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Gold and Silver Health Plans: Accommodating Demand Heterogeneity in Managed Competition

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Abstract

New regulation of health insurance markets creates multiple levels of health plans, with designations like “Gold” and “Silver”. The underlying rationale for the heavy-metal approach to insurance regulation is that heterogeneity in demand for health care is not only due to health status (sick demand more than the healthy) but also to other, “taste” related factors (rich demand more than the poor). This paper models managed competition with demand heterogeneity to consider plan payment and enrollee premium policies in relation to efficiency (net consumer benefit) and fairness (the European concept of “solidarity”). Specifically, this paper studies how to implement a “Silver” and “Gold” health plan efficiently and fairly in a managed competition context. We show that there are sharp tradeoffs between efficiency and fairness. When health plans cannot or may not (because of regulation) base premiums on any factors affecting demand, enrollees do not choose the efficient plan. When taste (e.g. income) can be used as a basis of payment, a simple tax can achieve both efficiency and fairness. When only health status (and not taste) can be used as a basis of payment, health status-based taxes and subsidies are required and efficiency can only be achieved with a modified version of fairness we refer to as “weak solidarity.” An overriding conclusion is that the regulation of premiums for both the basic and the higher level plans is necessary for efficiency.

1 Introduction

In economic terms, an individual’s utility from medical treatment generally depends on her health status (e.g., her general medical condition, the illness she suffers from, and the severity of this illness) as well as other factors such as her income, education and tastes which affect utility and demand for most goods and services. Respecting individual preferences calls for taking into account both sets of factors in deciding her best treatment. However, particularly in managed care environments, supply-side factors and rationing rules also affect care provided. The clinician treating this patient may not weigh all of the factors affecting her utility equally. Either because of professional inclination or unfamiliarity with patient preferences, clinicians may be more responsive to the individual’s health status than to other “taste” factors affecting her utility. An immediate consequence of this simple observation is that individuals in a health plan will receive similar treatment if their health status is the same, even if their benefits from the services are not. Social efficiency will not generally be served by such

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uniform treatment, and welfare could be improved if individuals with greater “taste” for health services were in different plans than those with lower taste.

In the U.S., pursuit of public policy objectives of extending coverage and controlling costs brings health insurance more under public control, and consequently, accommodating demand heterogeneity becomes an issue for regulation rather than simply being “left to the market.” One public policy response to demand heterogeneity creates “Gold”, “Silver” and possibly other heavy-metal plans representing levels of coverage and generosity. The publicly created health insurance market in Massachusetts designates Platinum, Gold and Silver Plans, and national health care reform calls for Platinum, Gold, Silver and Bronze. The design of efficient and equitable health policy in this policy context is the focus of this paper. We carry out the analysis when two types of health plans can efficiently serve tastes, a basic plan which we term “Silver” and a more generous plan which we term “Gold.”

This paper studies how to efficiently and fairly implement a “Silver” and “Gold” health insurance plan within a policy context of managed competition. In managed competition, private plans compete for enrollees subject to regulation of premiums and benefits (Enthoven, 1980). Managed competition characterizes health policy in many countries, including Germany, Israel, Netherlands, Switzerland, the U.S. and other countries where regulated private plans compete in a market for enrollees. Our “Silver Plan” covers a basic bundle of health care services. The “Gold Plan” offers better coverage/higher quality of care, but is more expensive. For efficiency, we want groups with a higher willingness to pay for health care to be in the Gold Plan. For fairness, we want the sick and the healthy to pay the same for plan membership in both plans. As far as we know, the literature does not contain a description of an enrollee premium-plan payment policy that achieves these two objectives.

After a literature review in Section 2, Section 3 describes our model in which consumers differ in two dimensions, health status and “taste” for health care, and are served by competing managed health care plans. A Regulator pays plans and may levy plan-specific taxes. Plans compete on services and premiums. We lay out explicit criteria for what we mean by efficiency and fairness. Efficiency is based on maximizing net consumer benefit. Fairness is based on the solidarity principle that the sick should pay the same as the healthy for health insurance. Section 4 considers the case in which both health status and “taste” are available as a basis of payment. The natural interpretation of “taste” in this case is “income,” a taste-related individual characteristic that can be used to condition premiums or as basis for taxation. We show that incremental cost pricing of individual premiums is efficient but unfair, and that average cost premiums are fair but not efficient. By use of a new policy with an income-based tax on plan membership the Regulator can achieve both an efficient and fair allocation.

Many factors affecting demand (e.g. subjective valuation of health) cannot be used as a basis for either Regulator payment to plans or premiums charged to enrollees. Section 5 considers regulation when taste cannot be used as a basis for payment. We show that no payment policy leads to both efficiency and fairness. When we weaken the solidarity principle to be that the sick pay no more for health insurance than the healthy, efficiency and fairness can be achieved. We describe the tax and premium policy that achieves efficiency and “weak solidarity” in this context. Section 6 concludes the paper and comments on applications of our analysis to payment systems built around the idea of managed competition.

2 Literature Review

From the beginning, proponents of managed competition recognized the problem of serving heterogeneous demands in a health insurance market in which a Regulator specifies a basic plan, and allows competition on price and quality (Diamond, 1992; Enthoven, 1980).

Heterogeneity in demand stems from differences in health status and heterogeneity associated with “taste” factors. Health status heterogeneity is addressed by risk-adjustment of the payments made to health plans.¹ Taste heterogeneity raises distinct issues and comes about when, for example, higher-income groups are willing to pay for higher quality care than is provided in the basic plan. “Taste adjustment” of plan payments would not attain efficiency if clinicians in a plan failed to allocate resources in response to tastes.²

Researchers have characterized premium policies that achieve either efficiency or fairness, but not both. One way to accommodate diverse tastes with a Silver and Gold Plan sets the premium for the Silver plan at the same for all. Then, the regulator charges each person the incremental cost they would incur in the Gold over the Silver Plan, and lets them choose the plan they want (Keeler, Carter, Newhouse, 1998). This premium policy efficiently sorts individuals among the plans, but by charging more for the sick, violates principles of equity.

