Search, Moral Hazard, and Equilibrium Price Dispersion*

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Abstract

We characterize optimal insurance coverage of a service whose price may vary across providers. The presence of insurance reduces households’ incentive to search for the lowest price, and weakens price competition. The interaction of the insurer, households, and service firms endogenously determine the distribution of service prices and the intensity of search. We find that a monopolist insurer offers full insurance, causing all service firms to charge an identical high price. A perfectly competitive insurance market typically results in partial insurance coverage and significant price dispersion. While additional draws from a price distribution will lower a household’s average price, the indirect effect of additional search on price competition has a much greater impact, and is responsible for at least 89% of the average price reduction.

Keywords: Contracts, coinsurance, search, moral hazard, price dispersion

JEL Classification: D40, D50, D81, D83, G22

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1 Introduction

In most markets where insurance plays a prominent role (such as medical services or auto repairs), the price of a particular service varies significantly from one firm to another.\footnote{Sorensen (2000) provides an empirical investigation of price dispersion in the prescription drug market (pricing the same drug across retailers). He documents that, on average, the highest posted price is over 50 percent above the lowest available price; furthermore, differences in pharmacy characteristics can account for at most 1/3 of the dispersion.} In a typical market, consumers respond to price dispersion by obtaining price quotes from a number of firms and selecting the lowest price. However, when an insurance company ultimately pays for most of the service, the consumer’s incentive to search is dramatically reduced — most of the price reduction obtained through search effort is passed on to the insurance company. With fewer searches, sales prices (and thus the expected insurance payout) are higher. This paper studies the optimal insurance contract in an environment with moral hazard due to search.

An insurance contract (or policy) consists of the premium charged to households as well as a coinsurance rate, defined as the percentage of an insurance claim that the household pays out-of-pocket. In offering a particular policy, an insurer must consider the incentives it creates for both households and service-providing firms. We depict this in a general equilibrium model in which the interactions between these agents endogenously determine the insurance policy, the distribution of service prices, and the search intensity of households. We find that when the insurance firm is a monopolist, the equilibrium contract results in full insurance and no price dispersion among service firms. However, a perfectly competitive insurance market, which offers the utility-maximizing contract, will typically result in partial insurance coverage and dispersed prices.

Furthermore, we examine the magnitude of moral hazard in search, measured as the change in the expected total cost of the event due to the presence of insurance. We decompose two effects which contribute to this rise in expected cost. First, a direct effect occurs when consumers request fewer quotes from the same distribution. Second, an indirect effect occurs because requesting fewer quotes results in less price competition among the firms, shifting the distribution toward higher prices. Indeed, we find that the latter effect is at least 8.6 times bigger than the former (for all parameter values), or in other words, is responsible for at least 89% of the cost increase caused by moral hazard. Thus, the general equilibrium feedback is in fact
the much larger concern in the incentive problem. To our knowledge, we are the first to distinguish this effect within the optimal contract literature.

In our model, there is a continuum of ex-ante identical households and service firms, and an insurance firm. Households face a random event (such as an auto accident or health problem) with some fixed probability. If the event occurs, the household must hire a service firm to fully repair the damage. This service is homogenous across the service firms, but each firm may charge a different price. Households know the distribution of offered prices, but can only learn the price charged by a particular firm by requesting a quote at a constant cost.

Households can insure against this event by purchasing a policy offered by the insurance firm, which specifies a premium as well as a coinsurance rate. If the event occurs, the policy reimburses a fraction of the actual price paid. We initially analyze household and service firm choices while taking the insurance contract as given. We then consider the contract that a pure monopolist insurer would offer, and compare this to the utility-maximizing contract that a competitive market would offer. All service firms are within the insurer’s approved network, meaning they have agreed not to charge more than an exogenously-set maximum allowable price.

Decisions occur in the following order: First, the insurance firm chooses which policy to offer. Households then accept or reject this policy. Next, service firms simultaneously set their prices. Finally, the event is realized for some of the households, who then decide how many quotes to request and select the lowest price among them.

Search is simultaneous, as in Burdett and Judd (1983); that is, a household receives all quotes at the same time. Unlike sequential search, a simultaneous search environment can generate equilibrium price dispersion even though firms and households are homogeneous. Another virtue of simultaneous search is that it approximates a situation in which the repair or surgery must take place within a short timeframe; Manning and Morgan (1982) and Morgan and Manning (1985) offer this and several other scenarios in which simultaneous search dominates sequential search.

Whenever the presence of insurance distorts incentives for the insured, causing an increase in expected payout, a moral hazard problem occurs. Two other forms of moral hazard are well known. First, the insured person may exercise less precaution

\footnote{This is purely a monetary loss, then, and ignores any irreparable damage. Ma and McGuire (1997) model health shocks as a monetary loss which can be partially recovered depending on the quantity and quality of health care purchased.}
(such as defensive driving), increasing the probability of loss. Second, the insured person may increase his consumption of the covered service (such as medical appointments), increasing the size of loss. These have been extensively studied, beginning with the work of Arrow (1963), Pauly (1968), Smith (1968), Zeuckhauser (1970), and Ehrlich and Becker (1972).

However, moral hazard in search has received much less attention, with the only formal analyses in Dionne (1981, 1984). In a model where the coinsurance rate is taken as exogenous and the distribution of prices is fixed regardless of the number of quotes requested by households, Dionne identifies the negative incentive effect of insurance on search behavior and hence on expected service prices. However, this neglects a crucial (and, as we show, larger) component of the story: the endogenous response of firms to household search.

There is substantial evidence of a positive relationship between insurance coverage and service firm prices. Using a product-level panel dataset of various drug purchases in Germany, Pavcnik (2002) shows that prices decreased significantly after a change in insurance coverage that made households responsible for a larger portion of their prescription purchases. Feldstein (1970, 1971) find that physicians and non-profit hospitals raise their prices as insurance coverage becomes more extensive. In fact, Feldstein (1973) estimates that raising the coinsurance rate for hospital stays from 33 to 50 percent would reduce prices sufficiently to increase welfare between 11 and 25 percent (net of the welfare cost of increased exposure to risk).

This paper relates to the optimal insurance literature, such as Crew (1969), Smith (1968), Pauly (1968), and Gaynor, Haas-Wilson, and Vogt (2000). In particular, Ma and McGuire (1997) shares the same spirit as our paper, though they examine a different aspect of moral hazard. In their model, health insurance contracts are incomplete because the quantity and quality of health care is not contractible; household or physician effort are hidden to some degree. This is a variation of moral hazard in consumption — households use more services, and physicians provide lower quality care. Our model follows a similar timing of insurance, service firm, and household decisions; but instead, the non-contractible elements are firm pricing and household quote requests, leading to moral hazard in search.

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3 Arrow (1963) mentions the potential problem: “Insurance removes the incentive on the part of individuals, patients, and physicians to shop around for better prices for hospitalization and surgical care.”
Nell, Richter, and Schiller (2009) also model the interaction between coinsurance and service prices. In their environment, product differentiation among service firms gives them spatial market power; thus, even though households are perfectly informed, they could choose to fill their prescription from a more expensive but closer pharmacy, for instance. In this sense, moral hazard arises because insurance is non-contractible on the location of purchase. However, there is no price dispersion in their analysis: they concentrate on symmetric equilibrium where all firms charge the same price.

Our model abstracts from some of the institutional details of insurance. For instance, all firms are assumed to be in the insurer’s preferred provider network; that is, households never consider firms outside of their network. Also, we do not model the negotiation process by which the maximum allowable price is set, nor can insurers engage in search on behalf of households. Finally, an insurance contract is limited to a coinsurance rate and a premium, though we discuss the effects of several enlargements to the contract space in the conclusion (Sec. 6).

The paper proceeds as follows: Section 2 presents the model in which the insurance contract is exogenous, and characterizes the equilibrium behavior of service firms and households. Insurance contracts are endogenized in Section 3; both the profit-maximizing and utility-maximizing contracts are characterized. Section 4 applies the model to prescription drug insurance, developing a numerical example which illustrates equilibrium behavior. Section 5 provides a measure of moral hazard in search and decomposes this into the direct and indirect effect. In Section 6, we discuss broader contract spaces and their consequences, and we offer conclusions in Section 7. The data procedure and all proofs appear in the appendices.

2 Exogenous Insurance Contract

2.1 Environment

Three types of agents interact in this economy: households, service firms, and an insurance firm. We assume a continuum (of measure one) of both households and service firms. Within each type, agents are identical ex-ante.

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4Since out-of-network prices are typically higher and their insurance reimbursement is less generous, this is probably an accurate depiction of most household choices. The exceptions are when emergency service is needed while traveling outside of the network area, or when significant quality differences exist among firms — both of which are beyond the scope of this model.
Households face a random event (such as an auto accident or health problem) with probability $\rho$. When the event occurs, the household hires a service firm to fully repair the damage. This service is homogenous across the service firms, but each firm may charge a different price. Households know the distribution of offered prices, $F(p)$, but can only learn the price $p$ charged by a particular firm by requesting a quote at a cost $c > 0$.

Households insure against this event by purchasing a policy offered by the insurance firm, which specifies a premium $\theta$ as well as a coinsurance rate $\gamma$. We initially consider this insurance contract as exogenously given and assume that all households insure; in Section 3, both the insurance policy and the decision to purchase it are endogenously determined. If the event occurs, the policy reimburses a fraction $1 - \gamma$ of the actual price paid. All service firms are within the insurer’s approved network, meaning they have agreed not to charge more than an exogenously-set maximum allowable price $M$.

