Pricing Health Benefits: A Cost-Minimization Approach

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Abstract

We study the role of health benefits in an employer's compensation strategy, given the overall goal of minimizing total compensation cost (wages plus health-insurance cost). When employees' health status is private information, the employer's basic benefit package consists of a base wage and a moderate health plan, with a generous plan available for an additional charge. We show that in setting the charge for the generous plan, a cost-minimizing employer should act as a monopolist who sells "health plan upgrades" to its workers, and we discuss ways tax policy can encourage efficiency under cost-minimization and alternative pricing rules.

1   Introduction

In the United States, employer-provided health benefits comprise an important part of employees' total compensation. In 2003, approximately 69% of the population received private health insurance, and for 88% of them this insurance was employment based (DeNavas-Walt *et al.,* 2004). The prevalence of employment-based health insurance is largely attributable to the cost of health insurance payments made through one's employer being exempt from taxation, and to employment-based group insurance being less expensive than individual (non-group) coverage due to lower per-capita administrative expenses and reduced adverse selection. Assuming workers value health insurance, these advantages make employer-provided health benefits an efficient means of compensation.

This paper analyzes how an employer should design and price its health benefits when it cannot observe workers' health care needs, given the goal of minimizing the total compensation cost of its workers. We consider an employer who offers two plans, a moderate plan, such as an HMO, and a more generous plan, such as a PPO or indemnity plan. The employer's compensation scheme therefore consists of a base wage paid to all employees, and an additional surcharge imposed on those who elect the more generous health plan instead of the moderate one.[1]

Although the employer may have an incentive to vary its base wage in order to influence the makeup of its workforce, in this analysis we take the employer's workforce as given in order to focus on how the employer should set the surcharge for generous coverage.[2] The employer's cost-minimizing surcharge depends on several factors. When an employee elects generous coverage, he pays the surcharge to the employer, which effectively decreases that employee's wage. However, since the generous plan is more expensive than the moderate one, this wage savings is partly offset by the additional cost of the employee's health insurance. In addition, as the employer increases the surcharge, fewer workers choose the generous plan, and this effect must also factor into the employer's decision.

The main insight of the cost-minimization approach is that in optimally balancing these effects, the cost-minimizing employer should act as a monopolist who sells "health plan upgrades" to its

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[1] Use of the term surcharge is intended to emphasize that it is a charge in addition to the charge for the moderate plan. It is not intended to imply that this charge is unfair.

[2] In particular, by decreasing its base wage, the employer lowers the wage paid to all of its employees but also increases its expected health care costs (because it attracts a sicker mix of workers). See Miller (2005) for an analysis of the employer's incentives to vary the base wage in order to affect the composition of its workforce.

employees. The optimal program involves equating the appropriate concepts of marginal revenue and marginal cost.

While the employer's monopoly power leads it to enroll too few workers in the generous plan (from a social perspective), the fact that the cost of employer-provided health benefits is not taxable induces the employer to lower the charge for generous coverage and enroll more workers in the generous plan than it would if these expenditures were treated as taxable income to the workers. When health status is private information and the employer is unable to base an employee's wage on his health status, the benefit of the preferential tax treatment is shared between the employer and the workers.

An important concern with employer-provided health benefits is that an employer that offers plans of differing intensity exposes itself to adverse selection, which may jeopardize the plans' viability. Given the choice of plans, those workers who expect to have the highest health care needs are drawn to the generous option. This adverse selection increases the average cost associated with that plan, leading the insurer to demand a higher per-worker premium from the employer. If the employer passes this price increase on to its employees, further adverse selection will result. Those in the generous plan with the lowest expected health care needs will choose to switch to the moderate plan, again increasing the average cost of caring for those who remain in the generous plan. In extreme cases, this phenomenon results in the so-called "premium death spiral," with a high premium leading to adverse selection leading to an even higher premium, the process continuing until the generous plan is no longer sustainable.

Adverse selection and premium spirals have received a great deal of attention in the literature, most often in contexts in which employers follow simple, non-optimal pricing rules.[3] This paper's analysis of cost-minimizing employers shows that these phenomena arise as consequences of the employer's approach to the benefits-design problem, and that adopting the cost-minimizing approach will tend to decrease their severity. A sophisticated employer should recognize that self-selection will affect the cost of any wage-benefit scheme and incorporate this into its planning. Seen in this light, the employer is not a passive force that may fall victim to adverse selection. Rather, it should design its compensation scheme in order to control selection and minimize its overall compensation

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[3]See Feldman and Dowd (1982, 1991), Cutler and Zeckhauser (1998), Cutler and Reber (1998), and Ellis and Aragao (2001).

cost.

This paper shows that as long as there are some workers for whom the incremental benefit of the generous plan is greater than its incremental cost, the generous plan is viable (i.e., it is chosen by a positive mass of workers) when the employer prices it according to the cost-minimization rule.[4] Thus, the cost-minimizing employer offers the generous plan whenever it is socially beneficial to do so. Other rules, such as the commonly-employed equal lump-sum contribution rule (in which the employer pays a fixed dollar amount toward the employee's health insurance regardless of which plan he chooses) do not have this property. It may be that offering the generous plan is both socially efficient and cost effective for the employer, yet employers following the equal lump-sum contribution rule fail to offer a viable generous plan.

This paper adopts a "total compensation" view of health benefits, according to which workers' employment decisions are driven by the total value of the compensation package offered to them, i.e., both wages and insurance contribute to inducing the worker to accept employment. Although we believe our implementation of the idea is novel, the view itself is not new. Pauly (1997) espouses this approach, as does the labor economics literature on compensating differentials, summarized in Rosen (1986), which holds that in a competitive market relative wages adjust so that a worker in a particular job is just compensated for any extraordinary benefits (or costs) he receives.