Enthoven and Kronick (1989) and others argue that managed competition accommodates tastes by allowing Gold Plans to both upgrade services over a Silver Plan and also charge a higher premium to pay for the upgrade. The idea, as expressed by Pizer, Frakt and Feldman (2003), is that “Beneficiaries who highly value certain benefits can search for a plan that offers those benefits and pay the marginal premium that corresponds to their choice.” This policy is fair in the sense that everyone pays the same for plan membership, but it fails to efficiently sort consumers between plans. If the premium for the Gold Plan is average (not marginal) incremental cost, low-cost consumers will be inefficiently discouraged and high-cost consumers will be inefficiently encouraged to join the Gold.³

As far as we know there has not been much research in economics addressing the issues of efficiency and equity in markets where consumers’ demand is driven by both tastes and need. One exception is Bundorf et al. (2009), who show in a theoretical analysis that uniform pricing will generally not lead patients to efficiently sort themselves across plans. We also obtain this result in the context of our model and use it as a benchmark for the analysis that follows. The second and larger part of their paper estimates the efficiency loss due to inefficient pricing. Our paper differs from Bundorf et al. (2009) in several important aspects. First, we study explicitly the market equilibrium that will emerge under different regulatory regimes. Second and more important, our concern is not only with efficiency but also with fairness. In fact, one of our main objectives is to demonstrate the tension between efficiency and fairness that emerges in markets where consumers differ not only in their needs but also in their tastes, and to propose mechanism to address this tension.⁴ Third, we propose several regulatory policies that can be applied to implement both an efficient and fair allocation, under various assumptions about the tools available to the regulatory agency.

¹A large literature in health economics studies how to pay plans so as to induce them to accept enrollees across risk groups and to provide services efficiently. For reviews, see Newhouse (2002) and Van de Ven and Ellis (2000). In managed competition the public sector collects the revenues and repackages it as risk-adjusted payments before sending it to plans. Importantly, decision makers within the health plans, i.e., clinicians, must be willing to allocate funds according to health status, a reasonable if oftentimes implicit assumption. Demand heterogeneity can also stem from factors clinicians may be less responsive to in resource allocation decisions, a point we call attention to in this paper.

²It would also likely be unacceptable politically to collectively finance a plan payment system that paid more for groups with higher taste for health care.

³In very special circumstances a single Gold Plan premium can sort consumers efficiently between two plans (see Feldman and Dowd (1982), Ellis and McGuire (1987) or Cutler and Reber (1998) for such models) but in general as we explain in more detail below, a single premium either set by the market or by a Regulator does not lead to efficient sorting between two plan types. Bundorf, Levin and Mahoney (2009) points out the special assumption in these models.

Miller (2005) considers optimal sorting in a different context, an employer setting an incremental premium employees must pay for a more generous plan. Miller points out that the employer may be able to set the payment (which in this context goes back to the employer) to extract some of the additional surplus sicker workers get from employer-based health insurance.

⁴Smart (2000) considers insurance against a financial loss when consumers differ in probability of loss and in risk aversion. This form of demand heterogeneity also interferes with efficiency of markets when forms can not price risk separately to the different risk groups.

In order to characterize premium and plan payment policies that achieve efficiency and fairness, we analyze payment policy within an explicit model of managed competition. Surprising in light of its popularity as a basis for national policy, the managed competition paradigm - competing managed care plans subject to regulation of benefits and premiums serving a diverse population - has not been formally modeled in the literature. Models of competitive health insurance markets drawing on Rothschild and Stiglitz (1976) show how a regulator should set risk adjusted payments (e.g., Glazer and McGuire, 2000) or regulate quality (Encinosa, 2001) in the presence of heterogeneity in health status, but not heterogeneity in taste. Analysis in papers incorporating “taste” of some form are conducted with two plans (or sectors) and disregard conditions of competitive equilibrium that come into play in managed competition.⁵ Other papers model heterogeneity as “distance” between two plans.⁶ To study regulation of payment policy in managed competition, we first construct a working model of managed competition with demand heterogeneity. Plans set premiums and benefits (subject to regulation). Consumers choose plans. Our purpose is to describe what the Regulator must do to ensure the market outcome is efficient and fair.

3 Consumers and Gold and Silver Managed Care Plans

Before we present the mechanics of our model, we call attention to the concepts of efficiency and fairness which play an important role in our analysis. By efficiency we mean the conventional utility maximization. The point to stress is that in our paper utility is affected by “taste” as well as “need,” and we regard both factors as equally legitimate when it comes to efficiency. Other approaches to health policy focus on need and implicitly assume that the same treatment is efficient for the entire population. If this were so, there is no efficiency rationale for Silver and Gold health plans. We are interested, in this paper, in a context in which the diversity among the population in taste for health care is regarded as a valid concern for social policy.

Fairness also matters for policy towards the social merit good, health insurance. In health policy, fairness is about health status (the sick should not pay more than the healthy) as well as ability to pay (the rich should pay more than the poor). In this paper, we base our concept of fairness on the European “solidarity principle” which dictates that individuals in poor health should pay the same for health insurance as those in good health.⁷ Principles of solidarity have been made most explicit in policy discussions in Germany.⁸ As Stock, Redaelli and Lauterbach (2006) explain, the guiding principle of Germany’s Social Health Insurance is solidarity: “Services are rendered according to medical need.” Furthermore, “[Financing] implies cross-subsidization from low to high risks, [and] from high-income to low-income earners...” Concern for fairness motivates regulation of health insurance premiums in the U.S. as well,

⁵Feldman and Dowd (1982); Ellis and McGuire (1987); Keeler, Carter and Newhouse (1998); Cutler and Reber (1998).

⁶Encinosa and Sappington (1997), Jack (2006), Olivella and Vera-Hernández (2007). Travel costs confer some market power on the two competing plans.

⁷For a review of the application of solidarity principles in the context of competing health plans, see Van de Ven and Ellis (2000). Sass (1995) is a European philosophical perspective on solidarity. Stone (1993), in a U.S. context contrasts solidarity principles with ideals of actuarial fairness in the organization and pricing of health insurance.

⁸In a recent interview, the then Minister of Health in Germany, Ulla Schmidt, put it this way: “My overarching personal goal as Minister of Health has been to preserve for Germany’s health system the principle of social solidarity, by which we mean that everyone in Germany should have guaranteed access to state-of-the-art medical care and contribute to the financing of this guarantee on the basis of the household’s ability to pay.” Cheng and Reinhardt (2008, p205).

prohibiting or limiting discrimination by health status.⁹ These strictures limit how well premiums charged to enrollees can match persons with health plans serving their preferences.