Note that demand for the service is perfectly inelastic; fraction $\rho$ of the population will always purchase one unit of service from some firm. The only question is what price they will pay for it. This assumed demand is needed to isolate the effect of moral hazard in search. If consumers had any elasticity in their demand, then the presence of insurance would encourage them to consume more units of service, which is moral hazard in consumption.

Decisions occur in the following order: Service firms simultaneously set their prices. Then the event is realized for some of the households, who must decide how many quotes to request and select the lowest price among them. We refer to the time prior to requesting quotes but after the event as ex-interim.

### 2.2 Household Quote Requests

In the last stage of the game, only those unlucky households who experience the event have a choice to make: the number $n$ of quotes to request. At that point, the distribution of service prices is fixed. The quotes are all received simultaneously, after which the household will choose the lowest among them.\(^5\)

Household utility is assumed to be quasi-linear with respect to search costs; that

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\(^5\)There is no option to seek another set of quotes, even if the first set were clustered on the high end of the distribution. Also, requesting a quote is prerequisite to obtaining service, so all unlucky households must have $n \geq 1$. 

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is, a form: $u(w) - cn$. To create a role for insurance, we assume that households are risk averse: $u' > 0$ and $u'' < 0$ for all $w$. The assumption that households are risk neutral with respect to search costs greatly improves tractability, and when $c$ is small relative to $w$, the form $u(w - cn)$ produces the same equilibrium behavior. The choice of $n$ is made so as to maximize ex-interim expected utility:

$$\max_{n \in \mathbb{Z}} V(n; \theta, \gamma, F(\cdot)) \equiv \int_{p}^{M} u(w - \theta - \gamma p) n(1 - F(p))^{n-1} dF(p) - cn.$$  \hspace{1cm} (1)

The objective function $V$ is a strictly concave function of $n$, as we demonstrate in the following proposition. Since $n$ is restricted to integer values, strict concavity ensures that there will either be a unique solution $n^*$ or households will be indifferent between requesting either $n^*$ or $n^* + 1$ quotes. If $u(\cdot)$ were linear utility, concavity would be a simple property of order statistics; Lemma 1 shows that the result still holds with risk averse households.

**Lemma 1.** *Ex-interim expected utility is strictly concave with respect to $n$.*

Thus, it is possible for ex-ante identical households to choose different numbers of quote requests. Yet, in light of the concavity of $V$, this can only occur over two consecutive numbers and the households must be indifferent between them. Among all households who incur losses, the fraction who request $n$ quotes is expressed as $q_n$.

### 2.3 Service Firms

The individual service firms are able to repair a household’s loss at constant marginal cost $r$. We assume $r < M$. Each firm sets a price $p$, taking as given the distribution of prices among other firms and the search behavior of consumers, represented by $F(\cdot)$ and $q_n$.\(^6\) Only $\rho$ percent of the population will be in the market for their service, and among those customers, a firm will only make the sale if its quoted price is lower than all other quotes requested by that customer. Thus, a firm considers not only the profit per sale, $p - r$, but also the probability of making the sale, as depicted in the firm’s expected profit:

\(^6\)In particular, an individual firm does not expect that raising its price will result in fewer searches, since it is only one of the continuum of firms and cannot affect the price distribution. This would only occur if a positive mass of firms raised their prices.
\[
\max_p \Pi_S(p) \equiv \begin{cases} 
\rho(p - r) \sum_{n=1}^{\infty} q_n n (1 - F(p))^{n-1} & \text{if } p \leq M \\
0 & \text{if } p > M.
\end{cases}
\] (2)

A Service Firm Equilibrium is a price distribution \( F(\cdot) \) and service firm profit \( \Pi_S \) such that, given the aggregate distribution of quote requests \( \{q_n\}_{n=1}^{\infty} \),

1. \( \Pi_S = \Pi_S(p) \) for all \( p \) in the support of \( F(\cdot) \)

2. \( \Pi_S \geq \Pi_S(p) \) for all \( p \).

In a service firm equilibrium, each firm is indifferent among all prices in the support. Thus, the price distribution may be interpreted in one of two ways. Each firm could select a particular price in the support with certainty, with an aggregate distribution \( F(\cdot) \) of those prices. Alternatively, one could see \( F(\cdot) \) as the mixed strategy employed by every firm in a symmetric equilibrium.

For any particular insurance policy \((\theta, \gamma)\), the interaction of service firms and households will determine the number of quote requests and the price distribution. An Insured Search Equilibrium for \((\theta, \gamma)\) is a price distribution \( F(\cdot) \), service firm profits \( \Pi_S \), and a distribution of household quote requests \( \{q_n\}_{n=1}^{\infty} \) such that:

1. \( F(\cdot) \) and \( \Pi_S \) constitute a service firm equilibrium given \( \{q_n\}_{n=1}^{\infty} \)

2. \( q_n > 0 \) only if \( n \) solves the household’s problem (Eq. 1)

3. \( \sum_{n=1}^{\infty} q_n = 1 \).

If the equilibrium \( F(\cdot) \) is a non-degenerate distribution, we refer to it as a dispersed price equilibrium.

### 2.4 Search and Price Dispersion

Before combining the interaction of household search and firm pricing, we note that the behavior of service firms in this model replicates that of firms in Burdett and Judd (1983). Thus the following results apply:

- If \( q_1 = 1 \), the unique service firm equilibrium has \( F(M) = 1 \) and \( F(p) = 0 \) for \( p < M \). That is, if everyone requests a single quote, there is no reason to compete on price, so everyone charges the maximum allowed.
• If \( q_1 = 0 \), the unique service firm equilibrium has \( F(r) = 1 \) and \( F(p) = 0 \) for \( p < r \). If everyone requests more than one quote, price competition will drive all firms to charge marginal cost.

• If \( q_1 \in (0, 1) \), the unique service firm equilibrium has continuous \( F(\cdot) \), with support \([p, M]\), for some \( p > r \). A dispersed price distribution can only arise if some fraction of the population requests only one bid. If so, some firms will offer high prices (including \( M \)), hoping to capture those who only request a single quote; others will offer lower prices in pursuit of those who request multiple quotes.

Combining these results with household search behavior will further narrow the possible insured search equilibria. For instance, no equilibrium exists in which \( q_1 = 0 \). In that case, a service firm equilibrium would require a degenerate price distribution, concentrated at \( r \). But if all firms choose the same price \( r \), there would be no reason for households to request more than one quote, requiring that \( q_1 = 1 \).

On the other hand, an insured search equilibrium always exists in which \( q_1 = 1 \) and all firms charge price \( M \). These choices are mutually consistent, since no firm will be undercut if no one searches twice, and no household should search multiple times if all prices are identical. This sort of result is common to all search models. Having eliminated the other possibility for a degenerate price distribution, we may appropriately refer to this as the degenerate equilibrium.

In order to have a dispersed price equilibrium, we need \( 0 < q_1 < 1 \). Because of the concavity of \( V \) with respect to \( n \), this means that \( q_2 = 1 - q_1 \); if households were indifferent between 1 and \( n \), then the quantities from 2 to \( n - 1 \) would produce strictly more utility. For notational ease, we set \( q = q_1 \). The existence of such an equilibrium depends on the parameters. For instance, when the cost of search is sufficiently high, no one can be enticed to search twice.

For a dispersed price equilibrium, the service firm’s profit can be written as: \( \Pi_S(p) = \rho(p - r)(q + 2(1 - q)(1 - F(p))) \). As stated earlier, \( F(p) \) must be continuous when \( q \in (0, 1) \). The precise distribution associated with a given \( q \) is derived from the requirement that all prices in the support be equally profitable. Thus \( (M - r)q = (p - r)(q + 2(1 - q)(1 - F(p))) \), which yields:

\[
F(p) = 1 - \frac{(M - p)q}{2(p - r)(1 - q)} \text{ for } p \in [p, M].
\]
The lower bound of the support, \( p \equiv r + \frac{(M-r)q}{2-\tilde{q}} \), is derived such that \( F(p) = 0 \). Also, \( dF(p) = \frac{(M-r)q}{2(1-q)(p-r)^2} \). Each service firm has an ex-ante expected profit of \( \Pi_S = \rho q (M-r) \). Thus, firm behavior and the resulting price distribution are entirely determined by \( q \), the fraction of people who request only one quote. Furthermore, a larger \( q \) results in prices more concentrated on the right tail of the distribution, as established in the following lemma.

**Lemma 2.** If \( \hat{q} < \tilde{q} \) then \( F(p; \hat{q}) > F(p; \tilde{q}) \) for each \( p \in [p, M] \).

**Proof.** Since \( \hat{q} < \tilde{q} \), \( \frac{\hat{q}}{1-\hat{q}} < \frac{\tilde{q}}{1-\tilde{q}} \). Hence \( F(p; \hat{q}) = 1 - \frac{(M-p)\hat{q}}{2(p-r)(1-\hat{q})} > 1 - \frac{(M-p)\tilde{q}}{2(p-r)(1-\tilde{q})} = F(p; \tilde{q}) \). □

In other words, when fewer people request multiple quotes, firms have less probability of being undercut; as a consequence, they can charge higher prices. In particular, the new distribution will first-order stochastically dominate the original distribution.

### 2.5 Insured Search Equilibrium Characterization

For a given insurance policy \((\theta, \gamma)\), the insured search equilibrium can be fully described by \( q \). The preceding subsection derived the price distribution and service firm profits as particular functions of \( q \). In addition, the quote requests \( q \) must be consistent with households maximizing expected utility, which is examined in this subsection.

In the case of the degenerate equilibrium (which exists for any insurance policy), this is easy. It is optimal for all households to request a single quote since all firms charge the same price.