A fundamental difference between this paper and previous academic work on health benefits is in the explicit treatment of employers as acting strategically in order to minimize expected compensation cost.[5] This is seen most clearly when the present paper is compared with Cutler and Reber (1998, hereafter CR), which employs an almost identical model to study the effects of Harvard University's change in its premium contribution strategy on employee demand for its plan offerings and on plan competition. Because the analysis is descriptive, CR does not take a position on Harvard's objective in designing its benefits package; it merely documents the effects of the rule change. Focusing on the adverse selection part of the problem, this paper provides a theory of

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[4]Although the cost-minimizing scheme offers the generous plan to some workers, it need not offer it to all workers for whom the marginal benefit outweighs the marginal cost.

[5]Two notable exceptions are Levy (1998), which examines the possibility that employers might use employee contributions for health plans as a means of separating workers who want health insurance from those who don't, allowing the employer to avoid buying health care coverage for those who do not value it, and Dranove, Spier, and Baker (2000), which argues that employers may require employees to contribute toward the cost of their health insurance in order to induce married employees to acquire health insurance from their spouses' employers instead.

how, from its own point of view, a cost-minimizing employer *should* act.

The paper continues with a description of the model in Section 2. Section 3 discusses cost-minimization with full information, and Section 4 derives and analyzes cost-minimizing compensation programs with private information. Section 5 discusses commonly used pricing rules, and Section 6 concludes.

2 The Model

2.1 Basic Structure

The basic structure of the model is similar to CR. The employer's workforce is fixed. Employees differ in expected health care costs but are otherwise identical. Let $c \in [0, \gamma]$, $\gamma > 0$, denote a worker's type, where c is normalized to be the expected cost of health care for this worker if enrolled in the generous plan. The cost of care for a worker of type c if enrolled in the moderate plan is given by αc, where $\alpha \in (0, 1)$. The consensus in the literature is the α is somewhere between 0.8 and 0.9 in the case where the moderate plan is an HMO and the generous plan is a PPO.[6]

An employee's utility is the sum of his wage and the utility from his health plan. We assume that all employees receive some health plan.[7] Denote the dollar-valued benefit derived by a worker of type c enrolled in the moderate plan as $m(c)$, where $m'(c) > 0$ for $c \in (0, \gamma)$. Let $g(c)$ denote the additional benefit derived by enrolling in the generous plan, where $g(c)$ is strictly increasing and strictly convex (i.e., $g'(c) > 0$ and $g''(c) > 0$ for $c \in (0, \gamma)$), and $g(0) = 0$.[8] Thus, a worker receiving (after-tax) wage w has utility $w + m(c)$ if he is enrolled in the moderate plan and $w + m(c) + g(c)$ if he is enrolled in the generous plan. We assume that all workers have (after-tax) reservation utility u_0, which is independent of c.[9]

The employer is risk neutral, and it is only concerned with minimizing its expected compensation

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[6] The 0.9 figure is put forth in Cutler and Reber (1998). Compared to an HMO, the Congressional Research Service reports α is approximately 0.82 when the generous plan is a fee-for-service plan, 0.89 when the generous plan is a preferred provider organization, and 0.88 when the generous plan is a point-of-service plan (Congressional Research Service, 1997).

[7] Miller (2005) considers when it is in the employer's interest to offer its workers a no-insurance option.

[8] Convexity ensures that a type-c worker never prefers a less generous plan than a lower-type worker.

[9] This would be the case if, for example, workers who are not employed by the firm do not purchase health insurance on their own. See Miller (2005) for an analysis of the case where workers' outside option includes the opportunity to purchase a health plan from the non-group market.

cost. While each worker knows his type, for the bulk of the analysis we assume that the employer is unable to observe workers' types. Let $F(c)$ be the cumulative distribution function of types in the employer's workforce, where $F(0) = 0$, $F(\gamma) = 1$. Distribution $F()$, assumed known by the employer, has continuous density function $f(c)$.

2.2 The Insurance Market

The employer contracts with an insurer to provide health insurance for its employees. This paper makes two assumptions regarding insurance providers. First, we assume that, based on observable characteristics of workers such as age, sex, and current health status, the insurance company is able to generate an unbiased estimate of the cost of caring for any individual worker (or group of workers).[10] Because the insurer is risk neutral, it is effectively as if the insurer can observe each worker's expected cost of care, i.e., his type.

Second, we assume that insurance companies operate in a perfectly competitive insurance industry. This assumption implies that, in equilibrium, the expected profit earned on any plan must be zero. Thus, for example, if the insurer provides the employer's generous plan, the total premium paid to the insurer in any equilibrium must equal the expected cost of caring for those enrolled in the generous plan.

While the zero-profit condition implied by the perfect-competition assumption appears strong, it is a necessary requirement for any equilibrium, given perfect competition in the insurance market. An alternative formulation of the insurance industry's breakeven constraint might require that the insurer break even overall but need not break even on each individual plan. That is, total payments to the insurer must equal the expected cost of care across those enrolled in both plans, but there may be cross-subsidization between the plans. However, such cross subsidization seems inconsistent with perfect competition. When the moderate plan subsidizes the generous plan, one might expect another insurer to offer the moderate plan at a lower cost.[11]

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[10] This assumption is consistent with industry practice, where insurers price policies based on an assessment of health risk using demographic data, but could also involve physical examinations of the members of the group. See Pauly and Herring (1999) for a discussion of the underwriting of individual and group policies.

[11] Further, as will become clear, our cost-minimizing employer is concerned with its total compensation cost, not how this cost is divided among those receiving the moderate and generous plans. Any insurer who is willing o cross-subsidize its plans will do so only if the employer purchases both plans from it. However, in this case cross-subsidization does not affect the total cost of health insurance remains the same. Thus, as long as the insurer earns zero profit overall, whether or not it cross-subsidizes has no affect on the employer's optimal strategy.

Before considering the employer's decision, we first characterize the socially optimal allocation of workers to plans. The incremental cost of enrolling a type-c worker in the generous plan is $(1-\alpha)c$, and the incremental benefit is $g(c)$. Hence, the surplus-maximizing allocation of workers to plans is for a type-c worker to elect generous coverage if and only if $g(c) \geq (1-\alpha)c$.