3.1 Consumers and Efficient Health Care

Four types of consumers differ by health status and a taste factor that we refer to for now as “income.” Later, in Section 5, we will use the more general term “taste” when the factor differentiating types is unavailable for use in payment policy. Consumers can be healthy (h) or sick (s), and poor (p) or rich (r). Type is unchanging and there is an equal number of each type. We define $v_{ij}(x)$ to be the benefit of health spending x to a consumer with health status i , $i = h, s$, and income j , $j = p, r$, where $v'_{ij} > 0$ and $v''_{ij} < 0$. Based on the discussion above, efficient level of care for each type is where $v'_{ij}(x_{ij}^*) = 1$. To simplify some of the discussion we further assume that $v'_{hj}(x) = v'_{sj}(k, x)$, $k > 1$ for every x , $j = p, r$.¹⁰

3.2 Plans' Rationing Rule

Clinicians in the plan ration care. The literature contains two rationing rules, one in which clinicians set quantity or a maximum quantity (Baumgardner, 1991; Pauly and Ramsey, 1999) and the other in which clinicians ration according to a shadow price, equating the value of care at the margin across users within a plan (Frank, Glazer and McGuire, 2000). Notably in these papers, the clinician's view of a patient's benefit from health care is identical to the patient's own view. We call attention to this assumption because in the current paper we allow taste to matter for the patient but not for the clinician.

We assume that benefits due to “health factors” matter to patients and doctors - patients because it is their health, and doctors because they are professionally trained to respond to health needs of patients. We assume, in contrast, benefits due to non-health factors matter to the patient but not to the doctor. What we have in mind is this: a rich person may have higher willingness to pay for health care than a poor person, but from the doctor's point of view, care to a rich person is no more valuable than care to a poor person. Provider rationing practices matter in managed care plans, the subject of this analysis. The assumption that patient taste does not affect provider decisions about resource allocation is obviously an extreme one. Our point - and all that matters for our results - is that rationing decisions are less responsive to taste than to health status.

Putting this in terms of our model, we make the following assumption about clinician rationing. The budget for health care in a plan is allocated among individuals so as to equalize clinicians' assessment of the marginal benefit from care to a shadow price: $v'_{ip}(x) = \lambda$, $i = h, s$. It is as if clinicians “see” only two benefit functions $v_{hp}(x)$ and $v_{sp}(x)$, and they disregard the elevated benefit the rich have over the poor. The shadow price, λ , exhausts the budget clinicians have to spend on their patients. The assumption we have made above that $v'_{hj}(x) = v'_{sj}(k, x)$ implies that $\frac{x_s}{x_h} = k$ in a plan. In other words, rationing by a shadow price implies the sick will get a proportion $k (> 1)$ more than the healthy in a plan, regardless of their income.

⁹Federal non-discrimination policies towards health insurance premiums are described in GAO (2003). Regulations are administered by the IRS, govern ERISA plans and prohibit discrimination in premiums charged and in premium contributions by employees according to health status. The Kaiser Family Foundation (2009) lists ten states that restrict use of health status in setting premiums in the individual health insurance market (often limiting the differential that can be charged by health status), and eight states that have some form of community rating regulation. This prohibition of discrimination on the basis of health status could also be cast as an efficiency issue: in a socially efficient policy, individuals would be protected from risk of changing health status.

¹⁰Higher demand for care among those with greater “taste” for health care could stem from two basic factors, ability to pay and preferences. The high and low-taste groups could have the same utility function, but if one group had more income, it would have higher demand than the low-income group. Alternatively, groups might have the same income but have different utility functions. In this paper, we do not distinguish between these two possibilities. In either case, economic efficiency calls for serving higher demand. Interpretation of equity could be affected by whether higher demand originates from ability to pay or from utility.

An obvious consequence of this assumption is that the healthy rich and healthy poor would be allocated the same health care in a plan, as would the sick rich and sick poor. Therefore, since $x_{ir}^* > x_{ip}^*$, it will not be efficient to put the rich and the poor in the same health plan. Note, however, that if the healthy and sick from the same income group were in the same health plan, clinician rationing by a shadow price could achieve the efficient health care for both the healthy and sick so long as the budget to spend is enough to pay for the efficient level of care. We can thus foresee that for efficiency the healthy and sick poor should be in the Silver Plan and the healthy and sick rich in the Gold Plan.

3.3 Regulation

Our main goal in this paper is to study whether and how the Regulator can induce plans to provide the efficient levels of care and individuals to sort themselves efficiently across plans without violating the criteria for fairness. Our leading assumption is that the levels of care provided by the health plans cannot be directly monitored (i.e., payments cannot be based on x_{ij}) and the Regulator must apply other mechanisms to induce plans to provide the efficient care. The “Regulator’s Policy” consists of health status risk-adjusted payments (made by the Regulator) to plans, denoted by π_i , $i = h, s$, and taxes (paid by the individuals to the Regulator) which may depend on the individual’s type and the plan she chooses, denoted by t_{ij}^m $i = h, s, j = p, r$ and $m = G, S$. After the Regulator announces its policy, plans choose their policy. A “plan’s policy” consists of the levels of services they will provide, denoted by $x = (x_h, x_s)$, and the premium individuals pay (directly to the plan) if they join the plan, denoted by $y = (y_{hp}, y_{hr}, y_{sp}, y_{sr})$. Given the Regulator’s Policy and the plans’ policy, individuals choose the plan that maximizes their net benefit.

More formally, we have in mind the following four-stage model:

- Stage 1** The Regulator announces its tax and risk adjustment policies (t, π) . In addition, the Regulator may impose some restrictions on the plans’ premiums.
- Stage 2** Each plan announces its policy (y, x) which consists of the premium individuals pay if they join the plan and the level service the plan provides. Each plan’s services consists of a pair (x_h, x_s) such that $x_s = kx_h$, $k > 1$.
- Stage 3** Individuals choose plans and plans must accept everyone. Individuals pay taxes to the Regulator and premiums to the plans according to the plan they have chosen. The Regulator pays plans the risk adjusted payments.
- Stage 4** Plans provide services.

It is important to notice here that even though the Regulator’s policy cannot be conditioned on the level of services the plans offer, it can be conditioned on the premiums the plans charge. Given the Regulator’s Policy in Stage 1, a *competitive equilibrium*, in Stage 2, is a profile of plans’ policies such that, given that each individual chooses the plan that maximizes her utility, each plan makes zero profit and no plan can offer another policy that will make a strictly positive profit.

