving efficiency. This brings us to the question: how can an insurer's incentives for efficiency be measured in the case of risk sharing and in the case of prior costs as an additional risk adjuster? This question is addressed in the next section.

4.3 Measuring incentives for efficiency

Section 4.3.1 presents overall indicators of an insurer's incentives for efficiency. These overall indicators are relevant under the assumption that an insurer tries to improve efficiency for all types of care within the specified benefits package together at once. Section 4.3.2 presents specific indicators of an insurer's incentives for efficiency. These indicators may be appropriate if an insurer's efficiency improving activities focus on various specific types of care within the specified benefits package or on specific subgroups of members.

4.3.1 Overall indicators

Insurer's portion of an overall efficiency gain
If capitation payments are supplemented with a form of risk sharing, the financial result for an insurer (R) equals its normative costs (NC) minus its actual costs (AC) plus the risk sharing reimbursement that it is entitled to (RSREIMB) minus the price that it has to pay for the risk sharing (RSPRICE). Any difference between the capitation payments plus the additional premiums and the normative costs is not relevant for this analysis and is therefore ignored. Then in the case of risk sharing:

(4.1) $R=(NC-AC)+(RSREIMB-RSPRICE)$.

Suppose that an insurer can reduce its actual costs while all other things are kept equal. Then its actual costs and - most likely - its risk sharing reimbursement will be lower. Its normative costs and the price it pays for the risk sharing will remain unchanged. A small change in the price of the risk sharing can be neglected here if the market share of the insurer is sufficiently small. The total efficiency gain can be split into a portion that is kept by the insurer and a portion that is taken by the regulator. The insurer's portion of the efficiency gain (IPEG) equals:

(4.2) $IPEG = (1-\Delta RSREIMB/\Delta AC)$.

The higher this measure, the higher are the incentives to improve efficiency. Suppose that an insurer is able to reduce the costs of each member by the same percentage. This situation can be analyzed theoretically with an assumption on the distribution of individual health care expenditures. Suppose that the probability density function of health care expenditures consists of a combination of an alternative distribution (yes/no costs) and a lognormal distribution for those members with positive costs. Assume that the mean costs are Dfl. 2,000, the coefficient of variation is four, the probability of positive costs is 0.8 and the correlation between the costs of individual members in two consecutive years is 0.3. Table 4.1 then presents the insurer's portion of the efficiency gain if the costs for each member are reduced by 10%.

Table 4.1. The insurer's portion of a ten percent overall efficiency gain (IPEG)

	Risk sharing high-risks	Risk sharing high-costs	Outlier risk sharing	Proportional risk sharing
PSE=0.089	p=0.0335	p=0.0012	T=40,000	a=0.089
IPEG	0.911	0.911	0.826	0.911
PSE=0.171	p=0.0757	p=0.0041	T=20,000	a=0.171
IPEG	0.829	0.829	0.695	0.829
PSE=0.288	p=0.1486	p=0.0119	T=10,000	a=0.288
IPEG	0.712	0.712	0.533	0.712
PSE=0.431	p=0.2554	p=0.0295	T=5,000	a=0.431
IPEG	0.569	0.569	0.364	0.569

PSE = proportion shared expenditures. p = fraction of designated members; T = threshold amount in guilders; a=weight on actual costs. Under the assumption of lognormally distributed individual annual health care expenditures and with E(AC)=Dfl. 2,000; cv=4; π=0.8 and ρ=0.3.

Given a certain threshold amount (T), the proportion shared expenditures under outlier risk sharing was calculated with Equation (3.3) of the previous chapter. Then with Equation (3.1) and (3.2) of the previous chapter, the fractions of designated members under risk sharing for high-risks and risk sharing for high-costs (p) were calculated such that they yield the same proportion of shared expenditures. Next the risk sharing reimbursement after the assumed costs reductions were calculated. Given the reduction of the actual costs and the reduction of the risk sharing reimbursement, the insurer's portion of the efficiency gain was calculated via Equation (4.2).
The insurer's portion of the efficiency gain is the same under risk sharing for high-risks, risk sharing for high-costs and proportional risk sharing and equals one minus the proportion shared expenditures. Under outlier risk sharing the insurer's efficiency gain is smaller and therefore its incentives for efficiency are smaller. The reason is that under outlier risk sharing the costs above the threshold reduce by a larger percentage than the total costs. With the other forms of risk sharing, the same members remain designated and their costs reduce by the same percentage as the costs of non-designated members. Consequently, in these cases, the insurer's portion of the efficiency gain equals exactly one minus the proportion shared expenditures.

The conclusion is that, given a certain proportion shared expenditures, the four forms of risk sharing yield different incentives for efficiency. If an insurer can reduce the costs of each member by a certain percentage, its own portion of the efficiency gain is the same under risk sharing for high-risks, risk sharing for high-costs and proportional risk sharing and equals one minus the proportion shared expenditures. Under outlier risk sharing, the insurer's portion of the efficiency gain is smaller.

Under the assumption that all members stay with their insurer and that a discount factor can be neglected, the insurer's portion of the efficiency gain in the case of prior costs as an additional risk adjuster is[15]:

[15] Like previous studies the empirical analyses in the second part of the study are restricted to one-year prior costs with prior costs as a continuous variable as far as these costs are above

(4.3) IPEG = $(1-\Delta NC_{t+1}/\Delta AC_t)$,

where ΔNC_{t+1} is the change in the normative costs of the insurer for the next year. In comparison with Equation (4.2), the change in risk sharing reimbursement in the current year is replaced by the change in normative costs for the next year.

Weighted expenditures

Another way to measure incentives for efficiency is to assume that (some) incentives for efficiency are present as long as (a part of) the marginal expenditures for a member in a year are born by the insurer itself. As soon as it is certain that these marginal expenditures are fully shared between the insurer and the regulator, the insurer's incentives for efficiency with respect to the expenditures for this member in this year are zero.

Under proportional risk sharing, one minus the proportion shared expenditures then is a good indicator of an insurer's incentives for efficiency. It can be seen as a normalized weighted sum of an insurer's expenditures during the year. All expenditures are weighted with the weight on the normative costs.

Under the assumption that all members stay with their insurer and that a discount factor can be neglected, with prior cost as a continuous variable, the so-called weighted expenditures (WE) can be calculated as:

(4.4) WE = $(1-\beta)$,

where β is the coefficient of prior costs in the capitation formula.

Under risk sharing for high-risks, members are designated for risk sharing at the start of a year. Again, one minus the proportion shared expenditures is a good indicator of the insurer's incentives for efficiency. Here, it can be seen as a weighted sum of an insurer's expenditures in which the weight is zero for designated members and the weight is one for non-designated members.

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a certain threshold.

Under risk sharing for high-costs, the regulator specifies a certain fraction of members that may be designated. Given this fraction, an insurer can estimate a threshold amount such that the fraction of its members that will have costs above this threshold equals the fraction of members that it is allowed to designate. Risk sharing for high-costs with such an implicitly defined threshold yields similar incentives for efficiency as outlier risk sharing with the same threshold[16].

For a particular member the probability that he or she will be designated is higher as the (implicit) threshold amount is lower. This probability further depends on:

- The already incurred costs of the member.
- The medical problem of the member.
- The health status of the member before the medical problem occurred.
- The number of days until the end of the year.

The higher the already incurred costs, the more severe the medical problem, the worse the health status before the medical problem occurred, and the more days remain until the end of the year, the higher is the probability that the member will be designated in that year, thus the lower are the insurer's incentives for efficiency with respect to this member. However, the method below only needs the already incurred costs of a member, because we are interested in an insurer's *average* incentive per guilder that is spent below the threshold.

Suppose that an insurer divides expenditures below the threshold (T) into n cost intervals of length k (n=T/k). Then the insurer can calculate after each k guilders that are spent for a member, the probability that the total annual expenditures of this member will exceed the threshold given its already incurred costs:

(4.5) $P(AC>T \mid AC>i*k) = P(AC>T)/P(AC>i*k)$ for $i=0..n$.

[16] The insurer's incentives for efficiency can not be exactly the same because of the uncertainty about the exact threshold amount under risk sharing for high-costs. Nevertheless the method presented here will treat risk sharing for high-costs and outlier risk sharing the same.

One minus this probability is an indicator of the insurer's incentives for efficiency with respect to the next k guilders to be spent on this member during the rest of the year (IFE[i]). This gives a monotonic decreasing function that starts near one for the first cost interval (i=0) and ends with zero for costs above the threshold (i=n).

(4.6) IFE[i] = 1 − (P(AC>T)/P(AC>i*k)) for i=0..n.

The overall incentives for efficiency for the expenditures below the threshold can be seen as a weighted sum of the incentives for efficiency per cost interval. These are weighted with the probability that expenditures in the relevant interval occur. The weighted expenditures below the threshold (WEBT) can be estimated as:

(4.7) WEBT = ($\sum_{i=0}^{n-1}$[P(AC>i*k)−P(AC>T)] / $\sum_{i=0}^{n-1}$[P(AC>i*k)]).

The incentives for efficiency above the threshold are zero. So the total weighted expenditures (WE) can be calculated as the product of the weighted expenditures below the threshold and the percentage of the expenditures below the threshold.

(4.8) WE = WEBT*((E(AC|AC<T)*P(AC<T) + T*P(AC>T)) / E(AC)).

This so-called weighted expenditures measure is an indicator for the insurer's incentives for efficiency under outlier risk sharing ór risk sharing for high costs. It can vary between zero and one. The higher the weighted expenditures, the higher are the insurer's incentives for efficiency.
Under the assumption that the probability density function of health care expenditures consist of a combination of an alternative distribution (yes/no costs) and a lognormal distribution for those members with positive costs, Figure 4.1 gives an example of the insurer's incentives for efficiency per cost interval (IFE[i]). As previously, the mean costs equal Dfl. 2,000; the coefficient of variation equals four and the probability of positive costs equals 0.8.
In Figure 4.1 the threshold amount equals Dfl. 20,000 and it is assumed that the

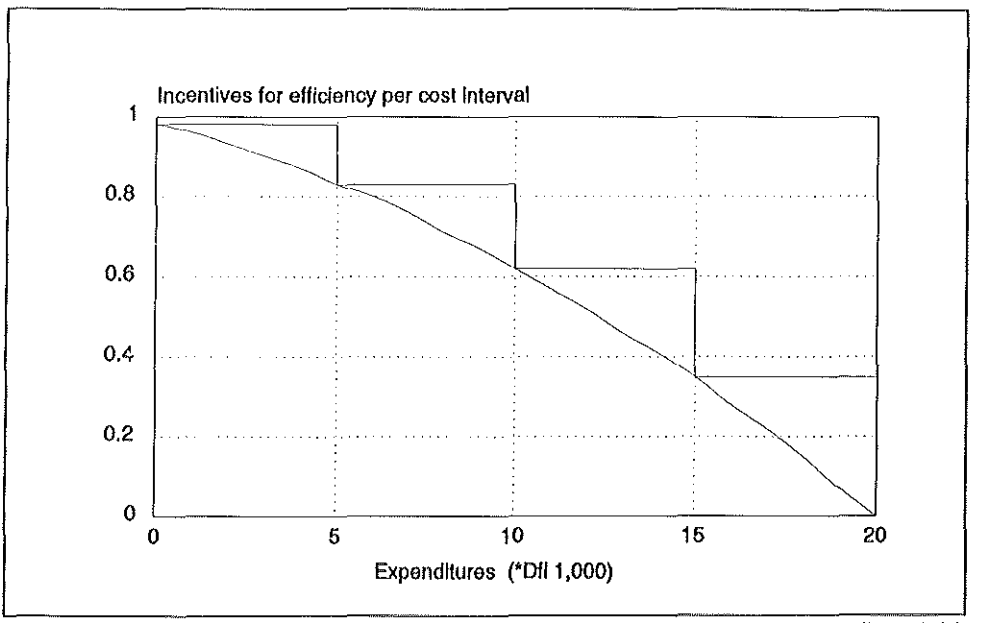

Figure 4.1 Incentives for efficiency per cost interval below the (implicit) threshold (T=Dfl. 20,000; k=Dfl. 5,000; and n=4)

insurer divides expenditures below the threshold into four cost intervals of length Dfl. 5,000. The figure shows that for the first Dfl. 5,000 to be spent on a member, the incentives for efficiency are nearly one. If a member's costs exceed Dfl. 5,000, the insurer recalculates its incentives for efficiency with respect to this member. Then, the incentives for efficiency for this member reduce to about 0.82. After the insurer has spent Dfl. 10,000 for a member, the insurer's incentives for efficiency are 0.62 and after Dfl. 15,000, these incentives are 0.35 only. At Dfl. 20,000 the incentives for efficiency with respect to this member reduce to zero.

With these incentives for efficiency per cost interval as weights, it can be calculated that the insurer's weighted expenditures equal 0.77. That is the insurer's incentives for efficiency are 77% of those under flat capitation payments.

An extreme case is that the insurer updates its incentives for efficiency with respect to a member only at the time the member exceeds the threshold. Then the insurer would retain its incentives for efficiency nearly at one until the

member's costs exceed the threshold. At that moment the insurer immediately lowers its incentives for efficiency with respect to this member to zero. It can be calculated that the weighted expenditures equal 0.81 in this case. This value is slightly lower than one minus the proportion shared expenditures under outlier risk sharing. The latter value is 0.83. The reason is that in the latter case, the expenditures below the threshold are weighted with weight one whereas in the first case the weight is a little smaller. Consequently one minus the proportion shared expenditures under outlier risk sharing yields an overestimation of an insurer's incentives for efficiency[17].
Another extreme case is that the insurer continuously updates its incentives for efficiency with respect to each member. For this situation, the resulting weights are also depicted in Figure 4.1. The application of these weights yields 0.65 for the weighted expenditures.

Table 4.2 presents these results for the weighted expenditures along with those for other values of the threshold and the length of the cost intervals.

Table 4.2. Weighted expenditures for different thresholds and different cost intervals

T \ k	↓0	1,000	5,000	10,000	20,000	40,000
40,000	0.80	0.83	0.87	0.89	0.90	0.90
20,000	0.65	0.71	0.77	0.79	0.81	n.a.
10,000	0.48	0.55	0.64	0.67	n.a.	n.a.
5,000	0.30	0.40	0.49	n.a.	n.a.	n.a.

T=(Implicit) threshold amount under outlier risk sharing ór risk sharing for high-costs.
k=Length of cost intervals below the threshold. Under the assumption of lognormally distributed individual annual health care expenditures and with E(AC)=Dfl. 2,000; cv=4; π=0.8 and ρ=0.3.

[17] One minus the proportion shared expenditures under outlier risk sharing equals 0.91, 0.83, 0.71, 0.57 for the thresholds Dfl. 40,000, Dfl. 20,000, Dfl. 10,000 and Dfl. 5,000 respectively.

It clearly shows that the higher the threshold and the larger the cost intervals, the higher are an insurer's incentives for efficiency. Of course the correct length of the cost intervals is unknown. Especially in the longer run, it is unlikely that the appropriate value is near the threshold amount. Consequently one minus the proportion shared expenditures under *outlier risk sharing* yields an overestimation. On the other hand infinitely small cost intervals are impossible in practice. Therefore the left column yields an underestimation of the insurer's incentives for efficiency. It can be shown that the values in the left column equal one minus the proportion shared expenditures under risk sharing for high-costs with an implicit threshold T (see appendix). Thus one minus the proportion shared expenditures under *risk sharing for high-costs* yields an underestimation of the insurer's incentives for efficiency.

An appropriate value for the length of the cost intervals could be the average price of a one-night stay in a hospital. In the Netherlands this price is about Dfl. 1,000. Therefore Table 4.2 also presents the total weighted expenditures for this length of the cost intervals.

With prior costs as a risk adjuster and measured as a continuous variable as far as these costs are above a certain threshold (T), the situation resembles that of outlier risk sharing and risk sharing for high-costs. For expenditures above the threshold, the insurer's incentives for efficiency are one minus the relevant coefficient (β_T) in the capitation formula. For expenditures below the threshold, the insurer's incentives for efficiency are initially nearly one and then gradually decrease towards the value one minus β_T.

Summarizing this subsection proposed two overall indicators for an insurer's incentives for efficiency: the insurer's portion of overall efficiency gains and the insurer's weighted expenditures.

4.3.2 Specific indicators

The efficiency improving activities of an insurer might be different for different types of care within the specified benefits package or for different subgroups of insureds. Thus it is interesting to measure an insurer's incentives for efficiency

with respect to various types of care and various subgroups. This can be done by calculating the insurer's portion of certain efficiency gains.

Uniform proportional savings for specific types of care
In the case of a reduction of *hospital costs*, the more hospital costs are shared, the smaller will be the insurer's portion of the efficiency gain. It can be expected that given a certain proportion shared expenditures, more hospital costs are shared in the case of risk sharing for high-costs or outlier risk sharing than in the case of risk sharing for high-risks. Therefore given a certain proportion shared expenditures, the insurer's portion of the efficiency gain can be expected to be larger in the latter case.
In an extreme case of risk sharing for high-risks, say with 10% designated members, the savings on members with unpredictable hospital admissions can still be seen in the financial result of the insurer and therefore the insurer's portion of the efficiency gain will not be zero. However, in an extreme case of risk sharing for high-costs, say with 10% designated members, or an extreme case of outlier risk sharing, say with a threshold of Dfl. 5,000, virtually none of such savings can be seen in the financial result of the insurer and therefore the insurer's portion of the efficiency gain will be near zero.

In the case of a cost reduction for *physical therapy*, given a certain proportion shared expenditures, more of these costs can be expected to be shared in the case of risk sharing for high-risks than in the case of risk sharing for high-costs or outlier risk sharing. Therefore the insurer's portion of the efficiency gain for this type of care can be expected to be larger in the latter cases. Even with the extreme cases mentioned above it is unlikely that the insurer's portion of the efficiency gain will be near zero. With and without the cost reduction, a substantial part of these costs will not be shared.

A uniform proportional reduction of the *hospital costs* of each member seems a relevant assumption if the length of stay can be reduced by about the same percentage for each admission. However, the literature suggests that health maintenance organizations not only have lower hospital costs because they are able to reduce length of stay but also because they have lower admission rates,

suggesting non-uniform proportional reductions of the hospital costs (Siu et al., 1988; Miller and Luft, 1994). Tools that may contribute to this are preadmission certification, mandatory second opinion and practice guidelines. An insurer's incentives to use such tools to avoid discretionary hospitalizations will be analyzed separately.

Avoiding discretionary hospital admissions
In the case of avoiding discretionary hospital admissions, given a certain proportion shared expenditures, it is hard to predict whether the insurer's portion of the efficiency gain will be largest in the case of risk sharing for high-risks, risk sharing for high-costs ór outlier risk sharing. In cases that are not too extreme, it can be expected that the insurer's portion of the efficiency gain will be relatively high. The reason is that discretionary hospital admissions are unlikely to be very predictable and/or expensive.

Non-uniform proportional savings for hospital care as well as for other types of care could also be achieved if managed care activities of an insurer focus on specific groups of members. Enthoven and Singer (1996) as well as Armstrong (1997) gave examples of successfully applied disease management and (high-cost) case management principles.

Uniform proportional savings for specific subgroups of members
The insurer's portion of the efficiency gain depends on the costs of the designated members within such a group, with and without the savings. If all members of the group are designated in both situations, the insurer's portion of the efficiency gain will be zero. This could well be the case for renal disease patients. Given a certain proportion shared expenditures, it is hard to predict whether the measure will be largest in the case of risk sharing for high-risks, risk sharing for high-costs ór outlier risk sharing. In the extreme cases mentioned above, the insurer's portion of the efficiency gain will be near zero for members with chronic (high-cost) conditions. For members with acute (high-cost) conditions, the measure might be relatively high in the case of risk sharing for high-risks whereas under risk sharing for high-costs ór outlier risk sharing, it might be near zero.

4.4 Conclusions

Under flat capitation payments as well as under demographic capitation payments, an insurer keeps the entire revenue of its cost reducing activities itself. In that case an insurer's incentives for efficiency are as great as possible. Introducing risk sharing reduces an insurer's incentives for efficiency. The same holds if prior costs are included as a risk adjuster in the capitation formula. In both cases a selection-efficiency tradeoff takes place. Previous studies hardly quantified an insurer's incentives for efficiency under risk sharing or under capitation payments that are partly based on prior costs. This chapter developed indicators of (the reduction of) an insurer's incentives for efficiency for these situations. This is a necessary step before the selection-efficiency tradeoff can be optimized.

Section 4.1 showed that an insurer can use several tools to improve the efficiency of care such as: utilization management, disease management, (high-cost) case management, selective contracting with providers, financial incentives, negotiating lower fees and offering different insurance modalities. The application of (combinations of) several tools might focus on: all expenditures within the specified benefits package or expenditures for specific types of care. It may also focus on specific groups of members.

Section 4.2 focused on potential savings that could be achieved when insurers apply tools for improving efficiency. Evidence from the United States with various forms of managed care shows that this may improve efficiency compared with indemnity insurance. For instance, in California, the adoption of managed care and managed competition has led to a broad decline in health care costs to employment groups, which was followed by premium reductions of up to 10 percent.
Introducing a utilization review program for hospital care has reduced inpatient expenses by 8.1 percent and overall medical expenses by 4.4 percent.
Furthermore, there are several examples of successfully applied disease management or case management principles, for instance a 39 percent reduction of the costs for patients with congestive heart failure and costs savings of 15-35

percent for diabetics.

Section 4.3 addressed the measurement of an insurer's incentives for efficiency. Two methods have been proposed to analyze these incentives. The first method focuses on the portion of the efficiency gain that will be kept by the insurer itself.
If, ceteris paribus, an insurer can reduce certain costs, its actual costs and - most likely - its risk sharing reimbursement will be lower. Therefore the efficiency gain can be split into a portion that is kept by the insurer and a portion that is taken by the regulator. The higher the insurer's portion of the efficiency gain, the higher are its incentives to employ efficiency improving activities. The insurer's portion of the efficiency gain can be calculated under various assumptions with respect to costs savings that it could achieve: overall savings, savings for specific types of care and savings for specific groups of members.

The second method yields an overall indicator for incentives for efficiency only. It assumes that (some) incentives for efficiency are present as long as (a part of) the marginal expenditures for a member in a year are born by the insurer itself. As soon as it is certain that these marginal expenditures are fully shared between the insurer and the regulator, the insurer's incentives for efficiency with respect to the expenditures of this member in this year are zero.
Under this assumption one minus the proportion shared expenditures is a good indicator of incentives for efficiency under proportional risk sharing and under risk sharing for high-risks. It can be seen as a normalized weighted sum of the insurer's expenditures during the year.
Under outlier risk sharing and under risk sharing for high-costs, the regulator specifies a threshold and a fraction of members that may be designated respectively. For an insurer, the fraction of designated members under risk sharing for high-costs implicitly defines, with some uncertainty about the exact value, a threshold amount. For expenditures above the threshold, the insurer's incentives for efficiency are zero and for expenditures below the threshold, the insurer's incentives for efficiency are lower than one. Suppose that an insurer divides its expenditures below the threshold into n cost intervals of length k. Then, the

insurer can calculate the probability that the annual expenditures of a member will exceed the threshold, given its already incurred costs. Subsequently, one minus this probability is an indicator of the insurer's incentives for efficiency per cost interval. The insurer's overall incentives for efficiency can be seen as a weighted sum of the incentives for efficiency per cost interval. These are weighted with the probability that expenditures in the relevant interval occur. The resulting weighted expenditures measure is an overall indicator of the insurer's incentives for efficiency under outlier risk sharing and risk sharing for high-costs.
If an insurer uses one cost interval below the threshold only, the weighted expenditures will be lower than one minus the proportion shared expenditures under outlier risk sharing with this threshold. Thus the latter value yields an overestimation of the insurer's incentives for efficiency. Furthermore it has been shown that if the length of the cost intervals below the threshold is infinitely small, the weighted expenditures yield a value of one minus the proportion shared expenditures under risk sharing for high-costs with this implicit threshold. Thus one minus the proportion shared expenditures under risk sharing for high-costs yields an underestimation of the insurer's incentives for efficiency.
It has been shown that, if an insurer quickly recalculates its incentives for efficiency with respect to a member after some expenditures have occurred, the weighted expenditures give similar results as the insurer's portion of an overall efficiency gain.

Section 4.3 showed that the insurer's portion of the efficiency gain as well as the insurer's weighted expenditures can be calculated if (high) prior costs is used as an additional risk adjuster. In this situation it is assumed that all members stay with their insurer and that a discount factor can be neglected.

Besides the tools for improving efficiency and the potential gross benefits of improving efficiency for an insurer, its efficiency improving activities might also be influenced by other factors such as: its working area and market share; the level of competition in the health insurance market and in the market for health care provision; and the role of employers. These factors may alter the

potential gross benefits of efficiency improving activities for an individual insurer as well as the costs of these activities.

Appendix chapter 4

Under risk sharing for high-costs and outlier risk sharing, the weighted expenditures (WE) measure is a function of the (implicit) threshold (T) and the length of the cost-intervals that the insurer distinguishes below the threshold (k). Under the assumption that an insurer continuously updates its incentives for efficiency with respect to individual members ($k \downarrow 0$), it has been claimed that the weighted expenditures equals one minus the proportion shared expenditures under risk sharing for high-costs with an implicit threshold T. This claim is proved below.

Proposition 4.1:
For any continuous probability density function of health care expenditures (Y), the limit of $k \downarrow 0$ {WE(T;k)} is one minus the proportion shared expenditures under risk sharing for high-costs with an implicit threshold T.

Proof:

$$\lim_{k \downarrow 0} WE(T;k) = \lim_{k \downarrow 0} \frac{\sum_{i=0}^{n-1} (P(Y>i*k) - P(Y>T))}{\sum_{i=0}^{n-1} P(Y>i*k)} = \frac{\int_0^T (P(Y>t) - P(Y>T))dy}{\int_0^T P(Y>T)dy}$$

Which by definition and via partial integration equals:

$$\frac{\int_0^T (F(T) - F(y))dy}{\int_0^T (1 - F(y))dy} = \frac{y*[F(T) - F(y)]_0^T - \int_0^T y*(-f(y))dy}{y*[1 - F(y)]_0^T - \int_0^T y*(-f(y))dy}$$

Which is equivalent with:

$$\frac{\int_0^T y*f(y)dy}{T*(1-F(T))-\int_0^T y*f(y)dy} = \frac{E(y|y<T)*F(T)}{T*(1-F(T)+E(y|y<T)*F(T)}$$

The costs below the threshold (T) expressed as a percentage of the total costs can be written as:

$$\frac{E(y|y<T)*F(T)+T*(1-F(T)}{E(y)}$$

By multiplying the last two formulae one gets:

$$\lim_{k\downarrow 0} WE(T;k) = \frac{E(y|y<T)*F(T)}{E(y)} = \frac{E(y)-E(y|y>T)*(1-F(T)}{E(y)}$$

This gives us:

$$\lim_{k\downarrow 0} WE(T;k) = 1 - \frac{E(y|y>T)*(1-F(T))}{E(y)}$$

which completes the proof.

5. Optimizing the tradeoff

The purpose of this chapter is to develop a systematic method for optimizing the tradeoff between selection and efficiency. The previous chapters described four forms of risk sharing and two variants of prior costs as a risk adjuster. Indicators of an insurer's incentives for selection and efficiency were also developed. Section 5.1 describes the decision problem of the regulator (Van Barneveld et al., 1999b). This section introduces some terminology and is restricted to a linear blend of flat capitation payments and full cost reimbursement. Thus, it considers the most simple capitation formula supplemented with the most simple form of risk sharing (i.e. proportional risk sharing). Section 5.2 extends the framework by including the possibility that the regulator employs a better capitation formula then flat capitation payments, but is still restricted to proportional risk sharing. Optimal proportional risk sharing variants will be derived analytically. Section 5.3 presents the conclusions.

5.1 The decision problem

This section addresses the following issues: feasible payment systems, the regulator's objective function with respect to these payment systems, the regulator's decision problem if it is restricted to a linear blend of flat capitation payments and full cost reimbursement, the optimal solution of the decision problem and a graphical illustration.

Feasible payment systems

Any payment system can be represented by a point $(x_1; y_1)$, where x_1 represents the reduction of an insurer's incentives for selection relative to the situation of flat capitation payments and y_1 represents an insurer's incentives for efficiency relative to the situation of flat capitation payments. If both coordinates are expressed as a fraction, they can vary between zero and one. The point (0; 1) represents flat capitation payments, i.e. the incentives for selection are not reduced in comparison with flat capitation payments and the incentives for

efficiency are fully retained in comparison with flat capitation payments. The point (1; 0) represents full cost reimbursement, i.e. the incentives for selection are fully removed in comparison with flat capitation payments and the incentives for efficiency are also fully removed. The point (1; 1) represents the perfect capitation formula: the incentives for selection are fully removed in comparison with flat capitation payments and the incentives for efficiency are fully retained in comparison with flat capitation payments. In Figure 5.1, point A represents flat capitation payments; and point B represents full cost reimbursement.

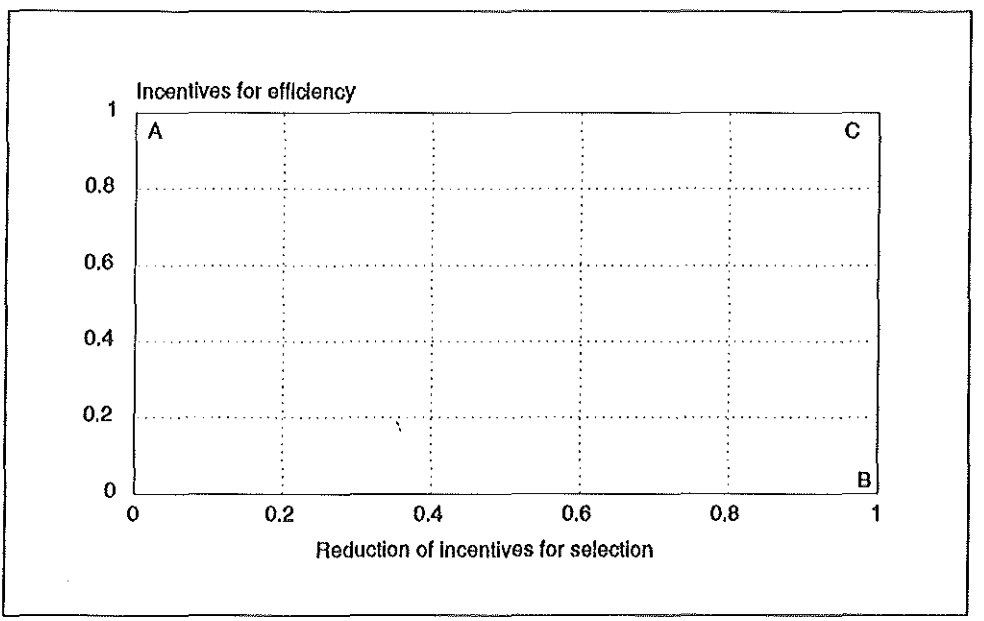

Figure 5.1 Flat capitation payments (A); Full cost reimbursement (B) and the perfect capitation formula (C)

Point C represents the perfect capitation formula. There is a growing consensus in the literature that this point may never be reached in practice. Some countries are trying to move from full cost reimbursement (B) into the direction of the perfect capitation formula (C) whereas others are trying to move from flat capitation payments (A) into the direction of C. That is, some countries are

trying to increase the insurers' incentives for efficiency while keeping their incentives for selection as low as possible (e.g. Belgium and the Netherlands). Other countries are trying to decrease the insurer's incentives for selection while keeping their incentives for efficiency as high as possible (e.g. Switzerland and the United States (Medicare)).
The line AB represents a possible linear blends of flat capitation payments and full cost reimbursement (i.e. all possible variants of proportional risk sharing). For example, if proportional risk sharing with a weight of 0.4 on actual costs ($a=0.4$) is employed as a supplement to flat capitation payments, the payment system is represented by the point (0.4; 0.6). The line AB satifies the following equation: $x+y=1$. How the regulator values different variants of proportional risk sharing depends on its objectives.

Objective function
Because this study assumes that the regulator intends to reduce an insurer's incentives for selection as much as possible while retaining its incentives for efficiency as much as possible, the preferences of the regulator satisfy the condition of strong monotonicity[18]. Formally, the condition of strong monotonicity is:

(5.1) If $A \geq B$ and $A \neq B$, then $A \succ B$.

In this condition, A and B both represent some payment system and are not necessarily equal to those in Figure 5.1. The condition states that if payment system A reduces the incentives for selection more than payment system B while it retains the same or even more incentives for efficiency, then the regulator prefers A above B. Similarly, if A retains more incentives for efficiency than B while the incentives for selection are the same or even less, than A is preferred above B. Given this assumption, it is clear that point C in

[18] It is also assumed that the preferences of the regulator with respect to different payments systems satisfy the usual assumptions with respect to preferences in micro-economic analysis: completeness, reflexivity, transitivity and continuity. Given these assumptions the preferences of the regulator with respect to different payment systems can be represented by some utility function (Varian, 1984).

Figure 5.1 is the optimal point for the regulator. That is why C is called the perfect capitation formula. The assumption of strong monotonicity is likely to be satisfied if considerations of validity, reliability, manipulation and feasibility are not included in the analysis (see chapter two).
It is further assumed that the preferences of the regulator satisfy the condition of convexity. Formally, this condition is stated as:

(5.2) Given $A \neq B$ and $A \neq C$, if $A \succeq C$ and $B \succeq C$, then $t*A+(1-t)*B \succeq C$
$\forall\ 0<t<1$.