To focus in the interesting case where each plan is efficiently provided to some workers, we assume that:

$$g'(0) < 1 - \alpha \text{ and } g(\gamma) > (1-\alpha)\gamma, \tag{1}$$

which implies that there exists a unique worker type $c_E \in (0, \gamma)$ such that:

$$g(c_E) = (1-\alpha)c_E. \tag{2}$$

That is, for type c_E the marginal benefit from the generous plan just equal its marginal cost. Under the efficient allocation, workers of type $0 \leq c < c_E$ receive the moderate plan and workers of type $c_E \leq c \leq \gamma$ receive the generous plan, where without loss of generality we adopt the convention that workers indifferent between the two plans choose the generous one.

2.3   Taxability of Employer Provided Health Benefits

In the United States, the cost of employer-provided health insurance is not considered taxable income to the employee for either federal or state income taxes, nor is it included in the tax base for (social security) payroll taxes.[12] Let t (with $0 < t < 1$) denote the relevant individual tax rate, inclusive of all of these factors.

For the purposes of this analysis, we ignore the question of whether the employer requires workers electing the moderate plan to pay part of the cost of their health insurance. Employees care only about their net wage and the health plan they receive, and under Section 125 of the Internal Revenue Code an employee's contribution for health insurance made through his employer can be made tax deductible (Gruber 2000). Thus, each dollar the employee must contribute for the moderate plan reduces the worker's net after-tax wage by $1-t$ dollars. In order to compensate the worker, the employer must increase his after-tax wage by $1-t$ dollars, which costs the employer

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[12] See Gruber and Poterba (1996). We ignore the corporate tax since both wages and health care expenditures are tax deductible for corporations.

1 dollar. Thus, whether the employee contributes for the moderate plan does not affect the employer's overall cost. To simplify the analysis, we assume that the employer takes advantage of Section 125. The results change only slightly if it does not.

3   Cost Minimization with Full Information

Before considering the employer's problem when workers' types are unobservable, we first briefly discuss the employer's problem when it can observe the health status of potential employees and base its compensation package on this information.

Under full information, the cost-minimizing employer chooses a type-specific wage for each worker so that the worker earns exactly his reservation utility from employment. This implies that workers receiving moderate coverage are paid pre-tax wage $\frac{u_0 - m(c)}{1-t}$ and workers receiving generous coverage are paid $\frac{u_0 - m(c) - g(c)}{1-t}$. Since a type-$c$ employee costs the employer $\frac{u_0 - m(c)}{1-t} + \alpha c$ if he receives moderate coverage and $\frac{u_0 - m(c) - g(c)}{1-t} + c$ if he receives generous coverage, the employer prefers that the type-c worker receive generous coverage whenever:

$$g\left(c\right) \geq \left(1 - t\right)\left(1 - \alpha\right) c. \tag{3}$$

Let c_F be the lowest-cost employee for which the employer prefers generous coverage to moderate, i.e., c_F satisfies (3) with equality. Comparing (3) with (2) shows that $c_F < c_E$. That is, with full information the employer gives generous coverage to some employees for whom the incremental benefit is less than its incremental cost. The reason for this is that, due to the tax advantage afforded employer-provided health benefits, the employer's cost of providing generous coverage is less than the true cost. Hence, c_F can also be thought of as the cut-off point for the tax-preferred socially optimal allocation of workers to plans, i.e., treating the employer's tax-preferred cost as the true cost of care.

In the full information case, the entire benefit of treating the employer's expenditure on health insurance as non-taxable accrues to the employer. To see why, note that as long as the employer can offer each worker a type-specific wage (as it can in the full information case), every type of employee will receive exactly his reservation utility from employment. This is true regardless of the

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taxability of the cost of health insurance. While making expenditures on health insurance taxable will affect which employees are enrolled in which plan, any benefits the workers receive from this will be offset by reduced wages.[13]

4   Cost Minimization with Private Information

While the full information case provides a useful benchmark, in practice employers rarely base what they charge employees for health insurance on health status, either because this information is unavailable to employers or because the employer is unable (or unwilling) to use it for compensation purposes.[14]   Because of this, the remainder of the analysis is concerned with the "private information" case in which the employer does not base the compensation package it offers to a particular worker on that worker's health status.

If the employer either does not know workers' types or is unable to act upon this knowledge, then its compensation plan will consist of a choice between moderate coverage and a higher wage or generous coverage and a lower wage. Thus, the difference in the wages can be thought of as the surcharge imposed on those who choose the generous plan. The employer's task is then to choose wages for workers electing each health plan (i.e., the surcharge) in order to minimize the expected compensation cost of its workers, subject to the constraints that each worker receives at least his reservation utility and chooses the health plan that maximizes his net benefit from employment.

4.1   Equilibrium Requirements

In our model, three parties make decisions: the employer, the workers, and the insurers. Our chief interest is in understanding the influence of the employer's compensation scheme on the resulting equilibrium and its behavior. Consequently, we impose the following structure on the game. The employer moves first, choosing its compensation practice. Then, after observing the employer's wage offerings, workers and insurers simultaneously choose their strategies.

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[13]In fact, if expenditures on health insurance are treated as taxable income, the employer will assign workers to plans in an efficient manner, i.e., workers of type $0 < c < c_E$ will be given the moderate plan and workers of type $c_E \leq c \leq \gamma$ will be given the generous plan.

[14]Encinosa and Selden (2001) report that in 1993 only 0.6% of workers receiving employment-related single coverage faced contributions that depended directly on health status, and less than 5% faced contributions that depended on anything at all, including smoking status, gender, age, or income.

Since the workers and insurers observe the employer's action before choosing their own strategies, the equilibrium concept we employ is subgame perfect Nash equilibrium. The equilibrium requirements (ER) are:

ER1: The employer chooses a menu of wage-health plan pairs in order to minimize its expected compensation cost (including both wage and health insurance costs) given that workers and insurers react optimally to this compensation scheme.