3.4 Fair Payment Policies

Each of the four types will be required to pay premiums and possibly taxes upon joining the Gold and Silver Plans. The distinction between premiums and taxes is that premiums are payments made to the plan that the plan can use for services, whereas taxes are paid to the government. Regulator payments to plans are assumed to be financed by distributionally acceptable taxes.¹¹

We say a payment policy is fair if the payments (health plan-related premiums and taxes) a sick person must make for the Gold Plan are equal to the payments a healthy person must make. The sick and healthy must also pay the same for the Silver Plan. Furthermore, for fairness we require payments a low taste (poor) person must make for each plan be no more than the payments made by a high taste (rich) person.¹² A payment policy that meets these conditions will be said to satisfy “strong solidarity.” Later we relax the health condition to an inequality (sick pay no more than the healthy at each plan) and refer to this as “weak solidarity.”

Note that our definition of fairness applies to premiums for both the Gold and the Silver Plan. One could argue alternatively that fairness is about the basic (or Silver Plan) and there is no equity issue associated with sicker people paying more than the healthy for a health plan upgrade. If a Gold Plan is relevant for just a small group in the upper end of the income distribution, this alternative position has merit. If, however, as is increasingly the case, a society’s basic plan is just that, large segments of the population, not just the elite, will be efficiently served by more generous coverage. In this case, fairness in Gold Plan premiums matters too.

3.5 Silver and Gold Plans Providing Efficient Care

In order to illustrate our main insights we analyze premium and payment policies in the context of an example where $v_{ij}(x_{ij}) = \gamma_{ij}(x_{ij})^{\frac{1}{2}}$, $\gamma_{hp} = 2$, $\gamma_{hr} = 3$, $\gamma_{sp} = 4$, and $\gamma_{sr} = 6$. In this section we use this example to describe the efficient care for the rich and the poor and the efficient allocation of types across plans. With these utility functions the efficient levels of care are

given by $x_{ij}^* = \frac{\gamma_{ij}^2}{4}$, $i = h, s$, $j = p, r$. As we have discussed above, since providers in each health plan do not distinguish between rich and poor individuals, one plan cannot provide the efficient levels of care for all types. Thus, in order for the rich types and the poor types to obtain their respective efficient level of care, two different plans must be offered, one (the “Silver Plan”) that provides the efficient levels of care for the healthy poor and the sick poor, and the other (the “Gold Plan”), that provides the efficient levels of care for the healthy rich and the sick rich. Notice, however, that in principle, a poor individual could choose to join the Gold Plan (in which case she would get the same level of care as the healthy rich if she is a healthy poor type and the same level of care as the sick rich if she is a sick poor type). Similarly, a rich individual could choose to join the Silver Plan and obtain the level of care as if she were a poor type.

Table 1 describes the benefits and costs, for each of the four types, in a Silver or Gold Plan. (Appendix A contains the analog of Table 1 for the more general case.) The Silver Plan provides the efficient level of care for the poor, and Gold Plan provides the efficient level of care for the rich. Note that, reflecting our assumption about rationing in managed care, the healthy poor and the healthy rich would get the same care in the Silver Plan (spending of 1). The rich benefit more from this care because of their higher γ in their benefit function. We explain briefly the origin of the numerical entries in Table 1. Consider first the Silver Plan, designed for the poor.

The efficient care for the healthy poor is $x_{hp}^* = 1$, since $\gamma_{hp} = 2$. At this cost, the benefit received by a healthy poor individual is found by putting this x^* into the healthy poor benefit function

¹¹This could be, for example, a payroll tax shared by employer and employee, as in Germany (Stock, Redaelli and Lauterbach, 2006). We disregard any efficiency consequences of tax finance in terms of distorting employment or other decisions. Taxes and subsidies in this analysis are aimed at correcting prices facing persons with different demands making choice of health plans. One can always add or subtract a constant tax or subsidy from every person to compensate for any fiscal imbalance between taxes collected and subsidies paid, in order to make the consumer tax-subsidy portion of health plan financing “budget neutral.” In this case, there are no implications of alternative premium policies studied here for the efficiency of taxation in the rest of the economy.

¹²Even though this last fairness condition is readily satisfied, we prefer to state it as part of our definition as it is usually understood to be part of what is meant by solidarity.

$2(x)^{\frac{1}{2}}=2$. A healthy rich person in the Silver plan gets the same care as the healthy poor, but since the healthy rich person benefits more ($y_{hr} = 3$), the benefit of the Silver Plan is 3 for this type. Efficient care for the sick poor $x_{sp}^*=4$, and the entries for the sick rich and poor in the Silver Plan are found in a similar fashion. Entries in the Gold Plan are based on efficient spending for the healthy and sick rich, and then assigning the corresponding benefits to each of the poor and the rich at this spending level.

Note that the net social benefit (benefit minus cost) of the healthy and sick poor is higher in the Silver Plan and the net social benefit of the rich types is higher in the Gold Plan. Efficiency requires the poor to be in the Silver Plan and the rich to be in the Gold plan. The budget for the Silver Plan is 5, the sum of the costs of efficient care for the poor healthy and poor sick (1 + 4). It can be readily seen that with a budget of 5, clinicians would allocate 1 to the healthy and 4 to the sick, confirming that the Silver Plan could enroll both the healthy and sick poor efficiently. The Gold Plan can enroll both the rich sick and healthy, and with a budget of 11.25, the sum of costs of effective care for the rich healthy and rich sick, provide the efficient care to both.

The policy problem of accommodating taste heterogeneity would be easily solved if providers allocated plan resources in response to taste as readily as they do in response to health status. In this case, there would be no need to have Gold and Silver Plans with higher and lower levels of funding. One plan, with demand-responsive providers, would fulfill efficiency. However, as long as there is some less response in rationing to taste than to health status, more than one type of plan is necessary for efficiency.

Note there is no demand-side cost sharing in any plan. Efficiency requires full coverage if health care need is uncertain. We are thus not concerned with financial risk aversion. We are also not concerned in this paper with moral hazard which would be roughly constant across all the premium policy options we consider.

4 Implementation When Both Health Status and Income are Available as a Basis of Payment

Suppose that both the individual's health status and her income (taste) are verifiable and, hence, can serve as a basis for taxes and payments. In the context of the example described in Table 1, we analyze three payment policies associated with different approaches to setting taxes and individual premiums. The health status risk-adjusted plan payments supporting these premium policies will also be described. The first two premium policies, incremental cost premiums and incremental average cost premiums, have been considered in the literature. We will show that these policies sacrifice fairness or efficiency. The third policy regulates Gold Plan premiums and introduces taxes to achieve both fairness and efficiency. Rather than offering formal propositions, we employ the example to make these points.