In condition (5.2), A, B and C all are some payment systems and not necessarily equal to those in Figure 5.1. The condition states that, if two payment systems A and B are preferred above a third payment system C, then all linear combinations of A and B are preferred above C. The assumption of convexity implies diminishing marginal rates of substitution given a certain level of the regulator's utility function. The marginal rate of substitution of x (instead of y) is defined as:

(5.3) $MRS = -(\delta y/\delta x)$.

In our application the marginal rate of substitution is the number of percentage points of incentives for efficiency that the regulator is willing to give up in order to obtain one extra percentage point reduction of incentives for selection. It seems likely that the preferences of the regulator satisfy diminishing marginal rates of substitution. As a result of the condition of convexity, any payment system that is represented by a point below the line AB can be ignored in the analysis, because such a payment system can be improved upon by employing a linear blend of flat capitation payments and full cost reimbursement. Therefore, the analysis is restricted to points $(x_1; y_1)$ that satisfy the following conditions:

(5.4) $0 \leq x_1 \leq 1$; $0 \leq y_1 \leq 1$; $x_1+y_1 \geq 1$; ($x_1 < 1$ ór $y_1 < 1$).

In Figure 5.1 these conditions state that only those payment systems that lie in the triangle ABC are of interest and that the payment systems are not identical

to the perfect capitation formula (C).

A well known utility function that satisfies both strong monotonicity and convexity is the CES-function (Constant Elasticity of Substitution).

(5.5) $U(x;y) = (b*x^c+(1-b)*y^c)^{1/c}$, where $0<b<1$; $-\infty<c<1$.

Taking the limit of c to zero yields a special case of this function: the Cobb-Douglas function, which equals (Varian, 1984):

(5.6) $U(x;y) = x^{b}*y^{1-b}$, where $0<b<1$.

For the purpose of this study, the Cobb-Douglas function is not too restrictive and appears to be convenient in the analysis. Therefore this study assumes that the regulator specifies its preferences via a Cobb-Douglas function. In particular, it is up to the regulator to provide the weight on reducing incentives for selection (b). It is assumed that this weight is chosen between zero and one. If it would be zero, the optimal payment system would be flat capitation payments; if it would be one, the optimal payment system would be full cost reimbursement.

The marginal rate of substitution in a Cobb-Douglas function is given by[19]:

(5.7) $MRS = -(\delta y/\delta x) = [\delta u/\delta x]/[\delta u/\delta y] = [b*x^{b-1}*y^{1-b}]/[(1-b)*x^{b}*y^{-b}] =$

$b/(1-b) * (y/x)$.

The factor $b/(1-b)$ indicates that given a relatively 'low' weight on reducing incentives for selection, the regulator is willing to give up little incentives for efficiency in order to obtain a (further) reduction of incentives for selection. A relatively 'high' weight on reducing incentives for selection means that the regulator is willing to give up many incentives for efficiency in order to obtain

[19] The second equation sign follows from: $\delta u=(\delta u/\delta x)*\delta x+(\delta u/\delta y)*\delta y=0$.

a (further) reduction of incentives for selection. This effect is depicted graphically in Figure 5.2 and 5.3 respectively where the weight on reducing incentives for selection is set equal to 0.25 and 0.75 respectively.

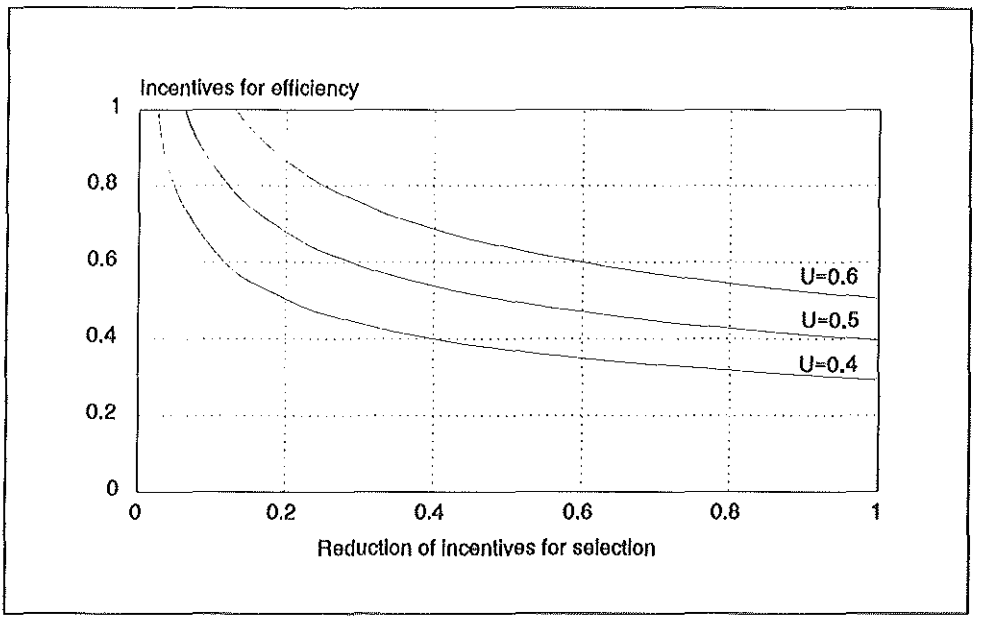

Figure 5.2 Three indifference curves of the utility function with b=0.25

Figure 5.2 shows that for the point (0.4; 0.55), the value of the utility function is 0.5. Suppose the regulator wants to achieve a reduction of the incentives for selection from 0.4 to 0.6 while retaining the same level of utility. Then the Figure shows that the regulator is willing to give up about 0.1 of the incentives for efficiency because the point (0.6; 0.45) also has a utility of 0.5. The marginal rate of substitution on the indifference curve $u_0=0.5$ in the point $x=0.4$ is about 0.5
$(=-(-10/20))$[20].
Figure 5.3 shows three indifference curves of the utility function where the

[20] More formally, given b and u_0, the marginal rate of substitution equals minus the derivative of the indifference curve $y=(u_0/x^b)^{1/(1-b)}$.

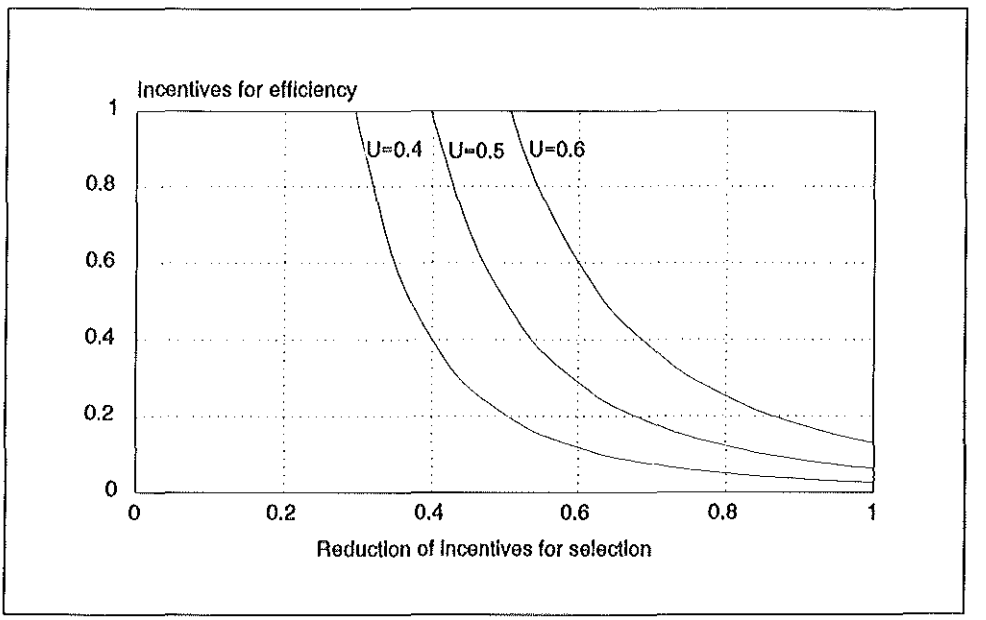

Figure 5.3 Three indifference curves of the utility function with b=0.75

weight on reducing incentives for selection is 0.75. It can be seen that the point (0.4; 1) yields a utility of 0.5. If, in this situation, the regulator wants to achieve a reduction of the incentives for selection from 0.4 to 0.6 while retaining the same level of utility, it is willing to give up about 0.7 of the incentives for efficiency. The marginal rate of substitution on the indifference curve $u_0=0.5$ in the point (0.4; 1) can be estimated to be 3.5 ($= -(-70)/20$). Thus, given the increase of the weight on reducing incentives for selection from 0.25 to 0.75, the marginal rate of substitution is higher and consequently the regulator is willing to give up more incentives for efficiency in order to obtain the same reduction in incentives for selection. Together Figure 5.2 and 5.3 show that the regulator's choice of the weight on reducing incentives for selection plays a crucial role when it wants to optimize the tradeoff between selection and efficiency.

Model

If the analysis is restricted to a linear blend of flat capitation payments and full

cost reimbursement, the line AB represents the available payment systems for the regulator. Assuming that the regulator makes a rational choice, its decision problem becomes:

(5.8) Maximize $U(x;y)=x^{b}*y^{1-b}$

Subject to $x+y=1$.

This problem can be solved by solving the first order condition[21].

(5.9) $\delta u/\delta y = \delta\{(1-y)^{b}*y^{1-b}\}/\delta y$

$\delta u/\delta y=0 \Leftrightarrow \delta \log[u]/\delta y = 0 \Leftrightarrow$

$\delta\{b*\log[1-y]+(1-b)*\log[y]\}/\delta y=0 \Leftrightarrow$

$-(b/(1-y)) + ((1-b)/y) = 0 \Leftrightarrow$

$y^{*}=1-b.$

Solution
The optimal solution $(x^{*}; y^{*})$ for this decision problem equals:

(5.10) $x^{*}=b;\ y^{*}=1-b.$

The optimal weight on actual costs (a^{*}) equals b.

(5.11) $a^{*} = b.$

Intuitively the more priority is given to the reduction of incentives for selection, the higher should be the weight on actual costs.

[21] Throughout this chapter the utility function is convex and the constraints are linear. Thus the second order condition for a maximum is satisfied in all cases.

Graphical illustration

Suppose that the regulator chooses the weight on reducing incentives for selection to be 0.5, then its utility function is:

(5.12) $U(x;y)=\sqrt{(x)}*\sqrt{(y)}$.

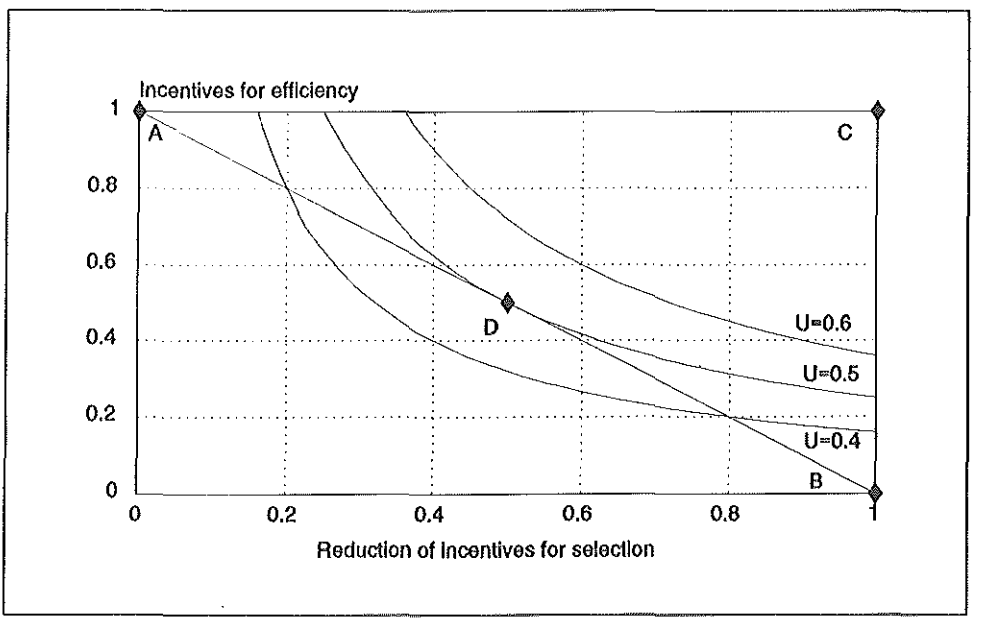

Figure 5.4 Optimal blend of flat capitation payments and full cost reimbursement (D) with b=0.5.

Thus, the utility of flat capitation payments as well as the utility of full cost reimbursement is zero and the perfect capitation formula has a utility of one[22]. Figure 5.4 shows three indifference curves of this utility function. It can be seen that proportional risk sharing may increase the regulator's utility in comparison with either flat capitation payments or full cost reimbursement. For instance a weight of 0.2 ór a weight of 0.8 on actual costs yields a utility value

[22] U(0; 1)=U(1; 0)=0; U(1; 1)=1.

of 0.4[23]. The optimal weight on actual costs equals 0.5 (Equation 5.11). The optimal point is (0.5; 0.5) which is labelled D (Equation 5.10). The maximum attainable value of the utility function is 0.5 (Equation 5.12).

Conclusion

Any payment system can be characterized via two indicators: one for the reduction of an insurer's incentives for selection relative to the situation of flat capitation payments (x) and one for its incentives for efficiency relative to the situation of flat capitation payments (y). If both coordinates are expressed as fractions, they can vary between zero and one. Then the point (0; 1) represents flat capitation payments; the point (1; 0) represents full cost reimbursement; and the point (1; 1) represents the perfect capitation formula.

Given some reasonable assumptions, a Cobb-Douglas function can be used to describe the regulator's preferences with respect to available payment systems: $U(x;y)=x^{b}*y^{1-b}$. The weight on reducing incentives for selection (b) has to be specified by the regulator. It is assumed that the regulator chooses this weight between zero and one. If it is zero, the optimal payment system is flat capitation payments; if it is one, the optimal payment system is full cost reimbursement.

A Cobb-Douglas function implies strong monotonicity. This reflects the assumption that the regulator intends to reduce an insurer's incentives for selection as much as possible while retaining its incentives for efficiency as much as possible. Given this assumption it is clear why the point (1; 1) is called the perfect capitation formula.

Furthermore a Cobb-Douglas function implies diminishing marginal rates of substitution. That is the more the incentives for selection are already reduced, the less incentives for efficiency the regulator is willing to give up in order to obtain a further reduction of incentives for selection. The higher the weight on reducing incentives for selection, the higher is the marginal rate of substitution. That is the higher the weight on reducing incentives for selection, the more incentives for efficiency the regulator is willing to give up in order to obtain a reduction of incentives for selection.

If the regulator is restricted to a linear blend of flat capitation payments and full

[23] U(0.2; 0.8)=U(0.8; 0.2)=0.4.

cost reimbursement, the optimal weight on actual costs equals the weight on reducing incentives for selection.

5.2 Optimal proportional risk sharing variants

It is likely that the regulator first tries to improve the capitation payments before introducing any form of risk sharing. For instance, the regulator may employ demographic capitation payments instead of flat capitation payments. This section derives optimal proportional risk sharing variants as a supplement to any capitation formula (Van Barneveld et al., 1999b).
Section 5.2.1 considers capitation payments that are independent of prior costs. Globally speaking such capitation payments do not reduce an insurer's incentives for efficiency relative to the situation of flat capitation payments. Therefore in section 5.2.1, the capitation formula can be represented by a point A' that lies on the line AC (see Figure 5.1).
Section 5.2.2 considers capitation payments that are partly based on prior costs. Such capitation payments will reduce an insurer's incentives for efficiency relative to the situation of flat capitation payments. Consequently, such capitation formulae can be represented by a point A' that lies below the line AC.
In both sections the line A'B represents all variants of proportional risk sharing that could be used as a supplement to the capitation payments. If A' has coordinates $(x_1;y_1)$, the line A'B is given by the following equation:
$x+((1-x_1)/y_1)*y=1$. Subsequently the regulator chooses the variant of proportional risk sharing that maximizes its utility function.

5.2.1 Capitation payments independent of prior costs

In this situation, the model becomes:

(5.13) Maximize $U(x;y)=x^{b}*y^{1-b}$

Subject to: $x = 1 - (1-x_1)*y$.

The first-order condition is:

(5.14) $\delta \log[u]/\delta y = 0 \Leftrightarrow$

$$\delta\{b*\log[1 - (1-x_1)*y] + (1-b)*\log[y]\}/\delta y = 0 \Leftrightarrow$$

$$-((1-x_1)*b) / (1 - (1-x_1)*y) + (1-b)/y = 0 \Leftrightarrow$$

$$y^* = (1-b)/(1-x_1).$$

The optimal solution is:

(5.15) $x^* = b;\ y^* = (1-b)/(1-x_1)$

Because we are looking on the line between $(x_1;\ 1)$ and $(1;\ 0)$, this optimal solution has to satisfy the condition:

(5.16) $x^* > x_1$.

Therefore this solution is only valid in the case that $b > x_1$.

Define a^* as the optimal weight on full cost reimbursement in this situation. Then a^* can be written as:

(5.17) $a^* = (b-x_1)/(1-x_1)$.

In the case that $b < x_1$, it is optimal to employ the capitation formula only, because along the line A'B, U(x;y) then is a decreasing function in x (see appendix).

Graphical illustration

Figure 5.5 provides a graphical illustration given demographic capitation payments and given that the weight on reducing incentives for selection is 0.5.

It is assumed that demographic capitation payments yield A' is (0.15; 1)[24]. The optimal point (0.5; 0.588) is labelled D (Equation 5.15). The optimal weight on actual costs equals 0.41 (Equation 5.17). The maximum value of the utility function is 0.54 (Equation 5.13).

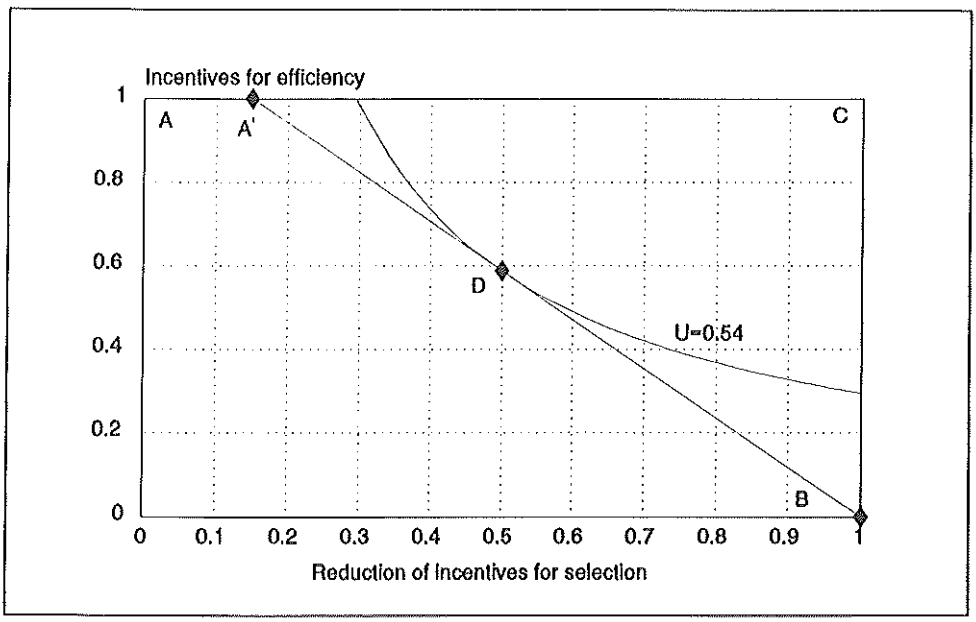

Figure 5.5 Optimal blend of demographic capitation payments and full cost reimbursement (D) with b=0.5.

Numerical examples

Table 5.1 presents numerical examples for three different capitation formulae and for three different weights on reducing incentives for selection. The capitation formulae represent flat capitation payments, a demographic model and an improved model respectively. The improved model represents a capitation formula that is partly based on diagnostic cost groups (see chapter two). It is

[24] This assumption is based on the R^2-value for demographic capitation formulae found in previous studies together with the theoretical analysis presented in the appendix of chapter two.

assumed that the point A' equals (0; 1); (0.15; 1) and (0.25; 1) respectively[25].

Table 5.1 Optimal weights in a blend of capitation payments and full cost reimbursement for three capitation formulae and three weights on reducing incentives for selection

	b=0.25			b=0.5			b=0.75		
	U	a^*	U^*	U	a^*	U^*	U	a^*	U^*
Capitation formula									
Flat	0	0.25	0.57	0	0.5	0.5	0	0.75	0.57
Demographic	0.62	0.12	0.64	0.39	0.41	0.54	0.24	0.71	0.59
Improved	0.71	0	0.71	0.50	0.33	0.57	0.35	0.67	0.61

b is the parameter in the regulator's utility function $U(x;y)=x^b*y^{1-b}$.
U is the utility of employing the capitation formula only.
a^* is the optimal weight on actual costs in the blend of the capitation formula and full cost reimbursement.
U^* is the value of the utility function when using the optimal blend.

The Table provides a clear illustration of the following points:
(1) An improvement of the capitation formula reduces the need for risk sharing. Suppose the regulator chooses the weight on reducing incentives for selection as 0.5. Then, under flat capitation payments, the maximum value of the utility function equals 0.5 and the optimal weight on actual costs equals 0.5. For the demographic model, the maximum value of the utility function is 0.54 and the optimal weight on actual costs is 0.41 only. Thus the regulator's utility is higher while the weight on actual costs is lower. This implies that given a demographic capitation formula, a utility level of 0.5 can be reached with an even lower

[25] The assumed reductions of the incentives for selection are based on the R^2-values that were found for such capitation formulae in previous studies together with the theoretical analysis presented in the appendix of chapter two.

weight on actual costs than 0.41. Consequently, given an improvement of the capitation formula, the extent of risk sharing can be reduced without lowering the regulator's utility.

(2) Whether the demographic model supplemented with proportional risk sharing is preferred above the improved model without risk sharing, depends on the weight on reducing incentives for selection.
If this weight is 0.25, the improved model yields a utility of 0.71 which is higher than the maximum utility of the demographic model supplemented with proportional risk sharing ($U^*=0.64$). However, if the weight on reducing incentives for selection is 0.5 or 0.75, the improved model yields a lower utility value than the demographic model supplemented with proportional risk sharing (0.5 versus 0.54 and 0.35 versus 0.59).
The regulator is indifferent between both systems if the weight on reducing incentives for selection is about 0.43. This can be shown by solving the equation:

(5.18) $b^b*[(1/0.85)*(1-b)]^{1-b} = 0.25^b$

The left-hand side of the equation is the utility of the demographic model supplemented with proportional risk sharing (if $b>0.15$) and the right-hand side is the utility of the improved model without risk sharing.

5.2.2 Capitation payments partly based on prior costs

The regulator may include a risk adjuster based on prior costs in its capitation formula. Such a capitation formula implies a reduction of an insurer's incentives for efficiency relative to the situation of flat capitation payments. Three situations can be distinguished (see Figure 5.6):
(1) The optimal point is found on the line A'B. In this situation, the optimal point is a blend of the capitation formula and full cost reimbursement (i.e. proportional risk sharing).
(2) The optimal point is found on the line AA'. In this situation, the optimal point is a blend of flat capitation payments and the capitation formula.
(3) The optimal point is A'. In this situation, it is optimal to employ no blend at

all.

Figure 5.6 gives an example of the place of the point A' if the capitation formula is partly based on prior costs. In the Figure, A' is (0.4; 0.7). This represents the prior cost model as discussed in chapter two[26].

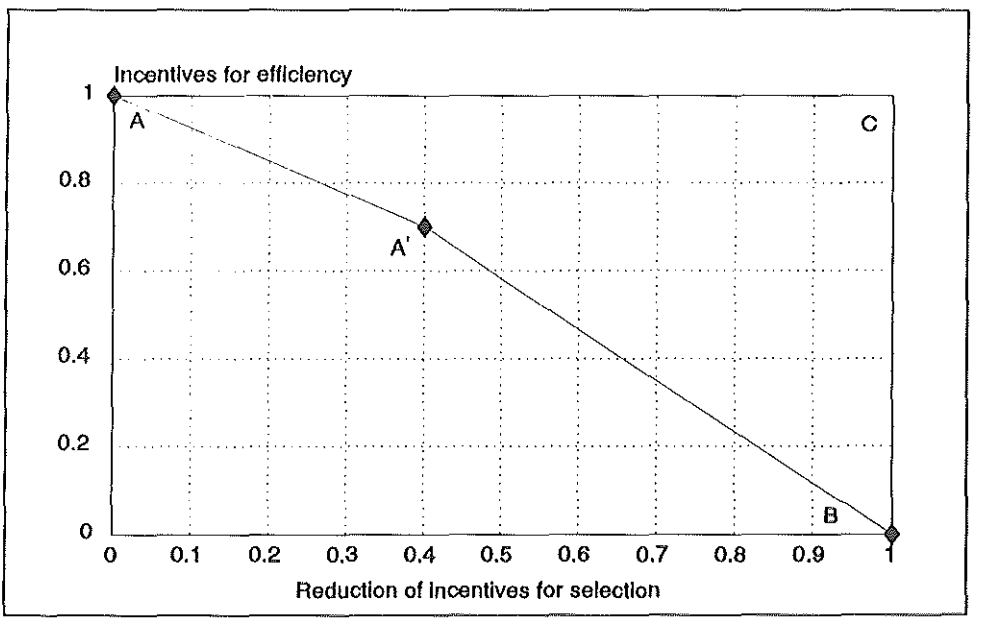

Figure 5.6 Potential place of the prior cost model (A')

In the first situation, the model becomes:

(5.19) Maximize $U(x;y)=x^{b}*y^{1-b}$

Subject to: $x = 1 - ((1-x_1)/y_1)*y$.

[26] The assumed reduction of incentives for selection is based on the R^2-values in previous studies for a capitation formula that is partly based on prior costs and the theoretical analysis presented in the appendix of chapter two. The assumed reduction of incentives for efficiency is based on Van Vliet and Ven (1993). They found an estimated coefficient of 0.3 for prior costs in a capitation formula based on demographic variables and prior costs.

The first-order condition is:

(5.20) $\delta\log[u]/\delta y = 0 \Leftrightarrow$

$\delta\{b*\log[1 - ((1-x_1)/y_1)*y] + (1-b)*\log[y]\}/\delta y = 0 \Leftrightarrow$

$-(((1-x_1)/y_1)*b) / (1 - ((1-x_1)/y_1)*y) + (1-b)/y = 0 \Leftrightarrow$

$y^* = (y_1/(1-x_1))*(1-b).$

The optimal solution is:

(5.21) $x^* = b;\ y^* = y_1 * (1-b) / (1-x_1)$

Because we are looking on the line between $(x_1;\ y_1)$ and $(1;\ 0)$, this optimal solution has to satisfy the conditions:

(5.22) $x^* > x_1;\ y^* < y_1.$

Therefore, this solution is only valid in the case that $b > x_1$.

Define a^* as the optimal weight on full cost reimbursement in this situation. Then a^* can be written as:

(5.23) $a^* = (b-x_1)/(1-x_1).$

In the second situation, the model becomes:

(5.24) Maximize $U(x;y) = x^b * y^{1-b}$

Subject to: $x = (x_1/(y_1-1))*(y-1).$

The first-order condition is:

(5.25) $\delta\log[u]/\delta y = 0 \Leftrightarrow$

$\delta\{b*\log[(x_1/(y_1-1))*(y-1)] + (1-b)*\log[y]\}/\delta y = 0 \Leftrightarrow$

$((x_1/(y_1-1))*b) / ((x_1/(y_1-1))*(y-1)) + ((1-b)/y) = 0 \Leftrightarrow$

$y^* = 1-b.$

The optimal solution equals:

(5.26) $x^* = (x_1*b)/(1-y_1)$; $y^* = 1-b.$

Because we are looking on the line between (0; 1) and $(x_1; y_1)$, this optimal solution has to satisfy the conditions:

(5.27) $x^* < x_1$; and $y^* > y_1$.

Therefore this solution is only valid in the case that $b < (1-y_1)$.

Define $a^\#$ as the optimal weight on flat capitation payments in this situation. Then, $a^\#$ can be written as:

(5.28) $a^\# = 1 - (b/(1-y_1))$.

If the first and second situation do not hold, that is if $(1-y_1) < b < x_1$, the optimal point equals A'. Then it is optimal to employ no blend at all. Along the line between $(x_1; y_1)$ and (1; 0), the utility function appears to be a decreasing function in x and along the line between $(x_1; y_1)$ and (0; 1), the utility function then appears to be a decreasing function in y (see appendix).

The conclusion is that given the preferences of the regulator and the place of the capitation formula in Figure 5.6 , it is possible to derive the optimal proportional risk sharing variants analytically. For relatively 'low' weights on reducing incentives for selection, it is optimal to employ a blend of flat capita-

tion payments and the capitation formula; for relatively 'high' weights on reducing incentives for selection, it is optimal to employ proportional risk sharing. For intermediate weights on reducing incentives for selection, it is optimal to employ the capitation formula only. In the remainder of this section, a graphical illustration is presented as well as some numerical examples.

Graphical illustration

Figure 5.7 provides a graphical illustration where A' represents the prior cost model. Based on chapter two, the point A' equals (0.4; 0.7). If the weight on reducing incentives for selection is lower than 0.3, the optimal solution is found on the line between A and A'. For instance, if it is 0.25 the Figure shows that the optimal solution is (0.333; 0.75) which is labelled D_1. If the weight on reducing incentives for selection is higher than 0.4, the optimal solution is found on the line between A' and B. For instance, if it is 0.75 the Figure shows that the optimal solution is (0.75; 0.292) which is labelled D_2. For weights on reducing incentives for selection that are greater than 0.3 but smaller than 0.4, the optimal solution equals A'.

Numerical examples

Table 5.2 presents numerical examples for three different capitation formulae and for three different weights on reducing incentives for selection. The capitation formulae represent: a demographic model, an improved model, and a prior cost model. The points $(x_1; y_1)$ are assumed to be (0.15; 1); (0.25; 1) and (0.4; 0.7) respectively. With Table 5.2, several interesting comparisons can be made:

(1) The regulator's choice between the improved model and the prior cost model, both without risk sharing, depends on the weight on reducing incentives for selection.

If this weight is 0.25, the improved model is preferred above the prior cost model. If the weight is 0.5 or 0.75, the opposite holds. The regulator will be indifferent between both models if the weight on reducing incentives for selection is about 0.43. This can be shown by solving the equation:

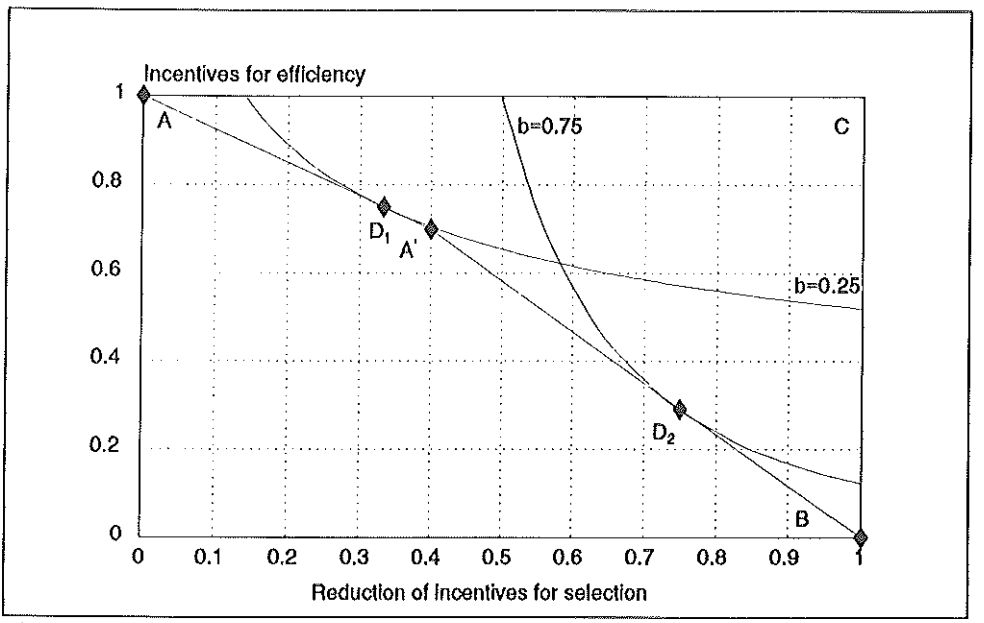

Figure 5.7 Optimal blend of the prior cost model and either full cost reimbursement (D_2) ór flat capitation payments (D_1).

(5.29) $0.25^b = 0.4^b * 0.7^{1-b}$.

The left-hand side equals the utility of the improved model and the right-hand side that of the prior cost model.
The explanation is that the weight on reducing incentives for selection reflects the preferences of the regulator. A 'low' weight means that reducing incentives for selection is not so important whereas maintaining incentives for efficiency is very important. Given a 'low' weight, the improved model performs better than the prior cost model. For 'high' weights on reducing incentives for selection, reducing incentives for selection becomes more important and maintaining incentives for efficiency less so. As a result above a certain weight on reducing incentives for selection, the prior cost model is preferred above the improved model.