To have a dispersed price equilibrium, however, households must be indifferent between requesting one or two quotes. Therefore, we solve for the \( q \) which equates the expected utility of one request to the expected utility of two requests:

\[
(1 - \rho)u(w - \theta) + \rho \left( \int_{\bar{p}}^{M} \frac{q(M-r)}{2(1-q)(p-r)^2} u(w - \theta - \gamma p) dp - c \right) = (1 - \rho)u(w - \theta) + \rho \left( \int_{\bar{p}}^{M} \frac{q^2(M-p)(M-r)}{2(1-q)^2(p-r)^3} u(w - \theta - \gamma p) dp - 2c \right)
\]
which simplifies to:

\[ \Delta(\theta, \gamma, q) \equiv \int_{r+(M-r)q}^{M} \frac{(M-r)((M-r)q + r - p)q}{2(1 - q)^2(p - r)^3} u(w - \theta - \gamma p)dp - c = 0. \]  

(4)

For any particular \((\theta, \gamma)\), Equation 4 may have zero, one, or many solutions. With linear utility, it is straightforward to show that there are at most two dispersed price equilibria. The following establishes the same result for risk averse households, with some restrictions on parameters.

**Proposition 1.** Let \(a(w) = -\frac{u''(w)}{u'(w)}\) represent the Arrow-Pratt absolute measure of risk aversion. If \(-(M - r)^2\gamma^2a'(w - \theta - \gamma M) < 16\), there are no more than two \(q\) such that \(\Delta(\theta, \gamma, q) = 0\).

The assumption is trivially satisfied when \(u\) has increasing or constant absolute risk aversion; it only limits the rate at which absolute risk aversion may decrease. In practice, this condition is not hard to satisfy (while still generating dispersed price equilibria). For instance, with CRRA utility \(u(w) = \frac{w^{1-\sigma}}{1-\sigma}\), \(a'(w) = -\frac{\sigma}{w^2}\) and the left hand side of the condition would be \(\sigma \left( \frac{(M-r)\gamma}{w-\theta-\gamma M} \right)^2\). As long as \(w - \theta - \gamma M > M - r\) (which, with a competitive insurance premium, is satisfied if \(w > 2M\)), then term in parenthesis will be less than 1, allowing risk aversion \(\sigma\) to be quite high while still satisfying the assumption.

We are also interested in how equilibrium responds to changes in policy parameters. Define \(Q(\theta, \gamma) \equiv \{q \in [0, 1] : \Delta(\theta, \gamma, q) = 0\}\) as the correspondence of dispersed price insured search equilibria. The next lemma establishes some basic smoothness properties of \(Q(\cdot)\).

**Lemma 3.**

1. \(Q(\theta, \gamma)\) is a closed, upper hemi-continuous correspondence.

2. If \(Q(\theta, \gamma)\) has no more than two members for any \((\theta, \gamma)\), then
   
   (a) if \(Q(\theta, \gamma)\) has exactly two members, it is lower hemi-continuous at \((\theta, \gamma)\).
   
   (b) if \(Q(\theta, \gamma)\) has exactly one member, it is only lower hemi-continuous at \((\theta, \gamma)\) on the restricted domain \([0, \theta] \times [\gamma, 1]\).

In essence, this states that the fraction of people requesting one quote will respond continuously to small changes in the policy (provided that there are never more
than two dispersed price equilibria). The exception occurs when there is exactly one dispersed price equilibrium. In that case, a small increase in the premium or decrease in the coinsurance rate would make a single quote request strictly better than two for all $q$, causing $Q$ to be empty. A small decrease in $\theta$ or increase in $\gamma$, however, would still result in a small change in $q$ (and in fact leads to two dispersed price equilibria). Generically, there will be either zero or two dispersed price equilibria; having exactly one is not generic, since (as shown in the proof) this only occurs when $\frac{\partial \Delta}{\partial q} = 0$.

Dispersed price equilibria must be solved for numerically — analytic solutions are not possible even in the case of linear utility, and risk aversion only increases the complexity of Equation 4. In Section 4, we provide a calibration and numerical solution that demonstrates the typical equilibrium behavior. One of the features of greatest interest can be derived analytically: how changes in the coinsurance rate affect the number of people who request two quotes.

**Proposition 2.** Suppose there are exactly two dispersed price equilibria $(\theta, \gamma, \hat{q})$ and $(\theta, \gamma, \tilde{q})$, with $\hat{q} < \tilde{q}$. In equilibrium, $\frac{\partial \hat{q}}{\partial \gamma} < 0$ and $\frac{\partial \tilde{q}}{\partial \gamma} > 0$.

The first result is intuitive: if a consumer pays a higher fraction of the final price, he has more at stake and is willing to expend more effort in search. As a consequence, a larger fraction of consumers requests two quotes. This only applies to the smaller $\hat{q}$, however (i.e. when more people already are searching). The other equilibrium behaves counterintuitively as a consequence of search externalities: if everyone else reduces their search effort, the price distribution becomes less dispersed, giving me less incentive to search as well.

We now examine the effect of a change in $\theta$, $\gamma$, or $q$ on ex-ante expected utility, which is $EU(n; \theta, \gamma, q) \equiv (1 - \rho)u(w - \theta) + \rho V(n; \theta, \gamma, q)$. Note that $q$ reflects the aggregate search decisions, and determines the service price distribution, $F(\cdot)$. Of course, in equilibrium, $n = 1$ (and, in a dispersed equilibrium, $n = 2$) maximizes expected utility, allowing us to simplify this expression. Indeed, we find it useful to compute the average expected utility across households who request one bid and those requesting two, which is the same as ex-ante expected utility in equilibrium. With slight abuse of notation, we depict this by merely dropping $n$ as an argument of $EU$. 

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\[ EU(\theta, \gamma, q) \equiv (1 - \rho)u(w - \theta) + \rho q \left( \int_p^M \frac{q(M - r)}{2(1 - q)(p - r)^2} u(w - \theta - \gamma p) dp - c \right) \]

\[ + \rho(1 - q) \left( \int_p^M \frac{q^2(M - p)(M - r)}{2(1 - q)^2(p - r)^3} u(w - \theta - \gamma p) dp - 2c \right) \]

\[ = (1 - \rho)u(w - \theta) + \rho \left( \int_p^M \frac{q^2(M - r)^2}{2(1 - q)(p - r)^3} u(w - \theta - \gamma p) dp - (2 - q)c \right). \tag{5} \]

In either a dispersed or degenerate equilibrium, the partial derivatives of \( EU \) are unambiguous and follow one’s intuition. Higher premiums, higher coinsurance, or fewer people searching twice (and hence higher service prices) will harm households. Of course, the latter is not an exogenous parameter, but knowing this partial derivative allows us to consider the total derivative below.

**Lemma 4.** Suppose \((\theta, \gamma, q)\) is an insured search equilibrium. Then \( \frac{\partial EU}{\partial \theta} < 0 \), \( \frac{\partial EU}{\partial \gamma} < 0 \), and \( \frac{\partial EU}{\partial q} < 0 \).

This result stops short of stating how expected utility responds to an exogenous change of \( \gamma \) in equilibrium. This would be given by:

\[ \frac{dEU}{d\gamma} = \frac{\partial EU}{\partial \theta} \left( \frac{\partial \theta}{\partial \gamma} + \frac{\partial \theta}{\partial q} \frac{\partial q}{\partial \gamma} \right) + \frac{\partial EU}{\partial \gamma} + \frac{\partial EU}{\partial q} \frac{\partial q}{\partial \gamma} \]

Among degenerate equilibria, this total derivative greatly simplifies, since \( \frac{\partial q}{\partial \gamma} = 0 \); it can be readily shown that \( \frac{dEU}{d\gamma} < 0 \) in such a case. An increase in \( \gamma \) will leave the price distribution unchanged (all firms charge \( M \)) and hence the expected cost of premiums summed with out-of-pocket expenses is unchanged. Yet households are exposed to greater variance in wealth.

Among dispersed price equilibria, the sign of \( \frac{dEU}{d\gamma} \) depends on parameters. Note that the last term is positive when \( q \) is the smaller of two dispersed price equilibria, while the second term is negative. The sign of the first term might depend on the market structure of the insurance industry, but typically one would expect premiums to fall as coinsurance rises, and premiums to rise as the average service firm price increases (i.e. due to higher \( q \)). If so, the first term will be positive.

In our numerical computation of dispersed price equilibria with calibrated pa-
rameter values, we find that equilibrium expected utility is initially increasing in $\gamma$, and typically reaches an interior maximum before $\gamma = 1$. In other words, when coinsurance is increased from a low initial level, more quote requests occur, and the households’ benefit from lower prices exceeds the harm of greater exposure to risk. However, the marginal benefit falls as $\gamma$ increases, and eventually, greater coinsurance causes expected utility to decrease.

3 Endogenous Insurance Contracts

We next consider the decisions of the insurer in setting the terms of the insurance policy. We will examine the contracts produced under two insurance market structures: monopoly and perfect competition.

Here, the model begins with the insurance firm selecting a policy $(\theta, \gamma)$. This is a take-it-or-leave-it offer to households, who have an outside option to remain uninsured (possibly requesting a greater number of quotes). The insurance plan is purchased if it is individually rational. That is, the expected utility from accepting insurance and searching once or twice (which are equal in a dispersed equilibrium) must be at least as big as the expected utility of rejecting insurance and requesting an optimal number of quotes, given the price distribution determined by $q$: $EU(1; \theta, \gamma, q) \geq \max_n EU(n; 0, 1, q)$.

Note that $q$ reflects the average number of people searching once. Thus, a single household treats this as fixed relative to his own decision. As a practical consequence, when considering the consequences of being uninsured, the household expects to face the same distribution of service firm prices as when insured. Beyond this point, service firms and households behave as depicted in the insured search equilibrium.