4.1 Incremental Cost Premiums

Under the incremental cost premium policy, the Regulator, in Stage 1, sets no taxes or subsidies and makes a risk-adjusted payment to any plan equal to the cost of providing the efficient care for the poor: $\pi_i = x_{ip}^*$, $i = s, h$. In our example, $\pi_s = 4$, $\pi_h = 1$. Furthermore, the Regulator sets no restrictions on plans' premium so that a premium could depend both on individual's health status and her income. In such a case, in Stage 2, two plans will be offered in equilibrium, Gold and Silver. The Silver plan will charge no premium and will provide the efficient level of care for the poor. The premium for the Gold Plan for each person will be: $y_{ij} = x_{ir}^* - x_{ip}^*$, $i = h, s, j = r, p$. (In our example, the incremental premiums are $y_{hp} = y_{hr} = 1.25$, $y_{sp} = y_{sr} = 5$.) The Gold

Plan will provide the efficient levels of care for the rich. It is straightforward to see that this policy leads to efficiency. The poor are in the Silver Plan, the rich in the Gold Plan. Every person receives the first-best level of care and both plans break even.

Competition forces Silver and Gold Plans to spend their revenue. Silver Plans spend their budget, coming entirely from risk-adjusted plan payments, on efficient care for the sick and healthy poor. Gold Plans, paid by the regulator and by individual premiums from the healthy rich and sick rich, have just enough to provide efficient care for the rich. Assuming a Gold Plan can price discriminate by health status, competition also forces Gold Plans to choose these premiums, since these are the premiums that when the money is spent on care, maximize the net benefit of the rich.

As shown earlier by Keeler, Carter and Newhouse (1998), the incremental cost policy thus implements the efficient care with a Silver and Gold Plan as described in Table 1. The problem with this policy is that it violates our standard of fairness. The sick pay more, an incremental cost premium of 5, to join a Gold Plan than the healthy, an incremental cost premium of 1.25.

Result 4.1: Regulatory policy allowing incremental cost premiums can implement an efficient Silver and Gold Plan, but, by charging more to the sick, violates fairness.

4.2 Incremental Average Cost Premiums

In practice in managed competition, health plans are generally prohibited from charging higher premiums to individuals with worse health status. Consider next a policy in which a Regulator makes a health status risk-adjusted payment to plans, and plans are free to charge any premium, so long as it is the same to every enrollee. Thus, $\pi_i = x_{ip}^*$ $i = s, h$, as before; but now, $y_{ij} = y$, $i = h, s$, $j = p, r$, where the level of y is chosen independently by each plan. A key feature of the example in Table 1 is that the extra benefit to the healthy rich type from going to the Gold Plan is less than the extra benefit to the sick poor type. This implies that there is no premium for the Gold Plan that would attract the healthy rich and not the sick poor. For the Gold Plan to attract the healthy rich, it must be that $y \leq 1.5$, the difference between the healthy rich benefit in the Gold Plan and their benefit on the Silver Plan. For the Gold Plan not to attract the sick poor, it must be that $y \geq 4$, the difference is between the sick poor benefit in the Gold Plan and their benefit in the Silver Plan. Obviously, no premium satisfies these two constraints, and therefore efficiency is not possible under this policy.

The condition in our example that the healthy rich are willing to pay less than the sick poor to join the Gold Plan is not restrictive. With continuous types, it will certainly be true that the healthiest among the rich would pay less to join a Gold Plan than the sickest among the poor. And with this, no premium sorts the two groups efficiently. Note that risk adjustment cannot fix this problem.

Result 4.2: No payment policy with a single premium for all enrollees at the Gold Plan can implement the efficient care.

Note that this result about any single premium failing to achieve efficiency applies to the particular form of single premium, the average cost premium. The result parallels the argument made by Bundorff, Levin, and Mahoney (2009).

This result leaves open the question of what an equilibrium would look like in the case of a single premium. As far as we know the managed competition equilibrium with taste heterogeneity has not previously been portrayed in the literature. We describe the equilibrium in our example here, which turns out, not surprisingly, to be an application of Rothschild and Stiglitz (1976).

Suppose that, in Stage 1, the Regulator announces no taxes or subsidies, and a risk adjustment policy paying a plan $\pi_i = x_{ip}^*$ for each individual whose health status is i , $i = h, s$. Further, assume that plans must charge the same premium to all enrollees. In equilibrium, two plans will be offered. One plan (the Silver Plan) will charge no premium and will offer the first-best levels of care for the poor (x_{hp}^*, x_{sp}^*). The other plan (the Gold Plan) will charge a premium of 5, the incremental cost for the sick rich, and will offer the first-best levels of care for the rich (x_{hr}^*, x_{sr}^*). The Gold Plan will attract only the sick-rich individuals whereas the Silver Plan will attract all other individuals, namely, the healthy-poor, the sick-poor and the healthy-rich. Notice that this equilibrium is inefficient since the healthy-rich individuals choose the Silver Plan instead of the Gold Plan, and hence, they do not receive their first best level of care. Appendix B demonstrates that this outcome is an equilibrium in the case of our example.

The two-plan equilibrium that emerges in our example is not the only possible form of equilibrium in managed competition with taste heterogeneity. It is also possible for equilibrium to be characterized by a Silver Plan serving the poor and two plans serving the rich. In a result reminiscent of a Rothschild-Stiglitz separating equilibrium, the sick rich would get efficient care in a plan they choose, and the healthy rich would be in a plan that maximizes their utility subject to separating from the sick rich. Note that this equilibrium is also inefficient as the healthy rich do not get efficient care.

4.3 Average Cost Premiums and Income-Based Taxes

We have shown in the previous two sections that the incremental cost premium policy is efficient but unfair and the average cost premium policy is fair but inefficient. In this section we describe a new policy that achieves both efficiency and fairness. The new policy involves several key elements. First, the Regulator sets the premium for the Silver *and* the Gold Plan (to prevent separation). Second, the premium for the Gold Plan is based on average cost so as to maintain fairness. Third, income-based taxes direct the rich and the poor to the Gold and Silver Plan respectively.