(2) Suppose that the regulator - for whatever reason - does not want to employ

the improved model. Then it is interesting to make some comparisons between the demographic and the prior cost model.

Table 5.2 Optimal weights in a blend of capitation payments and full cost reimbursement for three capitation formulae and three weights on reducing incentives for selection

	b=0.25			b=0.5			b=0.75		
	U	a*	U*	U	a*	U*	U	a*	U*
Capitation formula									
Demographic	0.62	0.12	0.64	0.39	0.41	0.54	0.24	0.71	0.59
Improved	0.71	0	0.71	0.50	0.33	0.57	0.35	0.67	0.61
Prior costs	0.61	0#	0.61	0.53	0.17	0.54	0.46	0.58	0.59

b is the parameter in the utility function $U(x;y)=x^b*y^{1-b}$.
U is the utility of employing the capitation formula only.
a* is the optimal weight on actual costs.
U* is the value of the utility function when using the optimal blend.
#) In this situation, it is optimal to employ a blend of flat capitation payments and the capitation formula with a weight of 0.167 on flat capitation payments. This blend only marginally increases the utility of the regulator. Due to rounding, U and U* are the same.

First let us compare the demographic model and the prior cost model both without risk sharing. Then it depends on the weight on reducing incentives for selection which model is preferred. The regulator is indifferent between both models if the weight on reducing incentives for selection is about 0.27. This can be shown by solving the equation:

(5.30) $0.15^b = 0.4^b*0.7^{1-b}$.

The left-hand side equals the utility of the demographic model and the right-hand side that of the prior cost model.

Second it is possible to compare the prior cost model with the demographic model supplemented with proportional risk sharing in which the weight on actual costs is set equal to the coefficient of prior cost in the prior cost model. This coefficient is assumed to be 0.3. For the demographic model supplemented with proportional risk sharing, the possible variants are represented by the line:

(5.31) $x = 1 - 0.85 * y$.

If the weight on actual cost equals 0.3, then the incentives for efficiency (y) are 0.7, and consequently, the incentives for selection (x) must be 0.405. Thus the demographic model supplemented with proportional risk sharing then is represented by the point (0.405; 0.7). This point almost equals the coordinates of the prior cost model ($x=0.4$ and $y=0.7$). Because the coordinates of both payment systems are nearly equal, the difference between these systems is negligible small. This finding supports Newhouse's remark that actual costs and prior costs have similar incentives effects (Newhouse, 1994). However, it crucially depends on the place of the points $(x_1;y_1)$ for the demographic model and the prior cost model respectively. These points are assumed to be (0.15; 1) and (0.4; 0.7) respectively. In the second part of this study, these assumptions are verified in an empirical analysis (see chapter eight).

Third the demographic model can be supplemented with proportional risk sharing in which the weight on actual costs is set equal to the optimal value instead of 0.3.
Then, given the previous comparison, the demographic model supplemented with proportional risk sharing is preferred above the prior cost model without risk sharing. The difference in utility level between both payment systems depends on the weight on reducing incentives for selection. For 'intermediate' weights, the difference is small. For instance if the weight is 0.5, the demographic model supplemented with proportional risk sharing yields a maximum utility of 0.54 whereas the prior cost model yields a utility of 0.53.
For 'low' weight on reducing incentives for selection, the difference can be larger. For instance if the weight is 0.25, the demographic model supplemented with proportional risk sharing yields a maximum utility of 0.64 whereas the

prior cost model yields a utility of 0.61. The lower the weight on reducing incentives for selection, the larger is the difference between both systems.
For 'high' weights on reducing incentives for selection, the difference can also be large. For instance if the weight is 0.75, Table 5.2 shows that the demographic model supplemented with proportional risk sharing yields a maximum utility of 0.59 whereas the prior cost model yields a utility of 0.46 only. The higher the weight on reducing incentives for selection, the larger is the difference between both payment systems.

Finally the prior cost model might also be supplemented with proportional risk sharing. Then for relatively 'low' weights on reducing incentives for selection, the demographic model supplemented with risk sharing outperforms the prior cost model supplemented with risk sharing. For instance if the weight on reducing incentives for selection is 0.25, the demographic model yields a maximum utility of 0.64 whereas the prior cost model yields a maximum utility of 0.61. The lower the weight on reducing incentives for selection, the larger is the difference between both payment systems. For higher weights on reducing incentives for selection, the difference between both payment systems becomes negligible small. For instance if the weight is 0.5, the two payment systems both yield a maximum utility of 0.54. The higher the weight on reducing incentives for selection, the smaller is the difference between the two payment systems.

To sum up this section derived optimal proportional risk sharing variants as a supplement to capitation payments analytically. Applications require information on an insurer's incentives for selection and efficiency under the capitation payments and the weight the regulator assigns to either (reducing) selection or (retaining) efficiency.
With the situation of flat capitation payments as a reference point, the regulator may first try to include risk adjusters other than prior costs in the capitation formula. Such risk adjusters will reduce incentives for selection while they - generally speaking - will fully retain incentives for efficiency. Given the assumption of strong monotonicity in the previous section, including such risk adjusters into the capitation formula always improves the regulator's utility.

Second the regulator may include a risk adjuster based on prior costs into the capitation formula. Then an insurer's incentives for selection may be further reduced but its incentives for efficiency are also reduced. It depends on the weight on reducing incentives for selection versus retaining incentives for efficiency, whether the inclusion of prior costs in the capitation formula improves the regulator's utility.
Third the regulator may use risk sharing as a supplement to capitation payments. Then given the incentives for selection and efficiency under the capitation formula and given the weight on reducing incentives for selection, optimal proportional risk sharing variants can be calculated easily.

5.3 Conclusions

This chapter presented a systematic method for optimizing the tradeoff between selection and efficiency in a regulated competitive individual health insurance market when dealing with proportional risk sharing.

Section 5.1 showed that any payment system can be characterized via two indicators: one for the reduction of an insurer's incentives for selection (x) relative to flat capitation payments and one for the insurer's incentives for efficiency (y) relative to flat capitation payments. Flat capitation payments maximize the incentives for selection and efficiency while full cost reimbursement minimizes both incentives. The perfect capitation formula combines maximum incentives for efficiency with minimum incentives for selection.
Given some reasonable assumptions on the preferences of the regulator with respect to different payment systems, a Cobb-Douglas function can be used to describe its preferences: $U(x; y)=x^{b}*y^{1-b}$. The weight on reducing incentives for selection (b) must be specified by the regulator. If this weight is zero, flat capitation payments are optimal; if it is one, full cost reimbursement is optimal. It is assumed that the regulator chooses the weight on reducing incentives for selection between zero and one. If the regulator is restricted to a blend of flat capitation payments and full cost reimbursement, the optimal weight on actual costs equals the weight on reducing incentives for selection.

Section 5.2 showed that optimal proportional risk sharing variants can also be derived analytically if the regulator employs a better capitation formula than flat capitation payments. For instance the regulator may employ a demographic capitation formula. Depending on the incentives for selection and efficiency under the capitation formula employed, for 'low' weights on reducing incentives for selection it is optimal to use a blend of flat capitation payments and the capitation formula; for 'high' weights it is optimal to use a blend of the capitation formula and "full cost reimbursement"; and for intermediate weights it is optimal to use no blend at all. In the latter situation, the capitation formula itself is optimal. Numerical examples illustrated that an improvement of the capitation formula reduces the need for risk sharing. Consequently countries that are considering a regulated competitive health insurance market may start implementing a crude capitation formula supplemented with an extensive form of (proportional) risk sharing. If in the future, the regulator is able to improve its capitation formula, the extent of risk sharing can be reduced without lowering the regulator's utility.

Under the assumption that a demographic model reduces incentives for selection by 15% in comparison with flat capitation payments and that a prior costs model reduces incentives for selection by 40% and incentives for efficiency by 30%, several comparisons were made[27]. If the demographic capitation payments are supplemented with proportional risk sharing with a weight on actual costs that equals the weight on prior cost in the prior cost model, then both payment systems have similar incentives effects. If the assumptions are correct, the difference between these two payment systems is small.
Demographic capitation payments may also be supplemented with the optimal pro-portional risk sharing variant. Such a payment system is preferred above the prior cost model for relatively 'low' and for relatively 'high' weights on reducing incentives for selection. For intermediate weights the difference between both payment systems is still small.
Finally the prior cost model may also be supplemented with proportional risk

[27] These assumptions are based on previous theoretical and empirical studies (see chapter two). They will be verified empirically in the second part of the present study.

sharing. Then only for very low weights on reducing incentives for selection, the difference between both payment systems is of any importance. In that case, the demographic model supplemented with proportional risk sharing is preferred. In the other cases the difference between both payment systems is negligible small.

This chapter was restricted to proportional risk sharing. The other main forms of risk sharing as presented in chapter three could not be analyzed analytically. Therefore the next part of the study moves to an empirical analysis of tradeoffs between selection and efficiency. Preliminary empirical results have been presented in Van Barneveld et al. (1998).

Appendix chapter 5

Section 5.2.1 considered capitation payments that are independent of prior costs. Such a capitation formula can be represented by a point $A'(x_1; y_1)$ where $0 \leq x_1 < 1$ and $y_1 = 1$. If $A=(0; 1)$, $B=(1; 0)$, and $C=(1; 1)$, A' lies on the line AC and possible blends of the capitation formula and full cost reimbursement are represented by the line A'B (see Figure 5.5 of the main text). It is assumed that the regulator has a Cobb-Douglas utility function with parameter b: $U(x;y)=x^{b}*y^{1-b}$. It has been claimed that if $b<x_1$, it is optimal to employ the capitation formula only, because along the line A'B, the utility function is decreasing in x. This claim is proved below.

Proposition 5.1:
If $U(x;y)=x^{b}*y^{1-b}$ and $\{b<x_1$ and $y=(1-x)/(1-x_1)\}$ then $\delta u/\delta x<0$ for $x>x_1$.

Proof:
$U(x;y) = x^{b}*y^{1-b} \Leftrightarrow$

$U(x) = x^{b}*((1-x)/(1-x_1))^{1-b} \Leftrightarrow$

$\delta u/\delta x < 0 \Leftrightarrow \delta \log[u]/\delta x < 0,$

$\delta \log[u]/\delta x = (b/x) - ((1-b)/(1-x)) \Leftrightarrow$

$(b - x) / (x*(1-x)).$

The denominator is positive and the nominator is negative for $x>b$, which completes the proof.

Section 5.2 considered capitation payments that partly depend on prior costs. Such a capitation formula can be represented by a point $A'(x_1; y_1)$ where

$0 \leq x_1 < 1$ and $0 \leq y_1 < 1$. It has been claimed that if $(1-y_1) < b < x_1$, it is optimal to employ the capitation formula only because along the line A'B, the utility function is decreasing in x and along the line A'A, the utility function is decreasing in y.
The first part of this claim can be stated as:

Proposition 5.2.a
If $U(x;y) = x^{b}*y^{1-b}$ and $\{b < x_1$ and $y=(y_1/(1-x_1))*(1-x)\}$ then $\delta u/\delta x < 0$ for $x > x_1$.

Proof:
$U(x;y) = x^{b}*y^{1-b} \Leftrightarrow$

$U(x) = x^{b}*((y_1/(1-x_1))*(1-x))^{1-b} \Leftrightarrow$

$\delta u/\delta x < 0 \Leftrightarrow \delta \log[u]/\delta x < 0,$

$\delta \log[u]/\delta x = (b/x) - ((1-b)/(1-x)) \Leftrightarrow$

$(b - x) / (x*(1-x)).$

The denominator is positive and the nominator is negative for $b < x$, which completes the proof of proposition 5.2.a.
The second part of the claim can be stated as:

Proposition 5.2.b
If $U(x;y) = x^{b}*y^{1-b}$ and $\{b > (1-y_1)$ and $x=(x_1/(y_1-1))*(y-1)\}$ then $\delta u/\delta y < 0$ for $y > y_1$.

Proof:

$U(x;y) = x^{b}*y^{1-b} \Leftrightarrow$

$U(y) = ((x_t/(y_t - 1))*(y-1))^{b}*y^{1-b}$

$\delta u/\delta y < 0 \Leftrightarrow \delta \log[u]/\delta y < 0,$

$\delta \log[u]/\delta y = (b/(y-1)) + ((1-b)/y) \Leftrightarrow$

$(y + b - 1) / ((y-1)*y).$

The denominator is negative and the nominator is positive for $b>(1-y)$, which completes the proof of proposition 5.2.b. Together with proposition 5.2.a, this shows that the claim is true.

Part two:

Empirical analysis

6. Data, methods and demographic capitation payments

The empirical analyses of this study are based on a data set with information for six consecutive years (1988-1993) of 47,210 individual members of one Dutch sickness fund ("Zorg en Zekerheid"). Originally the data were gathered in the context of a study on capitation payments based on diagnostic information from prior hospitalizations (Lamers, 1997a). First this chapter provides a description of the data and a verification of some of the assumptions that were made in the first part of this study (section 6.1). For instance the assumption of lognormally distributed health care expenditures and the assumed maximum predictable variance in individual annual health care expenditures are verified. Second this chapter briefly summarizes the methods that will be used in the empirical analyses (section 6.2). Third under the assumption that the regulator employs demographic capitation payments without any form of risk sharing, section three presents predictable profits and losses for an insurer. Finally some conclusions are summarized.

6.1 Data

The data set includes demographic variables as well as the annual health care expenditures for several types of care and the diagnoses from hospital admissions. Because the expenditure data for 1988 and 1989 were incomplete, these expenditures are not included in the present study. All members in this panel data set were insured from January 1, 1988 until January 1, 1993. During 1993 drop-out from the panel could occur as a result of deaths and switches of insurer. Every member had the same insurance coverage and the same insurance modality. There were no deductibles or copayments. The data set is globally representative for all Dutch sickness fund members with respect to

demographic variables[28].

Demographics and disenrolment
Table 6.1 shows descriptive statistics for some demographic variables in the data set.

Table 6.1 Demographic variables

		Degree of urbanization	
Mean age	40 years	very strongly urban	11%
		strongly urban	27%
% Men	55%	moderate	26%
		little urban	22%
% Disabled[a]	6.9%	rural	14%

N=47,210.
[a]) This indicates that the individual compulsorily participates in the public health insurance sector because he or she receives a disability allowance from the government.

In 1993 2.7% of the persons in the data set left the sickness fund (1.1% died and 1.6% switched insurer). For these persons the costs in 1993 are raised to annual rates. At the same time weights are assigned for the part of the year they were in the data set. This means for example that for a person who disenrols at the end of March and who had 10,000 guilders health care expenditures during the first three months in 1993, the annual rate becomes 40,000 guilders and the assigned weight one quarter. By applying this procedure mean costs per person-year for the total data set are not changed.

[28] All employees (and their family members) earning an annual income below a certain level are insured compulsorily in the public health insurance sector by one of the nearly 30 sickness funds. About two-thirds of the Dutch population is insured this way. Except for a limited group of civil servants who have their own mandatory scheme, the remainder of the Dutch population, consisting mainly of self-employed and higher-income groups, can and does voluntarily buy health insurance from one of the about 50 private health insurance companies.

Costs for several types of care

The annual per-person health care expenditures include the costs of inpatient room and board, both inpatient and outpatient specialist care, prescribed drugs, medical devices, paramedical services, dental care, obstetrics and maternity care, and sick-transport. The costs of care provided by the general practitioner are excluded because they received a uniform annual fee for each sickness fund member in their practice regardless of medical consumption. All cost data refer to actual charges.

Table 6.2 shows that in 1993 about 4% of the members did not have any health care expenditures at all. The probability of positive costs per type of care ranges from about 5% for obstetrics and maternity care to about 79% for prescribed drugs. The average health care expenditures are Dfl. 1,941.

Table 6.2 Costs for several types of care in 1993

	Mean	Standard deviation	Probability of positive costs
Types of care			
1) Hospital care, specialist care and sick-transport[a]	1,233	6,392	0.56
2) Prescribed drugs	406	1,119	0.79
3) Paramedical services[b]	116	399	0.17
4) Medical devices	44	364	0.06
5) Dental care	100	215	0.69
6) Obstetrics and maternity care	43	610	0.05
Total	1,941	6,938	0.96

N=47,210.

[a]) In 1993, the Dutch government required the sickness funds to administer a large part of the specialists care under the hospital care. Because the distinction between these two types of care is vague, they are taken together in one category. Sick-transport often is transport to a hospital. Therefore these costs are also included in the first cost-category.

[b]) Paramedical services mainly consists of physical therapy (about 95%).

The standard deviation is Dfl. 6,938. Therefore the coefficient of variation is about 3.6 (≈6,938/1,941). In the context of capitation payments and risk sharing, the focus is mostly on the total costs of members. However, when analyzing an insurer's incentives for selection, subgroups will be formed on the basis of total prior costs, prior costs for prescribed drugs and for paramedical services. When analyzing an insurer's incentives for efficiency with respect to specific types of care, the first three categories will be distinguished as specific types of care within the benefits package. The reason for distinguishing these types of care is that an insurer may use selective contracting with respect to hospitals, pharmacists and physical therapists as a tool for selection as well as for efficiency improvements. Together the costs for these types of care constitute about 90% of the total costs.

It is well known that in a certain year, many people have relatively low costs and few have relatively high costs. Together with the fact that some people do not have any expenditures at all, such a distribution is typical for annual health care expenditures. Van der Laan (1988) showed that the lognormal distribution better fits positive health care expenditure data than nine other theoretical distributions. Therefore in the first part of the study, some analyses were presented based on the assumption of lognormally distributed (positive) health care expenditures. However, in the present data set, various chi-square tests rejected the hypothesis of lognormal distributed (positive) health care expenditures ($p < 0.05$). Thus the results of the theoretical analyses that are based on this assumption have to be interpreted with caution.

The right tail of the empirical distribution appears to be thicker than that of the lognormal distribution. This is in line with findings of other researchers (Duan et al., 1983). To give some insight in this tail of the empirical distribution, which is the most interesting in the context of capitation payments and risk sharing, Table 6.3 shows some percentile scores. For instance it can be seen that in 1993, 1% of the members have costs above Dfl. 28,250. Five percent of the members have more costs than Dfl. 7,454 and ten percent more than Dfl. 3,762.

Table 6.3 Some percentile scores for three types of care in 1993

	P_{99}	P_{95}	P_{90}
Types of care			
1) Hospital care, specialist care and sick-transport	24,766	5,141	1,593
2) Prescribed drugs	4,101	1,866	1,107
3) Paramedical services	1,833	744	392
Total	28,250	7,454	3,762

N=47,210. Overall mean costs are Dfl. 1,941. Other percentile scores for total costs are: P_{98}=Dfl. 16,573; P_{97}=Dfl. 11,912; P_{96}=Dfl. 9,220.

Table 6.4 shows Pearson correlations for the total costs in the four consecutive years. In comparison with previous research the correlations are rather high but the pattern is similar. Based on these correlations and following the method of Van Vliet (1992), it has been estimated that in the present data set at most 25 percent of the variance among individual annual health care expenditures is predictable by means of factors reflected in past spending.

Table 6.4 Pearson correlations for total costs

	1991	1992	1993
1990[a]	0.306	0.233	0.188
1991[b]		0.367	0.274
1992			0.425

N=47,210.

[a]) The costs in 1990 do not include the expenditures for prescribed drugs and medical devices because these are not available in the data set.

[b]) The costs for prescribed drugs in 1991 are incomplete. Three months are missing.

Previous estimates of this maximum ranged from about 15% to at most 20% (Newhouse et al., 1989; Van Vliet, 1992). One of the reason for the relatively high correlations and high maximum predictable variance in the present data set is that, in contrast to other studies, the total costs now include costs for prescribed drugs.

Table 6.5 shows the mean costs in 1993 for subgroups formed on the basis of demographic variables. With respect to age the costs vary between Dfl. 750 for the young (5-19 years) and about Dfl. 6,000 for the elderly (>=80 years). In rural areas the mean costs are about Dfl. 1,600 and in very strongly urban areas the mean costs are about Dfl. 2,200. The mean costs for disabled persons are about Dfl. 3,700 which is more than twice as much as for persons who are not disabled.
If the capitation payment would be the same for every individual, it is easy to identify (non-)preferred risks on the basis of demographic variables. The young, those living in rural areas and those that are not disabled would form preferred risks while the others would be non-preferred risks. Capitation payments that are based on demographic variables take into account the systematic variation in health care expenditures for subgroups based on demographic variables. Consequently demographic capitation payments reduce incentives for selection in comparison with flat capitation payments. However, besides systematic variation of health care expenditures between subgroups based on demographic variables, it is well known that there is other systematic variation as well. In section three some examples will be given.

Hospital admissions and diagnoses
For each year and each hospital admission, the diagnosis is known in the form of the relevant code from the ICD-9-CM coding system[29]. In principle, the disease is recorded that is diagnosed on admission because the sickness fund has to be notified of the reason for admission. However, notification is often delayed until after the discharge in which case the more informative discharge diagnosis is recorded.

[29] ICD-9-CM=International Classification of Disease 9th edition Clinical Modification.

Table 6.5 Mean costs in 1993 for subgroups formed on the basis of demographic variables

	Men		*Women*		Total	
Age						
5-19	850	(79)	651	(31)	750	(42)
20-34	1,518	(53)	785	(42)	1,154	(34)
35-49	1,638	(83)	1,339	(78)	1,512	(58)
50-64	2,454	(129)	2,645	(170)	2,535	(104)
64-79	4,031	(191)	5,174	(307)	4,483	(168)
>=80	5,548	(334)	6,881	(631)	5,912	(298)
Degree of urbanization						
Very strongly urban	2,348	(151)	1,967	(156)	2,186	(109)
Strongly urban	2,134	(86)	1,712	(95)	1,952	(64)
Moderate	2,130	(84)	1,849	(98)	2,004	(64)
Little urban	2,167	(104)	1,648	(93)	1,922	(71)
Rural	1,776	(114)	1,495	(139)	1,643	(89)
Disabled						
No	2,019	(45)	1,543	(46)	1,808	(32)
Yes	3,721	(299)	3,752	(285)	3,737	(206)
Total	2,116	(46)	1,723	(49)	1,941	(33)

N=47,210. Costs for obstetrics and maternity care appear to have been assigned to men instead of women in many cases. Therefore, the costs for men between 20 and 40 years are higher than could be expected on the basis of national statistics and for women in the same age groups they are lower. The standard error of the mean is presented between parentheses.

The diagnoses can be classified into so-called diagnostic cost groups. These were originally developed by Ash et al. (1989) in the context of the Medicare system in the United States. Lamers (1998) has developed diagnostic cost groups specifically for the Dutch situation. The present study mainly uses her

classification into five groups based on follow-up costs in the second and third year after hospital admission. This classification is used for distinguishing subgroups that might be employed by insurers to trace (non)-preferred risks.
In 1992 6.6% of the members in the data set were hospitalized. The average length of stay for hospitalized members was about 12.4 days. In 1993 these figures were 7.4% and 13.0 days respectively.

Health survey data
In February 1993 a mailed health survey was conducted under those in the data set (Lamers, 1997b). The main purpose of the survey was to gather information on health status and (additional) medical consumption. About 15,000 persons received the health survey. They formed a random sample of the data set. The health survey was sent to 13,472 adults between 15 and 90 years old and to the parents of 1,509 children aged 5 to 14 years. The parents were asked to complete the questionnaire for their child. The net response rate for the total sample was 70.4%[30]. An analysis of the nonresponse showed that response was associated with age, sex, degree of urbanization and type of insurance. After correction for differences in demographic variables, respondents and non-respondents differed in utilization for several types of care. Relatively more users than non-users responded. Response was not associated with utilization of care related to severe conditions such as inpatient hospital care. The conclusion from the nonresponse analysis was that nonresponse bias resulted in a small overestimation of utilization of outpatient care.
In the health survey individuals were asked whether they suffered from certain chronic medical conditions. The total list of chronic conditions included about 25 conditions. The present study uses seven of these conditions. For the other conditions, the number of members suffering from them was considered to be too small, or members suffering from them did not have much higher costs on average than average members.

[30] For 10,553 of the 47,210 members, health survey data is available.

6.2 Methods

In the empirical analyses cost predictions of the regulator and the insurer are simulated. Moreover several variants of the four forms of risk sharing as well as several variants of prior costs as a risk adjuster are employed. This section briefly describes the methods used.

Cost predictions
To generate two costs predictions for each individual, two regression models are used, a so-called demographic model and a so-called selection model. Both models are estimated by means of ordinary least squares with an individual's health care expenditures in 1993 as dependent variable and various risk adjusters as independent variables. This statistical specification closely follows the cell-based approach which is generally the form in which capitation payments are calculated in practice. Based on previous research it is likely that using a log-transformation of the dependent variable, or a two-part or even a four-part model would yield similar predictive accuracy as the more simple linear model (Duan et al., 1983; Lamers and Van Vliet, 1996). The *demographic* model includes 31 dummies for age/sex groups, four dummies for degree of urbanization and one dummy for disability as risk adjusters. This model resembles the capitation formula that has been used in the Dutch sickness fund sector since 1995. Besides the demographic variables, the *selection* model also includes diagnostic cost groups and the total costs in 1992, 1991 and 1990 as risk adjusters. It is assumed that the regulator uses the demographic model to calculate the normative costs and that the insurer uses the selection model to trace (non)-preferred risks. Some regression results are presen-ted in section 6.3. The estimated coefficients are given in the appendix.

Variants of risk sharing
For each of the four forms of risk sharing several variants are simulated by varying the relevant parameters. Given certain parameter values the proportion of the expenditures that would be shared between the insurer and the regulator is calculated. Under *risk sharing for high risks* it is assumed that the insurer designates those members with the highest costs in the year immediately

preceding. This provides a good simulation of the consequences of risk sharing for high risks (see appendix). For each variant the overall indicators of the insurers' incentives for selection and efficiency are calculated. Then the mean result for various subgroups is presented, given a certain overall level of incentives for efficiency. Finally, given a certain overall level of incentives for selection, the insurers' portion of an efficiency gain is calculated under the assumption that the costs of certain types of care or for certain subgroups are reduced by a certain percentage. The results of this systematic comparison of risk sharing variants as a supplement to demographic capitation payments are given in chapter seven.

Variants of prior costs

Like risk sharing, prior costs as a risk adjuster can take many forms. Three essential elements are: the types of care to which the costs refer, the period to which "prior" refers and the way the costs are included as a risk adjuster. In comparison with the essential elements of a form of risk sharing as given in chapter three, it is not necessary to have a list of members and to have a financing mechanism. Prior costs as a risk adjuster applies to all members and the addition of this risk adjuster will - in general - lower the weights (estimated coefficients) of the demographic risk adjusters. The difference between the weights of the demographic risk adjusters without prior costs as a risk adjuster on the one hand and those with prior costs as a risk adjuster on the other hand, automatically reflect a certain financing mechanism.

In line with the choices that were made with respect to risk sharing, prior costs will refer to all types of care within the specified benefits package, will refer to a period of one year and will be included as a continuous variable as far as the costs are above a certain threshold. These choices prevent manipulation by insurers that could occur in the registration of different types of care and with expenditures around thresholds. They are also in line with previous studies that have analyzed prior costs as a risk adjuster (see chapter two).

In comparison with the formal description of forms of risk sharing, the parameters p and D are redundant. The parameter T remains the same but now refers to the costs in the previous year and the parameter a is replaced by an estimated coefficient b_T. Because the estimated coefficient b_T automatically follows from

the choice of the threshold, the prior cost models that will be analyzed in this study are described by one parameter only, i.e. the threshold. Like the main forms of risk sharing, the resulting capitation formulae that are partly based on prior costs do not seem difficult to implement, provided that the necessary cost data are available on individual level. The results of prior costs as an additional risk adjuster next to the demographic risk adjusters are given in chapter eight. These results are compared with those of the four forms of risk sharing as studied in chapter seven.

6.3 Demographic capitation payments

This section analyzes the incentives for selection if the regulator applies demographic capitation payments without any form of risk sharing. In section 6.3.1 the overall indicators are calculated and in section 6.3.2 the predictable profits and losses for various subgroups are presented.

6.3.1 Overall selection

Table 6.6 shows the R^2-value, the mean absolute result and the mean absolute predicted result for flat capitation payments and demographic capitation payments. For the calculation of the mean absolute predicted result, it is assumed that the insurer uses the selection model. The latter model yielded an R^2-value of about 0.22 and a mean absolute result of Dfl. 1,967. Because it has been estimated that the maximum R^2-value for the present data set is 0.25, it seems likely that the selection model can hardly be improved by an insurer given the available data.

The R^2-value of the demographic model is about 0.05. This is about one-fifth of the maximum R^2-value, which is comparable with the results of previous studies (see chapter two). The mean absolute result for the demographic model is Dfl. 2,250. This is a reduction of about seven percent in comparison with the mean absolute result for flat capitation payments. However, expressing the reduction this way does not take into account that the mean absolute result of the selection model is still Dfl. 1,967. So, the maximum reduction of the mean absolute

result appears to be about Dfl. 448. Therefore, the reduction of the mean absolute result in comparison with flat capitation payment is about 37% of the maximum reduction.

Table 6.6 R^2-value, mean absolute result and mean absolute predicted result for two capitation models

	R^2	MAR	MAPR
FLAT	0	2,415	1,482
DEMO	0.047	2,250	982

N=47,210. FLAT=same capitation payment for each individual. DEMO=demographic model. MAR=mean absolute result. MAPR=mean absolute predicted result.

The mean absolute predicted result of the demographic model is Dfl. 982. This is a reduction of about 34% in comparison with the mean absolute predicted result of flat capitation payments. As argued in chapter two, the mean absolute predicted result yields a better indication of incentives for selection than the R^2-value or the mean absolute result. Therefore it is concluded that, globally speaking, demographic capitation payments reduce an insurer's incentives for selection by about one-third in comparison with flat capitation payments.

Table 6.7 shows the mean absolute result and several versions of a weighted mean absolute predicted result for the demographic model. As argued in chapter two, the latter indicator is useful if small profits and losses are irrelevant for selection. In all cases the weighted mean absolute predicted result is only slightly lower than the mean absolute predicted result.

The last column shows that, if the weighing is right, the mean absolute predicted result yields an overestimation of the incentives for selection of less than 10%. Thus under demographic capitation payments the question whether small profits and loss are relevant for selection seems unimportant. In any case their incentives for selection appear to be large. This is in line with the results of the

theoretical analysis as presented in the appendix of chapter two.

Table 6.7 (Weighted) mean absolute predicted result for demographic capitation payments

	α_1	α_2	DEMO	Overestimation	
				Absolute	Relative
MAPR	0	0	982	n.a.	n.a.
WMAPR[a]	10	10	973	9	0.9%
WMAPR[a]	20	20	946	36	3.8%
WMAPR[a]	30	30	898	84	9.3%
WMAPR[b]	Dfl. 100	Dfl. 100	978	4	0.4%
WMAPR[b]	Dfl. 200	Dfl. 200	962	20	2.1%
WMAPR[b]	Dfl. 300	Dfl. 300	925	57	6.2%
WMAPR[a]	30	10	933	49	5.3%
WMAPR[b]	Dfl. 300	Dfl. 100	934	48	5.1%

N=47,210. DEMO = demographic model. MAPR = mean absolute predicted result. WMAPR= weighted mean absolute predicted result. The overestimation is calculated as (MAPR−WMAPR) and ((MAPR−WMAPR)/WMAPR)*100% respectively.

[a]) Small predictable profits and losses are defined in relative terms, i.e. those profits and losses that are smaller than α_1% and α_2% of the predicted costs based on the selection model respectively.

[b]) Small predictable profits and losses are defined in absolute terms, i.e. those profits and losses that are smaller than Dfl. α_1 and Dfl. α_2 respectively.

The (weighted) mean absolute predicted result can not be calculated for all forms of risk sharing. Therefore Table 6.8 shows the mean result for (non)-preferred risks for flat capitation payments as well as demographic capitation payments. Preferred risks are those for whom the cost prediction of the selection model is lower than that of the capitation model. Others are non-preferred risks.

Table 6.8 Mean result for (non)-preferred risks for two capitation models

	FLAT		DEMO	
	N (%)	MR	N (%)	MR
Preferred risks	72.9	1,011	76.5	661
Non-preferred risks	27.1	-2,715	23.5	-2,152

N=47,210. FLAT=same capitation payment for each individual. DEMO=demographic model. MR=mean result.

Under flat capitation payments 72.9% of the members form the group of preferred risks and 27.% form the group of non-preferred risks. The mean profit for preferred risks is Dfl. 1,011 and the mean loss for non-preferred risks is Dfl. 2,715. If flat capitation payments are replaced by the demographic model, about 76.5% of the members are preferred risks and about 23.5 are non-preferred risks. Under the demographic model, the mean profit for preferred risks is Dfl. 661 and the mean loss for non-preferred risks is Dfl. 2,152. Based on these findings the demographic model reduces the incentives for selection by about 31% in comparison with flat capitation payments[31].