ER2a: Given the employer's compensation scheme, each worker chooses the insurance/wage pair that maximizes his utility (and satisfies his reservation utility requirement).

ER2b: Given the employer's compensation scheme, the insurers compete among themselves to offer insurance plans to the employer. All plans offered in equilibrium must earn zero profit.

Because insurers and workers move simultaneously, equilibrium requirements ER2a and ER2b are imposed at the same time and define the equilibrium of the subgame created by the employer's choice of compensation scheme. Condition ER1 then requires that the employer choose the compensation plan that induces its most preferred subgame equilibrium.

Equilibrium requirements ER2a and ER2b are the same as those imposed by CR, except we impose the additional requirement that each worker must receive at least his reservation utility from employment. As in CR, in the present paper the employer moves first and the insurers and employees react to its choice. However, there is no analog to ER1 in CR because that paper does not posit that the employer chooses its compensation plan in order to maximize some objective. CR simply takes the employer's choice (i.e., Harvard's change in its premium-subisidy policy) as given and derives the second-stage equilibrium.

4.2   Worker Behavior

Since we have taken the employer's workforce as fixed, in order to meet workers' reservation utility requirements, the employer must offer (after-tax) wage $w_0 = u_0 - m(0)$ to employees who receive the moderate health plan. Since the benefits from health insurance increase with c, this wage ensures that all worker types earn a surplus of at least u_0 from employment. Let w_g denote the after-tax take-home wage paid to workers who elect generous insurance. It is often convenient to

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think of w_0 as the base wage offered to all employees and $w_0 - w_g$ as the surcharge to employees for generous coverage, measured in terms of the reduction in after-tax wages. Without loss of generality, assume $w_g \leq w_0$. Since we do not consider other forms of employee cost sharing (e.g., copayments or deductibles), the surcharge is equivalent to the employee's out-of-pocket contribution for the generous plan.

A worker who chooses the moderate plan earns utility $w_0 + m(c)$, and a worker who chooses the generous plan earns utility $w_g + m(c) + g(c)$. Hence, a type-c worker prefers generous coverage if and only if $g(c) \geq w_0 - w_g$. Since $g(0) = 0$ and $g(c)$ is increasing, define c_g to be the lowest-cost worker who elects generous coverage. That is,

$$g(c_g) = w_0 - w_g, \tag{4}$$

if such a c_g exists.[15] Given wages w_0 and w_g, the workers who accept employment self-select into two groups. Workers of type $0 \leq c < c_g$ choose moderate coverage at wage w_0, and workers of type $c_g \leq c \leq \gamma$ choose to pay the surcharge and receive generous coverage at wage w_g.

When workers' types are private information, all workers except those of type $c = 0$ earn more than their reservation utility from employment. Workers of type $0 < c < c_g$ earn utility $w_0 + m(c)$, while workers of type $c_g \leq c \leq \gamma$ earn utility $w_0 + m(c) + g(c) - g(c_g)$. Thus, not only do almost all worker types earn a rent, but this rent is increasing in workers' health care needs. This is an example of the informational rent earned by less attractive agents in any pooling equilibrium. Unhealthy workers benefit from the presence of healthy workers because high wages must be offered to all in order to induce those who get little benefit from health care to accept employment.

4.3 The Employer's Optimization Problem

We now turn to the employer's cost minimization problem. If workers of type $0 \leq c < c_g$ choose moderate coverage and workers of type $c_g \leq c \leq \gamma$ choose generous coverage, perfect competition among insurers implies that, in equilibrium, the employer's cost of the moderate and generous plans are $\int_0^{c_g} \alpha c f(c|c_m)$ and $\int_{c_g}^{\gamma} c f(c|c_m) \, dc$, respectively.[16] Therefore, anticipating equilibrium behavior

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[15] If $w_0 = w_g$, then $c_g = 0$. If $w_0 - w_g > g(\gamma)$, then $c_g = \gamma$.

[16] CR assume the same cost structure. This is also the relevant cost structure if the employer self-insures, as do many large employers. Marquis and Long (1999) analyze self-insurance in seven states and find that 56% of employers

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by the workers and insurers, the employer's cost minimization problem is:

$$\min_{0 \le w_g \le w_0} \int_0^{c_g} \left(\frac{1}{(1-t)} w_m + \alpha c \right) f(c)\, dc + \int_{c_g}^{\gamma} \left(\frac{1}{(1-t)} w_g + c \right) f(c)\, dc, \tag{5}$$

subject to (4).

Since (4) defines a one-to-one relationship between w_g and c_g, we can treat the employer's problem as choosing c_g, and rewrite the employer's problem as:

$$\min_{0 \le c_g \le \gamma} \phi(c_g) = \alpha \int_0^{c_g} cf(c)\, dc + \int_{c_g}^{\gamma} cf(c)\, dc \tag{6}$$
$$+ \frac{1}{(1-t)} w_0 - \frac{1}{(1-t)} g(c_g) \int_{c_g}^{\gamma} f(c)\, dc.$$

The first two terms of $\phi(c_g)$ comprise the expected cost of health care, the third term is the cost of the base wage paid to all workers, and the final term is the portion of wages recovered as surcharges for the generous health plan. Throughout the paper, we assume a unique solution to the employer's problem, which we denote c_g^*.

Differentiating (6) with respect to c_g yields the following (necessary) characterization of c_g^*.

Proposition 1 : *The cost-minimizing choice of c_g is characterized by:*

$$-\frac{1}{(1-t)} g'(c_g^*)(1 - F(c_g^*)) + \left(\frac{1}{(1-t)} g(c_g^*) - (1-\alpha) c_g^* \right) f(c_g^*) \begin{cases} \ge 0 & if \quad c_g^* = 0 \\ = 0 & if \quad 0 < c_g^* < \gamma \\ \le 0 & if \quad c_g^* = \gamma \end{cases} . \tag{7}$$

The surcharge for generous coverage is $w_0 - w_g = g(c_g^*)$.