3.1 Monopolist Insurance Firm

The insurance firm is risk neutral and seeks to maximize expected profit. The insurer understands that household search behavior can be affected by the policy terms, and that this influences the service firms’ price distribution. In other words, they recognize that $q$ depends on $\theta$ and $\gamma$. For a given $(\theta, \gamma)$, expected profit is given by:

$$\Pi_I(\theta, \gamma, q) \equiv \theta - \rho(1 - \gamma) \sum_{n=1}^{\infty} q_n(\theta, \gamma) \left( p + \int_p^M (1 - F(p; \theta, \gamma))^n dp \right).$$ (6)
The term in parenthesis is the expected lowest price when \( n \) quotes are requested (using integration by parts). After applying the results regarding service firm equilibria, this simplifies greatly as shown in the following lemma.

**Lemma 5.** Given that fraction \( q \) of those with losses only request one quote, the insurance profits will be: 
\[
\Pi_I(\theta, \gamma, q) = \theta - \rho(1 - \gamma)(r + q(M - r)).
\]

The proof is a straightforward computation. Similarly, the household’s expected out-of-pocket costs (i.e., unreimbursed service expense) is \( OP \equiv \rho \gamma(r + q(M - r)) \).

When the firm offers a particular contract \((\theta, \gamma)\), it must anticipate which \( q \) the contract will generate. As established in the previous section, there are potentially three \( q \) for any contract: a degenerate equilibrium \((q = 1)\) and up to two dispersed equilibria. To depict the insurer’s beliefs about the resulting equilibrium, let the function \( \tilde{Q}(\theta, \gamma) \) select a \( q \in Q(\theta, \gamma) \cap \{1\} \) for each policy. We need no further restrictions on these beliefs to characterize the insurer’s profit maximizing contract. It is essential to remember, however, that for any \( \gamma \) in the neighborhood of 0, there is no dispersed equilibrium and hence \( \tilde{Q}(\theta, \gamma) = 1 \).

We then define a **Monopoly-insured Search Equilibrium** as a policy \((\theta^*, \gamma^*)\) and quote requests \( q^* \) such that:

\[
(\theta^*, \gamma^*) \in \arg \max_{\theta \in [0, M], \gamma \in [0, 1]} \theta - \rho(1 - \gamma)(r + q^*(M - r)) \quad \text{s.t.} \quad q^* \in \tilde{Q}(\theta, \gamma) \quad \text{and} \quad EU(1; \theta, \gamma, q^*) \geq \max_n EU(n; 0, 1, q^*).
\]

This definition fits the principal-agent framework, where the insurer (principal) must choose a contract that is both incentive compatible and individually rational for the household (agent). The latter is represented in the participation constraint. The former is embodied in \( \tilde{Q}(\theta, \gamma) \), requiring that it be an insured search equilibrium given \( \theta \) and \( \gamma \). By imposing this requirement, the principal is forced to anticipate not only the direct effect of the contract on search behavior \((q)\) but also its indirect impact on the price distribution \((F)\).

The remarkable consequence of monopolization is that the insurer prefers service firms to have a degenerate price distribution. The insurance firm offers full insurance, even knowing that this results in the highest possible service firm prices. The intuition for this result is that the monopolist’s profit is precisely the risk premium he can extract from the household. By discouraging search, the insurer increases the size of
loss from the negative event and hence the variance in the household’s wealth. Thus, households are willing to pay a larger risk premium (in addition to the insurer’s expected payout). The claim is formalized in the following proposition.

**Proposition 3.** Let \( X = \max\{\theta, p\} \). Suppose \( \rho \leq \frac{1}{2} \) and \( \frac{u'(w-X)}{u'(w)} < \frac{\theta}{\rho(p+(M-r)(1-q)q)} \) for all \( q \). A pure monopolist insurer will maximize profits by setting \( \gamma^* = 0 \) and \( \theta^* \) such that \( EU(1; \theta^*, \gamma^*, 1) = EU(1; 0, 1, 1) \).

We note that the imposed assumptions are only sufficient conditions. While those bounds are not as tight as possible, the used assumptions provide the simplest expression and have some intuitive content. The first condition ensures that the negative event is not too likely. If violated in the extreme (e.g. \( \rho \approx 1 \)), the contract becomes more about pre-payment than insurance, altering how households are impacted by changes in coinsurance.

The second condition requires that the utility function not have too much curvature. This is sufficient for households to find insurance more valuable after an increase in \( q \). There are two sources of variance in household wealth: whether the event occurs (i.e. the variance between \( w - \theta \) and \( w - \theta - OP \)) and the actual price paid when it does (i.e. the variance around \( OP \) in actual out-of-pocket expenses, \( \gamma p \)). Under this assumption, households derive greater value from the insurer smoothing the first source of risk, while the second is a lower-order concern. Using the concept of certainty equivalence, one could restate this condition entirely in terms of the model primitives, though the statement would be cumbersome.

### 3.2 Perfectly Competitive Insurance Market

Following Schlesinger and Venezian (1986), Gaynor, Haas-Wilson, and Vogt (2000), and Nell, Richter, and Schiller (2009), we define a perfectly competitive insurance market as one that charges a competitive premium and maximizes household expected utility. Since insurance coverage has constant returns to scale (we have assumed no fixed costs), the number of insurance firms is indeterminate but inconsequential; we will proceed as though there is a single firm.

The insurance firm’s profit is calculated the same as in Lemma 5; since this must be zero, the competitive premium is \( \theta(\gamma, q) \equiv \rho(1 - \gamma)(r + q(M - r)) \). With this competitive premium, the set of potential search equilibria for a particular coinsurance
rate is \( \bar{q}(\gamma) \equiv \{ q \in [0, 1] : \Delta(\theta(\gamma, q), \gamma, q) = 0 \text{ or } q = 1 \} \). We define a \textit{Competitively-insured Search Equilibrium} as a policy \((\theta^*, \gamma^*)\) and quote requests \(q^*\) such that:

\[
(\theta^*, \gamma^*, q^*) \in \arg \max_{\theta \in [0, M], \gamma \in [0, 1], q \in \bar{q}(\gamma)} \text{EU}(\theta, \gamma, q \text{ s.t. } \theta = \theta(\gamma, q) \text{ and } \text{EU}(1; \theta, \gamma, q) \geq \max_n \text{EU}(n; 0, 1, q)).
\]

The first constraint imposes a competitive insurance premium, while the second constraint ensures that households are willing to purchase the insurance. Again, \(\bar{q}(\gamma)\) embodies the equilibrium response of service firm pricing and household search behavior.\(^7\)

It is straightforward to show that if \(q^* = 1\) in a competitively-insured search equilibrium, then \(\gamma^* = 0\). As long as there is a degenerate price distribution, coinsurance serves no purpose, and only interferes with the efficient transfer of risk from the household to the insurer. Similarly, when there are dispersed equilibria for a particular \(\gamma\), \(\bar{q}(\gamma)\) has multiple values but the smallest \(q\) produces the highest expected utility, as a consequence of Lemma 4. Then, one must compare this partial insurance policy to the full insurance policy to determine which yields higher expected utility.

Beyond these results, the maximization of \(\text{EU}\) is not analytically tractable. In practice, one must numerically compute the dispersed equilibrium associated with each potential coinsurance rate and find the maximizer. This is typically a concave function with an interior maximizer, because of the tradeoffs between higher search incentives and higher exposure to risk. In Section 4, we illustrate a typical dispersed equilibrium, with parameters chosen to match stylized facts on prescription drugs. We also demonstrate how changes in the coinsurance rate affect the service firm price distribution, the expected cost of the event, and expected utility. In Section 4.2, we characterize how the utility-maximizing coinsurance rate responds to changes in the various parameters.

Typically, the dispersed price equilibrium with partial coverage will dominate the degenerate equilibrium with full coverage, giving a remarkably different outcome than a monopolist would. In extreme circumstances, however, it is possible that competitive markets will produce the full insurance outcome. Most often, this is simply because a dispersed equilibrium does not exist for any coinsurance rate; \textit{i.e.}\(^7\)Our model does not analyze the simultaneous coexistence of distinct insurance policies, since households are homogenous.
even with no insurance, the cost of a quote request is too high relative to the potential benefits, \( M - r \). But with deliberately chosen parameters, one can find outcomes where dispersed equilibria exist for some coinsurance rates, and yet are dominated by full insurance. In such a case, the protection from insurance is more valuable to the household than the lower prices obtained via search. This requires the marginal cost of production, \( r \), to be very high, while \( M \) is not much higher; an example and further details are offered in Section 4.2.

### 3.3 Welfare Results

In addition to the equilibrium outcome for household utility, we may also inquire about total welfare. For this, we consider a perfectly competitive insurance market (which thus has zero profits) and examine household expected utility when they are given the profits of service firms as a lump sum. Thus, total welfare is expressed as \( \Omega(\gamma, q) \equiv EU(\theta(\gamma, q) - \Pi_S(q), \gamma, q) \). (Equivalently, one could examine the sum of the household’s certainty equivalent and service firm profits.)

Service firm profits unambiguously increase as \( q \) rises, which is readily apparent since \( \Pi_S = \rho q (M - r) \). The insurance policy \( (\theta, \gamma) \) has no direct effect on those profits. In Lemma 4, we examined how expected utility was affected by changes in \( q, \gamma, \) and \( \theta \), but the equilibrium effect was ambiguous in its sign. The aggregate welfare consequences, however, are unambiguous; indeed, welfare is maximized under full insurance, even though this creates a degenerate price distribution.