6.3.2 Selection of subgroups

Table 6.9 shows the mean costs and the mean result in 1993 for subgroups formed on the basis of certain costs in 1991. The costs in 1993 for the 1%-group with the highest total expenditures in 1991 are Dfl. 15,428, which is more than seven times the average. The mean predictable loss in 1993 for this subgroup is Dfl. 11,673 per member. For those individuals who had no costs in 1991, the mean costs in 1993 are about Dfl. 729 per member and the mean profit in 1993 is about Dfl. 900 per member. For the 1%-group with the highest expenditures for prescribed drugs in 1991, the mean costs in 1993 are Dfl. 15,945 per member and the mean loss is about Dfl. 12,000 per member.

[31] This reduction almost equals the reduction of the mean absolute predicted result. The small difference is caused by a small difference between the mean predicted costs by the selection model and the mean actual costs for the two subgroups that are distinguished.

Table 6.9 Mean costs and mean result in 1993 for subgroups formed on the basis of certain costs in 1991

	N (%)	Mean costs in 1993		Mean result in 1993 under the DEMO-model
Total costs 1991				
0	14.3	729	(43)	883
1-2,164	75.7	1,603	(29)	266
2,165-4,651	5	4,550	(211)	-1,843
4,652-17,918	4	6,062	(331)	-2,978
>17,918	1	15,428	(1,525)	-11,673
Prescribed drugs 1991				
0	28.4	838	(34)	711
1-619	61.5	1,637	(33)	231
620-1,098	5	4,924	(234)	-1,574
1,099-2,451	4	7,268	(350)	-3,633
>2,451	1	15,945	(1,341)	-12,118
Paramedical services 1991				
0	83	1,672	(32)	212
1-336	7	2,398	(128)	-491
337-621	5	2,858	(215)	-694
622-1,532	4	3,551	(210)	-1,063
>1,532	1	10,077	(1,073)	-6,403

N=47,210. Overall mean costs are Dfl. 1,941. For each subgroup, the mean result differs statistically significantly from zero (two-sided t-test, $p<0.05$). The standard error of the mean is presented between parentheses.

For the 1%-group with the highest costs for paramedical services in 1991, the mean costs in 1993 are Dfl. 10,077 per member and the mean loss is about Dfl. 6,000 per member. For those without prescribed drugs (about 20%) or without paramedical services (about 80%), the mean profit is about Dfl. 700 and Dfl.

200 per member respectively[32]. These findings clearly show that, if the regulator applies demographic capitation payments without any form of risk sharing, those with high prior costs form non-preferred risks for an insurer whereas those with low prior costs form preferred risks.

Table 6.10 shows the mean costs and the mean result in 1993 for some subgroups formed on the basis of prior hospitalization data. For those in diagnostic cost group 4 or 5 in 1992 (about 0.2%), the average costs in 1993 are about Dfl. 27,000 and the mean loss is more than Dfl. 20,000. About 0.4% has been hospitalized with a diagnosis in diagnostic cost group 4 or 5 in the previous four years. Their average costs in 1993 are about Dfl. 16,000 and the mean loss is about Dfl. 12,000. About one percent had at least one hospitalization in three of the four preceding years. Their average costs are about Dfl. 16,000 and the mean loss is about Dfl. 12,000. For those without an hospitalization in 1992 (about 93%), the mean profit in 1993 is about Dfl. 300. For those who were not hospitalized in the previous four years (about 80%), the mean profit is almost Dfl. 500. Thus, based on prior hospitalization data, an insurer can easily identify (non)-preferred risks.

Table 6.11 shows the mean costs and the mean result for subgroups based on the presence of certain chronic conditions, the use of home care, the consultation of an alternative practitioner and the level of education. The average costs are highest for those suffering from a serious heart disease, diabetes mellitus or cancer, and for those using home care. For the subgroups formed on the basis of education the differences are small. However, with respect to this socio-economic variable, it should be noted that the data set includes sickness fund members only and therefore higher-income groups are virtually not included. Those with a chronic condition, especially those suffering from diabetes, a serious heart disease or cancer, form non-preferred risks. The mean loss for those with at least one chronic condition (about 40%) is Dfl. 820. For those

[32] In the remainder of this study the mean costs and the mean result for a certain subgroup refer to the mean costs and the mean result *per member* of the specific subgroup, unless stated otherwise.

suffering from diabetes (1.7%), a heart disease (1.8%) or cancer (1.2%), the mean loss is about Dfl. 2,900, Dfl. 4,300 and Dfl. 5,600 respectively.

Table 6.10 Mean result in 1993 for subgroups formed on the basis of hospital admissions and diagnostic cost groups in previous years

	N (%)	Mean costs in 1993	Mean result in 1993 under the DEMO-model
DCG in 1992			
0	93.3	1,569 (26)	305
1	2.3	3,513 (309)	-1.395
2	1.8	7,253 (592)	-4,179
3	0.9	14,387 (1,283)	-10,694
4+5	0.2	26,672 (5,857)	-22,601
Unknown[a]	1.5	5,975 (498)	-2,828
Highest DCG in the period 1989-1992			
1	8.3	2,371 (111)	-417
2	5.6	4,493 (213)	-1,584
3	3.1	9,218 (548)	-5,732
4+5	0.4	16,027 (2,411)	-12,159
Unknown[a]	2.8	3,295 (218)	-623
No. years with hospitalization in the period 1989-1992			
0	79.8	1,307 (24)	468
1	15.5	3,222 (105)	-812
2	3.7	6,329 (371)	-3,262
3 or 4	1	16,079 (1,423)	-12,398

N=47,210. Overall mean costs are Dfl. 1,941. For each subgroup, the mean result differs statistically significantly from zero (two-sided t-test, $p<0.05$). The standard error of the mean is presented between parentheses.

[a]) These persons were hospitalized but the diagnosis is not available.

Table 6.11 Mean result in 1993 for subgroups formed on the basis of health survey data

	N (%)	Mean costs in 1993		Mean result in 1993
Presence of chronic conditions[a]				
None	61.1	1,097	(53)	523
At least one	38.9	3,260	(156)	-820
Asthma	5.0	3,839	(360)	-1,408
Heart disease	1.8	8,062	(1,268)	-4,330
Hypertension	6.9	4,228	(476)	-1,123
Diabetes mellitus	1.7	6.492	(1,001)	-2,895
Arthrosis	6.3	4,036	(371)	-755*
Rheumatism	2.9	4,480	(770)	-1,411*
Cancer	1.2	8,747	(2,052)	-5,602
Use of home help ór nursing				
No	95.1	1,625	(57)	178
Yes	4.9	7,098	(791)	-3,487
Use of alternative practitioner				
No	90.8	1,834	(72)	49*
Yes	9.2	2,292	(186)	-475
Education[b]				
Low	58.3	2,147	(94)	-50*
Medium	28,0	1,422	(103)	37*
High	10.3	1,209	(145)	249
Unknown	3.4	3,393	(612)	-209*

N=10,553. Overall mean costs are Dfl. 1,890. The standard error of the mean is presented between parentheses.

*) Not statistically significantly different from zero (two-sided t-test, $p>0.05$).

[a] These conditions were still under treatment in 1993. Asthma includes chronic bronchitis and COPD. Heart disease refers to a serious heart disease or heart attack. Arthrosis refers to arthrosis of knees, hips or hands.

[b] Low='LBO' or less; Medium='MAVO' or 'MBO'; High='HAVO', 'VWO', 'HBO' or 'WO'. This refers to levels of education that are usually distinguished in The Netherlands.

For those that suffer from arthrosis or rheumatism the mean loss is not statistically significantly different from zero. The predictable loss for those individuals that receive some form of home care (about 5%) is about Dfl. 3,500.
Those without any chronic condition, those that do not receive home care, those that do not consult an alternative practitioner and those with a high education generate predictable profits. These profits range from about Dfl. 200 for those that do not use home care to almost Dfl. 600 for those without any chronic conditions.

Summarizing this section clearly shows that an insurer can easily identify systema-tic variation in individual health care expenditures that is not accounted for by demographic capitation payments. In line with the findings of other studies the predictable profits and losses are substantial. Therefore demographic capitation payments leave ample room for selection by insurers.

6.4 Conclusions

The data set contains administrative data for six consecutive years (1988-1993) for about 47,200 members of one Dutch sickness fund. Every member had the same insurance coverage and the same insurance modality. The data include demographic variables, the annual costs for several types of care and the diagnoses from hospital admissions. For a subset of about 10,500 members, health survey data is available also. The average health care expenditures in 1993 are Dfl. 1,941.
An important difference with previous studies is that the data set for the present study includes the costs of prescribed drugs, at least for the last two years. This has the following consequences. First only four percent of the members did not have any health care expenditures in 1993. In previous studies, the percentage of members without any expenditures was generally much larger. Second the distribution of health care expenditures is somewhat less skew than in previous studies. The coefficient of variation is about 3.6 whereas in previous studies it was at least four. Nevertheless the right tail of the distribution still is thicker than that of the theoretical lognormal distribution. Therefore, in the present data

set, several chi-square tests rejected the hypothesis of lognormally distributed (positive) expenditures. Third the correlation between the total costs in two consecutive years is about 0.4. In previous studies this correlation was about 0.3 only. Finally the maximum variance in individual annual health care expenditures that is predictable by means of factors reflected in past spending is estimated to be 0.25. Previous estimates of this maximum ranged from about 0.15 to at most 0.20 (Newhouse et al., 1989; Van Vliet, 1992).
Given these findings it is clear that most theoretical analyses that were presented in the first part of this study should be interpreted with caution. Remember that these theoretical analyses are based on the assumption of lognormally distributed (positive) health care expenditures and illustrated with numerical examples assuming average costs of Dfl. 2,000, a coefficient of variation of four, a probability of positive costs of 0.8 and a correlation between the total costs in two consecutive years of 0.3.

Although there are some differences with previous studies, the systematic variation in health care expenditures that can be traced by demographic variables in the present study is similar. The average costs for those of 80 years or older is about Dfl. 6,000 which is about three times the overall average. The average costs for those below 20 years is about Dfl. 750. The average costs in rural areas are lower than in very strongly urban areas. The costs of those who receive a disability allowance from the government are almost twice the overall average. A regression model with age, gender, degree of urbanization and disability as risk adjusters explained about five percent of the variance in individual annual health care expenditures which is about one-fifth of the estimate of the maximum predictable variance in the present data set. This finding is comparable with other studies on demographic capitation payments. Under demographic capitation payments an insurer can easily identify subgroups that generate substantial predictable profits or losses. Consequently insurers have strong incentives for selection. For instance, for the group of 1% with the highest total costs or with the highest costs for prescribed drugs two years ago, the mean loss is about Dfl. 12,000 per member. For those without any costs two years ago the mean profit is about Dfl. 900 per member.
For those with a hospitalization in at least three of the four preceding years the

mean loss is about Dfl. 12,000 per member. For those without a hospitalization in each of the four preceding years the mean profit is about Dfl. 500 per member.
For those that suffer from a serious heart disease, diabetes or cancer, the mean losses are about Dfl. 4,300, Dfl. 2,900 and Dfl. 5,600 per member respectively. For those without any chronic medical condition the mean profit is about Dfl. 500 per member.
Finally for those that receive some form of home care, the mean predictable loss is about Dfl. 3,500 per member. For those that do not receive any home care, the mean predictable profit is about Dfl. 200 per member. Thus, although demographic variables are useful to calculate capitation payments, they are certainly not sufficient. Generally speaking demographic capitation payments reduce an insurer's incentives for selection by about one-third in comparison with flat capitation payments. It was shown that ignoring some small predictable profits and losses hardly influences this conclusion.

The next chapter supplements the demographic capitation payments with several variants of the four forms of risk sharing and focuses on the reduction of the incentives for selection. Because risk sharing also reduces an insurer's incentives for efficiency, this effect is also analyzed. As argued in chapter five, it is up to the regulator to weigh the reduction of incentives for selection against the reduction of the incentives for efficiency.

Appendix chapter 6

Table A.6.1 Coefficients of the demographic and the selection model

	Women	Men	Women	Men
5-9	410	497	195	323
10-14	504	636	320	278
15-19	349	747	191	494
20-24	397	881	210	568
25-29	381	1,290	165	783
30-34	660	1,356	363	791
35-39	730	1,117	464	707
40-44	804	1,221	514	732
45-49	1,192	1,359	599	745
50-54	1,313	1,610	770	983
55-59	1,809	1,679	987	862
60-64	2,286	2,555	1,336	1,223
65-69	4,409	2,794	2,675	1,430
70-74	5,284	4,115	2,874	2,172
>=75	6,242	5,144	3,717	2,662
Very strongly urban	217		49	
Strongly urban	303		158	
Moderate	250		101	
Little urban	261		133	
Disabled	2,080		887	
DCG 1992=1			-2,234	
DCG 1992=2			-1,411	
DCG 1992=3			79	
DCG 1992=4 or 5			7,324	
DCG 1992=unknown			-2,093	
DCG 1991=1			-475	
DCG 1991=2			-133	
DCG 1991=3			1,128	
DCG 1991=4 or 5			5,733	
DCG 1991=unknown			-144	
DCG 1990=1			79	
DCG 1990=2			645	
DCG 1990=3			1,579	
DCG 1990=4 or 5			-293	
DCG 1990=unknown			-326	
Total costs in 1992			0.46	
Total costs in 1991			0.14	
Total costs in 1990			0.11	

Table A.6.1 shows the estimated coefficients for the demographic model (left) and for the selection model (right). The estimated coefficients of some groups are not statistically significantly different from zero and in some cases, the estimated coefficients of two groups do not differ statistically significantly. Nevertheless these groups are retained (separately) in the model(s). One reason is that regulators commonly use a cell-based approach to calculate normative cost levels in practice. Another reason is that the present study mainly focuses on the overall accuracy of the cost predictions.

Designation strategy in the case of risk sharing for high risks

To analyze risk sharing for high risks empirically, an assumption has to be made about the designation strategy of the insurer. It will be assumed that the insurer designates those members who have had the highest costs in the year immediately preceding. Additional analyses have shown that a designation strategy based on the highest predicted losses of the insurer (i.e. the cost prediction of the selection model minus the cost prediction of the demographic model) would increase the insurer's revenue by about one percent only. Therefore the empirical illustrations slightly *under*estimate the potential of risk sharing for high risks to reduce predictable profits and losses for an insurer, because the insurer could employ better designation strategies. On the other hand, the empirical illustrations slightly *over*estimate the potential of risk sharing for high risks because lags in claims processing would prevent insurers from employing our designation strategy exactly and because they have no claims history of new enrolees. However, insurers might employ the most recent claims history of their members and for new enrolees some relevant indicator of the claims history might be passed from one insurer to another. If insurers update their claims files every month, they can use information of the first 10 or 11 months of a year to decide whether members are designated for risk sharing for the next year. With respect to new enrolees an alternative might be to pass on from one insurer to another information about whether a member was designated for risk sharing in the previous year. Based on these findings and considerations, it seems likely that the empirical analyses provide a good illustration of the potential consequences of risk sharing for high risks.

Table A.6.2 Actual and normative costs as a percentage of total costs for designated members under risk sharing for high risks

	1%	2%	3%	4%
Members designated on the basis of their predicted loss				
Actual costs	11.7	16.6	21.0	24.3
Normative costs	1.9	3.7	5.4	6.9
Difference	9.8	12.9	15.6	17.4
Members designated on the basis of their total costs in the previous year				
Actual Costs	10.9	16.8	20.4	23.8
Normative Costs	2.0	3.9	5.6	7.2
Difference	8.9	12.9	14.8	16.6

N=47,210. The normative costs equal the predicted costs based on the demographic model. The predicted loss for a member is calculated as predicted costs via the selection model minus the predicted costs via the demographic model.

7. Risk sharing as a supplement to demographic capitation payments

This chapter analyzes the reduction of an insurer's incentives for selection as well as for efficiency if the four forms of risk sharing as described in chapter three, are used as a supplement to demographic capitation payments[33]. For each form of risk sharing several variants are employed. In all cases the risk sharing is financed via a uniform percentage of the normative costs (see appendix). First section 7.1 presents the proportion shared expenditures for the risk sharing variants. Then section 7.2 compares the forms of risk sharing using the overall indicators of incentives for selection and efficiency. Given a certain overall level of incentives for efficiency, section 7.3 analyzes the incentives to select various subgroups. Given a certain overall level of incentives for selection, section 7.4 analyzes the incentives to improve efficiency for different types of care and for different subgroups. Section 7.5 contains the conclusions.

7.1 Proportion shared expenditures

Under proportional risk sharing the proportion shared expenditures equals the weight on the actual expenditures. Table 7.1 shows the proportion shared expenditures for some variants of the other three forms of risk sharing. Under risk sharing for high-risks for 1% of the members, the proportion shared expenditures is 0.11[34]. If 8% of the members are designated, the proportion shared expenditures is 0.34. Under risk sharing for high-costs for 0.25% of the members, the proportion shared expenditures is 0.13. In this case members with costs above Dfl. 60,236 are designated. If 4% of the members are designated, the proportion shared expenditures is 0.52 and the implicit threshold is Dfl. 9,207. Under outlier risk sharing with a threshold of Dfl. 40,000, the propor-

[33] The main findings of this chapter can also be found in Van Barneveld et al. (1999b).

[34] Remember that under *risk sharing for high risks* it is assumed that an insurer designates those members with the highest costs in the previous year (see also chapter six).

tion shared expenditures is 0.09. About 0.6% of the members have costs above Dfl. 40,000. If the threshold is lowered to Dfl. 5,000, the proportion shared expenditures is 0.44 and about 7.3% of the members are designated.

Table 7.1 Proportion shared expenditures per risk sharing variant

RSHR (p)	1%	2%	3%	4%	8%
PSE	0.11	0.17	0.20	0.24	0.34
RSHC (p)	0.25%	0.5%	0.75%	1%	4%
PSE	0.13	0.19	0.24	0.28	0.52
Implicit threshold	60,236	43,287	34,197	28,344	9,207
ORS (T)	40,000	30,000	20,000	10,000	5,000
PSE	0.09	0.13	0.19	0.31	0.44
% Designated	0.6	0.9	1.6	3.7	7.3

N=47,210. PSE=proportion shared expenditures. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

For risk sharing for high-costs and outlier risk sharing these results are in line with those of the theoretical analyses of chapter three. For risk sharing for high-risks the empirical proportion shared expenditures appears to be substantially higher then the theoretical one. Part of this difference is due the higher correlation between the costs in 1992 and 1993 than was assumed in the theoretical analysis (0.4 versus 0.3). Equation (3.1) of chapter three shows that a higher correlation leads to a larger proportion shared expenditures. However, this could not explain the whole difference. Apparently Equation (3.1) yields an

underestimation of the proportion shared expenditures. In Table 7.1 the results for the main forms of risk sharing should be read separately. It is not yet intended to compare the results of the main forms of risk sharing. Such a comparison will be made in the next section.

7.2 Overall results

This section compares the consequences of the four forms of risk sharing using the overall indicators of incentives for selection and efficiency. As shown in the previous chapter, under demographic capitation payments, the mean profit on preferred risks is Dfl. 661 and the mean loss on non-preferred risks is Dfl. 2,152. Table 7.2 shows the mean result for both subgroups after the demographic model has been supplemented with risk sharing. After *risk sharing for high-risks* for 1% of the members has been added to the demographic model, the mean profit on the preferred risks reduces to Dfl. 487. The mean loss on the non-preferred risks reduces to Dfl. 1,584. In comparison with flat capitation payments, the incentives for selection are now reduced by 49%. If 4% of the members are designated, the reduction is 64%. After *risk sharing for high-costs* for 0.25% of the members, the mean profit on preferred risks is reduced to Dfl. 505. The mean loss on non-preferred risks is reduced to Dfl. 1,644. The incentives for selection are reduced by 48% in comparison with flat capitation payments. If 1% of the members are designated, the reduction is 59%. After *outlier risk sharing* with a threshold of Dfl. 40,000, the mean profit on preferred risks is reduced to Dfl. 549.
The mean loss on non-preferred risks is reduced to Dfl. 1,787. The incentives for selection are reduced by 43% in comparison with flat capitation payments. If the threshold is lowered to Dfl. 10,000, the reduction is 62%.

Table 7.2 Mean result for (non)-preferred risks and the reduction of the incentives for selection

	N	DEMO	RSHR (1%)	RSHR (2%)	RSHR (3%)	RSHR (4%)
Preferred	76.5	661	487	411	375	342
Non-pref.	23.5	-2,152	-1,584	-1,336	-1,220	-1,113
Reduction[a]		0.31	0.49	0.57	0.61	0.64
	N	DEMO	RSHC (0.25%)	RSHC (0.5%)	RSHC (0.75%)	RSHC (1%)
Preferred	76.5	661	505	454	417	392
Non-pref.	23.5	-2,152	-1,644	-1,478	-1,357	-1,275
Reduction[a]		0.31	0.48	0.52	0.57	0.59
	N	DEMO	ORS (40,000)	ORS (30,000)	ORS (20,000)	ORS (10,000)
Preferred	76.5	661	549	514	458	363
Non-pref.	23.5	-2,152	-1,787	-1,671	-1,489	-1,181
Reduction[a]		0.31	0.43	0.46	0.52	0.62

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

[a]) The reduction is expressed as a fraction in comparison with flat capitation payments (see also chapter five).

Risk sharing also reduces an insurer's incentives for efficiency. Chapter four showed that under *risk sharing for high risks* or *high-costs*, the insurer's portion of this efficiency gain equals one minus the proportion shared expenditures if an

insurer reduces all expenditures by a certain percentage. Under *outlier risk sharing* the insurer's portion of the efficiency gain will be lower than one minus the proportion shared expenditures. Table 7.3 shows the insurer's portion of the efficiency gain if the insurer reduces all expenditures by 10%. The latter figure is based on the findings in chapter four.

Table 7.3 Insurer's portion of a ten percent overall efficiency gain (IPEG)

RSHR (p)	1%	2%	3%	4%	8%
IPEG	0.89	0.83	0.80	0.76	0.66
RSHC (p)	0.25%	0.5%	0.75%	1%	4%
IPEG	0.87	0.81	0.76	0.72	0.48
ORS (T)	40,000	30,000	20,000	10,000	5,000
IPEG	0.80	0.74	0.66	0.51	0.38

N=47,210. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing. IPEG=insurer's portion of the efficiency gain.

Under outlier risk sharing with a threshold of Dfl. 40,000, the insurer's portion of the efficiency gain is 0.80. If the threshold is Dfl. 5,000, it is 0.38. These results for outlier risk sharing are comparable to those of chapter four.
In Table 7.2 and 7.3 the results for the main forms of risk sharing should still be read separately. In order to make a comparison between the main forms of risk sharing, these overall results are now placed in Figure 7.1. The x-axis shows the reduction of the predictable profits and losses as given in Table 7.2. The y-axis shows the insurer's portion of the efficiency gain as given in Table

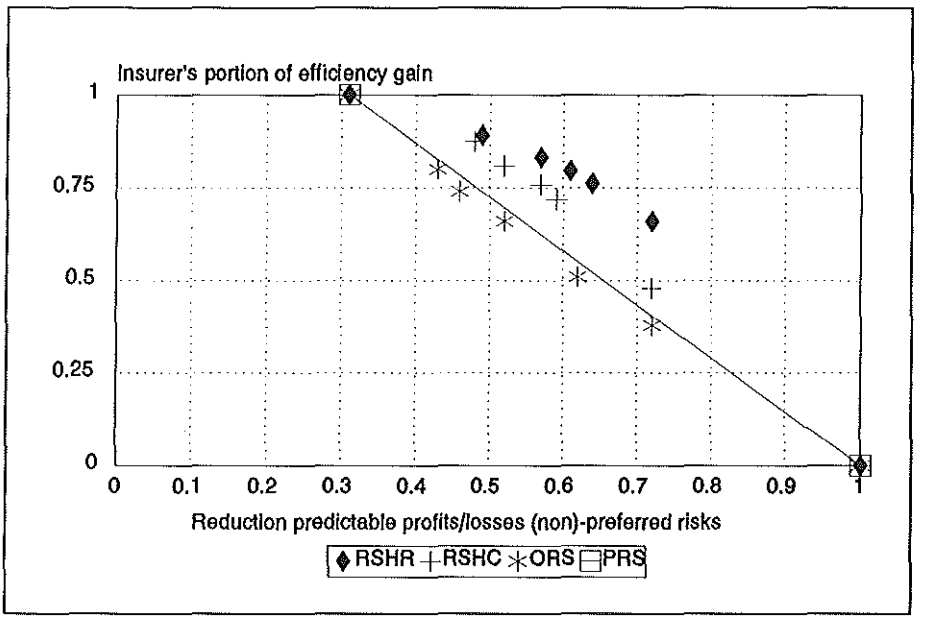

Figure 7.1 Overall results for four main forms of risk sharing as a supplement to demographic capitation payments

7.3. The point (0.31; 1) represents *demographic capitation payments* without any form of risk sharing. The line between (0.31; 1) and (1; 0) represents all possible variants of *proportional risk sharing*. The points in the Figure show the variants of the other three forms of risk sharing. The Figure clearly shows that *risk sharing for high-risks* yields a better tradeoff between selection and efficiency than the other forms of risk sharing. Given a certain reduction of incentives for selection, the incentives for efficiency are higher. The other way around, given a certain level of incentives for efficiency, the reduction of the incentives for selection is higher. The performance of *proportional risk sharing* and *outlier risk sharing* is comparable with the former slightly better. *Risk sharing for high-costs* has an intermediate position. In the remainder of this chapter, the other (overall) indicators of incentives for selection and efficiency are used to evaluate the consequences of the four forms of risk sharing. The purpose is to investigate whether the conclusions above remain valid.

Table 7.4 The reduction of incentives for selection if small predictable profits and losses are irrelevant for selection

	α_1	α_2	DEMO	RSHR (2%)	RSHR (4%)
Reduction[a]	0%	0%	0.31	0.57	0.64
Reduction[b]	10%	10%	0.32	0.58	0.65
Reduction[b]	30%	30%	0.34	0.60	0.67
Reduction[c]	Dfl. 100	Dfl. 100	0.31	0.57	0.64
Reduction[c]	Dfl. 300	Dfl. 300	0.34	0.59	0.66

			RSHC (0.5%)	RSHC (1%)	ORS (30,000)	ORS (10,000)
Reduction[a]	0	0	0.52	0.59	0.46	0.62
Reduction[b]	10%	10%	0.53	0.60	0.47	0.62
Reduction[b]	30%	30%	0.55	0.61	0.49	0.64
Reduction[c]	Dfl. 100	Dfl. 100	0.52	0.59	0.46	0.62
Reduction[c]	Dfl. 300	Dfl. 300	0.54	0.60	0.49	0.63

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

[a]) See also Table 7.2.

[b]) Persons with a small predictable profit are defined as those for whom the cost prediction based on the demographic model minus that of the selection model is smaller than α_1% of the cost prediction of the selection model. Persons with a small predictable loss are defined similarly with α_2 instead of α_1.

[c]) Small predictable profits and losses are defined in absolute rather than relative terms.

Another overall indicator of incentives for selection

Table 7.4 shows the results under the assumption that insurers ignore small predictable profits and losses. This does not appear to change the reduction of the incentives for selection very much. Moreover the relative performance of

the forms of risk sharing is not changed in comparison with Figure 7.1. Therefore the conclusion that risk sharing for high risks as well as risk sharing for high costs yield a better tradeoff between selection and efficiency than either outlier or proportional risk sharing is also true if insurers ignore small predictable profits and losses.

Another overall indicator of incentives for efficiency
As explained in chapter four the so-called weighted expenditures measure is an alternative overall indicator of an insurer's incentives for efficiency. Under *risk sharing for high-risks* and *proportional risk sharing*, this measure equals one minus the proportion shared expenditures. Under *risk sharing for high costs* or *outlier risk sharing*, it depends on the (implicit) threshold and the length of the cost interval after which an insurer is assumed to recalculate its incentives for efficiency with respect to future expenditures for a particular member in the remainder of a year.

Table 7.5 shows the weighted expenditures for six thresholds and three lengths of the cost intervals. The length of the cost intervals is varied between Dfl. 1,000 and Dfl. 10,000. The latter value is chosen because nearly all threshold amounts in the Table can be divided into parts of Dfl. 10,000 and because larger cost intervals seem unrealistic.
If the threshold is Dfl. 60,000 and the length of the cost intervals is Dfl. 10,000, the weighted expenditures measure is 0.94. The lower the threshold and the smaller the cost intervals, the lower is the weighted expenditures measure. If the threshold is Dfl. 5,000 and the length of the cost intervals is Dfl. 1,000, it is 0.38.
With this overall indicator of incentives for efficiency, *risk sharing for high-cost* with a certain implicit threshold performs better than *outlier risk sharing* with the same threshold. The incentives for efficiency then are the same, but under risk sharing for high-costs the incentives for selection are lower.
For instance, risk sharing for high-costs for 0.5% of the members implies a threshold of about Dfl. 43,000 and a reduction of the incentives for selection of 52% (see Table 7.1 and 7.2). Outlier risk sharing with a threshold of Dfl. 40,000 reduces the incentives for selection with 43% only (see Table 7.2).

Another example is risk sharing for high-costs for 0.75% of the members. This implies a threshold of about Dfl. 34,000 and reduces the incentives for selection with 57% (see Table 7.1 and 7.2). Outlier risk sharing with a threshold of Dfl. 30,000 reduces the incentives for selection with 52% only (see Table 7.2).

Table 7.5 Weighted expenditures

T (Dfl.)\k (Dfl.)	1,000	5,000	10,000
60,000	0.89	0.93	0.94
50,000	0.86	0.90	0.92
40,000	0.82	0.87	0.89
30,000	0.77	0.83	0.85
20,000	0.69	0.76	0.79
10,000	0.56	0.64	0.66
5,000	0.38	0.51	n.a.

N=47,210. T=(implicit) threshold under risk sharing for high-cost or outlier risk sharing. k=length of the cost intervals below the threshold.

Let us now compare *risk sharing for high-costs* with *risk sharing for high-risks*. If the length of the cost interval is near zero, chapter four showed that the weighted expenditures measure under risk sharing for high costs equals one minus the proportion shared expenditures. Thus it also equals the insurer's portion of the efficiency gain if the costs for each member is reduced by a certain percentage. Therefore, for small costs intervals, risk sharing for high-risks remains preferable above risk sharing for high-costs. For instance, if the length of the cost intervals is Dfl. 1,000 and risk sharing for high costs for 1% of the members is considered, the implicit threshold is lower than Dfl. 30,000 (see Table 7.1). Therefore the weighted expenditures measure is lower than 0.77 (see Table 7.5) and the reduction of incentives for selection is 0.59. Risk sharing for high risks for 4% of the members yields similar incentives for efficiency (see Table 7.3), but the reduction of incentives for selection then is 0.64 (see Table 7.2).

However, if the length of the cost interval is larger, risk sharing for high costs may become preferable above risk sharing for high risks. For instance, if the length of the cost interval is Dfl. 10,000 and risk sharing for high costs for 1% of the members is considered, the implicit threshold is about Dfl. 30,000, the weighted expenditures measure is about 0.85, and the reduction of incentives for selection is 0.59. Risk sharing for high risks for less than 2% of the members yield similar incentives for efficiency (see Table 7.3). In that case the reduction of incentives for selection is lower than 0.57 (see Table 7.2).
Thus with the weighted expenditures measure as an overall indicator of incentives for efficiency, which form of risk sharing yields the best selection-efficiency tradeoff depends on the assumption how quickly an insurer recalculates its incentives for efficiency with respect to a member after some expenditures have occurred.

Generally speaking this section showed that risk sharing for high risks and risk sharing for high costs yield a better tradeoff between selection and efficiency than either outlier risk sharing or proportional risk sharing.

7.3 Selection of subgroups

This section analyzes an insurer's incentives to attract or deter specific subgroups under the assumption that the regulator wants to retain an overall level of 80% for an insurer's incentives for efficiency[35]. The easiest way to achieve this level of efficiency is to apply *proportional risk sharing* with a weight of 0.2 on actual costs. This reduces the predictable profits and losses for each subgroup by 20%. As alternatives the regulator may apply *risk sharing for high-risks* for 3% of the members, *risk sharing for high-costs* for 0.5% of the members or *outlier risk sharing* with a threshold of Dfl. 40,000 (see Table 7.3).

[35] The appendix shows additional results under the assumption that the regulator wants to retain 65% of the overall incentives for efficiency.

Table 7.6 Mean result in 1993 for subgroups formed on the basis of certain costs in 1991

	N (%)	DEMO	RSHR (3%)	RSHC (0.5%)	ORS (40,000)	PRS (0.2)
Total cost 1991						
0	14.3	883	662	661	768	706
1-2,164	75.7	266	83	132	191	213
2,165-4,651	5	-1,843	-1,524	-1,484	-1,708	-1,474
4,652-17,918	4	-2,978	-1,371	-2,098	-2,504	-2,382
>17,918	1	-11,673	-2,684	-3,679	-6,899	-9,338
Prescribed drugs 1991						
0	28.4	711	516	514	614	569
1-619	61.5	231	77	118	166	185
620-1,098	5	-1,574	-1,471	-1,106	-1,405	-1,259
1,099-2,451	4	-3,633	-2,152	-2,635	-3,045	-2,906
>2,451	1	-12,118	-3,470	-5,894	-8,526	-9,694
Paramedical services 1991						
0	83	212	130	152	178	170
1-336	7	-491	-407	-424	-482	-393
337-621	5	-694	-427	-418	-503	-555
622-1,532	4	-1,063	-820	-939	-1,033	-850
>1,532	1	-6,403	-2,540	-3,791	-4,722	-5,122

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing. All results are statistically significantly different from zero, two-sided t-test, $p<0.05$.