Proof: Follows directly from the first-order condition for (6).∎

Consider an interior solution, i.e., one where (7) holds with equality. The first term on the left-hand side of (7) captures the fact that increasing c_g increases the surcharge that can be imposed on all workers who elect generous coverage, since the size of the surcharge is determined by the marginal benefit of generous coverage earned by the lowest-cost employee who elects it. Increasing c_g also

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with more than 500 employees self-insured in 1997.

causes some workers who used to elect generous coverage to elect moderate coverage instead. These workers must then be paid a higher wage but incur lower expected health costs. The difference in these two, the impact on total compensation of shifting the marginal worker to the moderate plan, is captured by the second term on the left-hand side of (7).

Under the cost-minimizing plan the surcharge for electing generous coverage is $g\left(c_g^*\right)$. One way to interpret this is that the employer is a monopolist who sells health care plans to its workers at price $g\left(c_g^*\right)$. To see why, let $p = w_0 - w_g$ be the price of generous insurance. Demand for generous health coverage is then given by $D(p) = 1 - F\left(g^{-1}(p)\right)$. The employer's insurance cost is:

$$C(p) = \alpha \int_0^{g^{-1}(p)} cf(c)\,dc + \int_{g^{-1}(p)}^{\gamma} cf(c)\,dc.$$

Hence for fixed w_m the employer's problem is equivalently written:

$$\max_{p \geq 0} \frac{1}{(1-t)} D(p)\,p - C(p).$$

Differentiating with respect to p and setting the result equal to zero,

$$\frac{1}{(1-t)}\left(1 - F\left(g^{-1}(\tilde{p})\right) - f\left(g^{-1}(\tilde{p})\right)\frac{dg^{-1}(\tilde{p})}{dp}\tilde{p}\right) + (1-\alpha)\frac{dg^{-1}(\tilde{p})}{dp}g^{-1}(\tilde{p})\,f\left(g^{-1}(\tilde{p})\right) = 0,$$

at the optimal price, $\tilde{p}$. Let $\tilde{c}_g$ be the lowest-cost type who elects generous coverage at price $\tilde{p}$. Substituting in that $\frac{dg^{-1}(p)}{dp} = \frac{1}{g'(c_g)}$ and $g^{-1}(p) = c_g$, and rearranging,

$$-\frac{1}{(1-t)}g'(\tilde{c}_g)\left(1 - F(\tilde{c}_g)\right) + \frac{1}{(1-t)}g(\tilde{c}_g)\,f(\tilde{c}_g) - (1-\alpha)\tilde{c}_g f(\tilde{c}_g) = 0 \qquad (8)$$

Note that (8) is identical to (7), and therefore $\tilde{c}_g = c_g^*$. Seen this way, $g\left(c_g^*\right)$ is the price paid by each worker who elects generous coverage, and (7) is the monopolist's optimality condition requiring that, at the optimum, the marginal revenue due to selling the generous plan to slightly sicker people (the first two terms of (8)) is just equal to the marginal cost of providing them with more generous care (the final term of (8)).

For ease of exposition, we have assumed that c_g^* is unique. However, in light of the monopoly analogy, it is straightforward to see that the problem of multiple solutions for the cost-minimizing

employer is the same as that facing a monopolist with a non-concave profit function. In this case, condition (7) is necessary but not sufficient for a global maximum. Investigation of the second order conditions and comparison of local maximizers will identify the global maximum.[17]

The corner solution where $c_g^* = 0$ is easily ruled out under our assumptions.

Corollary 1 :*The cost-minimizing employer offers moderate coverage to at least some employees, i.e., $c_g^* > 0$.*

Proof: At $c_g^* = 0$, the second term on the left-hand side of (7) is zero since $g(0) = 0$. The first term is negative, contradicting the possibility that $c_g^* = 0$ is optimal.∎

Intuitively, workers with low health-care needs assign a vanishingly low value to generous coverage, and therefore if the employer wants them to choose generous coverage it must select a very small surcharge. However, since this means the surcharge must be low for all workers, it is preferable for the employer to increase the surcharge, just as it is in a monopolist's interest to raise the price it charges above the competitive price.

The other corner solution, where $c_g^* = \gamma$, is of particular importance because it represents the situation where the forces of adverse selection are so strong that the employer does not find it worthwhile to offer the generous plan. The possibility that the cost-minimizing employer could prefer not to offer a viable generous plan can also be eliminated. Evaluating (7) at $c_g^* = \gamma$, this situation is possible only if:

$$g(\gamma) \leq (1 - t)(1 - \alpha)\gamma. \tag{9}$$

However, condition (9) can be satisfied only if it would not be socially desirable to offer the generous plan to any worker, i.e., only if no worker values the generous plan more than its incremental cost. This possibility is ruled out by assumption (1).

Corollary 2 : *The cost-minimizing employer offers generous coverage to at least some employees, i.e., $c_g^* < \gamma$.*

Proof: According to assumption (1), $g(\gamma) > (1 - \alpha)\gamma$, and so $g(\gamma) > (1 - t)(1 - \alpha)\gamma$, contradicting the possibility that $c_g^* = \gamma$ is optimal.∎

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[17]For a wide variety of natural distributions of c and specifications of $g(c)$, the solution of the employer's problem is, in fact, unique.

While Corollary 2 establishes that the employer will give generous coverage to some employees, it does not imply that the employer's plan will give generous coverage to all workers for whom it is worthwhile, i.e., that $c_g^* = c_E$. As noted above, the employer's incentive to act as a monopolist will give it a tendency to restrict the quantity of workers receiving generous coverage in order to drive up the price.

To gain further insight into the employer's problem, it is useful to rewrite (7) as (for an interior solution):

$$g\left(c_g^*\right)\left(1 + \frac{1}{\varepsilon}\right) = (1-t)(1-\alpha)c_g^*, \tag{10}$$

where ε is the elasticity of demand (willingness to pay) for the generous plan, $\varepsilon = -\frac{f\left(c_g^*\right)}{g'\left(c_g^*\right)}\frac{g\left(c_g^*\right)}{\left(1-F\left(c_g^*\right)\right)}$. The left-hand side of (10) is the monopolist's marginal revenue.