**Proposition 4.** Assuming \( \rho \leq \frac{1}{2} \), total welfare \( \Omega(\gamma, q) \) is maximized when \( \gamma = 0 \) and \( q = 1 \).

Three important factors produce this result. First, recall that demand is perfectly inelastic for the repair service; consequently, pricing above marginal cost creates no deadweight loss in this model. If demand showed some price sensitivity, households would see greater welfare gains as coinsurance rises and these would offset reductions in firm profit. As it is here, however, any price decrease is simply a transfer from firms to households.

At the same time, there are two costs which cause total welfare to decline as \( \gamma \) rises. First, search effort is a real cost. Although households find it individually rational to incur extra search costs in response to higher coinsurance, this reduces total wealth in the economy. Second, higher coinsurance rates place more of the risk...
on households rather than risk neutral insurers. In our calibration below, these costs prove to be minor.

It should also be noted that this analysis assumes equal ownership of the service firms among all households. If ownership were concentrated in a subset of the population, full insurance would (on net) help consumers who own the firms, while harming the remaining consumers. The optimal policy would lie between full insurance and the utility-maximizing, partial-insurance policy, where the balance between these would be determined by the Pareto weights placed on each group.

4 A Calibrated Example

Since the model is not analytically solvable (even with linear utility), we now illustrate equilibrium behavior by calibrating parameters to data on purchases of prescription drugs and numerically solving for a competitively-insured search equilibrium. The aim of this numerical example is to provide (in a plausible context) a sense of the magnitude of the problem that moral hazard in search creates and, through comparative statics, indicate when a high coinsurance rate might be optimal.

A large sample of household drug purchases is provided in the 2005 Medical Expenditure Panel Survey, compiled by the US Department of Health and Human Services. This data set is described in Appendix A, along with details of our calibration procedure. The market for prescription drugs is well suited to our theory due to the homogeneity of the product within each drug, the heavy presence of insurance in the market, and the significant price dispersion that is observed.

We use CRRA preferences $u(w) = \frac{w^{1-\sigma}}{1-\sigma}$, setting $\sigma = 4$. Using Maximum Likelihood Estimation, we set the parameters which cannot be directly observed ($q$, $M$, $r$, and $c$) so as to match our equilibrium conditions to the observed price distribution (annualized). The details of this procedure are also found in Appendix A; from this, we obtain the values listed in Table 1. As discussed in the appendix, the data

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8See footnotes 1 and Appendix A.

9This provides a moderate amount of risk aversion while still being within the range of values that are commonly accepted for individuals. Lower values for $\sigma$ reduces the importance of insurance, and if small enough, result in a utility-maximizing coinsurance rate of 100%.

10This is to say that the household faces a negative event at the beginning of the year; if it occurs, 12 purchases of a 30-day supply are required. Moreover, households only perform a search when they first fill the prescription; all refills are made with the same service firm at the same price. This appears to be largely consistent with the data.
and theory are very closely aligned in the selection of $q$, $r$, and $M$, and does well with most others. The coinsurance rate $\gamma$ is the hardest to match, since the data lacks details on individual insurance plans and the theory assumes a single plan. However, the features described in this section are qualitatively robust to changes in the parameters.

Table 1: Calibrated parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w$</td>
<td>$23,788$</td>
<td>Matched to average personal income in data</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>5.9%</td>
<td>Matched to average coinsurance rate among population</td>
</tr>
<tr>
<td>$\rho$</td>
<td>11.1%</td>
<td>Matched to fraction of population using drugs in data</td>
</tr>
<tr>
<td>$q$</td>
<td>22.0%</td>
<td>Theoretical distribution of prices (Eq. 3) matched to price distribution of the data</td>
</tr>
<tr>
<td>$M$</td>
<td>$3,260.4$</td>
<td></td>
</tr>
<tr>
<td>$r$</td>
<td>$640.8$</td>
<td></td>
</tr>
<tr>
<td>$c$</td>
<td>$4.8 \times 10^{-17}$ utils</td>
<td>Solved by requiring indifference between one and two searches (Eq. 4). ($15.38$ in certainty equivalent terms)</td>
</tr>
</tbody>
</table>

4.1 Insured Search Equilibria

In order to observe how insured search equilibria vary with coinsurance rates, we compute $q$ for a grid of values of $\gamma \in [0, 1]$, with $\theta$ set to the competitive premium. Figure 1 illustrates the resulting solution pairs. Several features of this graph are qualitatively robust for variations in the parameter values:

- The degenerate equilibrium ($q^* = 1$) exists for any coinsurance rate, and for low coinsurance rates ($\gamma < 5.4\%$), it is the only equilibrium.

- A sharp discontinuity occurs where the dispersed price equilibrium emerges, which is to say that as $\gamma$ approaches 5.4%, a new equilibrium at $q^* = 37\%$ emerges. Nearly two-thirds of the population suddenly begins to request two quotes.

- At higher rates of coinsurance, two dispersed price equilibria exist. The higher of these (the upper branch of the curve) behaves counterintuitively, in that less search occurs as coinsurance increases, as mentioned in conjunction with
Figure 1: Insured search equilibrium pairs of fraction of single quotes, $q$, and coinsurance rate, $\gamma$.

Proposition 2. Note that the calibration produced a $(\gamma, q)$ pair on the lower branch of the curve. The rest of our analysis considers these lower equilibria.

Of course, each of these equilibria result in a different service firm price distribution. Figure 2 plots the cumulative distribution function $F(p)$ in the equilibrium, for selected coinsurance rates. At $\gamma = 5.4\%$, a wide price distribution suddenly emerges. As $\gamma$ increases beyond that point, the distribution increasingly concentrates on lower prices. However, the largest price reductions occur between 5.4% and 15%, and there is little movement beyond $\gamma = 50\%$.

This dramatic change in the price distribution has a stark effect on the insurance premiums and out-of-pocket costs paid in each insured search equilibrium. These are illustrated in Figure 3. In the degenerate equilibrium range, an increase in the coinsurance rate simply transfers responsibility from the insurance firm to the individual; the total expected cost remains constant. When the dispersed price equilibrium emerges at $\gamma = 5.4\%$, the reduction in the price distribution is reflected in a discontinuous drop of nearly $200 in both insurance premium and out-of-pocket costs. At higher coinsurance rates, premiums fall and out of pocket costs rise, yet the total cost strictly decreases.

Clearly higher coinsurance results in lower expected prices for households; yet it also leaves the household exposed to more risk from the negative event. The net effect of these two factors on ex-ante utility is represented in Figure 4. The
Figure 2: Equilibrium distribution of prices for selected coinsurance rates: $\gamma = 99\%$ (Solid), 50\% (Long Dash), 15\% (Short Dash), 6\% (Dotted), 5.4\% (Dot Dash), and $\gamma < 5.4\%$ (Solid).

Figure 3: Ex-ante expected costs for each coinsurance rate, $\gamma$: insurance premium (solid), out-of-pocket (dotted), and total costs (dashed). The discontinuity at $\gamma = 5.4\%$ indicates where a dispersed equilibrium first emerges. Note the break in the y-axis.
price reductions are more important initially, but eventually are not sufficient to compensate for additional risk. For a simple interpretation of utility, we translate expected utility into dollar terms by finding the certainty equivalent wealth for each level of coinsurance; that is, the wealth $w$ such that $\frac{w^{1-\sigma}}{1-\sigma} = EU(\theta, \gamma, q)$.

While considering expected utility, we should also note that the participation constraint binds for dispersed price equilibria with a coinsurance rate below 6%. For instance, when the dispersed price equilibrium first emerges at $\gamma = 5.4\%$, a household would increase its certainty equivalent wealth by $6.2$ by foregoing insurance and, should the event occur, requesting 7 quotes. As $\gamma$ increases, this advantage quickly erodes; the probability of drawing a low price from $F(\cdot)$ increases, so an uninsured household would request fewer quotes.

The utility-maximizing coinsurance rate occurs at $\gamma^* = 53.4\%$, with an expected total cost of $72.7$. For some perspective as to the magnitude of moral hazard in search, consider that under full insurance ($\gamma = 0\%$), the expected total cost of the event is $361.9$, nearly 5 times as large! Of course, under the utility-maximizing insurance contract, households shoulder more of the risk; however, the utility cost of this risk only amounts to $1.2$ reduction in certainty equivalent wealth. In sum,
expected utility is 1.2% larger at $\gamma^* = 53.4\%$ compared to $\gamma = 0\%$.

Figure 4 also confirms our welfare results: the sum of certainty equivalent wealth plus service firm profits is maximized under full insurance with a degenerate price distribution. For these parameters, equilibrium total welfare is strictly decreasing in $\gamma$ even among dispersed price equilibria. Note, that the magnitude is quite small ($2.8\$ lost in total welfare moving from $\gamma = 0$ to $\gamma = 53.4\%$), though the distributional consequences are non-trivial ($289.2\$ reduction in service firm profit and a $286.4\$ increase in certainty equivalent wealth).