Although the previous section showed that risk sharing for high-risks then yields the greatest reduction of the overall predictable profits and losses, the results may be different with respect to different subgroups. Table 7.6 shows the

predictable profits and losses for the subgroups formed on the basis of certain costs in 1991. For instance, for those with the highest costs in 1991, the mean predictable loss is reduced to Dfl. 2,684 under risk sharing for high-risks, to Dfl. 3,679 under risk sharing for high-costs and to Dfl. 6,899 under outlier risk sharing. Under proportional risk sharing the predictable loss is Dfl. 9,338. Similar results are found for those with the highest costs for prescribed drugs in 1991 and for those with the highest costs for paramedical services in 1991.
For those without any costs in 1991 or those without costs for prescribed drugs or paramedical services, risk sharing for high risks and risk sharing for high costs yield similar remaining profits. These profits are lower than those under outlier risk sharing or proportional risk sharing.

Table 7.7 shows the subgroups formed on the basis of prior hospitalization data. For instance for those who were hospitalized in at least three of the four preceding years, the remaining predictable loss under risk sharing for high risks is about Dfl. 2,600. Under risk sharing for high costs the remaining loss is about Dfl. 5,100. Under outlier risk sharing it is about Dfl. 8,100 and under proportional risk sharing Dfl. 9,900.

Table 7.8 shows the consequences for subgroups formed on the basis of health survey data. For almost all subgroups with people that suffer from certain chronic conditions, risk sharing for high-risks as well as risk sharing for high costs lead to larger reductions of the predictable losses than either outlier risk sharing or proportional risk sharing. For instance, for those suffering from a serious heart disease, risk sharing for high risks reduces the mean predictable loss to about Dfl. 1,900 and risk sharing for high costs reduces it to about Dfl. 2,000. Under outlier risk sharing and under proportional risk sharing, the remaining loss is about Dfl. 3,400. For those suffering from cancer, risk sharing for high-risks reduces the mean predictable loss to about Dfl. 1,200 and risk sharing for high-costs to Dfl. 2,000. Under outlier risk sharing the remaining loss is about Dfl. 3,500 and under proportional risk sharing it is Dfl. 4,500. For those without any chronic condition, risk sharing for high risks reduces the predictable profit to about Dfl. 320 and risk sharing for high costs reduces it to Dfl. 380. The profits after outlier risk sharing and proportional risk sharing are

about Dfl. 450 and Dfl. 420 respectively.

Table 7.7 Mean result in 1993 for subgroups formed on the basis of hospital admissions and diagnostic cost groups in previous years

	N (%)	DEMO	RSHR (3%)	RSHC (0.5%)	ORS (40,000)	PRS (0.2)
DCG in 1992						
0	93.3	305	80	156	224	244
1	2.3	-1,395	-781	-866	-1,173	-1,116
2	1.8	-4,179	-1,472	-2,344	-3,160	-3,343
3	0.9	-10,694	-1,382	-4,425	-7,420	-8,555
4+5	0.2	-22,601	-1,734	-7,546	-12,391	-18,081
Unknown[a]	1.5	-2,828	-947	-1,989	-2,430	-2,262
Highest DCG in the period 1989-1992						
1	8.3	-417	-474	-414	-436	-334
2	5.6	-1,584	-1,114	-1,133	-1,418	-1,267
3	3.1	-5,732	-1,694	-2,614	-4,060	-4,586
4+5	0.4	-12,159	-2,803	-5,090	-7,412	-9,727
Unknown[a]	2.8	-623	-465	-673	-680	-498
No. years with hospitalization in the period 1989-1992						
0	79.8	468	226	281	371	374
1	15.5	-812	-620	-640	-755	-650
2	3.7	-3,262	-1,558	-1,959	-2,575	-2,610
3 or 4	1	-12,398	-2,593	-5,088	-8,143	-9,918

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing. All results are statistically significantly different from zero, two-sided t-test, $p<0.05$.

[a]) These persons were hospitalized but the diagnosis is not available.

Table 7.8 Mean result in 1993 for subgroups formed on the basis of health survey data

	N (%)	DEMO	RSHR (3%)	RSHC (0.5%)	ORS (40,000)	PRS (0.2)
Presence of chronic conditions						
None	61.1	523	322	375	451	418
At least one	38.9	-820	-504	-586	-708	-656
Asthma	5.0	-1,408	-1,187	-1,305	-1,428	-1,127
Heart disease	1.8	-4,330	-1,874	-2,034	-3,424	-3,464
Hypertension	6.9	-1,123	-322*	-538	-775	-899
Diabetes	1.7	-2,895	-1,617	-1,752	-2,398	-2,316
Arthrosis	6.3	-755*	-599	-770	-787	-604*
Rheumatism	2.9	-1,411*	-833	-1,072	-1,176	-1,129*
Cancer	1.2	-5,602	-1,205*	-1,954	-3,469	-4,482
Use of home help ór nursing						
No	95.1	178	81	82	126	142
Yes	4.9	-3,487	-1,589	-1,608	-2,479	-2,790
Use of alternative practitioner						
No	90.8	49*	55*	66	58*	39*
Yes	9.2	-475	-529	-637	-553	380
Education						
Low	58.3	-50*	-44*	-42*	-50*	-40*
Medium	28.0	37*	31*	23*	32*	30*
High	10.3	249	138	118*	192	199
Unknown	3.4	-209*	91*	172*	10*	-167*

N=10,553. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

*) The mean result is not statistically significantly different from zero, two-sided t-test, $p > 0.05$.

Similar results are found for the subgroups formed on the basis of the use of home care. For the subgroups formed on the basis of the consultation of an alternative practitioner, the profits and losses are hardly changed by risk sharing.
For the subgroups formed on the basis of education, the profits and losses do not differ statistically significantly from zero in most cases.

Summarizing the results support the conclusion of the previous section that, given a certain overall level of incentives for efficiency, risk sharing for high risks and risk sharing for high costs yield greater reductions of incentives for selection than either outlier risk sharing or proportional risk sharing.

7.4 Efficiency for types of care or for subgroups

This section analyzes an insurer's incentives to improve efficiency for different types of care or for different subgroups of insureds under the assumption that the regulator wants to reduce the overall incentives for selection by 50% in comparison with flat capitation payments[36]. The easiest way to achieve this is to supplement the demographic capitation payments with *proportional risk sharing* with a weight of 0.3 on actual costs[37]. This reduces the incentives for efficiency by 30% irrespective of the types of care or the subgroups of members. Instead of proportional risk sharing the regulator may apply *risk sharing for high-risks* for about 1.5% of the members, *risk sharing for high-costs* for 0.5% of the members ór *outlier risk sharing* with a threshold of Dfl. 20,000 (see Table 7.2). Although section two showed that risk sharing for high risks yields the smallest reduction of the overall incentives for efficiency, the results may be different for different types of care or different subgroups.

[36] The appendix shows additional results under the assumption that the regulator wants to reduce incentives for selection by about 70% in comparison with flat capitation payments.

[37] This weight (a) was found by solving the following equation: $0.5=0.31-a*(1-0.31)$, where 0.31 is the reduction already achieved by using the demographic model and 0.5 is the desired reduction after proportional risk sharing has been added to the demographic model.

Table 7.9 shows the insurer's portion of the efficiency gain under the assumption that the costs for the type of care involved are reduced by 10%. This percentage is based on chapter four. Under risk sharing for high-risks the insurer keeps 83% of the efficiency gains with respect to hospital and specialist care. Under risk sharing for high-costs or outlier risk sharing, the insurers' portion of the efficiency gain is 72% and 52% respectively.

Table 7.9 Insurer's portion of a ten percent efficiency gain for specific types of care

	RSHR (1.5%)	RSHC (0.5%)	ORS (20,000)	PRS (0.3)
Hospital and specialists care	0.83	0.72	0.52	0.70
Prescribed drugs	0.90	0.94	0.88	0.70
Paramedical services	0.93	0.98	0.92	0.70

N=47,210. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

If the insurer reduces the costs for prescribed drugs or paramedical services by 10%, the insurer's portion of this efficiency gain is highest under risk sharing for high-costs: 94% and 98% respectively. For the other forms of risk sharing, the insurer also keeps a high percentage of the efficiency gain. Therefore these variants of risk sharing hardly seem to influence an insurer's incentives for efficiency with respect to prescribed drugs and paramedical services.

Table 7.10 shows the insurer efficiency gain if the costs of some subgroups are reduced by 20%. This figure is based on chapter four. Risk sharing for high-costs yields the largest insurer's portions of the efficiency gain and outlier risk sharing the smallest. For instance of the savings on those suffering from diabetes, the insurer keeps 89% under risk sharing for high-costs, 71% under risk sharing for high-risks and 57% under outlier risk sharing.
Except for those that suffer from cancer or a serious heart disease, risk sharing

for high-risks and risk sharing for high-costs retain more incentives for efficiency than proportional risk sharing. For all subgroups outlier risk sharing performs worse than proportional risk sharing. Therefore it can be concluded that for many subgroups that an insurer may choose for the application of disease management principles, the insurer's portion of the efficiency gain under risk sharing for high risks or for high costs is higher than under outlier risk sharing or proportional risk sharing.
The Table also shows the potential consequences of avoiding discretionary hospital admissions. The definition of a discretionary hospital admission is based on Lamers (1998). She defined high discretion diagnoses as those for which day case treatment may be an acceptable alternative for hospital admission. For persons that are put into a diagnostic cost group because they were hospitalized with a discretionary diagnosis, it is assumed that their total costs could have been reduced by 20% if the hospitalization in question had been avoided[38]. The results of this simulation are similar to those of a uniform reduction of hospital and specialist care. An explanation is that discretionary hospital admissions apparently are as predictable and/or expensive as other hospital admissions.

Summarizing this section confirms that, given an overall level of incentives for selection, risk sharing for high risks and risk sharing for high costs retain more incentives for efficiency than either outlier risk sharing or proportional risk sharing.

[38] The reduction of 20% could not be based on findings in the literature review in chapter three. Therefore, as a sensivity analysis, this simulation has also been performed with reductions of 10% and 30%. This yielded similar results as those presented in Table 7.10.

Table 7.10 Insurer's portion of a twenty percent efficiency gain for specific subgroups

	RSHR (1.5%)	RSHC (0.5%)	ORS (20,000)	PRS (0.3)
Asthma	0.87	0.98	0.70	0.70
Heart disease	0.68	0.76	0.41	0.70
Hypertension	0.70	0.77	0.61	0.70
Diabetes	0.71	0.89	0.57	0.70
Arthrosis	0.84	0.89	0.68	0.70
Rheumatism	0.80	0.99	0.68	0.70
Cancer	0.47	0.65	0.38	0.70
Avoiding discr. hosp.[a]	0.81	0.75	0.54	0.70

N=10,553. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.
[a]) Under the assumption that the costs for members with a discretionary hospital admission are reduced by 20%.

7.5 Conclusions

This chapter analyzed the reduction of the incentives for selection and efficiency if the regulator employs various forms of risk sharing as a supplement to demographic capitation payments. For each of the four forms as described in chapter three, several variants were simulated by varying the relevant parameter[39]. The main conclusion is that *risk sharing for high risks* and *risk sharing for high costs* yield better tradeoffs between incentives for selection and efficiency than either *outlier risk sharing* or *proportional risk sharing*.
Given a certain overall level of incentives for efficiency, risk sharing for high risks and risk sharing for high costs yield greater reductions of the predictable

[39] Remember that for the empirical illustrations of risk sharing for high risks, it is assumed that an insurer designates those members with the highest costs in the previous year.

profits and losses. This can be illustrated by the following results. Without risk sharing the mean predictable loss for non-preferred risks was about Dfl. 2,150. If the regulator wants to retain 80% of the incentives for efficiency, it may apply proportional risk sharing with a weight of 20% on the actual costs. This reduces the mean predictable loss to about Dfl. 1,700. The regulator may also apply risk sharing for high risks for 3% of the members, risk sharing for high costs for 0.5% of the members or outlier risk sharing with a threshold of Dfl. 40,000. The latter variant yielded a similar predictable loss for the non-preferred risks as proportional risk sharing. However, the predictable loss under risk sharing for high risks or risk sharing for high costs is lower: about Dfl. 1,200 and Dfl. 1,500 respectively. For preferred risks, the results are similar. The mean predictable profit without risk sharing is about Dfl. 660. Under proportional risk sharing and outlier risk sharing, it is about Dfl. 530 and Dfl. 550 respectively. Risk sharing for high risks and risk sharing for high costs yielded a greater reduction of the predictable profit. The remaining profit was about Dfl. 380 and Dfl. 450 respectively.
In a similar manner, given a certain overall level of incentives for selection, risk sharing for high risks and risk sharing for high costs retain more incentives for efficiency than either outlier risk sharing or proportional risk sharing. This can be illustrated by the following findings. If the regulator wants to reduce the overall incentives for selection to 50% of those under flat capitation payments, it may supplement the demographic capitation payments with proportional risk sharing with a weight of 30% on actual costs. This reduces the incentives for efficiency by 30% irrespective of the type of care or the subgroups involved. The regulator may also apply risk sharing for high risks for 1.5% of the members, risk sharing for high costs for 0.5% of the members or outlier risk sharing with a threshold of Dfl. 20,000. An insurer's incentives for reducing the expenditures for hospital and specialists care appeared to be highest in the case of risk sharing for high risks and risk sharing for high costs. Under these forms of risk sharing, an insurer keeps about 83% and 72% of the efficiency gains respectively. Under outlier risk sharing the insurer keeps 52% only.

Given that some countries currently apply demographic capitation payments without any form of risk sharing whereas others supplement them with outlier

risk sharing or proportional risk sharing, the policy relevance of these findings is that these countries may improve their payment system for competing health insurers either by implementing a form of risk sharing or by changing their form of risk sharing.

The results of *risk sharing for high risks* in comparison with *risk sharing for high costs* are mixed. There seem to be two main advantages of risk sharing for high risks in comparison with risk sharing for high costs. First, given an overall level of incentives for efficiency, it yields greater reductions of the large predictable losses for those with high prior costs, with many prior hospital admissions and with serious chronic conditions. Second, given an overall level of incentives for selection, it retains more incentives for efficiency with respect to hospital and specialists care and with respect to members that have unpredictable high expenditures. The main disadvantage of risk sharing for high risks in comparison with risk sharing for high costs is that, for limited extents of risk sharing, it retains less incentives for efficiency with respect to several subgroups that could be selected for the application of disease management principles. Therefore regulators that try to optimize the tradeoff between selection and efficiency have to ask themselves: how do we value an overall reduction of incentives for selection ór efficiency in comparison with specific reductions? The answer to this question may depend on the tools for selection and efficiency that insurers are supposed to have, the potential gains of selection and efficiency for an insurer, and the (negative) effects if tools for selection and efficiency are employed.

Appendix chapter 7

Additional results section 7.2

In the empirical analyses the risk sharing is financed via a proportional reduction of the normative costs. Table A.7.1 shows the mean result for some subgroups based on demographic variables. Without risk sharing and under *proportional risk sharing*, the mean result for these subgroups is zero.

Table A.7.1 Mean result in 1993 for subgroups formed on the basis of demographic variables

	RSHR (3%)	RSHC (0.5%)	ORS (40,000)	RSHR (8%)	RSHC (1.6%)	ORS (20,000)
Age						
5-19	-38*	-53	-26*	-67	-125	-71
20-34	-89	-83	-51	-106	-185	-107
35-49	8*	-47*	-10*	6*	-87	-54*
50-64	153	49*	45*	204	124	70*
65-74	92*	288	136*	154*	391	251
>=75	-5*	204*	57*	-56*	678	374
Disabled						
No	-38*	-23*	-15*	-45	-34	-23
Yes	517	317	199*	600	465	312

N=47,210.

*) Not statistically significantly different from zero (two-sided t-test, $p<0.05$). For subgroups formed on the basis of gender or degree of urbanization, the mean results were not statistically significantly different from zero.

The Table clearly shows that these forms of risk sharing may introduce some selection problems that are not present without risk sharing or under proportional risk sharing, given that the risk sharing is financed via a uniform percentage of the normative costs. For disabled persons and persons of 35 years or

older, insurers will be overpaid whereas for others they will be underpaid. Generally speaking the extent of the overpayment is small and for some age-groups not statistically significantly different from zero. If the regulator wants to retain the mean result for the subgroups in Table A.7.1 at zero, it has to use a more refined financing mechanism for the risk pool (i.e. such that risk sharing is budget-neutral for each of these subgroups).

Suppose that insurers are aware of the new opportunities to select if the risk sharing is financed via a uniform percentage of the normative costs. Then the overall indicator of incentives for selection as applied in this chapter may have yielded an overestimation of the reduction of the incentives for selection. In the main text, it is assumed that an insurer distinguishes (non)-preferred risks by comparing its own cost predictions for its members with the cost predictions that are made by the regulator. Subsequently we looked at the profits and losses for preferred risks and non-preferred risks respectively. The division into (non)-preferred risks was kept the same when risk sharing was introduced. However, under *risk sharing for high risks* or *outlier risk sharing*, an insurer may redefine its (non)-preferred risks[40]. Following this approach gave the results of Table A.7.2. These results were calculated as follows:

- It is assumed that the costs predicted by the regulator for each individual are not changed by the introduction of risk sharing.
- The estimation of the selection model by the insurer is changed such that it takes into account the applied form and variant of risk sharing. Under risk sharing for high risks, the members that are designated for risk sharing are not included in the estimation of the model. These members are labelled non-preferred risks because it is assumed that the insurer has to pay a percentage of their normative costs to the regulator. Under outlier risk sharing the dependent variable is truncated at the threshold value.
- It is assumed that the insurer perfectly predicts the percentage of the normative costs that it has to pay for the risk sharing and that the insurer lowers the predicted costs by the regulator for each individual by this percentage.
- Subsequently it is assumed that the insurer defines preferred risks as those for

[40] Under risk sharing for high costs, it seems hard for an insurer to redefine its preferred and non-preferred risks.

whom the cost prediction based on its selection model is lower than the predicted costs by the regulator. For non-preferred risks, the opposite holds.
- Finally the mean result for the (non)-preferred risks is calculated as well as the reduction of the incentives for selection in comparison with flat capitation payments.

Table A.7.2 Overall reduction of incentives for selection

RSHR (p)	1%	2%	3%	4%
Indicator in the main text	0.49	0.57	0.61	0.64
With redefining (non)-preferred risks	0.45	0.50	0.52	0.55
ORS (T)	40,000	30,000	20,000	10,000
Indicator in the main text	0.43	0.46	0.52	0.62
With redefining (non)-preferred risks	0.45	0.49	0.54	0.65

N=47,210. RSHR=demographic model + risk sharing for high risks. ORS=demographic model + outlier risk sharing.

The conclusion is that the reduction of the incentives for selection may have been overestimated slightly in the case of *risk sharing for high risks*, but not in the case of *outlier risk sharing*. Moreover this overestimation does not affect the main conclusions of this chapter[41].

Additional results section 7.3
Suppose that the regulator wants to retain about 65% of the incentives for efficiency. Then it may apply proportional risk sharing with a weight of 0.35 on actual costs. The regulator may also apply risk sharing for high-risks for 8% of the members, risk sharing for high-costs for 1.6% of the members or outlier

[41] Nevertheless the usefulness of a refined financing mechanism for the risk pool may increase if demographic capitation payments are improved by including more and better risk adjusters in the capitation formula.

risk sharing with a threshold of Dfl. 20,000. Tables A.7.3 through A.7.5 show the consequences of these risk sharing variants for the incentives to attract or deter certain subgroups. Roughly speaking the results are similar to those presented in the main text. Thus the conclusion in section 7.3 does not seem to depend on the extent of the risk sharing.

Table A.7.3 Mean result in 1993 for subgroups formed on the basis of certain costs in 1991

	N (%)	DEMO	RSHR (8%)	RSHC (1.6%)	ORS (20,000)	PRS (0.35)
Total cost 1991						
0	14.3	883	568	545	667	574
1-2,164	75.7	266	14*	68	134	173
2,165-4,651	5	-1,843	-927	-1,249	-1,506	-1,198
4,652-17,918	4	-2,978	-735	-1,214	-1,939	-1,936
>17,918	1	-11,673	-1,591	-1,839	-4,571	-7,587
Prescribed drugs 1991						
0	28.4	711	428	404	519	462
1-619	61.5	231	17*	56	114	150
620-1,098	5	-1,574	-1,192	-854	-1,125	-1,023
1,099-2,451	4	-3,633	-1,478	-1,828	-2,504	-2,361
>2,451	1	-12,118	-1,356	-3,379	-6,162	-7,877
Paramedical services 1991						
0	83	212	89	114	151	138
1-336	7	-491	-271	-384	-436	-319
337-621	5	-694	-343	-325	-440	-451
622-1,532	4	-1,063	-609	-709	-907	-691
>1,532	1	-6,403	-1,312	-2,294	-3,634	-4,162

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

*) The mean result is not statistically significantly different from zero, two-sided t-test, $p>0.05$.

Table A.7.4 Mean result in 1993 for subgroups formed on the basis of hospital admissions and diagnostic cost groups in previous years

	N (%)	DEMO	RSHR (8%)	RSHC (1.6%)	ORS (20,000)	PRS (0.35)
DCG in 1992						
0	93.3	305	52	88	161	198
1	2.3	-1,395	-479	-676	-963	-907
2	1.8	-4,179	-845	-1,286	-2,301	-2,716
3	0.9	-10,694	-1,039	-2,233	-4,914	-6,951
4+5	0.2	-22,601	-767	-2,502	-7,663	-14,691
Unknown	1.5	-2,828	-731	-1,231	-1,897	-1,838
Highest DCG in the period 1989-1992						
1	8.3	-417	-401	-414	-426	271
2	5.6	-1,584	-743	-705	-1,111	-1,030
3	3.1	-5,732	-1,117	-1,374	-2,842	-3,726
4+5	0.4	-12,159	-1,620	-2,274	-4,956	-7,903
Unknown	2.8	-623	-442	-577	-645	-405
No. years with hospitalization in the period 1989-1992						
0	79.8	468	161	183	287	304
1	15.5	-812	-512	-476	-641	-528
2	3.7	-3,262	-1,021	-1,231	-1,977	-2,120
3 or 4	1	-12,398	-1,070	-2,584	-5,480	-8,059

N=47,210. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing. All results are statistically significantly different from zero, two-sided t-test, $p<0.05$.

Table A.7.5 Mean result in 1993 for subgroups formed on the basis of health survey data

	N (%)	DEMO	RSHR (8%)	RSHC (1.6%)	ORS (20,000)	PRS (0.35)
Presence of chronic conditions						
None	61.1	523	253	277	380	340
At least one	38.9	-820	-397	-434	-596	-533
Asthma	5.0	-1,408	-727	-1,023	-1,278	-915
Heart disease	1.8	-4,330	-1,727	-978	-2,269	-2,815
Hypertension	6.9	-1,123	-216*	-374	-615	-730
Diabetes	1.7	-2,895	-964*	-1,354	-1,834	-1,882
Arthrosis	6.3	-755*	-370*	-423	-704	-490*
Rheumatism	2.9	-1,411*	-429*	-860	-1,069	-917*
Cancer	1.2	-5,602	-974*	-1,369	-2,418	-3,642
Use of home help ór nursing						
No	95.1	178	58	43*	109	115
Yes	4.9	-3,487	-1,133	-837	-1,714	-2,267
Use of alternative practitioner						
No	90.8	49*	43*	57*	59*	32*
Yes	9.2	-475	-412	-545	-572	-309
Education						
Low	58.3	-50*	-25*	4*	-32*	-33*
Medium	28.0	37*	19*	-58*	4*	24*
High	10.3	249	104*	48*	129*	162
Unknown	3.4	-209*	-38*	263*	134*	-136*

N=10,553. DEMO=demographic model. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

*) The mean result is not statistically significantly different from zero, two-sided t-test, $p > 0.05$.

Additional results section 7.4

Suppose the regulator wants to reduce incentives for selection by about 70% in comparison with flat capitation payments. To achieve this it may apply demographic capitation payments supplemented with proportional risk sharing with a weight of about 0.6 on actual costs[42]. The regulator may also apply risk sharing for high-risks for 8% of the members, risk sharing for high-costs for 4% of the members or outlier risk sharing with a threshold of Dfl. 5,000. Table A.7.6 and A.7.7 show the consequences of these risk sharing variants for an insurer's incentives to improve efficiency for specific types of care or for specific subgroups.

Table A.7.6 Insurer's portion of a ten percent efficiency gain for specific types of care

	RSHR (8%)	RSHC (4%)	ORS (5,000)	PRS (0.57)
Hospital and specialists care	0.63	0.30	0.20	0.43
Prescribed drugs	0.66	0.79	0.66	0.43
Paramedical services	0.71	0.85	0.69	0.43

N=47,210. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

Roughly speaking the results are similar to those presented in the main text. A minor difference is that in Table A.7.7 the insurer's portion of the efficiency gain under risk sharing for high risks is now generally higher than under risk sharing for high costs. Thus the conclusion that, given an overall level of incentives for selection, risk sharing for high costs retains more incentives for efficiency with respect to several subgroups seems only true for limited extents of risk sharing.

[42] This weight (a) was found by solving the following equation: $0.7=0.31-a*(1-0.31)$, where 0.31 is the reduction already achieved by using the demographic model and 0.7 is the desired reduction after proportional risk sharing has been added to the demographic model.

Table A.7.7 Insurer's portion of a twenty percent efficiency gain for specific subgroups

	RSHR (8%)	RSHC (4%)	ORS (5,000)	PRS (0.57)
Asthma	0.52	0.48	0.35	0.43
Heart disease	0.39	0.26	0.16	0.43
Hypertension	0.47	0.39	0.31	0.43
Diabetes	0.37	0.33	0.27	0.43
Arthrosis	0.53	0.47	0.31	0.43
Rheumatism	0.44	0.47	0.30	0.43
Cancer	0.22	0.17	0.13	0.43
Avoiding discr. hosp.[a]	0.58	0.24	0.10	0.43

N=10,553. RSHR=demographic model + risk sharing for high-risks. RSHC=demographic model + risk sharing for high-costs. ORS=demographic model + outlier risk sharing.

[a]) Under the assumption that the costs for members with a discretionary hospital admission are reduced by 20%.

8. Prior costs as an additional risk adjuster

This chapter studies prior costs as an additional risk adjuster next to those of the demographic model[43]. The results are compared with those of the four forms of risk sharing as a supplement to demographic capitation payments as presented in the previous chapter. Section 8.1 starts with a comparison of the total costs in the previous year as an additional risk adjuster with proportional risk sharing. Subsequently the costs in the previous year as far as these costs are above a certain threshold is used as an additional risk adjuster. By varying the threshold several variants of this risk adjuster are simulated. Although this risk adjuster clearly reduces an insurer's incentives for efficiency, previous studies did not analyze this effect. Section 8.2 presents the overall indicators of incentives for selection and efficiency. Section 8.3 compares prior costs as a risk adjuster with outlier risk sharing and proportional risk sharing. Section 8.4 compares prior costs as a risk adjuster with risk sharing for high risks and risk sharing for high costs. Section 8.5 contains the conclusions.

8.1 A prior cost model versus proportional risk sharing

The most simple way to include prior costs as a risk adjuster is to add the total costs in the previous year as an independent variable to the demographic model. Such a prior cost model has been estimated with the available data. The estimated coefficients can be found in the appendix (Table A.8.1). The R^2-value of the prior cost model was 0.197 and the mean absolute result was Dfl. 2,000. Table 8.1 shows the mean absolute predicted result as well as the mean result for (non)-preferred risks. Because the estimated coefficient of prior costs is about 0.41, the results are compared with those of proportional risk sharing with a weight of 41% on actual expenditures. Irrespective of the types of care or the subgroups, the insurer's portion of any efficiency gain will be 0.59 for both payment systems. So, roughly speaking, the incentives for efficiency are

[43] The main findings of this chapter can also be found in Van Barneveld et al. (1999c).

reduced to about 60% in comparison with flat capitation payments.

Table 8.1 Mean absolute predicted result and mean result for (non)-preferred risks

	DEMO	PC	PRS (0.41)
MAPR	982	358	579
Reduction[a]	0.34	0.76	0.61
Preferred risks	661	119	390
Non-pref. risks	-2,152	-386	-1,270
Reduction[a]	0.31	0.88	0.59

N=47,210. DEMO=demographic model. PC=prior cost model. PRS=demographic model + proportional risk sharing. MAPR=mean absolute predicted result. Preferred risks are those members for whom the cost prediction based on the selection model is lower than that of the demographic model. Others are non-preferred risks.
[a]) Reduction in comparison with flat capitation payments.

The mean absolute predicted result for the prior cost model is Dfl. 358. This is a reduction of about 76% in comparison with flat capitation payments.
Supplementing the demographic model with proportional risk sharing yields a mean absolute result of Dfl. 579. This is a reduction of 61% only.
The mean result for (non)-preferred risks as an overall indicator of incentives for selection gives similar results. The mean profit for preferred risks under the prior cost model is Dfl. 119 and the mean loss on non-preferred risks is Dfl. 386. This is a reduction of about 88% in comparison with flat capitation payments. The demographic model supplemented with proportional risk sharing yields a reduction of these predictable profits and losses of 59% only.

Figure 8.1 summarizes the overall results in a graph. The x-axis shows the reduction of the mean absolute predicted result and the y-axis the insurer's portion of an efficiency gain. The graph strongly suggests that given the level of incentives for efficiency (about 60% in comparison with flat capitation pay-

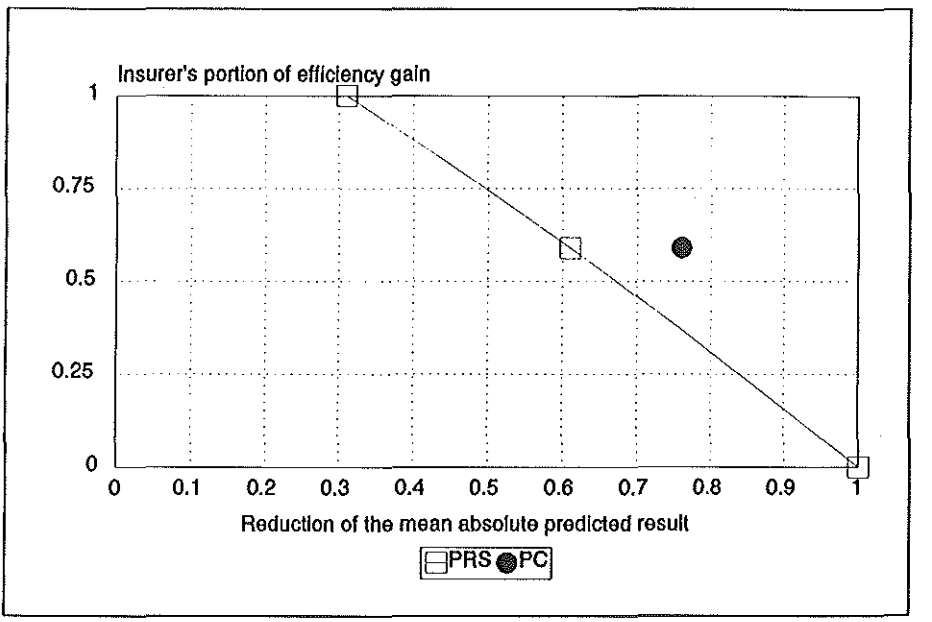

Figure 8.1 Overall results for the prior cost model and proportional risk sharing

ments), prior costs as a risk adjuster reduces the incentives for selection more than proportional risk sharing. An explanation is that prior costs are more strongly correlated with potential selection tools of an insurer than actual costs.

Let us now look at some subgroups that might be attracted or deterred by an insurer (Table 8.2). For those without any costs for prescribed drugs in 1991, the mean profit in 1993 was about Dfl. 710 for demographic capitation payments. If the total costs in the previous year are included as risk adjuster, the remaining profit is about Dfl. 350. If proportional risk sharing is used as a supplement to the demographic capitation payments, the remaining profit is higher, namely Dfl. 420.
For the group of 1% with the highest expenditures for prescribed drugs in 1991, the mean loss under the prior cost model is about Dfl. 6,400. Under proportional risk sharing it is about Dfl 7,150.

Table 8.2 Mean result in 1993 for several subgroups

	N (%)	DEMO	PC	PRS (0.41)
Prescribed drugs in 1991				
0	28.4	711	352	420
1-619	61.5	231	118	136
620-1,098	5	-1,574	-787	-929
1,099-2,451	4	-3,633	-1,743	-2,144
>2,451	1	-12,118	-6,394	-7,149
No. of years with hospitalization in the period 1989-1992				
0	79.8	468	52	276
1	15.5	-812	87*	-479
2	3.7	-3,262	10*	-1,924
3 ór 4	1	-12,398	-5,418	-7,315
Presence of chronic conditions[a]				
None	61.1	523	252	309
At least one	38.9	-820	-352	-484
Asthma	5.0	-1,408	-635*	-831
Heart disease	1.8	-4,330	-1,316*	-2,555
Diabetes	1.7	-2,895	-1,387*	-1,708
Cancer	1.2	-5,602	-2,550*	-3,306
Use of home care[a]				
No	95.1	178	82	105
Yes	4.9	-3,487	-1,260*	-2,057

N=47,210. DEMO=demographic model. PC=prior cost model. PRS=demographic model + proportional risk sharing.

a) N=10,553.