Comparing (10) with (3) establishes that fewer workers receive generous coverage under private information than under full information, i.e., $c_g^* > c_F$. Extending the monopoly analogy, in the full information case, the employer is a perfectly price discriminating monopolist, reducing the wage of each worker who receives generous coverage by his willingness to pay for it. Because of this, the employer has an incentive to offer generous coverage to all workers who value generous coverage more than its (tax-subsidized) incremental cost. When the monopolist cannot price discriminate, it charges a price above the competitive price. The result is that fewer workers receive generous coverage.

Expression (10) is useful in thinking about how the preferential tax treatment afforded employer-provided health benefits impacts employer policy and through it employee welfare. Even when there is no tax advantage to providing health benefits, the employer still has an incentive to act as a monopolist, which results in the employer enrolling fewer workers in the generous plan than is socially optimal. That is, if $t = 0$, $c_g^* > c_E$. Relative to this benchmark, making employer-provided health benefits tax advantaged decreases the firm's marginal cost of providing generous coverage to more workers, and therefore induces the employer to charge less for the generous plan and provide generous coverage to more workers.[18] Thus, while the employer's monopoly power leads it to charge a high price for generous coverage and enroll too few workers (from a social perspective) in the

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[18]Selden (1999) proves the related result that in a Rothschild-Stiglitz model a linear premium subsidy (such as preferential tax treatment) reduces adverse selection.

generous plan, the tax deductibility of employer-provided health insurance reduces this distortion. Indeed, it is straightforward to show that there exists a tax rate that induces socially optimal sorting.

Unlike in the full information case, when worker types are private information (or the employer is unable/unwilling to use this information in settings wages), the firm and workers share the benefits of the tax subsidy. As in the full information case, the firm benefits directly through the fact that the government now subsidizes the cost of its health plans. On the other hand, since the employer cannot hold workers to their reservation utility levels when it cannot base wages on health status, some of the benefit of the subsidy passes through to the workers. In particular, the workers who received generous care in the absence of the tax subsidy benefit through the lower charge, and the additional workers who receive generous care only when health insurance expenditures are subsidized benefit because these workers value generous care more than its out-of-pocket cost, $g(c_g)$.[19] The only workers who do not benefit from the tax subsidy are those who receive the moderate plan both with and without the tax subsidy.

Expression (10) also suggests that as employee demand for employer-provided generous coverage becomes more elastic, the employer provides generous coverage to more of its employees at a lower price. In fact, as demand becomes perfectly elastic (i.e., $\varepsilon \to -\infty$), the employer's choice of c_g^* approaches the tax-preferred socially optimal level, where $g(c) = (1-t)(1-\alpha)c$. Speculating outside the model considered here, factors that might make demand for employer-provided generous coverage more elastic include provision of better substitutes in the form of government-provided or subsidized individual coverage, decreases in barriers to switching jobs, or increased employer competition for employees.[20]

5 Other Rules and Adverse Selection

The cost-minimization approach focuses on setting the surcharge for the generous plan to induce the employees to sort themselves as the employer desires. The size of the surcharge determines

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[19]Increasing the rate of tax-preference also reduces the cost of employing unhealthy workers, which provides a counterbalance to incentives for health-based discrimination. I thank a referee for this observation.

[20]In a Rothschild-Stiglitz model, Crocker and Moran (2003) study the role of barriers to worker mobility in promoting more complete insurance.

how employees will sort themselves into plans and the equilibrium premiums the plans will charge. Given this surcharge, the employer must pay the remainder of the employees' premiums. Thus, the surcharge and employees' and insurers' equilibrium behavior determine the employer's subsidies.

Firms' actual approaches to pricing their health plans typically involve the opposite order. Employers begin by assuming that each worker should pay the per-worker premium that the insurer charges the employer for the plan that employee chooses. Taking this as a baseline, the employer then decides how and in what way to subsidize the employees' insurance cost. Employees' and insurers' equilibrium behavior combine with the employer's subsidy policy to determine the insurance premiums and, through them, the difference in the employees' out-of-pocket contribution for the generous plan, i.e., the surcharge.[21]

The two most widely used rules have the employer either paying an equal lump sum subsidy (ELS) for the employee's insurance, regardless of which plan is chosen, or the employer subsidizing an equal percentage of the premium (EPP) of whichever plan the employee chooses.[22] In either case, the worker bears the remainder of the premium cost for whichever plan he elects.

Since the premium competitive insurers charge employers for a particular plan is proportional to the average cost of its enrollees, under either the ELS or EPP subsidy rule the cost to the worker of changing plans depends on enrollment choices of other workers. This dependence leaves the system vulnerable to adverse selection and, in extreme cases, the type of premium "death spiral" experienced by Harvard University in the mid 1990s, during which Harvard's most generous health plan became so expensive that Harvard stopped offering it.

CR studies the Harvard case. In the early 1990s, Harvard's health plan offerings included the generous Blue Cross/Blue Shield PPO as well as several less-generous HMO's. In 1995, the university changed its premium-contribution policy from a generous EPP-subsidy rule to an ELS-

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[21]The difference in the order in which quantities are determined is apparent in CR. In order to implement the efficient assignment of workers to plans, they suggest choosing different lump-sum subsidies for the plans. In this case, the workers' out-of-pocket contribution for the generous plan is the sum of the difference in premiums and the difference in subsidies. Appropriate choices of the unequal subsidies will, in fact, induce efficient sorting, although computation of the subsidies needed to do so is somewhat complicated. The task is much simpler for an employer following the approach of this paper, who sets the surcharge in order to manage worker self-selection. If such an employer had the goal of inducing efficient sorting (rather than minimizing cost), it would simply set the out-of-pocket contribution for the generous plan at $g(c_E)$, which would lead to the efficient allocation of workers to plans.