Note that in our calibration, we observe an average coinsurance rate of 5.9\% in the prescription drug market. Under that contract, expected total cost would be $135.5\$, and the utility cost of the risk is negligible. As discussed in Appendix A, it is difficult to rationalize this low coinsurance rate as part of a competitively-insured search equilibrium, even with extreme risk aversion. In our view, this reflects some monopoly power in the insurance market which, as shown in Section 3.1, biases insurers toward lower coinsurance rates. It is striking that the observed coinsurance rate is very close to the rate at which the participation constraint becomes binding, bearing in mind that the participation constraint was not used in calibration. In other words, to exploit some monopoly power, the insurer has reduced coinsurance to the lowest rate that is still consistent with a dispersed price equilibrium.
If the insurance market were fully monopolized, however, the profit maximizing policy would provide full coverage and induce a degenerate equilibrium, with an insurance premium of $497.1 (compared to $361.9 for a full insurance contract in perfectly competitive markets, and $33.9 under the utility-maximizing contract), earning \( \Pi_I = 135.2 \). This result of Proposition 3 is illustrated in Figure 5. This depicts the maximum risk premium the insurer can extract without violating the participation constraint, which depends on \( \gamma \) and the resulting \( q \). The dotted line arises from the degenerate equilibria, which produces strictly more profit than any dispersed price equilibria (represented by the dashed and solid lines). The solid line (nearly on the axis) is associated with the lower branch of the dispersed price equilibria focused on above, and offers only minuscule profits of at most $7.5; once the coinsurance rate is greater than \( \gamma = 0.33 \), the participation constraint binds. In dispersed price equilibria, households can self-insure to some degree through additional search, which reduces their willingness to pay for an insurance policy; however, additional search would be fruitless in a degenerate equilibrium, which generates the dramatic difference in profits.

### 4.2 Comparative Statics

Since we must numerically solve this model, an important question is how the equilibrium contract changes under different parameters. We examine the expected-utility-maximizing contract, denoted by \( (\theta^*, \gamma^*, q^*) \). Here we provide these comparative statics as well as the intuition as to why contracts respond in this particular manner. Much of this can be framed in terms of the positive externality of search: people choose how many quotes to request based on their private cost and benefit, yet additional search will reduce prices for all households needing a repair, including those who only search once.

- **Higher cost of requesting a quote**: A 1% increase in the cost of search \( c \) results in a 0.3% increase in the equilibrium coinsurance rate.

As \( c \) increases, the second quote request becomes less attractive to households; if \( \gamma \) were unchanged, a smaller fraction would request two quotes. Yet the positive externality of search is still as great as before; so \( \gamma^* \) must increase to give added incentive for search. Even after increased coinsurance, the number of people requesting two quotes still falls (\( q^* \) rises by 0.9%).
• **Higher probability of loss**: A 1% increase in event probability $\rho$ results in a 0.2% increase in the equilibrium coinsurance rate.

The probability of loss $\rho$ has very little impact on an individual’s incentive to search. In Equation 4, note that it does not appear except for its effect on insurance premiums. However, because the event is more likely, more people will need repair service, increasing the positive externality. Thus, increasing $\gamma^*$ encourages more search ($q^*$ falls by 0.2%) and lowers prices for all households.

• **Higher risk aversion**: A 1% increase in risk aversion $\sigma$ results in a 0.3% decrease in the equilibrium coinsurance rate.

As $\sigma$ increases, it becomes more important to smooth risk for households. Thus, a lower $\gamma^*$ is better for households, even though it results in fewer people searching twice ($q^*$ falls by 0.4%) and higher prices.

• **Higher marginal cost of service**: For this comparative static, we shift both $r$ and $M$ by the same dollar amount, thus keeping the potential markup the same and only increasing the marginal cost of service. A 1% increase in $r$ results in a 0.6% decrease in the equilibrium coinsurance rate.

Although prices are higher as $r$ increases, the expected benefit of search (the price reduction) is unchanged. On the other hand, the higher expected cost of the event is equivalent to a reduction in expected wealth. Thus, absolute risk aversion increases and it is better to forego some price competition in order to insure households more fully. Thus, $\gamma^*$ lowers and fewer people search twice ($q^*$ rises by 0.8%).

• **Higher potential markup**: A 1% increase in the maximum allowed price $M$ results in a 0.15% decrease in the equilibrium coinsurance rate.

As $M$ increases, households naturally have greater incentive to search because of the wider price distribution they face. Thus, $\gamma^*$ can be lowered and still have a net result of more people requesting two quotes ($q^*$ falls by 1.3%). Indeed, the surprising result is that expected utility under the equilibrium contract *rises*, in spite of the higher $M$! In our model, $M$ is exogenous, but this suggests that if the insurer could choose this price cap, competitive markets would encourage them to loosen it (since it benefits the consumers).
The remaining parameter, \( w \), is less interesting. A decrease in \( w \) looks very similar to an increase in \( r \); its only real effect is in increasing absolute risk aversion.

We repeated these computations for a variety of parameter values, and in all cases these comparative statics maintain the same sign. As \( \gamma^* \) becomes small, generally the magnitude of the comparative static diminishes; as \( \gamma^* \) becomes large, it eventually hits a corner solution at 1.

It is also possible that a competitively-insured market will offer the full insurance contract. For instance, full insurance dominates all partial insurance contracts if \( r \geq \$3,015 \) (a nearly 5-fold increase), leaving all other parameters unchanged. Alternatively, if \( M \leq \$773 \) (a 76% decrease), no partial insurance contract can produce a dispersed equilibrium, so again, a competitive market would offer full insurance. The same occurs after large increases in \( c \) or \( \sigma \). Changes in \( \rho \) have negligible effect. Note that the changes in \( r \), \( M \), and \( c \) all reduce the potential gains from search, while greater risk aversion increase the value of full insurance.

In summary, we can see that a competitively-insured search equilibrium generates higher coinsurance rates when search costs or the probability of loss are high, or when risk aversion, cost of provision, or the maximum allowable price are low. Most of these confirm what one would expect, such as insuring consumers more fully when they are risk averse or having consumer pay for a larger fraction of routine care (high \( \rho \)) or low-cost prescriptions (low \( r \)).

Two results are somewhat surprising: First, higher coinsurance is needed precisely when it is more costly to obtain price quotes. This continues to be true up until dispersed equilibria cease to exist for all \( \gamma \). Second, a higher maximum allowable price is actually better for consumers (after equilibrium adjustment of contracts). This effect diminishes as \( M \) increases, but is still positive when \( M = w \).

5 Measuring Moral Hazard

We quantify the effect of moral hazard in search using the ex-ante expected total cost of repair, which includes all expenditures, whether paid for by insurance or out-of-pocket. Here, as in other forms of moral hazard, the presence of insurance will cause the expected cost to be higher than it would be without.

In Sections 3.1 and 3.2, we derived expressions for expected out-of-pocket expenses and competitive premiums, respectively. Their sum, the *ex-ante total cost*, is \( \rho(r + ... \)
\[(M - r)q^*\) in equilibrium (\$72.7 in our calibration). Note that this is not directly affected by \(\gamma\) or \(\theta\); \(q^*\) is the only endogenous variable that directly enters. Of course, any change in \(\gamma\) or \(\theta\) that induces a higher fraction of people to request two quotes will drive down total cost.

The policy observed in the data has a much lower coinsurance rate and consequently a higher fraction of people requesting a single quote. We now consider the implications of moving from the observed policy to the utility-maximizing policy. As a benchmark, suppose we naively believed that increasing the coinsurance rate from 5.9% to 53.4% would have no effect on consumer search behavior or service firm pricing. This is to say, if there were no moral hazard in search, the fraction requesting one quote would be constant at \(\bar{q} = 0.22\) (the insured search equilibrium value for \(\gamma = 5.9\%\)) regardless of the coinsurance rate. As a consequence, total expected cost would be \(\rho(r + (M - r)\bar{q})\) (\$135.2 in our calibration) for any insurance policy; an increase in \(\gamma\) would reduce the insurance premium, but that would be exactly offset by increases in expected out-of-pocket costs.

We measure moral hazard, then, as the difference between expected cost in an environment without moral hazard (i.e. search is fixed at \(\bar{q}\)) and expected cost in an insured search equilibrium (i.e. at the equilibrium \(q^*\)), which is: \(\rho(M - r)|\bar{q} - q^*|\) or \$62.5 per household in our calibration.

In our model, two effects contribute to the moral hazard problem. The direct effect is that, by requesting more quotes, the household has more draws from the distribution, giving additional chances to obtain a lower quote. This effect was the sole focus of Dionne (1981), for instance. There is also an indirect (or general equilibrium) effect: as more households request a second quote, they encourage greater price competition among the firms, actually lowering the distribution of prices. Our model is the first to incorporate both effects — and the latter effect is much larger than the former.

We would like to decompose the two effects. To isolate the direct effect on total cost, we consider what would happen to total cost (off the equilibrium path) if the service firm price distribution were fixed, but the fraction of households requesting one quote can vary. In particular, firms set prices as if fraction \(\bar{q}\) of the population searches once, even though \(q^*\) actually do. The ex-ante total cost \(EC(q^*, \bar{q})\) in this
The two large parenthetical terms are the expected price after one or two quote requests, respectively; note that these only depend on $\bar{q}$. The direct effect of moral hazard is then measured as the difference between this cost and the cost when there is no moral hazard: $|\rho(r + (M - r)\bar{q}) - EC(q^*,\bar{q})|$. Indeed, this equation simplifies to:

$$H \equiv \frac{\bar{q} \ln \left( \frac{2 - \bar{q}}{\bar{q}} \right) - 2(1 - \bar{q})\bar{q}}{2(1 - \bar{q})^2}.$$

For the calibration, this amounts to $5.6$ of the $62.5$ change in cost; in other words, $8.9\%$ of the change in total cost is due to the direct effect of additional search.