*) The mean result is not statistically significantly different from zero (two-sided t-test, $p>0.05$).

For those that were not hospitalized in the previous four years, the predictable profit when employing demographic capitation payments was about Dfl. 470. The prior cost model reduces this profit to about Dfl. 50. The remaining profit under proportional risk sharing is about Dfl. 280.
For those with a hospitalization in at least three of the four preceding years, the predictable loss is about Dfl. 12,000 when using demographic capitation payments.
For the prior cost model and for the demographic model supplemented with pro-portional risk sharing, the predictable losses are about Dfl. 5,400 and Dfl. 7,300 respectively. Similar results are found for the subgroups formed on the basis of the health survey data.

Summarizing the inclusion of the total costs in the previous year as an additional risk adjuster next to demographic variables yields a better tradeoff between selection and efficiency than supplementing demographic capitation payments with proportional risk sharing.

In the remainder of this chapter the total costs in the previous year are included as far as these costs are above a certain threshold. By varying the threshold the level of incentives for selection and efficiency can be varied. Subsequently the results of prior costs as a risk adjuster will be compared with those of the four forms of risk sharing as studied in the previous chapter.

8.2 Overall results

This section presents the overall indicators of incentives for selection and efficiency for prior cost models with varying thresholds. Four different threshold values are employed: Dfl. 40,000, Dfl. 20,000, Dfl. 10,000 and Dfl. 5,000. Moreover the results are compared with those of the demographic model and the prior cost model without a threshold (i.e. T=Dfl. 0) as studied in the previous section.

8.2.1 Incentives for selection

Table 8.3 presents the (weighted) mean absolute result. The R^2-values and the mean absolute results are given in the appendix (Table A.8.2). The mean absolute predicted result is Dfl. 830 if the threshold is Dfl. 40,000. The lower the threshold, the lower is the mean absolute predicted result. If the threshold is Dfl. 5,000, the mean absolute predicted result is Dfl. 546. The Table also shows an example of the weighted mean absolute predicted result. In this example predictable profits and losses that are smaller than 20% of the costs predicted by the selection model are assumed to be irrelevant for selection. The weighted mean absolute predicted result varies between Dfl. 253 for the prior cost model and Dfl. 946 for the demographic model. Under the assumption that the weighing is right, the Table shows the overestimation of incentives for selection if the mean absolute predicted result is used as an indicator instead of the weighted mean absolute predicted result.

Table 8.3 (Weighted) mean absolute result for several prior cost models

Model	MAPR	WMAPR $\alpha_1=\alpha_2=20\%$[a]	Overestimation Absolute	Relative
DEMO	982	946	36	3.8%
PC(40,000)	830	783	47	5.7%
PC(20,000)	726	671	55	8.2%
PC(10,000)	611	539	72	13.4%
PC(5,000)	546	465	81	17.4%
PC(0)	358	253	105	41.5%

N=47,210. Before estimating the models, the costs in 1992 have been multiplied by a factor such that the overall mean costs in 1992 equal those in 1993. MAPR=mean absolute predicted result. WMAPR=weighted mean absolute predicted result. DEMO=demographic model. PC(T)=prior cost model with a threshold of Dfl. T.

[a]) Small predictable profits and losses are defined as those predictable profits and losses that are smaller than α_1% and α_2% of the predicted costs based on the selection model.

It shows that the overestimation - whether expressed in absolute or in relative terms - is higher as the capitation model increases in predictive power. This suggests that especially in the case of relatively good capitation formulae, the problem of selection is seriously overestimated by the conventional ways of measuring incentives for selection.

Because the mean absolute predicted result is not available for the forms of risk sharing, Table 8.4 shows the mean result for (non)-preferred risks. With this indicator of incentives for selection, the prior cost models can be made comparable to the forms of risk sharing.

Table 8.4 Mean result for (non)-preferred risks and the reduction of the incentives for selection in comparison with flat capitation payments

	N (%)	DEMO	PC (40,000)	PC (20,000)	PC (10,000)	PC (0)
Preferred	76.5	661	549	476	384	119
Non-pref.	23.5	-2,152	-1,785	-1,548	-1,250	-386
Reduction[a]		0.31	0.43	0.51	0.60	0.88

N=47,210. DEMO=demographic model. PC=prior cost model. Preferred risks are defined as those members for whom the cost prediction based on the selection model is lower than that based on the demographic model. For non-preferred risks, the opposite holds.
[a]) The reduction is expressed as a fraction in comparison with flat capitation payments (see also chapter five).

For instance the overall incentives for selection under the prior costs model with a threshold of Dfl. 10,000 are reduced by 60% in comparison with flat capitation payments. Table 7.2 of the previous chapter shows that risk sharing for high risks of about 3% of the members, risk sharing for high costs for about 1% of the members and outlier risk sharing with a threshold that is somewhat higher than Dfl. 10,000 yield a similar overall level of incentives for selection. For proportional risk sharing the comparable variant is that with a weight of

0.42 on actual costs[44].

8.2.2 Incentives for efficiency

Table 8.5 shows the overall indicators of incentives for efficiency. The insurer's portion of the efficiency gain is calculated with the assumption that the costs of each member are reduced by 10%. The weighted expenditures measure is calculated with various lengths of the costs interval below the threshold. The insurer's portion of the efficiency gain varies between 0.59 if the threshold is zero and 0.86 if the threshold is Dfl. 40,000. As in the previous chapter, the higher the threshold and the larger the length of the costs interval below the threshold, the higher is the weighted expenditures measure. If the threshold is Dfl. 40,000 and the costs intervals are Dfl. 10,000, the weighted expenditures measure is 0.92.

Table 8.5 Overall indicators of incentives for efficiency

Model	IPEG = WE(k↓0)	WE (k=1,000)	WE (k=5,000)	WE (k=10,000)
PC (40,000)	0.86	0.88	0.91	0.92
PC (20,000)	0.82	0.83	0.87	0.88
PC (10,000)	0.77	0.79	0.83	0.84
PC (5,000)	0.73	0.75	0.79	
PC (0)	0.59			

N=47,210. IPEG=insurer's portion of the efficiency gain. WE(T;k)=weighted expenditures given a threshold of Dfl. T and cost intervals of Dfl. k below the threshold. PC(T)=prior cost model with a threshold of Dfl. T.

Because it seems unrealistic that, especially in the longer run, during a year an insurer will not recalculate its incentives for efficiency with respect to (future)

[44] The weight 0.42 equals (0.6−0.31)/(1−0.31), where 0.6 is the desired level of the reduction of incentives for selection and 0.31 is the reduction that is already achieved by using the demographic capitation payments.

expenditures for a member in the remainder of the year, large values for the length of the costs intervals below the threshold yield an overestimation of the incentives for efficiency. Therefore the insurer's portion of the efficiency gain is used as the overall indicator of incentives for efficiency. Based on this indicator of incentives for efficiency, the prior cost models can be made comparable to the forms of risk sharing. For instance the prior cost model with a threshold that is somewhat lower than Dfl. 20,000 yields an insurer's portion of the efficiency gain of about 0.8. This value can also be reached with risk sharing for high risks of 3% of the members, risk sharing for high costs for 0.5% of the members and outlier risk sharing with a threshold of Dfl. 40,000 (see chapter seven, Table 7.3).

The next section compares the consequences of prior costs as an additional risk adjuster with those of outlier risk sharing and proportional risk sharing. The reason for comparing a prior cost model with specifically these forms of risk sharing first is that they are nowadays applied in Belgium and The Netherlands (Van de Ven and Ellis, 1999). Although the previous chapter showed that risk sharing for high risks and risk sharing for high costs yield better tradeoffs between selection and efficiency, they are not applied in practice.

8.3 Prior cost models versus outlier or proportional risk sharing

Section 8.3.1 presents the overall results for the prior cost models as well as those of outlier risk sharing and proportional risk sharing. Section 8.3.2 compares the predictable profits and losses for several subgroups given a certain overall level of incentives for efficiency. Section 8.3.3 compares the incentives for efficiency with respect to various types of care and with respect to various subgroups given a certain overall level of incentives for selection.

8.3.1 Overall results

In Figure 8.2 the x-axis shows the reduction of the predictable profits/losses for (non)-preferred risks which is used as the overall indicator of incentives for

selection. The y-axis shows the insurer's portion of the efficiency gain which is used as the overall indicator of incentives for efficiency.

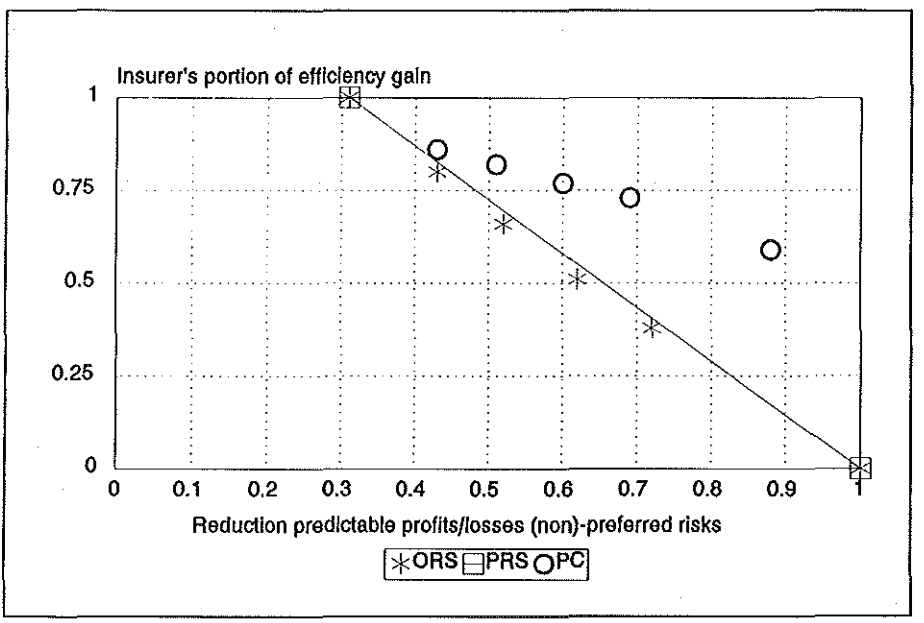

Figure 8.2 Overall results of prior costs as an additional risk adjuster and those of outlier risk sharing and proportional risk sharing

The Figure suggests that prior costs as an additional risk adjuster yields a better tradeoff between selection and efficiency than either outlier risk sharing or proportional risk sharing. The lower the incentives for efficiency, the larger the advantage of prior costs as a risk adjuster seems to be.

8.3.2 Selection of subgroups

Suppose that the regulator wants to retain 80% of the overall incentives for efficiency in comparison with flat capitation payments. Then it may apply a prior cost model with a threshold of Dfl. 15,000[45]. Instead the regulator may apply outlier risk sharing with a threshold of Dfl. 40,000 or proportional risk

[45] This threshold value was found via trial and error.

sharing with a weight of 0.2 on actual costs. Table 8.6 shows the remaining predictable profits and losses for various subgroups that may be attracted or deterred by an insurer. The mean profit for those without any costs for prescribed drugs in 1991 was about Dfl. 710 under the demographic model. Under the prior cost model the remaining profit is about Dfl. 590. Under outlier risk sharing and proportional risk sharing the remaining profit is about Dfl. 610 and Dfl. 570 respectively. For the group of 1% with the highest expenditures for prescribed drugs in 1991, the mean loss was about Dfl. 12,000 under the demographic model. The prior costs model reduces this loss to about Dfl. 8,600. Under outlier risk sharing and proportional risk sharing the remaining loss is about Dfl. 8,500 and Dfl. 9,700 respectively.
For those with a hospitalization in at least three of the previous four years, the remaining loss is about Dfl. 7,800 under the prior cost model. Under outlier risk sharing and proportional risk sharing the remaining loss is about Dfl. 8,100 and Dfl. 9,900 respectively. The subgroups that are formed on the basis of the health survey data give similar results. For instance for those with at least one chronic condition, the remaining loss is about Dfl. 620 under the prior cost model. Under outlier risk sharing and proportional risk sharing it is about Dfl. 710 and Dfl. 660 respectively.
For those who use some form of home care, the remaining loss is about Dfl. 2,200 under the prior cost model. Under outlier risk sharing and proportional risk sharing it is about Dfl. 2,500 and Dfl. 2,800 respectively.

Summarizing for most subgroups the predictable profits or losses are slightly smaller in the case of prior costs than in the case of these forms of risk sharing. The appendix shows that, if the required level of incentives for efficiency is lower, the differences between prior costs as a risk adjuster and these forms of risk sharing are larger.

Table 8.6 Mean result in 1993 for several subgroups

	N (%)	DEMO	PC (15,000)	ORS (40,000)	PRS (0.2)
Prescribed drugs in 1991					
0	28.4	711	592	614	569
1-619	61.5	231	161	166	185
620-1,098	5	-1,574	-1,353	-1,405	-1,259
1,099-2,451	4	-3,633	-2,860	-3,045	-2,906
>2,451	1	-12,118	-8,624	-8,526	-9,694
No. of years with hospitalization in the period 1989-1992					
0	79.8	468	279	371	374
1	15.5	-812	-571	-755	-650
2	3.7	-3,262	-1,472	-2,575	-2,610
3 or 4	1	-12,398	-7,757	-8,143	-9,918
Presence of chronic conditions[a]					
None	61.1	523	416	451	418
At least one	38.9	-820	-615	-708	-656
Asthma	5.0	-1,408	-1,118	-1,428	-1,127
Heart disease	1.8	-4,330	-2,342	-3,424	-3,464
Diabetes	1.7	-2,895	-2,351	-2,398	-2,316
Cancer	1.2	-5,602	-3,977	-3,469	-4,482
Use of home care[a]					
No	95.1	178	114	126	142
Yes	4.9	-3,487	-2,219	-2,479	-2,790

N=47,210. DEMO=demographic model. PC=prior cost model. ORS=demographic model supplemented with outlier risk sharing. PRS=demographic model supplemented with proportional risk sharing. All results differ statistically significantly from zero (two-sided t-test, $p<0.05$).

[a]) N=10,553.

8.3.3 Efficiency for types of care or for subgroups

Suppose the regulator wants to reduce the overall incentives for selection by 50% in comparison with flat capitation payments. Then it may apply a prior costs model with a threshold of Dfl. 18,000[46]. Instead it may also apply outlier risk sharing with a threshold of Dfl. 20,000 or proportional risk sharing with a weight of 0.3 on actual costs (see chapter seven, Table 7.9). Table 8.7 gives the insurer's portion of the efficiency gain if the costs of some types of care are reduced by 10% or the costs of some subgroups of insureds are reduced by 20%.

Table 8.7 Insurer's portion of a ten percent efficiency gain for specific types of care or a twenty percent efficiency gain for specific subgroups

	PC (18,000)	ORS (20,000)	PRS (0.3)
Types of care			
Hospital and specialists care	0.73	0.52	0.70
Prescribed drugs	0.93	0.88	0.70
Paramedical services	0.95	0.92	0.70
Subgroups[a]			
Asthma	0.83	0.70	0.70
Heart disease	0.68	0.41	0.70
Diabetes	0.76	0.57	0.70
Cancer	0.66	0.38	0.70

N=47,210. PC=prior cost model. ORS=demographic model supplemented with outlier risk sharing. PRS=demographic model supplemented with proportional risk sharing.
[a]) N=10,553.

Under the prior cost model the insurer retains 73% of the savings with respect to hospital and specialists care. This is slightly more than the 70% under

[46] This threshold was found via trial and error.

proportional risk sharing and substantially more than the 52% under outlier risk sharing. For savings on prescribed drugs and paramedical services, the insurer's portion of the efficiency gain is also highest under the prior cost model. A similar result is found for members that suffer from asthma or diabetes. For those that suffer from a serious heart disease or cancer, the insurer's portion of the efficiency gain is similar under the prior cost model and proportional risk sharing. Under outlier risk sharing, it is considerably lower. Summarizing, given a certain overall level of incentives for selection, the prior cost model retains more incentives for efficiency than either outlier risk sharing or proportional risk sharing. The appendix shows similar results for the situation that the regulator wants to reduce the overall incentives for selection with more than 50%.

The conclusion of this section is that including prior costs as an additional risk adjuster next to demographic variables yields a better tradeoff between selection and efficiency than supplementing demographic capitation payments with either outlier risk sharing or proportional risk sharing. Because the previous chapter already showed that risk sharing for high risks and risk sharing for high costs also yield a better tradeoff than outlier risk sharing or proportional risk sharing, an obvious question is: does prior costs as a risk adjuster yield a better tradeoff between selection and efficiency than risk sharing for high risks or risk sharing for high costs? This question is addressed in the next section.

8.4 Prior cost models versus risk sharing for high risks or high costs

Section 8.4.1 presents the overall results of the incentives for selection and efficiency. Section 8.4.2 compares the remaining predictable profits and losses for several subgroups given a certain overall level of incentives for efficiency. Section 8.4.3 compares the remaining incentives for efficiency with respect to various types of care and various subgroups given a certain overall level of incentives for selection.

8.4.1 Overall results

Figure 8.3 suggests that, given a relatively high level of incentives for efficiency, risk sharing for high risks and risk sharing for high costs yield a better tradeoff than prior costs as a risk adjuster. However, for a lower level of incentives for efficiency, the opposite seems to hold. Remember that the desired overall level of incentives for efficiency depends on the weight that the regulator assigns to reducing selection versus retaining efficiency (see chapter five).

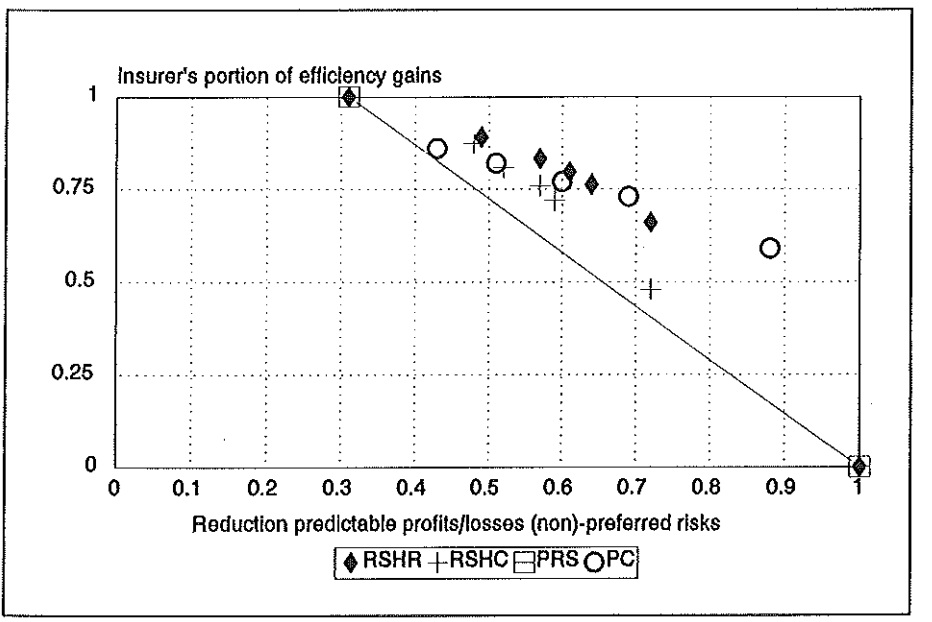

Figure 8.3 Overall results of prior costs as an additional risk adjuster and those of risk sharing for high-risks and risk sharing for high costs

8.4.2 Selection of subgroups

Table 8.8 shows the remaining predictable profits and losses for various subgroups of insureds. For those without any costs for prescribed drugs in 1991, the mean profit under demographic capitation payments was about Dfl. 710. Under the prior cost model this profit is reduced to about Dfl. 590. Under risk sharing for high risk and risk sharing for high costs, the remaining profit is

about Dfl. 520 and Dfl. 510 respectively. For the groups of 1% with the highest expenditures for prescribed drugs in 1991, the mean loss under the prior cost model is about Dfl. 8,600. Under risk sharing for high risks and risk sharing for high costs the remaining loss is about Dfl. 3,500 and Dfl. 5,900 respectively. For those without a hospitalization in the previous four years, the mean profit under the prior cost model is about Dfl. 280. Under risk sharing for high risks and risk sharing for high costs, it is about Dfl. 230 and Dfl. 280 respectively.
For those members that were hospitalized in at least three of the four preceding years, the mean loss is about Dfl. 7,800 under the prior cost model. Under risk sharing for high risks and risk sharing for high costs, it is about Dfl. 2,600 and Dfl. 5,100 respectively. For the subgroups formed on the basis of the health survey data, the results are similar. For instance, for those suffering from cancer, the mean loss under the prior cost model is still about Dfl. 4,000. Under risk sharing for high risks and risk sharing for high costs, it is about Dfl. 1,200 and Dfl. 2,000 respectively.

Summarizing, given some overall desired level of incentives for efficiency, risk sharing for high risks and risk sharing for high cost yield lower predictable profits and losses for the various subgroups than a prior cost model. For most subgroups risk sharing for high risks yields the lowest profits or losses.

8.4.3 Efficiency for types of care or for subgroups

If the regulator wants to reduce the overall incentives for selection to 50% in comparison with those under flat capitation payments, it may apply a prior cost model with a threshold of Dfl. 18,000. Instead it may also apply risk sharing for high risks for 1.5% of the members or risk sharing for high costs for 0.5% of the members. Table 8.9 shows the insurer's portion of the efficiency gain if the costs for some types of care are reduced by 10% or the costs for some subgroups of insureds are reduced by 20%. For the three types of care the insurer's portion of the efficiency gain under the prior cost model is similar to that under risk sharing for high costs. For hospital and specialists care it is higher under risk sharing for high risks. For prescribed drugs and paramedical services it is lower.

Table 8.8 Mean result in 1993 for several subgroups

	N (%)	DEMO	PC (15,000)	RSHR (3%)	RSHC (0.5%)
Prescribed drugs in 1991					
0	28.4	711	592	516	514
1-619	61.5	231	161	77	118
620-1,098	5	-1,574	-1,353	-1,471	-1,106
1,099-2,451	4	-3,633	-2,860	-2,152	-2,635
>2,451	1	-12,118	-8,624	-3,470	-5,894
No. of years with hospitalization in the period 1989-1992					
0	79.8	468	279	226	281
1	15.5	-812	-571	-620	-640
2	3.7	-3,262	-1,472	-1,558	-1,959
3 or 4	1	-12,398	-7,757	-2,593	-5,088
Presence of chronic conditions[a]					
None	61.1	523	416	322	375
At least one	38.9	-820	-615	-504	-586
Asthma	5.0	-1,408	-1,118	-1,187	-1,305
Heart dis.	1.8	-4,330	-2,342	-1,874	-2,034
Diabetes	1.7	-2,895	-2,351	-1,617	-1,752
Cancer	1.2	-5,602	-3,977	-1,205*	-1,954
Use of home care[a]					
No	95.1	178	114	81	82
Yes	4.9	-3,487	-2,219	-1,589	-1,608

N=47,210. DEMO=demographic model. PC=prior cost model. RSHR=demographic model + risk sharing for high risks. RSHC=demographic model + risk sharing for high costs.

a) N=10,553.

*) The mean result does not differ statistically significantly from zero (two-sided t-test, $p>0.05$).

For the subgroups the insurer's portion of the efficiency gain is highest in the case of risk sharing for high costs. With respect to asthma-patients it is lowest under the prior cost model. With respect to diabetes-patients and cancer-patients it is lowest under risk sharing for high risks. So which payment system retains most incentives for efficiency differs per type of care and per subgroup. As suggested by Figure 8.3, the appendix shows that, if the desired overall selection level is lower, prior costs as a risk adjuster retains more incentives for efficiency for the various types of care and for the various subgroups.

Table 8.9 Insurer's portion of a ten percent efficiency gain for specific types of care or a twenty percent efficiency gain for specific subgroups

	PC (18,000)	RSHR (1.5%)	RSHC (0.5%)
Types of care			
Hospital and specialists care	0.73	0.83	0.72
Prescribed drugs	0.93	0.90	0.94
Paramedical services	0.95	0.93	0.98
Subgroups[a]			
Asthma	0.83	0.87	0.98
Heart disease	0.68	0.68	0.76
Diabetes	0.76	0.71	0.89
Cancer	0.66	0.47	0.65

N=47,210. PC=prior cost model. RSHR=demographic model + risk sharing for high risks. RSHC=demographic model + risk sharing for high costs.
[a]) N=10,553.

Summarizing the conclusion of this section is that the results for prior costs as an additional risk adjuster, for risk sharing for high risks and for risk sharing for high costs are mixed. Whether prior costs as a risk adjuster yields a better tradeoff between selection and efficiency than these forms of risk sharing depends on the desired overall level of incentives for selection and efficiency (i.e. on the weight

the regulator assigns to reducing selection versus retaining efficiency) as well as on the weight the regulator assigns to specific reductions of incentives for selection and efficiency.

8.5 Conclusions

This chapter analyzed prior costs as an additional risk adjuster next to demographic variables. Several variants were simulated by varying the threshold above which the prior costs were included as a risk adjuster. The results were compared with those of the four forms of risk sharing of the previous chapter.
The main conclusion is that prior costs as a risk adjuster yields a better tradeoff between selection and efficiency than either *outlier risk sharing* or *proportional risk sharing*. This can be illustrated with the following findings. If the regulator wants to retain about 80% of the incentives for efficiency in comparison with flat capitation payments, it may apply prior costs with a threshold of Dfl. 15,000. This reduces the predictable profits and losses for (non)-preferred risks by about 55% in comparison with flat capitation payments. As alternatives the regulator may apply outlier risk sharing with a threshold of Dfl. 40,000 or proportional risk sharing with a weight of 0.2 on actual costs. With these risk sharing variants the reduction of the predictable profits and losses for (non)-preferred risks is about 45% only. Another illustration is as follows. Suppose the regulator wants to reduce the incentives for selection by about 70% in comparison with flat capitation payments. Then it may apply prior costs with a threshold of Dfl. 5,000. This reduces the overall incentives for efficiency by about 30%. Instead of prior costs as a risk adjuster, the regulator may apply outlier risk sharing with a threshold of Dfl. 5,000 or proportional risk sharing with a weight of 60% on the actual costs. Under these variants of risk sharing, the overall incentives for efficiency are reduced by about 40%.

These empirical findings imply that countries that currently apply outlier risk sharing or proportional risk sharing may improve the tradeoff between selection and efficiency by using prior costs as an additional risk adjuster instead.

The previous chapter already showed that *risk sharing for high risks* and *risk sharing for costs* also yield a better tradeoff between selection and efficiency than either outlier risk sharing or proportional risk sharing. Therefore this chapter subsequently focused on the question which payment system yields the best tradeoff: prior costs as a risk adjuster, risk sharing for high risks ór risk sharing for high costs? The answer depends on the weight the regulator assigns to an overall reduction of incentives for selection versus an overall retention of incentives for efficiency as well as the weights it assigns to specific reductions of incentives for selection and to specific retentions of incentives for efficiency. The main advantage of prior costs as a risk adjuster in comparison with risk sharing for high risks or high costs is that, given a relatively low desired overall level of incentives for selection, it retains more incentives for efficiency. The main disadvantage of prior costs as a risk adjuster in comparison with these forms of risk sharing is that, given a certain desired overall level of incentives for efficiency, it leaves larger predictable losses for non-preferred risks.

Appendix chapter 8

Additional results section 8.1

Table A.8.1 Coefficients of the demographic and prior cost models

	DEMO		PC	
	Women	Men	Women	Men
5-9	410	497	195	312
10-14	504	636	297	261
15-19	349	747	179	485
20-24	397	881	231	527
25-29	381	1,290	115	707
30-34	660	1,356	327	724
35-39	730	1,117	470	655
40-44	804	1,221	454	729
45-49	1,192	1,359	567	749
50-54	1,313	1,610	736	999
55-59	1,809	1,679	1,025	891
60-64	2,286	2,555	1,372	1,315
65-69	4,409	2,794	2,836	1,556
70-74	5,284	4,115	3,222	2,390
>=75	6,242	5,144	4,040	2,988
Very strongly urban	217		113	
Strongly urban	303		204	
Moderate	250		178	
Little urban	261		179	
Disabled	2,080		1,206	
Total costs in 1992			0.413	

N=47,210. DEMO=demographic model. PC=prior cost model. Before estimating the model, the costs in 1992 have been multiplied by a factor such that the overall mean costs in 1992 equal those in 1993.

Additional results section 8.2

Table A.8.2 Additional overall results for several prior costs models

	R^2	MAR	b_T
DEMO	0.047	2,250	n.a.
PC (40,000)	0.157	2,180	0.69
PC (20,000)	0.170	2,155	0.54
PC (10,000)	0.181	2,126	0.47
PC (5,000)	0.187	2,095	0.44
PC (0)	0.197	2,000	0.41

N=47,210. DEMO=demographic model. PC=prior cost model. MAR=mean absolute result. b_T=estimated coefficient of the costs in the previous year as far as these costs are above the threshold Dfl. T. The fraction of members with costs above the threshold is 0.5%, 1.6%, 3.7%, and 7.7% for the thresholds Dfl. 40,000, Dfl. 20,000, Dfl. 10,000 and Dfl. 5,000 respectively.

Table A.8.3 Weighted mean absolute predicted result for some prior cost models

	α_1	α_2	DEMO	PC (40,000)	PC (10,000)	PC (0)
MAPR	0	0	982	830	611	358
WMAPR[a]	10%	10%	973	818	592	307
WMAPR[a]	20%	20%	946	783	539	253
WMAPR[a]	30%	30%	898	725	470	215
WMAPR[b]	100	100	978	825	605	334
WMAPR[b]	200	200	962	807	582	318
WMAPR[b]	300	300	925	768	535	301

N=47,210. DEMO=demographic model. PC=prior cost model.

[a]) Small predictable profits and losses are defined in relative terms, i.e. those predictable profits and losses that are smaller than α_1% and α_2% of the predicted costs based on the selection model respectively.

[b]) Small predictable profits and losses are defined in absolute terms, i.e. those predictable profits and losses that are smaller than Dfl. α_1 and Dfl. α_2 respectively.

Additional results section 8.3

Table A.8.4 Mean result in 1993 for several subgroups

	N (%)	DEMO	PC (1,500)	ORS (20,000)	PRS (0.35)
Prescribed drugs in 1991					
0	28.4	711	444	519	462
1-619	61.5	231	111	114	150
620-1,098	5	-1,574	-1,005	-1,125	-1,023
1,099-2,451	4	-3,633	-1,976	-2,504	-2,361
>2,451	1	-12,118	-6,578	-6,162	-7,877
No. of years with hospitalization in the period 1989-1992					
0	79.8	468	82	287	304
1	15.5	-812	-22*	-641	-528
2	3.7	-3,262	-147	-1,977	-2,120
3 or 4	1	-12,398	-5,582	-5,480	-8,059
Presence of chronic conditions[a]					
None	61.1	523	290	380	340
At least one	38.9	-820	-455	-596	-533
Asthma	5.0	-1,408	-806	-1,278	-915
Heart disease	1.8	-4,330	-1,484*	-2,269	-2,815
Diabetes	1.7	-2,895	-1,578*	-1,834	-1,882
Cancer	1.2	-5,602	-2,695*	-2,418	-3,642
Use of home care[a]					
No	95.1	178	72	109	115
Yes	4.9	-3,487	-1,408*	-1,714	-2,267

N=47,210. DEMO=demographic model. PC=prior cost model. ORS=demographic model + outlier risk sharing. PRS=demographic model + proportional risk sharing.

[a]) N=10,553.

*) Not statistically significantly different from zero (two-sided t-test, $p>0.05$).

Table A.8.5 Insurer's portion of a ten percent efficiency gain for specific types of care or a twenty percent efficiency gain for specific subgroups

	PC (4,000)	ORS (5,000)	PRS (0.57)
Types of care			
Hospital and specialists care	0.64	0.20	0.43
Prescribed drugs	0.83	0.66	0.43
Paramedical services	0.84	0.69	0.43
Subgroups[a]			
Asthma	0.69	0.35	0.43
Heart disease	0.63	0.16	0.43
Diabetes	0.66	0.27	0.43
Cancer	0.62	0.13	0.43

N=47,210. PC=prior cost model. ORS=demographic model + outlier risk sharing. PRS=demographic model + proportional risk sharing.
[a]) N=10,553.

Additional results section 8.4

Table A.8.6 Mean result in 1993 for several subgroups

	N (%)	DEMO	PC (1,500)	RSHR (8%)	RSHC (1.6%)
Prescribed drugs in 1991					
0	28.4	711	444	428	404
1-619	61.5	231	111	17*	56
620-1,098	5	-1,574	-1,005	-1,192	-854
1,099-2,451	4	-3,633	-1,976	-1,478	-1,828
>2,451	1	-12,118	-6,578	-1,356	-3,379
No. of years with hospitalization in the period 1989-1992					
0	79.8	468	82	161	183
1	15.5	-812	-22*	-512	-476
2	3.7	-3,262	-147	-1,021	-1,231
3 or 4	1	-12,398	-5,582	-1,070	-2,584
Presence of chronic conditions[a]					
None	61.1	523	209	253	277
At least one	38.9	-820	-455	-397	-434
Asthma	5.0	-1,408	-806	-727	-1,023
Heart disease	1.8	-4,330	-1,484*	-1,727	-978
Diabetes	1.7	-2,895	-1,578*	-964*	-1,354
Cancer	1.2	-5,602	-2,695*	-974*	-1,369
Use of home care[a]					
No	95.1	178	72	58	43*
Yes	4.9	-3,487	-1,408*	-1,133	-837

N=47,210. DEMO=demographic model. PC=prior cost model. RSHR=demographic model + risk sharing for high risks. RSHC=demographic model + risk sharing for high costs.
[a]) N=10,553. *) Not statistically significantly different from zero (two-sided t-test, $p>0.05$).