[22]According to the Kaiser/HRET Employer Health Benefits Annual Survey (2002), 17% of workers had employers followed an ELS rule in 2002 (down from 28% in 1999) and 37% of workers had employers who followed an EPP rule in 2002 (up from 29% in 1999). Encinosa and Selden (2001) provide a discussion of the use of risk adjustment and other methods of pricing employee health benefits.

subsidy rule which imposed on workers a larger portion of the incremental cost of more generous care. As workers switched from the PPO to the HMOs, the difference in the average cost of the two plans increased. Under the ELS subsidy rule, this caused the employees' out-of-pocket contribution for the PPO to increase as well, which lead to further adverse selection. In just three years, declining enrollment forced the most generous plan, the Blue Cross/Blue Shield PPO, to be withdrawn because it could no longer be offered at a reasonable price.

Under an ELS subsidy rule such as the one Harvard used, the price paid by a worker who moves from the moderate plan to the generous plan is given by the difference in the average cost of those enrolled in each of the plans. This price, which we denote $p(c_g)$, is given by:[23]

$$p(c_g) = \int_{c_g}^{\gamma} c \frac{f(c)}{1 - F(c_g)} dc - \alpha \int_0^{c_g} c \frac{f(c)}{F(c_g)} dc.$$

Since such expenditures are made with pre-tax dollars, the worker's after-tax cost of the generous plan is $(1-t)p(c_g)$. Increasing c_g increases the average cost of both the generous and moderate plans. Consequently, whether $p(c_g)$ increases or decreases generally depends on the distribution of health costs. To simplify the discussion, we make the standard assumption that $p(c_g)$ crosses $g(c_g)$ no more than once.

The equilibrium under the ELS rule involves a type-c worker choosing generous coverage if and only if $g(c) > (1-t)p(c_g)$. Given that $p(c_g)$ and $g(c_g)$ cross no more than once, the equilibrium under the ELS rule involves workers of type $0 \leq c < c_g^{ELS}$ electing moderate coverage and workers of type $c_g^{ELS} \leq c \leq \gamma$ electing generous coverage, where c_g^{ELS} satisfies $g(c_g^{ELS}) = (1-t)p(c_g^{ELS})$, if such a point exists. If no such point exists, it must be that $g(c_g) > (1-t)p(c_g)$ for all $c_g > 0$. In this case, no workers elect the generous plan in the ELS equilibrium, and we let $c_g^{ELS} = \gamma$ without loss of generality.

Under the ELS rule, the employee's price for the generous plan is always greater than the true incremental resource cost of the marginal employee: $p(c_g) > (1-\alpha)c_g$. This is the fundamental reason why the ELS rule promotes adverse selection. Thus, in the absence of the tax-advantaged status of expenditures on employer-provided health benefits, the ELS rule enrolls too few workers in the generous plan: $c_g^{ELS} > c_E$. By decreasing the out-of-pocket contribution for the generous

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[23]Cutler and Reber (1998, p. 437) denote this quantity the "premium-out-of-pocket," or "P_{oop}."

plan, the tax advantage induces more workers to choose the generous plan. As with the cost-minimization rule, there is a tax rate that induces socially optimal sorting.

Under the ELS rule, the generous plan is not viable (i.e., is chosen by no workers) whenever $g(c_g) < (1-t) p(c_g)$ for all c_g. This is likely to be the case when workers' incremental value of the generous plan is small, the tax rate is low, or $p(c_g)$ is uniformly large.[24] As noted in (9) above, under the cost-minimizing scheme the generous plan remains viable whenever $g(\gamma) > (1-t)(1-\alpha)\gamma$. Comparing the ELS and cost-minimizing rules leads directly to Proposition 2.

Proposition 2 : *If the generous plan is viable under the ELS subsidy rule, then it is viable under cost minimization as well. However, the converse is not true. It may be that an employer following the cost-minimization rule would provide the generous plan to some workers, but an employer following the ELS rule would not.*

Proof:

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\begin{aligned}
(1-t)\, p\,(c_g) & = (1-t)\left(\int_{c_g}^{\gamma} c\frac{f(c)}{1-F(c_g)}dc - \alpha \int_{c_m^*}^{c_g} c\frac{f(c)}{F(c_g)-F(c_m^*)}dc\right) \\
& > (1-t)\left(\gamma - \alpha \int_{c_m^*}^{c_g} c\frac{f(c)}{F(c_g)-F(c_m^*)}dc\right) \\
& > (1-t)(1-\alpha)\gamma.
\end{aligned}
$$

Hence if $(1-t)\, p\,(c_g) < g\,(c_g)$ for some c_g, then $(1-t)(1-\alpha)\gamma < g(\gamma)$, proving the first part of the proposition. But, the reverse implication does not hold, i.e., it is possible to find specifications of the parameters of the problem where $\max_{c_g}\{(1-t)\, p\,(c_g)\} > g(\gamma) > (1-t)(1-\alpha)\gamma$ without violating any of our other assumptions, which establishes the second part of the proposition.∎

Proposition 2 establishes that there are times when an employer subsidizing according to the ELS rule would "lose" its generous plan to a premium death spiral, whereas the generous plan would have continued to be offered had the employer instead followed the cost-minimization approach. This is most likely to occur when $p(c_g)$ is uniformly large, i.e., when there is substantial dispersion

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[24]If $f(c)$ is highly concentrated near a single point, then $p(c_g)$ will tend to be small. When the distribution does not have this feature (e.g., the distribution has "fat tails" or multiple points of high density that are far from each other), $p(c_g)$ is more likely to be uniformly large.

in the distribution of health types.[25]   In such cases the employer's total compensation cost is lower

when the generous plan is offered than when it is not.   Thus, under the ELS-subsidy rule, there

are cases in which the death of the generous plan is not only inefficient and unnecessary, but also

unprofitable.   The cost-minimizing plan would have sustained the generous plan and lowered total

compensation cost.[26]   This underscores the fact that ELS is sub-optimal from both the firm's

perspective and from society's.