Indeed, we can analytically determine what fraction of the total moral hazard effect is due to the direct effect: $\frac{|\rho(r + (M - r)\bar{q}) - EC(q^*,\bar{q})|}{\rho(M - r)|q - q^*|}$. This simplifies to:

$$H \equiv \frac{\bar{q} \ln \left( \frac{2 - \bar{q}}{\bar{q}} \right) - 2(1 - \bar{q})\bar{q}}{2(1 - \bar{q})^2}.$$  

Surprisingly, $q^*$ and other parameters are cancelled out; the fraction $H$ only depends on the fixed reference point $\bar{q}$. $H$ is concave in $\bar{q}$, approaches $0$ as $\bar{q}$ approaches either $0$ or $1$, and reaches a maximum of $H \approx 0.104$ when $\bar{q} \approx 0.365$. Thus, the direct effect cannot account for more than $10.4\%$ of the change in total cost; the remaining $89.6\%$ must be due to the indirect effect. Put another way, the indirect effect is at least $\frac{0.896}{0.104} = 8.6$ times as big as the direct effect, and (if other $\bar{q}$ are used) potentially more. Note that this bound is independent of our calibrated parameters, applying to any dispersed price search equilibrium.

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\[i.e.\] the solution to $H'(\bar{q}) = 0$, which is $2(3 - \bar{q})(1 - \bar{q}) = (2 - \bar{q})(1 + \bar{q}) \ln \left( \frac{2 - \bar{q}}{\bar{q}} \right)$. This is approximately the same value of $q$ at which dispersed price equilibria first emerge.
6 Broader Contract Spaces

In our model, insurance firms are restricted to a particular class of contracts (i.e. those which reimburse a constant percentage of realized expenses). A natural extension of the model would be to allow a broader class of contracts, including: copays or deductibles (where the household pays for the first $x$ dollars of a claim), policy limitations (where the household is responsible for 100% of expenses above some amount), fixed payments (where the insurer pays a fixed amount on any claim, as well as coinsurance on actual expenses), or maximum out-of-pocket clauses (where coinsurance drops to 0% on any expenses beyond some threshold). In numerical computations, we have incorporated each of these, but found that none had a significant effect on search behavior beyond what coinsurance already provides.

Because of the prevalence of copays in prescription drug insurance, it is worth noting that copays (in the absence of coinsurance) can also induce a dispersed price search equilibrium as long as the copay is sufficiently high (e.g. roughly the average of $r$ and $M$). Households have some incentive to request two quotes whenever there is a reasonable probability of finding a price below the copay, in which case they face an effective coinsurance rate of 100%. For instance, Walmart and other grocery-store-based pharmacies have recently offered many generic drugs at a price of $\$4$, well below most insurance plan copays. When we examined a model with only copays using our calibration parameters, the utility-maximizing contract was dominated by the equilibrium outcome of the coinsurance-only model. This occurs because the copay (and thus, household exposure to risk) must be large to generate significant price competition.

Another policy tool used by insurance firms is negotiating a maximum allowable service price, $M$, which is exogenous in our model. To endogenize $M$, one should incorporate a bargaining process between the insurer and service firms. In the case of a perfectly competitive market, the insurer would maximize household utility while earning zero profits, so they are effectively bargaining on behalf of the households. Thus, the bargaining process divides the surplus between households and service firms, with relative bargaining power determining the split. If the insurer (i.e. the households) has all of the bargaining power, the clear outcome would be to set $M = r$, leaving no surplus to service firms. This would have the added benefit of creating a degenerate equilibrium, so no extra searches are needed.
However, if service firms have any bargaining power, this outcome will not be attainable. In fact, if a dispersed price equilibrium occurs, it is no longer clear that the insurer should strive for a lower $M$ — our comparative statics revealed that a lower $M$ does not always help consumers. Indeed, our numerical example showed that a higher maximum price induced greater search, allowed for lower coinsurance rates, and increased expected utility. This result is sensitive to parameter values, but even so, demonstrates that a broader understanding of moral hazard in search can turn conventional wisdom on its head.

If the insurance industry is monopolized, the negotiation of $M$ will be further complicated. Here, the insurer profits are identical to the households’ risk premium. By allowing higher prices, the insurer exposes households to greater variance in wealth and makes them willing to pay a larger risk premium. Under the conditions for Proposition 3, the insurer and service firms would both benefit from an increase in $M$, at the households’ expense. For $M$ sufficiently high, those conditions would be violated; at that point, insurer and service firm interests diverge and the real negotiation starts.

A final means of reducing moral hazard in search would be to require multiple price quotes from households before any reimbursement can be made. Auto insurers sometimes require multiple repair quotes, but this practice is completely absent in medical or prescription drug insurance. Perhaps insurers do not contract on the number of quotes because of the uncertainties in the search process, such as the availability and comparability of alternative service firms.

In our search framework, having all household request two or more quotes would force a degenerate price distribution in which all firms charge $r$. However, an alternative search framework would have households choose search intensity, which in turn determines the probability of obtaining a given number of quotes. Search intensity would not be contractible; and in this environment, one could investigate the desirability of insurance reimbursement based on the realized number of quotes received. We leave these interesting topics for future research.

7 Conclusion

Our model of moral hazard in search has allowed us to study optimal insurance contracts when service prices are endogenously determined. Accounting for the firms’
response to consumer search behavior significantly worsens the moral hazard problem. In our model, insurance companies realize that they can influence the search behavior with the terms of the contract. In particular, a higher coinsurance rate motivates more consumers to request a second price quote, which in turn spurs greater competition among service firms. We find that the indirect effect of search (i.e., greater price competition among firms) is at least 8.6 times as large as the direct effect (i.e., more quotes evaluated by households).

The theory also allows us to comment on the industrial organization of the insurance market and its impact on the equilibrium contract. When the insurance firm is a monopolist, the equilibrium contract results in full insurance and no price dispersion among service firms. However, when the insurance market is perfectly competitive, the utility maximizing contract typically offers partial insurance coverage and creates price dispersion.

Our model could easily be reinterpreted to consider programs for the reimbursement of employee expenses. Company policies range from full reimbursement, which is equivalent to having no coinsurance, to providing an expense stipend with the employee claiming any unused residual, similar to 100% coinsurance. Particularly for business travel, one might reasonably conclude that airline and hotel prices have been affected by the moral hazard problem of employees making travel arrangements.

From a policy point of view, our work has particular relevance to the debate regarding health savings accounts (HSAs). HSAs have high deductibles (essentially a 100% coinsurance rate) coupled with full coverage for catastrophic events. Advocates have cited increased price competition among health providers as one of the benefits of HSAs, since households covered by such plans will have incentive to shop around (at least for services that aren’t urgent or likely to exceed the full-coverage threshold). This paper offers some theoretical foundation for the optimality of that insurance arrangement. For instance, it is typically utility maximizing to have a 100% coinsurance rate on routine (i.e., highly likely) and minor (i.e., low marginal cost) health expenses. When search costs are extremely high (such as when medical attention is urgently needed) or when the marginal cost of providing the service is quite large (such as heart surgery), it is often utility maximizing to have a 0% coinsurance rate.

Several extensions to this work would make the model applicable to a broader range of situations. First and most important is to allow heterogeneity in insurance coverage, capturing the great variety of private and public insurance plans found co-
existing in the United States. Similarly, we could allow for heterogeneous households, differing in wealth, cost of search, or probability of loss. This would also enable investigation into adverse selection issues. The challenge associated with heterogeneity is that it significantly complicates the procedure of solving for the equilibrium price distribution, and may render the problem intractable even for numerical solutions.

We would also like to add a quality or product differentiation dimension to the service firms, since this is the aspect on which most people currently choose their medical care. Finally, we should note that extension of the present model to a multi-period environment is crucial to better quantify the magnitude of moral hazard. This would allow future premiums or coinsurance rates to be conditioned on claims paid in the past, as is the case with most auto insurance. Incorporating this dynamic framework would probably encourage additional search and hence reduce our estimates of the moral hazard problem.
A  Data Appendix

The Medical Expenditure Panel Survey (MEPS) is a survey of families and individuals in the U.S., providing a complete source of data on the cost and use of health care and health insurance coverage. In this paper, we use the 2005 Prescription Medicine Event File data that belongs to the Household Component of MEPS. It provides data from individual households on all their drug purchases, supplemented with data from their medical providers. An observation is registered each time a prescription is filled, indicating the prescribed medication (identified with the national drug code (NDC), which distinguishes among brand names), the date on which the person first used the medicine, and the amount paid from each potential source of drug coverage (private insurance, Medicare, out of pocket, etc.).

We focus on prescription drugs because of the homogeneity of the good (within a given NDC), yet the total price paid for a particular number of pills shows remarkable dispersion. For instance, a 30 day supply of 10 mg Lipitor pills was sold at anywhere from $52.60 to $236.69, and as our theory would predict, the distribution is highly skewed towards lower prices. Figure 6 depicts the observed distribution of prices, as well as the theoretical distribution found after calibrating $q$, $r$, and $M$. Moreover, prices are not significantly correlated with the source of payment. Moral hazard in search is a good candidate for explaining price dispersion in this market.

We performed the following calibration on an annual supply of 11 different drugs, listed in Table 2. Each of these had at least 800 observations in the sample. To maintain homogeneity within a market, we separate drugs by brand name, dosage, and number of pills filled in a particular prescription. After calibrating for these, we also calibrate the model for an aggregation of the drugs (whose values are reported at the bottom of the table), which are the parameters used in Section 4. The aggregate can be thought of as insuring against the event that any of these drugs are needed. The calibration approach is quite similar for an individual drug or for the aggregate.

A.1  Parameters held constant for all drugs

We use the following procedure to set parameter values:

\footnote{It is important to note that if some fraction of the population requested more than two quotes, the equilibrium price distribution would be bimodal, with a second spike near $M$. The observed data is fully consistent with all households requesting either one or two quotes.}
Wealth \((w)\): We chose \(w\) to match the average annual personal income in the data. We would prefer matching \(w\) to wealth, but this data is not available. However, in the U.S., average wealth and average income are fairly close to each other.