Table A.8.7 Insurer's portion of a ten percent efficiency gain for specific types of care or a twenty percent efficiency gain for specific subgroups

	PC (4,000)	RSHR (8%)	RSHC (4%)
Types of care			
Hospital and specialists care	0.64	0.63	0.30
Prescribed drugs	0.83	0.66	0.79
Paramedical services	0.84	0.71	0.85
Subgroups[a]			
Asthma	0.69	0.52	0.48
Heart disease	0.63	0.39	0.26
Diabetes	0.66	0.37	0.33
Cancer	0.62	0.22	0.17

N=47,210. PC=prior cost model. RSHR=demographic model + risk sharing for high risks. RSHC=demographic model + risk sharing for high costs.
[a]) N=10,553.

9. Conclusions and discussion

9.1 Conclusions

In the 1990s several European countries have introduced elements of regulated competition in their health insurance markets. The purpose of many of these reforms is to increase the insurers' incentives for efficiency and their responsiveness to consumers' preferences. A common element is the introduction of capitation payments through which the insurers are (largely) financed by the regulator. Commonly the regulator is the government, but it may also be an employer or a group of employers. With the capitation payments the insurers should provide or purchase a specified set of health care services for their members during a certain period, mostly a year. In some countries the capitation payments constitute the entire revenue of the insurers, but in most countries the insurers are allowed to quote an additional premium to their members. In the latter case the regulator usually requires an insurer to quote the same premium to each member that chooses the same insurance modality. A common problem in all countries is the implementation of adequate capitation payments. Currently employed capitation payments in Europe are mainly based on demographic variables only, which are relatively poor predictors of individual annual health care expenditures. Therefore, such capitation payments in combination with the premium rate restrictions provide insurers with strong incentives for preferred risk selection. In theory, the ideal solution for this problem is to include more and better predictors of individual annual health care expenditures in the calculation of the capitation payments. However, in most countries this appears to be very difficult in practice. As another solution for the problem of preferred risk selection, this study has analyzed various forms of risk sharing between the insurers and the regulator[47]. Risk sharing implies that an insurer is reimbursed by the regulator at the end of the year for some of the expenditures for some of its members. With risk sharing the regulator might give up some of the insurers' incentives for efficiency in exchange for a reduction of their

[47] A summary of this chapter together with a summary of the main empirical results can be found in Van Barneveld et al. (1999).

incentives for preferred risk selection. In the present study this tradeoff has been abbreviated as the tradeoff between selection and efficiency. Two central research questions were: which main forms of risk sharing can be distinguished? and which main form yields the best tradeoff between selection and efficiency, given demographic capitation payments and given the premium rate restrictions? These questions are interesting not only from a scientific point of view, but they are also highly relevant for health care policy in Europe. In the late 1990s some countries applied demographic capitation payments without any form of risk sharing (e.g. The Czech Republic, Germany and Switzerland). These countries might consider to implement some form of risk sharing. Some other countries have already implemented a form of risk sharing (e.g. Belgium and The Netherlands). These applications of risk sharing are limited to two forms: "outlier risk sharing" and "proportional risk sharing" (see chapter three)[48]. Such countries might consider to change their specific form of risk sharing if other forms yield a better tradeoff between selection and efficiency.
Besides Europe, the present study may also be relevant for other countries that have implemented regulated competition in their health insurance market(s) (e.g. the United States and Israel) or that are considering to implement such a regulatory regime (e.g. Taiwan).
Some assumptions were made with respect to the health insurance market. These assumptions deal with the benefits package, the enrolment procedures and the premium rate restrictions. First it was assumed that the regulator has specified a benefits package that covers acute care like hospital care, physician services and prescribed drugs. The insurers are allowed to offer different modalities of this benefits package. For long-term care it is assumed that the regulator employs a separate regulatory regime apart from the competitive scheme for acute care. For types of care that are not covered by the long-term care scheme or by the specified benefits for acute care, the insurers are allowed to offer supplemental health insurance. This supplemental health insurance is unregulated. Second it was assumed that there is an open enrolment period each

[48] In 1996, in The Netherlands an extensive form of risk sharing for so-called fixed hospital expenditures has been introduced as well. This specific form of risk sharing has not been analyzed empirically to preserve the international character of the study.

year. This means that an insurer has to accept anyone who wants to buy a modality of the specified benefits package. Third it was assumed that the insurers receive capitation payments based on demographic variables from the regulator and additional premiums from their members. With respect to the additional premiums, it was assumed that the regulator requires an insurer to quote the same premium to each member that chooses the same insurance modality. The study has been divided into two parts. The *first part* presented a conceptual framework for optimizing the tradeoff between selection and efficiency. The *second part* consisted of empirical analyses.

9.1.1 Part one: conceptual framework

Chapter two focused on the problem of preferred risk selection. It showed that an insurer can use many (subtle) tools for selection such as: the service of the insurer, the quality, reputation and service of its contracted health care providers, the design of insurance modalities as well as supplemental health insurance policies, selective advertising and direct mailing. Subsequently three negative effects of selection to society were mentioned: First for chronically ill the access to good health care may be hindered. Second efficient insurers might lose market share to inefficient insurers that are successful with selection. Third any resources used for selection can be seen as social welfare losses. So the prevention of selection is critical to the success of a regulated competitive individual health insurance market. Within the context of this study, the regulator may follow three strategies to prevent selection. First the regulator may use forms of procompetitive regulation, but on its own this can not be considered a promising strategy. Second the regulator can try to improve the capitation formula. In various countries this appears to be very difficult. Finally the regulator may introduce risk sharing between insurers and the regulator as a supplement to the capitation payments. This study mainly analyzed the latter approach.

In the literature various overall indicators of incentives for selection under various capitation formulae have been used: R^2-values, the mean absolute result and the mean absolute predicted result. In chapter two it was argued that the latter indicator is more useful than the other two. As a refinement of the mean absolute predicted result, it was suggested to ignore small predictable profits

and losses. These may be irrelevant for selection because an insurer has to take into account its costs of selection and the (statistical) uncertainties about the net benefits of selection. If this is right, the so-called weighted mean absolute predicted result is a better overall indicator of incentives for selection. Applying the conventional and new indicators in a theoretical analysis suggested that - if small predictable profits and losses are indeed irrelevant for selection - the conventional indicators yield an overestimation of incentives for selection, especially in the case of relatively good capitation formulae.
The overall indicators as mentioned above cannot be calculated in the case of risk sharing. Therefore, another overall indicator was proposed as well. This indicator is based on the sum of predictable profits and losses for an insurer, given the capitation formula of the regulator and certain cost predictions of the insurer itself.
Besides the overall indicators, the mean result for various subgroups is used as an indicator of an insurer's incentives to select or deter such subgroups.

Chapter three showed that many forms of risk sharing have been suggested in the literature, but that previous empirical studies were limited to separate analyses of two forms of risk sharing, each in a different setting. Subsequently a description of potential forms of risk sharing was given. Besides the period to which the risk sharing applies (usually one year), a description should at least cover the group of members for whom some risk is shared; the types of care for which the risk is shared, the extent of the risk that is shared and the price that insurers have to pay to share some risk. For the empirical analyses in the second part of the study, the following choices were made: an insurer is allowed to designate a certain percentage of its members (p) either at the start of a year (D=0) or at the end of a year (D=1). The risk sharing applies to all types of care within the specified benefits package. An insurer is entitled to receive a certain percentage (a) of the costs of a designated member as far as these costs are above a certain threshold (T). The risk sharing is financed via a proportional reduction of the normative costs. This percentage is set afterwards in such a way that the risk sharing is budget-neutral from the regulator's point of view. Further reducing the possibilities in such a way that each form of risk sharing has essentially one parameter, gave four main forms:

(1) Risk sharing for high risks ($0<p<1$; $D=0$; $a=1$; $T=0$).
(2) Risk sharing for high costs ($0<p<1$; $D=1$; $a=1$; $T=0$).
(3) Outlier risk sharing ($p=1$; $a=1$; $T>0$).
(4) Proportional risk sharing ($p=1$; $0<a<1$; $T=0$).
Under these four forms of risk sharing, designated members pay the same additional premium as other members. Moreover, they may even be unaware that their insurer has designated them for risk sharing.
By choosing different parameter values, one may get different variants of risk sharing. Optimizing the tradeoff between selection and efficiency not only includes the determination of the optimal form of risk sharing, but may also deal with determining the optimal variant of a certain form of risk sharing.

Chapter four focused on the efficiency-side of the tradeoff. It showed that an insurer can use several tools to improve the efficiency of care such as: utilization management, disease management, (high-cost) case management, selective contracting with providers of care, financial incentives, negotiating lower fees and offering different insurance modalities. The potential savings that could be achieved by insurers are substantial. For instance, in California the adoption of managed care and managed competition has led to a broad decline of health care costs to employment groups which was followed by premium reductions of up to 10 percent. Introducing a utilization review program in a hospital has reduced inpatient expenses by about 8 percent and overall medical expenses by about 4 percent. Furthermore there are several examples of successfully applied disease or case management techniques, for instance a reduction of about 40 percent of the costs for patients with congestive heart failure and cost savings of 15 to 35 percent for diabetics.
The proposed method for calculating an insurer's incentives for efficiency is as follows. Under the assumption that - ceteris paribus - an insurer reduces certain costs through efficiency measures, its actual costs and most likely its risk sharing reimbursement will be lower. Therefore, such an efficiency gain can be split into a portion that is kept by the insurer and a portion that is taken by the regulator. The higher the insurer's portion of the efficiency gain, the higher its incentives to employ the activities that are necessary to achieve the cost savings. The insurer's portion of the efficiency gain can be calculated under various

assumptions about cost savings. For example: overall savings, savings for specific types of care and savings for specific groups of members. As an alternative overall indicator, the so-called weighted expenditures have been proposed. This indicator is relevant under the assumption that (some) incentives for efficiency are present as long as (a part of) the marginal expenditures for a member in a year are born by the insurer itself. As soon as it is certain that these marginal expenditures are fully born by the regulator, the insurer's incentives for efficiency with respect to this member are zero. It has been shown that, if the insurer quickly recalculates its incentives for efficiency with respect to a member after some expenditures have occurred, the weighted expenditures give a outcome similar as the insurer's portion of an overall efficiency gain.

Chapter five combined the elements of the previous chapters into a systematic method for optimizing the tradeoff between selection and efficiency. As theoretical illustrations optimal proportional risk sharing variants were calculated, given some capitation formulae and given the preferences of the regulator with respect to reducing incentives for selection versus retaining incentives for efficiency. The theoretical illustrations in this chapter were restricted to proportional risk sharing because the other forms of risk sharing could not be analyzed in this way. This provided a strong argument to perform empirical analyses of tradeoffs between selection and efficiency as well.

9.1.2 Part two: empirical analysis

Chapter six presented a description of the data set that was available, the methods used in the empirical analyses and the incentives for selection if the regulator employs demographic capitation payments without any form of risk sharing. The data set contained administrative data for six consecutive years (1988-1993) for about 47,200 members of one Dutch sickness fund. All members had the same insurance coverage and the same insurance modality. The data included demographic variables, the annual costs for several types of care and the diagnoses from hospital admissions. For a subset of about 10,500 members, health survey data were available as well. The average health care expenditures per member were Dfl. 1,941 in 1993. In line with previous

studies, it was shown that under demographic capitation payments without any form of risk sharing, an insurer can easily identify subgroups that generate substantial predictable losses. For instance, for the group of 1% with the highest costs (or the highest costs for prescribed drugs) in the preceding two years, the mean predictable loss is about Dfl. 12,000 per member. For those with a hospitalization in at least three of the four preceding years (about 1% of the members), the mean predictable loss is also about Dfl. 12,000 per member. Based on the health survey data, members that suffer from a serious heart disease (about 1.8%), diabetes (about 2.7%) or cancer (about 1.2%) were distinguished. The mean predictable losses for these subgroups were about Dfl. 4,300, Dfl. 2,900 and Dfl. 5,400 per member respectively. Finally for those that receive some form of home care (about 4.9%), the mean predictable loss was Dfl. 3,500 per member. Nevertheless, it was concluded that - globally speaking - demographic capitation payments already reduce incentives for selection by about one-third in comparison with flat capitation payments. So demographic variables are useful for calculating capitation payments, but certainly not sufficient. Ignoring small predictable profits or losses did not change this conclusion.

Chapter seven analyzed the reduction of the incentives for selection and efficiency if the regulator would employ various forms of risk sharing as a supplement to the demographic capitation payments. For each of the four forms of risk sharing given in chapter three, several variants were simulated by varying the relevant parameter. Although the empirical distribution of individual annual health care expenditures differed statistically significantly from the theoretical lognormal distribution, the theoretical analyses in chapter three - that were based on the latter distribution - gave a good indication of the proportion of expenditures that would be shared between an insurer and the regulator. Moreover, the theoretical analyses of chapter four also gave a good indication of the two overall indicators of incentives for efficiency. The main conclusion of chapter seven was that risk sharing for high risks and risk sharing for high costs yield better tradeoffs between selection and efficiency than either outlier risk sharing or proportional risk sharing. The results for risk sharing for high risks and risk sharing for high costs are mixed. There seem to be two advan-

tages of the first type of risk sharing. First, given a certain desired overall level of incentives for efficiency, it yields greater reductions of the large predictable losses for those members with high prior costs, many prior hospital admissions and serious chronic conditions. Second, given a certain desired overall level of incentives for selection, it retains more incentives for efficiency with respect to hospital care and with respect to members that have unpredictable high expenditures. A disadvantage is that for limited extents of risk sharing, it retains less incentives for efficiency with respect to several subgroups that could be selected for the application of disease management principles.

Chapter eight analyzed prior year's costs as an additional risk adjuster next to demographic variables. Several variants were simulated by varying the threshold above which the costs were included as a risk adjuster. Unlike other promising risk adjusters, a cost-based risk adjuster clearly yields a tradeoff between selection and efficiency just like risk sharing. In line with the theoretical findings in chapter two, it was shown that - if small predictable profits and losses are irrelevant for selection - the conventional indicators yield an overestimation of incentives for selection, especially in the case of relatively good capitation formulae.
Obviously, it was interesting to compare the results of prior year's costs as a risk adjuster with those of risk sharing. The main conclusion was that prior year's costs as a risk adjuster yield a better tradeoff between selection and efficiency than either outlier risk sharing or proportional risk sharing. In comparison with risk sharing for high risks or high costs, the results of prior year's costs as a risk adjuster are mixed. An advantage is that, given a relatively low level of incentives for selection, it retains more incentives for efficiency. A disadvantage is that, given a certain desired overall level of incentives for efficiency, it leaves larger predictable losses for various non-preferred risks.

The *main conclusion* of the study can be summarized as follows. Supplementing demographic capitation payments with risk sharing for high risks or high costs as well as using prior year's costs as an additional risk adjuster yield a better tradeoff between selection and efficiency than supplementing demographic capitation payments with either outlier risk sharing or proportional risk sharing.

9.2 Discussion

9.2.1 Policy implications

Given the large incentives for selection under demographic capitation payments, it is remarkable that some countries still apply such capitation payments without any form of risk sharing. In 1999 this appears to be the case in The Czech Republic, Germany and Switzerland. These countries may improve the tradeoff between selection and efficiency by implementing some form of risk sharing or by using prior year's costs as an additional risk adjuster.

Some countries have supplemented their capitation payments with outlier risk sharing and/or proportional risk sharing. In 1999 Belgium employs proportional risk sharing, and The Netherlands employ a combination of outlier and proportional risk sharing. These countries may improve the tradeoff between selection and efficiency by changing their present form of risk sharing into risk sharing for high risks or high costs. Another option is to abolish their form of risk sharing while introducing prior year's costs as an additional risk adjuster for the calculation of the capitation payments.

In the Medicare program in the United States, at-risk health maintenance organiza-tions have received capitation payments based on demographic variables only, since the early 1980s. Although the possibilities for outlier risk sharing and proportional risk sharing have been discussed in the Medicare context, no form of risk sharing has been implemented. In the year 2000, the Health Care Financing Administration, which is responsible for the calculation of the capitation payments, will start using diagnostic information from previous hospitalizations as an additional risk adjuster. This will be a major step forward. A thorough evaluation of the then remaining incentives for selection seems worthwhile. In comparison with other studies such an evaluation could include several versions of the new indicator of incentives for selection (the so-called weighted mean absolute predicted result) that has been developed in chapter two and applied in chapter eight of the present study. If the remaining incentives for selection are still considered to be too large, supplementing the diagnoses-based capitation payments with some form of risk sharing may be a good way to

further reduce incentives for selection at the expense of some incentives for efficiency.
Besides the Medicare sector, the conclusions of this study may also be relevant for the Medicaid sector and the private health insurance sector in the United States where there are many applications of capitation payments which are sometimes supplemented with risk sharing.

In Israel some form of condition-specific risk sharing is being employed as a supplement to demographic capitation payments. This form of risk sharing covers five severe diseases and about six percent of the overall expenditures (Van de Ven and Ellis, 1999). This country could consider risk sharing for high risks or high costs as alternatives for its present form of risk sharing as well as prior year's costs as an additional risk adjuster.

Taking for granted that, at least in the short run, for most countries mentioned above it will be very difficult to improve their demographic capitation payments, experimentation with risk sharing for high risks or high costs and/or with prior year's costs as a risk adjuster seems promising. In the longer run, even if demographic capitation payments are improved substantially, it seems likely that limited forms of risk sharing will still be useful. The findings of this study as well as those on improving demographic capitation payments seem to imply that there are many technical possibilities to combine small incentives for selection with large incentives for efficiency in a regulated competitive individual health insurance market.

9.2.2 Limitations of the study

This study assumed that - given the capitation payments and given the premium rate restrictions - the regulator's *purpose with risk sharing* is to reduce the insurers' incentives for selection while maintaining their incentives for efficiency as much as possible. In related studies the purpose of risk sharing appears to be different (e.g. Beebe, 1992; Newhouse et al., 1997; Keeler et al., 1998). For instance, an additional purpose may be to reduce the insurers' incentives for quality skimping, to reduce the insurers' financial risk, or to reduce incentives for adverse selection.

Quality skimping or so-called stinting is the reduction of quality below the minimum level that is acceptable to society. This problem may even emerge in the theoretical case of 'perfect' capitation payments. Van de Ven and Schut (1994) have argued to employ a separate regulatory regime for types of care for which the problem of quality skimping is most relevant (e.g. long-term care for demented elderly) apart from the competitive regulatory regime for acute care.
An insurer's financial risk is related to the unpredictability of health care expenditures. As a result of pure chance, the financial result of an insurer may vary over the years. For relatively large insurers chance is not a problem and relatively small insurers can deal with this problem via voluntary risk-rated reinsurance techniques (Bovbjerg, 1992).
Adverse selection is caused by a consumer information surplus vis à vis the insurers. That is, consumers have more information about their health care risk than the information that insurers (are allowed to) use for discerning risk groups and setting premiums. If the insurers' incentives for preferred risk selection are reduced to such an extent that preferred risk selection is unprofitable, there may remain some opportunities for adverse selection but their extent is unknown. The potential consequences of adverse selection as a result of consumers' choices between various modalities of the specified benefits package, as simulated by Keeler et al. (1998), have not been analyzed here. However, the empirical analyses presented in chapter six through eight do provide - among others - an indication of an insurer's incentives to offer different insurance modalities of the specified benefits package in order to select good risks.
Obviously, the conclusions of the present study are not necessarily valid if the purpose of risk sharing is different. In that case different tradeoffs have to be made.

This study included *four main forms of risk sharing* in the empirical analyses. All forms of risk sharing can be seen as mandatory reinsurance for the insurers with a regulated reinsurance premium. This is especially true for outlier risk sharing and proportional risk sharing that have a clear analogy with "excess-of-loss" and "quota-share" reinsurance respectively. In addition, risk sharing for high-risks can be seen as a form of regulation that attempts to simulate, to some extent, the practice of refusing insurance to high-risk applicants for whom an

appropriate premium (capitation payment) cannot be calculated. This practice is common in a free health insurance market but is not allowed in a regulated competitive health insurance market with open enrolment.
Forms of condition-specific risk sharing were not included in the empirical analyses. Such a form of risk sharing may have the advantage of automatically varying fractions of designated members per insurer. With risk sharing for high risks or high costs, the regulator has to decide which fraction of the members an insurer is allowed to designate. Of course this fraction may vary per insurer, although the question of how to vary it may be difficult to answer. Advantages of risk sharing for high risks or high costs are that they prevent discussions over which conditions should make members eligible for risk sharing and they prevent manipulation by insurers. Especially these advantages led to the choice to exclude condition-specific risk sharing from the empirical analyses.
Because the main purpose of the study was to compare various main forms of risk sharing, the empirical analyses did not include some combinations of various main forms. Nevertheless, such combinations can be made, as is the case in The Netherlands in 1999, and may combine the best aspects of two or more separate forms of risk sharing.

It is clear that the *availability of specific data* may influence the type of capitation payments as well as the type of risk sharing to be used. This study assumed that the regulator has an operational definition of so-called "acceptable expenditures" within the context of the specified benefits package. This definition could become problematic if the specification of the benefits package becomes less detailed. In that case insurers have more opportunities to offer different insurance modalities of the specified benefits package.
In the empirical analyses the risk sharing is based on the total health care expenditures for a specified benefits package in a certain period (i.e. a year). If cost data are not available for all types of care within the specified benefits package, it might be possible to use imputed costs (based on volumes of health care use and imputed prices). Another option is to limit the risk sharing to types of care for which cost data are already available. For instance, the risk sharing could be limited to hospital care only (Beebe, 1992).

Finally, the precise form of the *premium rate restrictions* may influence the feasibility of risk sharing. This study assumed that an insurer has to quote the same premium to each member that chooses the same insurance modality. In 1999 these extreme premium rate restrictions are employed in several European countries (Van de Ven and Ellis, 1999). If these restrictions are loosened by requiring a certain minimum and maximum premium per insurer, executing outlier risk sharing and proportional risk sharing is still straightforward. However, executing risk sharing for high risks or high costs may pose a difficulty with premium calculations. To calculate the premium for a member, an insurer has to know for which part of future expenditures of this potential member it is at risk. With risk sharing for high risks or high costs, this is unclear at the time the insurer has to calculate the premium. Under such premium rate restrictions, the regulator is confronted with a very complex tradeoff between access, selection and efficiency (Van de Ven et al., 1999). If the premium rate restrictions are abolished, risk sharing may be used as a tool to reduce access problems. Without any premium rate restrictions, there is a tradeoff between access and efficiency and executing risk sharing for high risks or high costs may pose difficulties with the premium calculations of an insurer as mentioned above.

9.2.3 Further research

Further research on tradeoffs between the insurers' incentives for selection and efficiency in regulated competitive individual health insurance markets may focus on the following question: which combination of capitation payments and risk sharing yields the best tradeoff between selection and efficiency? Because market-oriented health care reforms including a regulated competitive health insurance market are being implemented in many countries, this question appears to be relevant in several settings.

This study was limited to combinations of demographic capitation payments and four forms of risk sharing. In the empirical analyses it was assumed that the capitation payments are calculated in the same way as in the situation without risk sharing and that the risk sharing was financed via a proportional reduction of the normative costs. Different combinations of capitation payments and risk

sharing may include:
- Other capitation payments such as capitation payments partly based on diagnostic information from previous hospitalizations and/or previously prescribed drugs (Clark et al.,1995; Ellis et al., 1996; Lamers and Van Vliet, 1996; Lamers, 1999; Weiner et al., 1996).
- Other forms of risk sharing such as condition-specific risk sharing and/or combinations of several main forms of risk sharing.
- Different ways of calculating the normative costs on which the capitation payments are based, and thereby financing the risk sharing differently, e.g. calculating normative cost levels on truncated expenditures if outlier risk sharing is employed.

For the empirical analyses in the second part of the study, a data set of Dutch sickness fund members has been used. So the empirical illustrations refer to a general population of all ages, although the higher-income groups mostly have private health insurance. Almost all health care expenditures covered by the Dutch Sickness Fund Act were included in the analyses, such as hospital care, specialists care, prescribed drugs, paramedical services, medical devices, some dental care, maternity care and sick-transport. Thus the analyzed benefits package is rather broad. The various combinations of capitation payments and risk sharing may be applied in different settings. Such different settings could include:
- Different populations, e.g. the elderly only. This may be relevant in the Dutch private health insurance market where - in 1999 - most people of 65 years or older are covered under a heavily regulated health insurance scheme (WTZ) in which insurers bear no financial risk. It is also relevant for the Medicare sector in the United States which covers mainly the elderly.
- Different benefits packages, e.g. for hospital costs only. This may be relevant for countries that lack the necessary data for all types of care included in the benefits package, but have the necessary information on hospital care. Another example is the current situation in the Dutch sickness fund sector where so-called fixed hospital expenditures are almost fully shared between the regulator and the insurer.

For future evaluations of payment systems for competing health insurers, one may introduce varying weights on specific reductions of incentives for selection as well as for efficiency. This could be seen as an extension of the conceptual framework as presented in the first part of the study. The weights may depend on the tools for selection and efficiency that the regulator expects to be used by insurers and on the importance the regulator assigns to the (negative) effects of these tools. In different settings a different set of weights may be useful. Finally, it seems worthwhile to study implementation issues more closely than was done in this study.

In sum, optimizing the tradeoff between selection and efficiency in the health insurance market is increasingly relevant for an increasing number of countries. Further research on this important issue deserves a high priority from both policy makers and health economists.

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Risicodeling als aanvulling op imperfecte normuitkeringen voor ziektekostenverzekering:

een afruil tussen selectie en doelmatigheid

Achtergrond

Sinds 1993 ontvangen ziekenfondsen normuitkeringen ter financiering van de ziektekosten van hun verzekerden. De normuitkeringen komen uit een Algemene Kas die hoofdzakelijk gevuld wordt met de inkomensafhankelijke premies van de ziekenfondsverzekerden[1]. De normuitkering voor een verzekerde is gelijk aan de verwachte ziektekosten in het komende verzekeringsjaar op grond van enkele demografische kenmerken van de verzekerde in kwestie, het zogenaamde normatieve kostenniveau, minus een vast bedrag. Deze normuitkering is onafhankelijk van de werkelijke kosten van de verzekerde in het betreffende jaar en onafhankelijk van het ziekenfonds dat de verzekerde gekozen heeft. Het verschil tussen de totale kosten van een ziekenfonds en het totaal aan ontvangen normuitkeringen dient tot uitdrukking te komen in de zogenaamde nominale premie die het ziekenfonds in rekening brengt bij zijn verzekerden. De overheid eist daarbij dat een ziekenfonds dezelfde nominale premie vraagt aan al zijn verzekerden. Wel mag de nominale premie per ziekenfonds verschillend zijn. Sinds 1996 mogen ziekenfondsverzekerden jaarlijks van ziekenfonds wisselen, waarbij voor de ziekenfondsen een acceptatieplicht geldt. Dat wil zeggen dat een ziekenfonds verplicht is ieder zich aanmeldende persoon die recht heeft op een ziekenfondsverzekering te accepteren. Tot 1992 waren ziekenfondsverzekerden op grond van hun woonplaats verplicht aangesloten bij het ziekenfonds dat in hun regio werkzaam was. Daarnaast is in 1994 de contracteerplicht voor ziekenfondsen opgeheven. Dit betekent dat zij niet langer verplicht zijn met iedere individuele beroepsbeoefenaar (bijvoorbeeld: huisartsen, tandartsen en fysiotherapeuten) een overeenkomst te hebben, maar dat zij nu zelf mogen beslissen met wie zij een contract afsluiten. In zo'n contract kunnen afspraken

[1] De Algemene Kas wordt beheerd door het College voor Zorgverzekeringen (voorheen de Ziekenfondsraad).

gemaakt worden over de prijs en kwaliteit van de te leveren zorg. Met bovengenoemde maatregelen heeft de overheid belangrijke stappen gezet in de richting van een gereguleerde concurrerende zorgverzekeringsmarkt met risicodragende zorgverzekeraars. Sinds 1988 is het overheidsbeleid - conform het advies van de commissie Dekker - erop gericht zorgverzekeraars en zorgaanbieders mede verantwoordelijk te maken voor doelmatigheid en kostenbeheersing in de zorgsector. De tot dan toe gehanteerde gedetailleerde overheidsregulering met betrekking tot het volume en de prijzen in de zorgsector, waarbij uitsluitend de overheid de verantwoordelijkheid droeg voor doelmatigheid en kostenbeheersing, wordt niet langer opportuun geacht. Sindsdien wordt gestreefd naar gereguleerde concurrentie zowel tussen zorgverzekeraars als tussen zorgaanbieders[2]. Hiervan wordt verwacht dat de zorgverzekeraars zich zullen inspannen om de doelmatigheid van de zorgverlening te bevorderen en dat zij in zullen spelen op de voorkeuren van hun verzekerden. Tot 1992 waren er geen (financiële) incentives voor ziekenfondsen om de doelmatigheid van de zorgverlening te bevorderen en/of in te spelen op de voorkeuren van hun verzekerden. De ziekenfondsen kregen namelijk achteraf al hun uitgaven vergoed door de Algemene Kas en verzekerden konden nauwelijks van ziekenfonds wisselen.
Een belangrijk obstakel bij de ingezette hervormingen is de implementatie van adequate normuitkeringen. De toepassing van demografische normuitkeringen in combinatie met de gehanteerde premieregulering leidt er namelijk toe dat de ziekenfondsen sterke incentives hebben om aan gunstige-risicoselectie te doen. Dit is de selectie van verzekerden waarvan een ziekenfonds verwacht dat zij winstgevend zullen zijn. Demografische variabelen blijken relatief slechte voorspellers van iemands toekomstige ziektekosten te zijn. Wanneer het normatieve kostenniveau van een verzekerde uitsluitend gebaseerd is op enkele demografische kenmerken, kan een ziekenfonds vrij eenvoudig een betere voorspelling van iemands toekomstige ziektekosten maken. Vervolgens kan een vergelijking van deze betere voorspelling met het normatieve kostenniveau aangeven of iemand een gunstig danwel een ongunstig risico vormt voor het

[2] Van 1988 tot 1994 omvatte dit streven zowel de kortdurende curatieve zorg zoals ziekenhuiszorg, specialistische hulp en huisartsenhulp als verschillende vormen van langdurige zorg ("care") zoals verpleeghuiszorg en gehandicaptenzorg. Vanaf 1994 is het streven beperkt tot de curatieve zorg.

ziekenfonds. Gunstige risico's worden gevormd door degenen voor wie het ziekenfonds zelf lagere uitgaven verwacht dan de verwachte uitgaven op grond van de demografische kenmerken die betrokken worden bij de berekening van de normuitkeringen. Uit eerder onderzoek is bekend dat - gegeven demografische normuitkeringen - gezonde personen gunstige risico's en met name chronisch zieken ongunstige risico's vormen. Een ziekenfonds zou op deze financiële incentives kunnen reageren door te trachten zoveel mogelijk gezonde verzekerden aan te trekken en chronisch zieken zoveel mogelijk te weren. - Hoewel dergelijke risicoselectie voor een ziekenfonds profijtelijk kan zijn, heeft het vanuit maatschappelijk oogpunt uitsluitend negatieve effecten (zie hoofdstuk twee). Het bij de berekening van de normuitkeringen betrekken van meer en betere voorspellers van iemands toekomstige ziektekosten is een ideale oplossing voor dit probleem. Hiermee kunnen - in theorie - de incentives tot risicoselectie worden weggenomen met behoud van de incentives tot doelmatigheid. In de praktijk blijkt het echter nogal moeilijk te zijn om de berekening van de normuitkeringen te verbeteren.

Gegeven demografische normuitkeringen en de premieregulering is risicodeling een andere oplossing voor het probleem van risicoselectie. Risicodeling tussen ziekenfondsen en de Algemene Kas impliceert dat ziekenfondsen sommige uitgaven voor sommigen van hun verzekerden achteraf vergoed krijgen door de Algemene Kas. Helaas vermindert risicodeling niet alleen de incentives voor ziekenfondsen om gunstige risico's te selecteren, maar ook de incentives voor ziekenfondsen om doelmatige zorg in te kopen. Bij risicodeling zal er dus een afruil plaatsvinden tussen incentives tot risicoselectie en incentives tot doelmatigheid. In deze studie wordt verondersteld dat de overheid met risicodeling beoogt de incentives tot risicoselectie zoveel mogelijk te verminderen, met zoveel mogelijk behoud van de incentives tot doelmatigheid.

In de ziekenfondssector is sinds de invoering van de normuitkeringen in hoge mate gebruik gemaakt van risicodeling. Daarbij zijn tot nu toe twee vormen van risicodeling gehanteerd, te weten proportionele verevening en overschadevergoeding (zie ook hoofdstuk drie)[3]. Andere vormen van risicodeling zijn even-

[3] Sinds 1996 wordt in de ziekenfondssector tevens een vorm van risicodeling gehanteerd voor zogenaamde vaste ziekenhuiskosten ("het splitsingsmodel"). Vanwege het internationale

wel ook denkbaar.