Specifically, consider a policy in which the Regulator sets the same risk-adjusted payment above, $\pi_i = x_{ip}^*$ $i = s, h$, and now offers a menu to the plans according to which they can choose for all their members a premium of 0 or a premium of the average of the incremental cost of the healthy and sick rich for care in the Gold Plan $y = \frac{(1.25+5)}{2} = 3.125$. A plan that charges the premium $y = 0$ will be referred to as a Silver Plan, and a plan that charges $y = 3.125$ will be referred to as a Gold Plan. Note that premiums for Silver and Gold Plans are set by regulation, not by plans as in the first two cases. Furthermore, introduce taxes. Let $t_r = 1.625$ be a tax on the rich and a negative tax (subsidy) to the poor $t_p = -.875$ if and only if they join a plan that charges a premium of 0. The healthy rich only gain an incremental benefit of 1.5 in the Gold Plan. When they must pay a premium for Gold of 3.125, they must be taxed at least 1.625 to not prefer Silver. Similarly, the sick poor gain 4 in benefits joining Gold. At the premium of 3.125, they must be subsidized at least .875 to prefer Silver.

Another interpretation of this policy is as a means-tested premium subsidy for the Silver Plan. The poor would be subsidized to join the plan, and the rich would pay a positive premium to join. We refer to these as subsidies and taxes in this paper however since the money flow is between the Regulator and the individual rather than between the Plan and the individual (as in the case of premiums).

It can readily be shown that if the Regulator sets the risk-adjusted payment to plans equal to efficient care for the poor, limits premiums to the two values above, and sets the taxes as just described, the competitive equilibrium will lead to the efficient care provided by a Silver and Gold Plan. The Gold Plan charges a single premium of incremental average cost. The poor go

to the Silver Plan, the rich to the Gold Plan. Furthermore, this outcome is fair. Healthy and sick of each income group face the same payments (premiums plus taxes) for membership in the plans. All the poor receive a subsidy in the Silver Plan.

The tax on the rich and subsidy to the poor for joining the Silver Plan keep the healthy rich from preferring the Silver Plan (when having to pay average incremental cost for the Gold Plan) and discourage the sick poor from the Gold Plan (when paying only the average incremental premium). Note that the poor receive the subsidy by staying in the Silver Plan, but the rich pay no taxes by electing the Gold Plan.

An important finding is that the Regulator must set the premiums for Gold Plans at the average incremental cost for the rich, rather than, as in the previous two cases, allowing Gold Plans to choose any combination of premium and services they wish. This prevents plans from setting a premium-service combination that separates the healthy from the sick leading to inefficient service for the healthy (a la Rothschild - Stiglitz). With the Gold Plan premium at the average incremental cost, the rich healthy subsidize the rich sick (as required by fairness).¹³

Result 4.3: Regulated premiums for both plans and imposing taste (income) based taxes and subsidies to join the Silver Plan can achieve efficiency and strong solidarity.

5 Taste Unavailable as a Basis for Payment Policy

So far we have equated “taste” for health care with “income.” Income is, however, only one of the non-health factors that affect willingness to pay for health care. Other factors such as subjective valuation of health, faith in technology, tolerance of side effects, etc., are less readily observable by regulators (or plans). Even if they were observable, these other factors affecting demand may not be a suitable basis of discriminatory taxes and subsidies. For example, willingness to pay for health care varies by education; yet is not acceptable to tax or subsidize based on years of schooling for purchase of health insurance. In this section, we consider the case in which taste is not available as a basis for payment policy. This may be due to unobservability or to inappropriateness as a basis for payment. In other words, we assume in this section that Regulator payments to health plans cannot be conditioned on taste; premiums plans charge individuals cannot be conditioned on taste; and finally, no taste-based subsidies or taxes are possible. However, health status and plan choice are observable and can be used as a basis for subsidies or taxes. In other words, the Regulator can choose t_s^S, t_h^S, t_s^G and t_h^G , a set of taxes on plans that can vary by health status.

We maintain assumptions about how managed care and managed competition work. Clinicians allocate the budget at a plan according to a shadow-price rule in which “taste-related” differences in benefits are ignored. Competition forces plans to spend their budgets. Individuals choose plans to maximize their benefits. What can be done to implement efficient care in this case? Can it be done fairly? To answer these questions, we turn again to our example. Table 2 expresses the constraints on payments and premiums for low and high-taste individuals to choose the right plans and for those plans to provide the efficient care. Note that to avoid introducing new notation, the $j = p, r$ subscript is retained, but now p indicates low-taste and r indicates high-taste. Conditions for fairness as well as efficiency are included in the Table. Imposing the conditions for efficiency and strong solidarity encounters a contradiction.

The first condition for efficiency is that health plans must be able to finance efficient care. Risk adjusted payments to the Silver Plan must sum to funds necessary to pay for efficient care for the low-taste, $x_{sp}^* + x_{hp}^*$ in the general case, or $4 + 1 = 5$ in our example. Note that these payments,

¹³As long as risk adjustment can fully capture differences in health cost and risk, this result extends to a continuum of health types.

π_s and π_h , just need to sum to 5, they need not be equal to 4 and 1 respectively. Furthermore, when the premium y is collected from enrollees in the Gold Plan, revenue to the plan must be enough to finance efficient care for the high-taste. Solidarity requires a single premium. We can solve for $y = 3.125$ in our example.

The next pair of conditions for efficiency ensure that the low-taste choose the Silver Plan. In general terms, the utility the low-taste sick person would get in the Gold Plan (care designed for the high-taste less premium for Gold less any tax on the sick joining the Gold Plan) must be less than the utility the sick low-taste person would get in the Silver Plan (efficient care for the low-taste less any tax for the sick joining the Silver Plan). These general conditions are translated into our numerical example on the right-hand side of the table. The conditions put inequality constraints on the values of the taxes on the Gold and Silver Plans.

The final set of conditions for efficiency ensure that the high-taste people choose the Gold Plan. These are developed in the same way and also put a pair of numerical inequality constraints on the values of taxes on the Gold and Silver Plans.

We can now see the contradiction. Solidarity requires payments for the sick and low-taste to be the same for each health plan. Since the Silver Plan is free and the premium for the Gold Plan is the same for all, solidarity then also requires plan-based taxes to be the same for the sick and healthy: $t_s^S = t_h^S = t^S$ and $t_s^G = t_h^G = t^G$. For the low-taste sick to choose the Silver Plan, $t^G - t^S \geq 0.875$, but for the high-taste healthy to choose the Gold Plan, $t^G - t^S \leq -1.625$, a contradiction. In other words, there is no set of taxes on Silver and Gold Plans using only health status (and not taste) that can implement the efficient level of care and satisfy our criteria for fairness.