Despite this finding, it is not necessarily the case that more employees receive generous coverage

under the cost-minimization rule than under the ELS rule.   Further, the cost-minimization approach

is not necessarily superior from a welfare perspective.   When a cost-minimizing employer chooses

to offer the generous plan, it does so in order to lower its compensation cost, not for any efficiency

reasons.

To shed further light on this issue, for an interior solution under the ELS rule, the healthiest

worker in the generous plan, type c_g^{ELS}, satisfies:

$$g\left(c_g^{ELS}\right) = (1-t)\left(\int_{c_g}^{\gamma} c\frac{f\left(c\right)}{1-F\left(c_g\right)}dc - \alpha\int_{c_m^*}^{c_g} c\frac{f\left(c\right)}{F\left(c_g\right)}dc\right). \tag{11}$$

Comparing (11) and (10) illustrates why, in general, c_g^* and c_g^{ELS} cannot be ordered independent

of the distribution of health types and the shape of $g\left(c\right)$.   According to (11), the ELS rule sets the

marginal worker's willingness to pay for the generous plan equal to the difference in the average cost

of the two plans.   The right-hand side of (10) differs from the right-hand side of (11) in that the

cost-minimizing employer cares about the actual cost of the marginal worker.   Since the difference

in the cost of the marginal worker is less than the difference in the average cost of the two plans,

the right-hand side of (10) is smaller than the right-hand side of (11).   All else equal, this leads the

cost-minimizing employer to put more workers in the generous plan.   However, the left-hand sides

of (11) and (10) differ as well.   Since the elasticity of willingness to pay for generous coverage is

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[25]Note that viability of the generous plan depends on the distribution of health types under the ELS rule but not under the cost-minimization rule.

[26]To be fair, the ELS approach also has strong advantages which do not emerge in this model.   Making employees pay the entire premium increase when choosing a more expensive health plan gives them strong incentives to choose less expensive plans, and this increased price sensitivity will increase insurers' incentives to lower their prices (Enthoven 1988; 2003).   Indeed, in their discussion of the Harvard case Cutler and Reber (1998) argue that increased plan-side competition resulting from adoption of the ELS rule reduced Harvard's premiums by 5 to 8 percent.

negative, the left-hand side of (10) is less than the left-hand side of (11). Taken in isolation, this induces the cost-minimizing employer to put fewer people in the generous plan than the ELS rule. Further, this effect is more pronounced when the willingness to pay is relatively inelastic (i.e., $|\varepsilon|$ is small). Since these two effects push in opposite directions, whether cost-minimization or ELS is more efficient (i.e., which rule comes closer to the socially optimal rule, (2)) cannot be determined without knowing more about the distribution of health types and the shape of $g(c)$.

The ELS rule is just one rule employers use. Other rules are less susceptible to adverse selection spirals. For example, Cutler and Zeckhauser (1998) contrast Harvard's practices with those used by the Group Insurance Commission of Massachusetts (GIC), which designs the health insurance options for state employees' health benefits. By Massachusetts law, the state must use a fairly generous EPP rule. Since employees' out-of-pocket contribution is only a small fraction of the difference in the cost of the two plans, this tends to dampen the effects of adverse selection. Consequently, it is more likely that the generous plan remains viable under such a rule. Indeed, Cutler and Zeckhauser explain that, because of its contribution rule and other cost-containment measures, the GIC has controlled the effects of adverse selection on its most generous plan viable.

6   Discussion

This paper has considered an employer with the goal of minimizing its total compensation cost and has argued that in setting the surcharge for generous coverage, the employer should act as a monopolist who sells health insurance upgrades to its employees. At the most general level, this principle advocates a change in approach to the benefits design problem: employers' primary focus should be on managing self-selection in order to minimize total compensation cost.[27] Such an approach can ameliorate common benefits-related problems employers face. For example, by explicitly considering the cost effects of differing selection, the employer controls it, reducing the likelihood and severity of unintended adverse selection and premium spirals.

The theory of firm behavior laid out in this paper provides a basis for thinking about how cost-minimizing employers will react to policy interventions such as changes in the tax code or the

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[27]In fact, even when the employer has some other goal, we would argue that it could more easily achieve it by focusing on choosing the surcharge that induces its desired behavior rather than adhering to some rule that leaves the surcharge endogenously determined by employees' choices.

structure of insurance markets, and the welfare implications of such interventions. However, while we might expect employer behavior to agree broadly with the model laid out here, it should be noted that a sizeable fraction of employers[28] explicitly adhere to ELS or EPP rules, not cost minimization. Those employers who are not minimizing cost may be doing so because they lack the knowledge or ability to do so, or they may be minimizing cost subject to different constraints than those considered in this paper. In either case, it may be difficult to develop robust conclusions about the effects of social policy interventions on employer behavior without a more complete positive model of how employers design their health benefits, and why. For example, while we argued that under either cost-minimization or ELS there is a tax rate that induces socially optimal sorting of workers into plans, the tax rate that does so depends on which rule the employer is using.[29] Thus, while there some robust policy conclusions that emerge even in the absence of a clear positive model of employer behavior (e.g., increasing the rate of tax preference increases enrollment in the generous plan), more specific policy conclusions will depend on a more nuanced understanding of what employers are doing and why.

This paper has made a number of simplifying assumptions, including assuming that all workers are equally productive, that employee demand for generous coverage depends only on health type, that the size and composition of the employer's workforce is exogenous, and that the employer has all of the bargaining power in the game with employees and insurers. While relaxing any of these assumptions would change the results somewhat, doing so would not affect the fundamental forces that drive the employer's decision. The cost-minimizing employer should merely incorporate these into its cost-minimization problem as constraints. Because they do not posit any objective for the firm, simple rules of thumb such as ELS or EPP will, in general, lead to outcomes that are suboptimal both from a social perspective and from the firm's perspective.

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[28] See footnote 22.

[29] In fact, for a wide variety of reasonable pricing rules increasing the tax preference for employer-provided health benefits increases the number of workers enrolled in the generous plan, and therefore there exists a tax rate that, from a social perspective, optimally sorts workers into plans.

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