Doelstelling en relevantie

In deze studie is onderzocht welke hoofdvormen van risicodeling onderscheiden kunnen worden én welke vorm het meest voldoet aan het bovengenoemde doel van risicodeling. Met andere woorden: welke vorm van risicodeling leidt - gegeven de demografische normuitkeringen en de premieregulering - tot de beste afruil tussen incentives voor risicoselectie en incentives voor doelmatigheid?

Deze vraag is niet alleen wetenschappelijk interessant, maar ook maatschappelijk relevant. De overheid zou namelijk kunnen overwegen een andere vorm van risicodeling te hanteren indien zo'n vorm tot een betere afruil tussen selectie en doelmatigheid leidt dan de huidige vorm.

In het streven naar gereguleerde concurrentie tussen zowel zorgverzekeraars als tussen zorgaanbieders is Nederland niet uniek. Verschillende Europese landen hebben in de jaren '90 soortgelijke hervormingen van de zorgsector in gang gezet. Ieder land loopt daarbij tegen dezelfde problematiek aan. De vraag welke vorm van risicodeling - gegeven demografische normuitkeringen en de premieregulering - tot de beste afruil tussen selectie en doelmatigheid leidt is dus niet alleen actueel in Nederland, maar ook in andere landen. Daarom is in de onderhavige studie gekozen voor een zoveel mogelijk internationaal karakter. De onderstaande veronderstellingen ten aanzien van de zorgverzekeringsmarkt maken daar onderdeel van uit.

Veronderstellingen

Ten eerste is verondersteld dat de overheid een zeker basispakket gedefinieerd heeft dat dekking geeft voor curatieve zorg zoals ziekenhuiszorg, specialistische hulp en voorgeschreven geneesmiddelen. De verzekeraars mogen verschillende polisvormen aanbieden met betrekking tot dit pakket voorzover deze alle voorgeschreven vormen van zorg omvatten. Voor vormen van langdurige zorg

karakter van deze studie is hiermee in de empirische analyses van dit proefschrift geen rekening gehouden. Het toepassen van dezelfde analyses binnen het kader van het splitsingsmodel leidt overigens tot dezelfde conclusies (Van Barneveld et al., 2000a; Van Barneveld et al., 2000b).

wordt verondersteld dat de overheid een apart regime hanteert, los van de curatieve zorg[4]. Voor vormen van zorg die niet gedekt zijn via de langdurige zorg of het basispakket voor curatieve zorg, kunnen verzekeraars aanvullende verzekeringen aanbieden. De markt voor deze aanvullende verzekeringen is volledig vrij. Ten tweede is verondersteld dat er een jaarlijkse acceptatieplicht geldt voor de basisverzekering. Ten derde is verondersteld dat de verzekeraars normuitkeringen ontvangen waarvan de hoogte op grond van demografische variabelen wordt vastgesteld en daarnaast een nominale premie van hun verzekerden. De overheid eist dat een verzekeraar dezelfde nominale premie in rekening brengt bij iedere verzekerde die dezelfde polisvorm van het basispakket heeft gekozen.

De studie bestaat uit twee delen. Het eerste deel is gewijd aan het opbouwen van een conceptueel kader voor het analyseren en optimaliseren van de afruil tussen selectie en doelmatigheid. Het twee deel presenteert empirische analyses.

Conceptueel kader

Hoofdstuk twee richt zich op het probleem van risicoselectie. Het geeft aan dat een verzekeraar verschillende (subtiele) instrumenten voor selectie kan hanteren zoals: de service van de verzekeraar, de kwaliteit, reputatie en service van zijn gecontracteerde zorgverleners, het aanbieden van verschillende polisvormen van het basispakket en van verschillende aanvullende (ziektekosten)verzekeringen, selectief adverteren en 'direct mailing'. Vervolgens zijn drie negatieve maatschappelijke effecten van selectie beschreven. Ten eerste kan de toegang tot goede zorg voor met name chronisch zieken in gevaar komen. Ten tweede kunnen doelmatige verzekeraars marktaandeel verliezen aan ondoelmatige verzekeraars die succesvol zijn met risicoselectie. Ten derde kunnen alle uitgaven aan risicoselectie gezien worden als maatschappelijke verliezen. Derhalve is het voorkomen van risicoselectie essentieel voor een succesvolle implementatie van een gereguleerde concurrerende markt voor individuele ziektekostenverzekeringen. Binnen de context van deze studie kan de overheid op drie manieren risicoselectie tegengaan. Ten eerste kan zij aanvullende

[4] Zoals de Algemene Wet Bijzondere Ziektekosten (AWBZ) in Nederland.

concurrentiebevorderende regelgeving hanteren, maar op zichzelf is dit geen veelbelovende aanpak. Ten tweede kan de overheid trachten meer en betere kenmerken van verzekerden bij de berekening van de normuitkeringen te betrekken. In Nederland en in verschillende andere landen blijkt dit echter erg moeilijk te zijn. Ten slotte kan de overheid risicodeling tussen verzekeraars en de Algemene Kas introduceren. Deze studie analyseert hoofdzakelijk de laatstgenoemde strategie.

In de literatuur worden verschillende indicatoren gebruikt voor het meten van de overall incentives tot risicoselectie bij verschillende normuitkeringenformules: R^2-waarden, het gemiddelde absolute resultaat en het gemiddelde absolute voorspelde resultaat. In hoofdstuk twee is betoogd dat de laatstgenoemde indicator zinvoller is dan de andere twee. Ter verfijning is voorgesteld sommige kleine voorspelbare winsten en verliezen te verwaarlozen. Zulke winsten en verliezen kunnen irrelevant zijn voor selectie omdat een verzekeraar ook rekening moet houden met de kosten van selectie en met (statistische) onzekerheden over de netto winst van selectie. Als dit juist is dan is het zogenaamde gewogen gemiddelde absolute voorspelde resultaat een betere indicator voor de overall incentives tot selectie. De toepassing van zowel de conventionele als de nieuwe indicatoren in een theoretische analyse laat zien dat - wanneer kleine voorspelbare winsten en verliezen inderdaad irrelevant zijn voor selectie - de conventionele indicatoren tot een overschatting leiden van de incentives tot selectie, met name in het geval van relatief goede normuitkeringenformules.

De bovengenoemde indicatoren kunnen niet berekend worden in het geval van risicodeling. Daarom is nog een andere overall indicator voorgesteld. Deze is gebaseerd op de som van de voorspelbare winsten en verliezen voor een verzekeraar, gegeven de normuitkeringen en gegeven bepaalde kostenvoorspellingen van de verzekeraar zelf. Naast deze overall indicator, wordt het gemiddeld resultaat per subgroep van verzekerden gehanteerd als indicator voor de incentives om personen uit de betreffende groep aan te trekken of juist te weren.

Hoofdstuk drie laat zien dat de internationale literatuur verschillende suggesties voor risicodeling bevat en dat voorgaande empirische studies naar risicodeling zich beperken tot afzonderlijke analyses van twee hoofdvormen in een verschil-

lende context. Vervolgens is een beschrijving gegeven van mogelijke vormen van risicodeling. Naast de periode waarop de risicodeling betrekking heeft, omvat een beschrijving van risicodeling tenminste de groep van verzekerden waarop de risicodeling betrekking heeft, de typen zorg, de mate waarin het risico wordt gedeeld en de prijs die een verzekeraar voor de risicodeling moet betalen. Voor de empirische analyses zijn de volgende keuzen gemaakt: een verzekeraar mag zelf een bepaald percentage van zijn verzekerden (p) aanmelden hetzij vóór aanvang van het jaar (D=0) waarop de risicodeling van toepassing is, hetzij aan het eind van dat jaar (D=1). De risicodeling heeft betrekking op alle vormen van zorg die opgenomen zijn in het basispakket. Een verzekeraar ontvangt een bepaald percentage (a) van de kosten van aangemelde verzekerden voorzover deze kosten boven een bepaald drempelbedrag (T) uitkomen. De risicodeling wordt gefinancierd door middel van een procentuele verlaging van de normkosten. Dit percentage wordt achteraf zodanig vastgesteld dat de risicodeling vanuit het oogpunt van de Algemene Kas budget-neutraal is. Vier hoofdvormen worden onderscheiden:

(1) Hoge-risicoverevening ($0<p<1;D=0;a=1;T=0$).
(2) Hoge-kostenverevening ($0<p<1;D=1;a=1;T=0$).
(3) Overschadevergoeding ($p=1;a=1;T>0$).
(4) Proportionele verevening ($p=1;0<a<1;T=0$).

Middels het kiezen van verschillende parameterwaarden ontstaan verschillende varianten per vorm van risicodeling. Het optimaliseren van de afruil tussen selectie en doelmatigheid heeft dus niet uitsluitend betrekking op het bepalen van de optimale vorm van risicodeling, maar ook kan per vorm van risicodeling gezocht worden naar de optimale variant.

In 1997 is een aangepaste variant van overschadevergoeding ingevoerd in de ziekenfondssector (T=4.500 gulden en a=0.9). De sinds 1993 gehanteerde verevening en nacalculatie komen gezamenlijk neer op de hier als vierde genoemde vorm van risicodeling[5].

[5] In Nederlandse beleidskringen wordt soms de term "hoge-kostenverevening" gebruikt voor de hier als derde genoemde vorm van risicodeling. Cruciaal is dat bij hoge-kostenverevening (vorm 2) een verzekeraar een volledige vergoeding ontvangt voor een beperkt percentage van zijn verzekerden terwijl het bij overschadevergoeding (vorm 3) gaat om een volledige vergoeding van de kosten van een verzekerde voor zover deze boven een bepaald drempelbedrag

Onder alle vier de vormen van risicodeling kunnen aangemelde verzekerden dezelfde nominale premie blijven betalen als overige verzekerden en kan aanmelding van de verzekerden voor risicodeling achter de schermen plaatsvinden. Risicodeling impliceert betalingen aan verzekeraars op grond de werkelijke uitgaven in het betreffende contractjaar voor hun aangemelde verzekerden. Risicodeling verschilt dus wezenlijk van normuitkeringen, omdat normuitkeringen onafhankelijk zijn van de werkelijke uitgaven in het betreffende contractjaar.

Hoofdstuk vier richt zich op de doelmatigheidskant van de afruil tussen selectie en doelmatigheid. Het geeft aan dat een verzekeraar verschillende instrumenten kan hanteren ter bevordering van de doelmatigheid van de zorg, zoals: utilization management, disease management, case management, selectieve contractering van zorgaanbieders, financiële incentives, onderhandelen over vergoedingen en het aanbieden van verschillende polisvormen. De potentiële besparingen die een verzekeraar kan bewerkstelligen blijken aanzienlijk te zijn. Zo heeft bijvoorbeeld in Californië de toepassing van managed care en gereguleerde concurrentie geleid tot een verlaging van de kosten voor groepen werknemers, waardoor de premie met tien procent kon worden verlaagd. De introductie van een utilization review programma voor ziekenhuiszorg heeft geleid tot een verlaging van de ziekenhuiskosten met ongeveer acht procent en van de totale kosten met ongeveer vier procent. Verder zijn er verschillende voorbeelden van succesvolle toepassingen van disease management of case management, bijvoorbeeld een verlaging van 40 procent van de kosten van patiënten met een hartinfarct en van 15 tot 35 procent voor diabetici.
De voorgestelde methode voor de berekening van de incentives voor doelmatigheid van een verzekeraar is als volgt. Onder de veronderstelling - ceteris paribus - dat een verzekeraar bepaalde ziektekosten kan verlagen door middel van doelmatigheidsbevordering, zullen zijn kosten maar waarschijnlijk ook de

uitkomen (de zogenaamde overschade). Bovendien heeft de laatstgenoemde vorm van risicodeling betrekking op alle verzekerden.

vergoedingen die hij ontvangt in het kader van de risicodeling, lager zijn[6]. Daarom kan de doelmatigheidswinst gesplitst worden in een deel dat ten goede komt aan de verzekeraar en een deel dat ten goede komt aan de Algemene Kas. Hoe hoger het deel voor de verzekeraar, hoe hoger de incentives tot doelmatigheid. De doelmatigheidwinst van een verzekeraar kan bepaald worden onder verschillende veronderstellingen omtrent besparingen: besparingen op alle uitgaven, op bepaalde vormen van zorg, op bepaalde subgroepen van verzekerden. In het eerste geval ontstaat een overall indicator voor de incentives tot doelmatigheid, in de andere gevallen een specifieke indicator voor incentives tot doelmatigheid met betrekking tot bepaalde zorgvormen of subgroepen.
De zogenaamde gewogen uitgaven zijn voorgesteld als alternatieve overall indicator voor de incentives tot doelmatigheid. Deze indicator is relevant onder de veronderstelling dat (sommige) incentives voor doelmatigheid aanwezig zijn zolang (een deel van) de marginale uitgaven voor een verzekerde in een jaar ten laste komen van de verzekeraar zelf. Zodra het zeker is dat deze marginale uitgaven volledig ten laste komen van de Algemene Kas is de incentive voor doelmatigheid verdwenen. Aangetoond wordt dat beide overall indicatoren voor de incentives tot doelmatigheid vergelijkbare uitkomsten geven indien een verzekeraar rekening houdt met de uitgaven die gedurende het jaar plaatsvinden.

Hoofdstuk vijf combineert de elementen van de voorgaande hoofdstukken in een systematische methode ter optimalisering van de afruil tussen selectie en doelmatigheid. Als theoretische illustratie van de methode worden optimale varianten van proportionele verevening bepaald, gegeven bepaalde normuitkeringen en gegeven de voorkeuren van de overheid met betrekking tot het reduceren van selectie versus het behouden van doelmatigheid. De theoretische illustraties in dit hoofdstuk beperken zich tot proportionele verevening, omdat de overige hoofdvormen van risicodeling niet op deze wijze geanalyseerd

[6] De ceteris paribus voorwaarde houdt onder meer in dat het bedrag dat de verzekeraar dient te betalen aan de Algemene Kas ter financiering van de risicodeling gelijk blijft. Bovendien is afgezien van een mogelijke verlaging van de normuitkeringen in de toekomst als gevolg van een verlaging van de kosten nu. In de huidige Nederlandse situatie met meer dan 25 ziekenfondsen zonder een ziekenfonds met een uitzonderlijk groot marktaandeel zijn dit redelijke veronderstellingen.

konden worden. Dit vormde een belangrijk argument om empirische analyses ten aanzien van de afruil tussen selectie en doelmatigheid uit te voeren.

Empirische analyses

Hoofdstuk zes geeft een beschrijving van het gegevensbestand, de methoden die worden gehanteerd en de incentives voor selectie indien er demografische normuitkeringen worden gehanteerd zonder enige vorm van risicodeling. Het gegevensbestand bevat administratieve gegevens voor zes achtereenvolgende jaren (1988-1993) van ongeveer 47.200 verzekerden van één ziekenfonds. De gegevens bestaan uit demografische kenmerken, de jaarlijkse kosten voor verschillende vormen van zorg en de diagnosen van ziekenhuisopnamen. Voor ongeveer 10.500 verzekerden zijn tevens gegevens uit een gezondheidsenquête beschikbaar. De gemiddelde ziektekosten in 1993 waren 1.941 gulden. In overeenstemming met eerder onderzoek laat dit hoofdstuk zien dat - bij demografische normuitkeringen zonder risicodeling - een verzekeraar vrij eenvoudig subgroepen van verzekerden kan identificeren die voorspelbare substantiële winsten of verliezen genereren. Bijvoorbeeld, voor degenen die twee jaar geleden tot de 1%-groep behoorden met de hoogste kosten (of de hoogste kosten voor voorgeschreven geneesmiddelen) is het voorspelbare verlies in het komende verzekeringsjaar ongeveer 12.000 gulden per persoon. Voor degenen die in tenminste drie van de voorgaande vier jaren een ziekenhuisopname hebben gehad (ongeveer 1% van de verzekerden) is het voorspelbare verlies ook ongeveer 12.000 gulden per persoon. Met de gegevens uit de gezondheidsenquête zijn verzekerden onderscheiden die achtereenvolgens een ernstige hartziekte hebben (ongeveer 1.8%), diabetes (ongeveer 1.7%) of kanker (ongeveer 1.2%). De gemiddelde voorspelbare verliezen per persoon in deze groepen zijn achtereenvolgens ongeveer 4.300 gulden, 2.900 gulden en 5.400 gulden. Ten slotte is het voorspelbare verlies voor degenen die wijkverpleging danwel thuiszorg (ongeveer 4.9%) ontvangen ongeveer 3.500 gulden per persoon. Desalniettemin wordt geconcludeerd dat demografische normuitkeringen de incentives tot risicoselectie met circa één-derde reduceren ten opzichte van ongedifferentieerde normuitkeringen[7]. Demografische variabelen zijn dus nuttig

[7] Dat wil zeggen eenzelfde normuitkering voor iedere verzekerde.

voor de bepaling van normuitkeringen maar zeker niet afdoende. Het verwaarlozen van kleine voorspelbare winsten en verliezen beïnvloedt deze conclusie nauwelijks.

Hoofdstuk zeven analyseert de afname van de incentives tot selectie en doelmatigheid wanneer er verschillende vormen van risicodeling worden gehanteerd als aanvulling op demografische normuitkeringen. Voor elk van de vier hoofdvormen zoals beschreven in hoofdstuk drie, worden verschillende varianten gesimuleerd door het variëren van de relevante parameter. Alhoewel de empirische verdeling van individuele jaarlijkse ziektekosten statistisch significant afwijkt van de theoretische lognormale verdeling bleken de theoretische analyses in hoofdstuk drie, die gebaseerd zijn op laatstgenoemde verdeling, een goede indicatie te geven van het percentage van kosten dat gedeeld wordt tussen de verzekeraars en de Algemene Kas. Daarnaast geven de theoretische analyses in hoofdstuk vier een goede indicatie van de overall incentives tot doelmatigheid bij de vier hoofdvormen van risicodeling. De belangrijkste conclusie van hoofdstuk zeven is dat hoge-risicoverevening en hoge-kostenverevening tot een betere afruil tussen selectie en doelmatigheid leiden dan zowel overschadevergoeding als proportionele verevening. De resultaten voor hoge-risicoverevening en hoge-kostenverevening zijn niet eenduidig. Er lijken twee voordelen te zijn van hoge-risicoverevening ten opzichte van hoge-kostenverevening. Ten eerste leidt dit, gegeven een zeker gewenst overall niveau van de incentives tot doelmatigheid, tot een grotere afname van de grote voorspelbare verliezen op verzekerden met hoge kosten in het verleden, veel ziekenhuisopnamen in het verleden en ernstige chronische aandoeningen. Ten tweede zijn, gegeven een gewenst overall niveau van de incentives voor selectie, de incentives voor doelmatigheid met betrekking tot ziekenhuiskosten en onvoorspelbaar hoge kosten groter. Een nadeel van hoge-risicoverevening in vergelijking met hoge-kostenverevening is dat er, bij een beperkte omvang van de risicodeling, minder incentives voor doelmatigheid zijn met betrekking tot enkele subgroepen die wellicht in aanmerking zouden komen voor het toepassen van disease management.

Hoofdstuk acht beschouwt de kosten in het voorgaande jaar als aanvullend

verdeelkenmerk naast de demografische verdeelkenmerken voor de bepaling van de normuitkeringen. Verschillende varianten van dit verdeelkenmerk worden gesimuleerd door te variëren met het drempelbedrag waarboven de kosten als verdeelkenmerk worden meegenomen. In tegenstelling tot andere veelbelovende verdeelkenmerken leidt een kostengerelateerd verdeelkenmerk tot een afruil tussen selectie en doelmatigheid, net als de verschillende vormen van risicodeling. In overeenstemming met de theoretische analyses in hoofdstuk twee, laat dit hoofdstuk zien dat - wanneer kleine voorspelbare winsten en verliezen irrelevant zijn voor selectie - de conventionele indicatoren tot een overschatting van de incentives voor selectie leiden, met name bij relatief goede normuitkeringenformules. Uiteraard is het interessant om de resultaten van kosten in het voorgaande jaar als verdeelkenmerk te vergelijken met de resultaten van risicodeling. De belangrijkste conclusie van dit hoofdstuk is dat de kosten in het voorgaande jaar als verdeelkenmerk tot een betere afruil tussen selectie en doelmatigheid leidt dan zowel overschadevergoeding als proportionele vereveneing. In vergelijking met hoge-risicoverevening en hoge-kostenverevening zijn de resultaten van kosten in het voorgaande jaar als verdeelkenmerk niet eenduidig. Een voordeel van kosten in het verleden als verdeelkenmerk is dat, gegeven een relatief laag niveau van de gewenste incentives tot selectie, de incentives tot doelmatigheid hoger zijn. Een nadeel is dat, gegeven een overall niveau van de gewenste incentive tot doelmatigheid, de voorspelbare verliezen voor verschillende subgroepen groter zijn.

Conclusie

Uit de empirische analyses blijkt dat het aanvullen van demografische normuitkeringen met hoge-risicoverevening of hoge-kostenverevening alsmede het hanteren van de kosten in het voorgaande jaar als extra verdeelkenmerk, tot een betere afruil tussen selectie en doelmatigheid leidt dan het aanvullen van demografische normuitkeringen met overschadevergoeding of proportionele verevening.

Beleidsimplicaties

Deze conclusie is relevant voor Nederland en verschillende andere Europese

landen[8]. In 1999 hanteren sommige landen demografische normuitkeringen zonder enige vorm van risicodeling (bijvoorbeeld Duitsland, Tsjechië en Zwitserland). Deze landen kunnen de afruil tussen selectie en doelmatigheid wellicht verbeteren door een vorm van risicodeling te introduceren of de normuitkeringen mede te baseren op de kosten in het voorgaande jaar. Andere landen hebben hun demografische normuitkeringen aangevuld met overschadevergoeding en/of proportionele verevening (bijvoorbeeld België en Nederland). Deze landen kunnen de afruil tussen selectie en doelmatigheid wellicht verbeteren door een andere vorm van risicodeling te gaan hanteren. Een andere mogelijkheid is om de gehanteerde vorm van risicodeling te vervangen door de kosten in het voorgaand jaar als verdeelkenmerk. De conclusie is ook relevant voor bijvoorbeeld de Verenigde Staten, Israël en Rusland waar gereguleerde concurrentie wordt nagestreefd tussen zorgverzekeraars en voor bijvoorbeeld Taiwan dat overweegt een dergelijk ordeningsprincipe op de zorgverzekeringsmarkt te gaan hanteren.

Ervan uitgaande dat het, op korte termijn, voor de meeste landen erg moeilijk zal zijn om hun demografische normuitkeringen sterk te verbeteren, lijkt het een goede stap om te gaan experimenteren met hoge-risicoverevening of hoge-kostenverevening en/of met de kosten in het voorgaand jaar als verdeelkenmerk. Op langere termijn, zelfs wanneer demografische normuitkeringen sterk verbeterd worden, lijkt het aannemelijk dat beperkte vormen van risicodeling nog steeds nuttig kunnen zijn. De bevindingen van deze studie alsmede die omtrent het verbeteren van normuitkeringen lijken te impliceren dat er voldoende technische mogelijkheden zijn om beperkte incentives voor selectie te combineren met sterke incentives voor doelmatigheid in een gereguleerde concurrerende markt voor individuele ziektekostenverzekering.

Beperkingen

De hieronder genoemde beperkingen van de studie zijn toegespitst op de ziekenfondssector in Nederland. De studie veronderstelt dat het *doel van risicode-*

[8] Van de Ven en Ellis (1999) geven een overzicht van de praktijk van normuitkeringen en risicodeling in verschillende landen.

ling is om, gegeven de normuitkeringen en de premieregulering, de incentives voor selectie zo veel mogelijk te verminderen en de incentives voor doelmatigheid zoveel mogelijk te behouden. In ander onderzoek zijn andere beoordelingscriteria gehanteerd. Bijvoorbeeld, in onderzoek in het kader van de Werkgroep Ontwikkeling Verdeelmodel (WOVM) wordt de zogenaamde verdelende werking van het gehele verdeelmodel ("normuitkeringen plus risicodeling") op ziekenfondsniveau vaak gehanteerd[9]. Wil men het verdeelmodel echter beoordelen op de incentivestructuur dan is met betrekking tot incentives voor selectie de "verdelende werking op subgroepniveau" het juiste beoordelingscriterium. Dit criterium geeft aan in hoeverre voorspelbare financiële resultaten voor bepaalde subgroepen van verzekerden afwijken van nul. In tegenstelling tot het criterium "verdelende werking op ziekenfondsniveau" is dit criterium, dat algemeen in de internationale literatuur wordt gehanteerd, niet gevoelig voor de toevallige risicosamenstelling van verzekeraarsportefeuilles en voor toevallige fluctuaties in het kostenniveau. Deze toevalsfluctuaties kunnen tot de verantwoordelijkheid van de verzekeraars gerekend worden. Voor relatief grote verzekeraars is toeval geen relevant probleem en relatief kleine verzekeraars kunnen zich tegen eventuele nadelige gevolgen van toeval verzekeren via vrijwillige en risico-gerelateerde herverzekeringscontracten. Vanzelfsprekend zijn de conclusies van dit onderzoek niet noodzakelijk geldig indien het doel van de risicodeling anders is dan verondersteld. In dat geval moeten andere afwegingen worden gemaakt.

In de empirische analyses van de studie worden *vier hoofdvormen van risicodeling* onderscheiden. Elke vorm van risicodeling kan gezien worden als een verplichte herverzekering voor de verzekeraars met een niet (volledig) aan het risico gerelateerde herverzekeringspremie. Dit geldt met name voor overschadevergoeding en proportionele verevening die een duidelijke analogie hebben met respectievelijk "excess-of-loss" en "quota share" herverzekeringscontracten. In aanvulling daarop kan hoge-risicoverevening gezien worden als een vorm van regulering die - tot op zekere hoogte - het weigeren van hoge-risicoverzekerden

[9] In Nederlandse beleidskringen lijkt dit een belangrijk beoordelingscriterium te zijn voor de uitkomsten van een verdeelmodel (zie ook Van Vliet, Lamers en Van de Ven, 1999).

waarvoor geen goede premie (normuitkering) bepaald kan worden, tracht te simuleren. Dit weigeren is gebruikelijk in een vrije verzekeringsmarkt, maar is niet toegestaan in een gereguleerde concurrerende verzekeringsmarkt met een periodieke acceptatieplicht. Omdat het vergelijken van hoofdvormen van risicodeling het primaire doel van de studie was, zijn er geen combinaties van hoofdvormen empirisch onderzocht. Desalniettemin kunnen dergelijke combinaties worden toegepast en kunnen zij wellicht de beste aspecten van twee of meer hoofdvormen verenigen.

Het moge duidelijk zijn dat de *beschikbaarheid van gegevens* van invloed kan zijn op de te hanteren normuitkeringenformule en de te hanteren vorm van risicodeling. Deze studie veronderstelt dat de overheid een definitie heeft van de zogenaamde "aanvaardbare kosten" binnen het kader van het gespecificeerde verstrekkingenpakket. In de ziekenfondssector is sinds de introductie van de normuitkeringen in 1993 nog steeds aan deze voorwaarde voldaan. Aan deze voorwaarde wordt in mindere mate voldaan wanneer de specificatie van het basispakket minder stringent is en wanneer ziekenfondsen verschillende polisvormen van het basispakket mogen gaan aanbieden.

Ten slotte kan de precieze *vorm van premieregulering* van invloed zijn op de te hanteren vormen van risicodeling. Deze studie veronderstelt - conform de situatie in de ziekenfondssector sinds 1993 - dat een ziekenfonds dezelfde nominale premie moet vragen aan iedere verzekerde. Indien deze extreme vorm van premieregulering zou worden gewijzigd in de voorwaarde van een zekere minimum- en maximumpremie per ziekenfonds, is overschadevergoeding en proportionele verevening nog steeds mogelijk. De implementatie van hoge-risicoverevening of hoge-kostenverevening zou moeilijkheden kunnen opleveren bij premiecalculaties door een ziekenfonds. Voor het bepalen van de premie voor een verzekerde moet een ziekenfonds weten voor welk deel van de toekomstige ziektekosten het financieel verantwoordelijk is. Bij hoge-risicoverevening of hoge-kostenverevening is dit niet geheel duidelijk op het moment dat het ziekenfonds de premie moet vaststellen. Met de genoemde vorm van premieregulering is er sprake van een ingewikkelde afruil tussen selectie, doelmatigheid en toegankelijkheid (Van de Ven et al., 1999). Indien geheel

wordt afgezien van enige vorm van (premie)regulering, is er sprake van een afruil tussen toegankelijkheid en doelmatigheid en kunnen hoge-risicoverevening en hoge-kostenverevening ook problematisch zijn in verband met premiecalculaties door een ziekenfonds.

Nader onderzoek

Nader onderzoek met betrekking tot de ziekenfondssector zou zich kunnen richten op de volgende vraag: welke combinatie van normuitkeringen en risicodeling geeft de beste afruil tussen selectie en doelmatigheid? Deze studie beperkt zich tot combinaties van demografische normuitkeringen en vier vormen van risicodeling. In de empirische analyses is verondersteld dat de normuitkeringen op eenzelfde wijze worden vastgesteld als in de situatie zonder risicodeling en dat de risicodeling wordt gefinancierd door een procentuele korting op de normkosten. Verschillende combinaties van normuitkeringen en risicodeling zouden gevormd kunnen worden door:

- Het hanteren van andere normuitkeringen, bijvoorbeeld normuitkeringen die mede gebaseerd zijn op diagnose kosten groepen en/of farmacie kosten groepen (Clark et al., 1995; Ellis et al., 1996; Lamers en Van Vliet, 1996; Lamers, 1999; Weiner et al., 1996).
- Het hanteren van andere vormen van risicodeling, bijvoorbeeld combinaties van verschillende hoofdvormen.
- Het anders vaststellen van de normkosten waarop de normuitkeringen zijn gebaseerd en daardoor het hanteren van een andere financiering van de risicodeling. Bijvoorbeeld door het berekenen van normatieve kostenniveaus op afgekapte kostengegevens indien een vorm van overschadevergoeding wordt gehanteerd.

De empirische analyses in deze studie zijn gebaseerd op een gegevensbestand van één ziekenfonds. De empirische illustraties gelden derhalve voor een algemene populatie van alle leeftijden, alhoewel de hogere-inkomensgroepen in Nederland veelal een particuliere ziektekostenverzekering hebben. De verschillende combinaties van normuitkeringen en risicodeling kunnen worden toegepast binnen verschillende kaders. Zo'n kader kan bijvoorbeeld gegeven worden door de populatie waarop het een en ander betrekking heeft. Gedacht kan worden aan

toepassingen binnen het kader van de particuliere ziektekostenverzekering. In deze sector worden sinds 1989 de meeste 65-plussers die geen aanspraak maken op een ziekenfondsverzekering of publiekrechtelijke ambtenarenregeling, verzekerd via de Wet Toegang tot Ziektekostenverzekering (WTZ). De WTZ heeft betrekking op circa 15% van de particulier verzekerden en circa 35% van de totale schade op de particuliere verzekeringsmarkt. Met betrekking tot deze uitgaven dragen de verzekeraars geen enkel financieel risico (Van de Ven et al., 1996).

Voor toekomstige evaluaties van verdeelmodellen zouden verschillende gewichten geïntroduceerd kunnen worden voor specifieke reducties van incentives voor selectie en doelmatigheid. Dit kan een uitbreiding vormen op het conceptuele kader zoals gepresenteerd in het eerste deel van de studie. De gewichten zouden af kunnen hangen van de instrumenten voor selectie en doelmatigheid waarvan de overheid verwacht dat ze gehanteerd zullen worden en van het belang dat de overheid hecht aan de (negatieve) gevolgen van deze instrumenten. Tot slot verdient het aanbeveling nader onderzoek te laten doen naar de uitvoeringsaspecten van verschillende vormen van risicodeling.

Samenvattend, het optimaliseren van de afruil tussen selectie en doelmatigheid op de zorgverzekeringsmarkt is in toenemende mate relevant voor Nederland alsmede voor een toenemend aantal andere landen. Nader onderzoek naar deze belangrijke afruil verdient een hoge prioriteit van beleidmakers en gezondheidseconomen.

Curriculum vitae

Erik Michiel van Barneveld (1969) attended VWO at the "Drie Waarden" in Schoonhoven from 1981 to 1987. He then studied econometrics at the Erasmus University Rotterdam (EUR) from 1987 to 1993. From 1990 to 1993 he worked as a student research assistant at the Department of Health Policy and Management (iBMG) at the EUR. This research focused on the calculation of risk-adjusted capitation payments for competing health insurers. After graduation he continued to work at the iBMG, first as research assistant, later as assistant professor.

From 1993 to 1995 he participated in several government-funded research projects on the financing of competing health insurers. Research results of these projects have been published in national and international journals.

At the end of 1995 he started this thesis that focuses on forms of risk sharing between health insurers and the regulator that can be used as a supplement to imperfectly risk-adjusted capitation payments. The main research results are currently under submission for publication. Next to his research activities, he has taught courses on statistics at the iBMG.

In 2000 he joined the health insurer "AGIS-Group" in Utrecht. This group has been formed in 1999 by three former Dutch sickness funds.

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