Result 5.1: When taste cannot be used as a basis of payment, no feasible Regulator’s Policy achieves efficiency and strong solidarity.¹⁴

Consider next what can be done if we modify the conditions for fairness to what we refer to as “weak solidarity.” By weak solidarity we mean that the tax on the sick should be no more than (rather than equal to) the tax on the healthy for joining a particular plan. In other words, weak solidarity requires: $t_s^S \leq t_h^S$ and $t_s^G \leq t_h^G$. In our example, if we set $t_s^G = t_h^G = 0$, conditions for efficiency imply $t_s^S = -0.875$ and $t_h^S = 1.625$, satisfying weak solidarity.

More generally, one can see that the constraints in Table 2 imply that if $v_{sp}(x_{sr}^*) - v_{sp}(x_{sp}^*) > v_{hr}(x_{hp}^*) - v_{hr}(x_{hp}^*)$, namely the incremental benefit of the sick low-taste type from joining the Gold Plan is higher than the incremental benefit of the healthy high-taste type from joining that plan, then the conditions for efficiency imply that $t_h^S - t_s^S > t_h^G - t_s^G$ and, hence: (i) strong solidarity (i.e., $t_h^G = t_s^G$ and $t_h^S = t_s^S$) cannot be achieved and (ii) weak solidarity ($t_h^S \geq t_s^S, t_h^G \geq t_s^G$) implies that $t_h^S - t_s^S > t_h^G - t_s^G \geq 0$. Thus, any increase in $t_h^S - t_s^S$ (i.e., a departure from strong solidarity in the Gold Plan) will also require an increase in $t_h^S - t_s^S$ (i.e. an even greater departure from strong solidarity in the Silver Plan). Therefore, to minimize deviation from strong solidarity, the best a Regulator can do is $t_h^G = t_s^G$ and $t_h^S \geq t_s^S$. Thus if, $v_{hp}(x_{hr}^*) - v_{hp}(x_{hp}^*) > v_{sr}(x_{sr}^*) - v_{sr}(x_{sp}^*)$, strict fairness cannot be achieved and the best one can do is $t_h^S = t_s^S$ and $t_h^G = t_s^G$.¹⁵

¹⁴Notice that Result 4.2 is in fact a special case of Result 5.1, in that in Result 4.2 t^S was set at 0.

In addition to the conditions about sorting of types among plans, implementation must also consider conditions for profit maximization by plans. For reasons similar to those discussed in Section 4.3, Regulatory policy must set the menu of premiums health plans can charge to be either 0 or the average incremental cost for efficient care for the rich in the Gold Plan, 3.125.

Result 5.2: When taste cannot be used as a basis of payment, Gold Plan premium regulation along with a subsidy to the sick and a tax to the healthy for joining the Silver Plan achieves efficiency and weak solidarity.

6 Discussion

Heterogeneity in demand for health care is one of the most well-established set of facts in health services research. Basic demographics and measured health status explain 10% or less of variation in health care utilization. Although provider-side factors also matter, much of the balance of the variation is linked to income, education, attitudes and other factors we refer to here as “taste” affecting demand for most goods and services. This paper derives the implications of the empirically important and systematic taste-related demand for health care for the regulation of competing health insurance plans.

Health plans can be differentiated in a horizontal (think “location”) as well as a vertical dimension. If, in addition, there are only one or a few plans at each location, another efficiency problem, monopoly power, is introduced. Our results on premium setting for efficient sorting on the basis of vertical differentiation are very likely to hold in this more general case. For example, consider a simple case of horizontal differentiation with a pair of Gold and a Silver Plans located at each end of a line, with consumers distributed along the line. Suppose both the risk-adjusted plan payments and the premiums charged to consumers are regulated. The Regulator can raise the risk adjusted premiums high enough to induce the efficient quality of care, even with monopoly power. Then the Regulator would need to follow rules much like we laid out in the text, to ensure efficient sorting and fairness.

In the presence of a range of demands for health care due to taste, efficiency calls for plans with higher levels of service for the higher-demand groups. The key barrier to achieving efficiency is that the healthy among the high taste group will find the basic plan attractive. The discriminatory premiums necessary to sort consumers efficiently may not be feasible or fair. This paper identifies ways around this problem by showing how, when there must be a single premium for the Gold Plan, efficiency and fairness can be attained.

The emphasis in the literature on managed competition has been on regulation of the basic (our Silver) plan, describing the appropriate risk adjustment, defining the benefit, and limiting premium discrimination by health-related factors. The main conclusion of our paper is that a more active regulatory policy can improve both efficiency and fairness. Rather than letting the market set the premium for a Gold Plan, the Regulator should specify the premium for Gold Plans. Then, the Regulator should subsidize the poor and tax the rich if they go to the Silver Plan. If income taxes and subsidies do not capture enough of taste differences, targeted subsidies and taxes on health status measures may be necessary. These taxes and subsidies can be set so that the sick pay no more for a health plan than the healthy (our “weak solidarity”).

As health care costs continue to increase, a viable Gold Plan may become an important element in national health policy. The extra costs in a Gold Plan are paid by consumers electing the

¹⁵If, however, the two inequalities above are reversed, and the marginal benefit to the sick low-taste type from joining the Gold Plan is lower than the marginal benefit to the healthy rich type from joining that plan, there exists a payment policy that implements the efficient allocation and for which $t_h^G = t_s^G$ and $t_h^S = t_s^S$.

plan. By permitting this outlet for higher demand, the publicly financed system can be kept at the basic level, conserving public funds. Health policy in a number of countries accommodates demand with some form of upgrade available to higher demand groups. In Germany, most residents must choose among “Silver Plans” with specified benefits that compete on service and premiums (within narrow bounds).¹⁶ Higher income groups can opt out of the Silver Plan choice and choose among “Gold Plans” competing on premiums and service and also subject to some regulation. In Israel and Switzerland, an “upgrade” consists of a complementary insurance policy to the basic plan.¹⁷

Questions of fairness are at the forefront of policy debates about health care and health insurance. Managed competition with differentiated plans is inherently less equal than a national policy oriented around a single plan for all, even if it attains equity in terms of “solidarity” principles. Other conceptions of fairness could be introduced into our analysis and may change the nature of the analysis and conclusions. To study tradeoffs between efficiency and other approaches to fairness, it is necessary to have a working model of managed competition with demand heterogeneity, and this paper describes a model that might be useful for such subsequent analysis.

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¹⁶See Thomson, Foubister and Mossailos (2009) for a summary of the German health insurance system within the context of financing systems in Europe. Sen (2009) lauds system in Western Europe that accommodate “those who have money and want to spend it [on health care]” through private practice and private insurance options.

¹⁷This is also possible in Germany.

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Appendix A. Benefits and Costs in Silver and Gold Plans - General Expressions

| Silver Plan | | | | |
|--------------------|--------------------|-------------|--------------------|-------------|
| | Healthy | | Sick | |
| | Benefit | Cost | Benefit | Cost |
| Poor | $v_{hp}(x_{hp}^*)$ | x_{hp}^* | $v_{sp}(x_{sp}^*)$ | x_{sp}^* |
| Rich | $v_{hr}(x_{hp}^*)$ | x_{hp}^* | $v_{sr}(x_{sp}^*)$ | x_{sp}^* |
| Gold Plan | | | | |

| Silver Plan | | | | |
|-------------|--------------------|-------------|--------------------|-------------|
| | Healthy | | Sick | |
| | <u>Benefit</u> | <u>Cost</u> | <u>Benefit</u> | <u>Cost</u> |
| | Healthy | | Sick | |
| | <u>Benefit</u> | <u>Cost</u> | <u>Benefit</u> | <u>Cost</u> |
| Poor | $v_{hp}(x_{hr}^*)$ | x_{hr}^* | $v_{sp}(x_{sr}^*)$ | x_{sr}^* |
| Rich | $v_{hr}(x_{hr}^*)$ | x_{hr}^* | $v_{sr}(x_{sr}^*)$ | x_{sr}^* |

Appendix B: Equilibrium in the Managed Competition with a Single Premium

In the proposed equilibrium, the healthy poor and the sick poor join the Silver Plan and receive their first-best level of care. The sick rich join the Gold Plan and receive their first-best level of care. Only the healthy rich individuals do not receive their first best level of care, as they join the Silver Plan. In order to prove that this is indeed an equilibrium, all one has to show is that no plan can offer another policy that will attract some individuals and will make positive profit. One possible such deviation is to attract only the healthy rich individuals. Suppose that a plan offers another policy (y', x') that attracts only the individuals of type hr then, in order for this to be a strictly profitable deviation, the following conditions must be satisfied:

$$\begin{aligned}
 3(x'_h)^{0.5} - y' &\geq 3 \\
 4(x'_s)^{0.5} - y' &\leq 8 \\
 6(x'_s)^{0.5} - y' &\leq 13 \\
 x'_s &= 4x'_h \\
 y' + 1 &\geq x'_h
 \end{aligned}$$

The left-hand side of the first condition above specifies the net benefit of an individual of type hr if she joins the new plan (y', x') . The first condition implies that type hr strictly prefers the new plan over the Silver Plan (which offers her a net benefit of 3).

Similarly, the second condition implies that type sp prefers the Silver Plan over the new plan and the third condition implies that type sr prefers the Gold Plan over the new plan. The fourth condition follows our assumption about how plan allocate their budget and the last equality simply implies that the new plan breaks even if it attracts only the healthy rich individuals.

One can easily verify that the conditions above can be satisfied only if $x'_h \leq 1$ and hence, no profitable deviation exists.

Another possible deviation is to offer a contract that will attract only types hr and sp . However, in a similar way, it can be shown that no such profitable deviation exists.

Table 1

Benefits and Costs in Silver and Gold Plans at Efficient Levels of Care

| Silver Plan | | | | |
|--------------------|----------------|-------------|----------------|-------------|
| | Healthy | | Sick | |
| | Benefit | Cost | Benefit | Cost |
| Poor | 2 | 1 | 8 | 4 |
| Rich | 3 | 1 | 12 | 4 |
| Gold Plan | | | | |
| | Healthy | | Sick | |
| | Benefit | Cost | Benefit | Cost |
| Poor | 3 | 2.25 | 12 | 9 |
| Rich | 4.5 | 2.25 | 18 | 9 |

Table assumes utility is for type i, j : $v_{ij} = \gamma_{ij}(x_{ij})^{\frac{1}{2}}$, with $\gamma_{hp} = 2$, $\gamma_{hr} = 3$, $\gamma_{sp} = 4$, and $\gamma_{sr} = 6$.

Table 2

Conditions for Implementing Efficient Care and Fairness When Taste is Unavailable as a Basis of Payment

| Conditions for Efficiency | |
|---|---|
| General Case | Table 1 Example |
| Health Plans Can Finance Efficient Care | |
| Silver: $\pi_s + \pi_h = x_{sp}^* + x_{hp}^*$ | $\pi_s + \pi_h = 4 + 1 = 5$ |
| Gold: $\pi_s + \pi_h + 2y = x_{sr}^* + x_{hr}^*$ | $5 + 2y = 9 + 2.25$ $y = 3.125$ |
| Low-taste Choose the Silver Plan | |
| Sick: $v_{sp}(x_{sr}^*) - y - t_s^G < v_{sp}(x_{sp}^*) - t_s^S$ | $12 - 3.125 - t_s^G < 8 - t_s^S$ or $.875 < t_s^G - t_s^S$ |
| Healthy: $v_{hp}(x_{hr}^*) - y - t_h^G < v_{hp}(x_{hp}^*) - t_h^S$ | $3 - t_h^G < 2 - t_h^S$ |
| High-taste Choose the Gold Plan | |
| Sick: $v_{sr}(x_{sr}^*) - y - t_s^G \geq v_{sr}(x_{sp}^*) - t_s^S$ | $18 - 3.125 - t_s^G \geq 12 - t_s^S$ |
| Healthy: $v_{hr}(x_{hr}^*) - y - t_h^G \geq v_{hr}(x_{hp}^*) - t_h^S$ | $4.5 - 3.125 - t_h^G \geq 3 - t_h^S$ or $-1.625 \geq t_h^G - t_h^S$ |
| Conditions for Fairness | |
| Strong solidarity: Equal payments for Sick and Healthy $t_s^S = t_h^S, t_s^G = t_h^G$ | |
| Weak solidarity: $t_s^S \leq t_h^S, t_s^G \leq t_h^G$ | |