The coinsurance rate \((\gamma)\): Although the data does report the dollar amount paid directly by the household rather than by various forms of insurance, it does not indicate whether the person must contribute a fixed amount for the prescription (a copay) or a fixed percentage (a coinsurance).\(^{13}\) This is important for our model, since the former would give no marginal incentive to search if the drug cost is greater than the copay.

To obtain a reasonable estimate for the average coinsurance rate among households, we turn to the Kaiser Foundation’s annual study of employer-provided insurance plans (Kaiser Family Foundation, 2006). From their report, one can compute that across all types of prescription drug policies, 14.9% of employees have a plan with some form of coinsurance, and among these plans, the average coinsurance rate

\(^{13}\)Indeed, even confidential data linking households to their insurance plan lacks details on the copay or coinsurance associated with prescription drugs.
is 26.2% on preferred drugs (which are approved brand-name drugs with no generic substitute). Another 2% have no coverage (and hence a 100% coinsurance rate). The remaining 83% have some form of copay, but essentially 0% coinsurance. Thus, we compute an average coinsurance rate for the population of 5.9%.

Admittedly, this is still not a perfect match to our model, which assumes all households face the same rate of coinsurance. However, addressing heterogeneity in the insurance coverage of households would add significant complexity to both the setup and solution of the model; we thus postpone this for future work. This rough aggregation is sufficient for our purposes of illustrating the equilibrium behavior.

A.2 Parameters set for each drug

The following parameters were calibrated specifically for each drug. The resulting values are reported in Table 2.

Percentage of population searching once (q), the marginal cost of production (r), and the maximum allowable price (M): The values of these three parameters are calculated from a Maximum Likelihood Estimation that best matches the theoretical distribution of prices to the observed distribution in the data.

The prices we observe in the data are accepted prices rather than offered prices, but it is a simple exercise to derive the cumulative distribution of the former using the cumulative distribution of the latter (expressed in Equation 3 as $F(p)$). In the model, $q$ of the population request only one quote and thus accept whatever they draw; so $F(p)$ of their accepted prices will be at or below price $p$. The remaining fraction of the population, $1 - q$, accepts the lowest of two quotes; thus, if either one or both of the quotes is below $p$, we observe an accepted price below $p$. This happens $1 - (1 - F(p))^2$ of the time. Hence, the theoretical cumulative distribution function of accepted prices is

$$G(p) = qF(p) + (1 - q)(1 - (1 - F(p))^2) = \left(1 + \frac{(M - p)q}{2(p - r)}\right) \left(1 - \frac{(M - p)q}{2(1 - q)(p - r)}\right).$$

(8)

This results in a probability density function of

$$G'(p) = \frac{q^2(M - r)^2}{2(1 - q)(p - r)^3}.$$  

(9)
Hence, the Likelihood Function is

\[ L = \prod_{i=1}^{n} \frac{q^2(M - r)^2}{2(1 - q)(p_i - r)^3}. \]  

(10)

Note that the solution to this problem must satisfy two constraints: first, the theoretical highest price has to be at least as big as the maximum observed price in the data: \( p_{\text{max}} \leq M \). Second, the theoretical lowest price cannot be larger than the minimum observed price: \( p = r + \frac{(M - r)q}{2 - q} \leq p_{\text{min}} \). Therefore, we solve a constrained optimization problem; typically, both constraints will bind. The results are presented in Table 2. In the aggregate case, we take the weighted average of these parameters across all drugs. Note that these parameters are estimated independently of the others; that is, \( w, \rho, \gamma \) and \( c \) are not used in fitting the price data to \( M, r, \) and \( q \).

The probability of event occurring (\( \rho \)): For each medicine, we used the sample weights and population estimates provided by MEPS to extrapolate the percentage of the whole population who purchased the drug, using this as \( \rho \). For the aggregate case, we set \( \rho \) to the fraction who used any of the listed drugs.

Search cost (\( c \)): This last remaining parameter is calibrated using Equation 4; that is, households are indifferent between requesting one or two quotes. This must be solved numerically, but typically has a unique solution for \( c \). The same procedure is used for the aggregate data, using the average \( q, r, \) and \( M \).

Note that we do not try to calibrate for \( \sigma \). One might consider adjusting this parameter until the observed coinsurance rate is in fact utility maximizing. Higher risk aversion will typically lower the coinsurance rate in the utility-maximizing contract, but not nearly enough. Even with extreme risk aversion as high as \( \sigma = 50 \), the equilibrium coinsurance rate is typically above 20%, far from the observed 5.9% average coinsurance rate.
Table 2: Estimated parameter values and expected cost, by drug

<table>
<thead>
<tr>
<th># of Obs</th>
<th>Prescription drug</th>
<th>ρ (%)</th>
<th>q (%)</th>
<th>r ($)</th>
<th>M ($)</th>
<th>c ($)</th>
<th>TC ($)</th>
<th>TC ($)</th>
<th>γ* (%)</th>
<th>TC ($)</th>
<th>Risk Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048</td>
<td>Lipitor – 10 mg</td>
<td>1.4</td>
<td>15.0</td>
<td>631.2</td>
<td>2840.4</td>
<td>11.2</td>
<td>41.1</td>
<td>13.9</td>
<td>47</td>
<td>9.4</td>
<td>0.3</td>
</tr>
<tr>
<td>1930</td>
<td>Lipitor – 20 mg</td>
<td>1.3</td>
<td>18.8</td>
<td>807.6</td>
<td>4008.0</td>
<td>17.6</td>
<td>52.6</td>
<td>18.5</td>
<td>47</td>
<td>10.8</td>
<td>0.6</td>
</tr>
<tr>
<td>1546</td>
<td>Norvasc – 10 mg</td>
<td>0.8</td>
<td>19.9</td>
<td>496.8</td>
<td>2234.4</td>
<td>9.7</td>
<td>18.9</td>
<td>7.1</td>
<td>52</td>
<td>4.3</td>
<td>0.2</td>
</tr>
<tr>
<td>1364</td>
<td>Prevacid – 30 mg</td>
<td>1.0</td>
<td>22.5</td>
<td>967.2</td>
<td>4737.6</td>
<td>22.0</td>
<td>45.2</td>
<td>17.3</td>
<td>45</td>
<td>9.4</td>
<td>0.6</td>
</tr>
<tr>
<td>1328</td>
<td>Albuterol – 90 mg</td>
<td>1.2</td>
<td>5.4</td>
<td>94.8</td>
<td>4135.2</td>
<td>12.3</td>
<td>50.8</td>
<td>3.8</td>
<td>76</td>
<td>1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>1197</td>
<td>Protonix – 40 mg</td>
<td>0.9</td>
<td>19.1</td>
<td>866.4</td>
<td>3883.2</td>
<td>16.7</td>
<td>36.4</td>
<td>13.5</td>
<td>44</td>
<td>8.3</td>
<td>0.4</td>
</tr>
<tr>
<td>1191</td>
<td>Flonase – 0.05 mg</td>
<td>1.6</td>
<td>67.8</td>
<td>313.2</td>
<td>1189.2</td>
<td>4.1</td>
<td>18.6</td>
<td>14.2</td>
<td>91</td>
<td>5.0</td>
<td>0.1</td>
</tr>
<tr>
<td>1133</td>
<td>Norvasc – 5 mg</td>
<td>0.6</td>
<td>24.9</td>
<td>315.6</td>
<td>1616.4</td>
<td>7.7</td>
<td>10.0</td>
<td>4.0</td>
<td>65</td>
<td>2.0</td>
<td>0.1</td>
</tr>
<tr>
<td>966</td>
<td>Lipitor – 40 mg</td>
<td>0.6</td>
<td>12.1</td>
<td>886.8</td>
<td>4974.0</td>
<td>19.0</td>
<td>31.4</td>
<td>8.7</td>
<td>44</td>
<td>5.7</td>
<td>0.3</td>
</tr>
<tr>
<td>941</td>
<td>Lexapro – 10 mg</td>
<td>0.8</td>
<td>22.9</td>
<td>536.4</td>
<td>2178.0</td>
<td>9.5</td>
<td>18.4</td>
<td>7.7</td>
<td>50</td>
<td>4.7</td>
<td>0.2</td>
</tr>
<tr>
<td>890</td>
<td>Advair Diskus – 250/50</td>
<td>0.7</td>
<td>26.6</td>
<td>1269.6</td>
<td>4135.2</td>
<td>17.4</td>
<td>28.0</td>
<td>13.7</td>
<td>36</td>
<td>8.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Aggregate</td>
<td></td>
<td>11.1</td>
<td>22.0</td>
<td>640.8</td>
<td>3260.4</td>
<td>15.4</td>
<td>361.9</td>
<td>135.2</td>
<td>53</td>
<td>72.7</td>
<td>1.2</td>
</tr>
</tbody>
</table>

- \( TC \) denotes the household’s expected total cost of the prescription. This is the sum of the insurance premium and the expected coinsurance payments out-of-pocket, totaling \( \rho(r + q(M - r)) \) in the model.

- \( Risk Cost \) measures the reduction in household welfare from being only partially insured (though at the utility maximizing \( \gamma^* \)). It is computed as \( w - CE - TC \), where \( CE \) is the household’s certainty-equivalent wealth at equilibrium.
B Proofs

B.1 Lemma 1

Proof. First, ex-interim utility can be transformed via integration by parts to become:

\[ u(w - \theta - \gamma p) - \gamma \int_p^M u'(w - \theta - \gamma p)(1 - F(p))^n dp - cn. \]

The second derivative (w.r.t. \( n \)) of ex-interim utility is:

\[ -\gamma \int_p^M u'(w - \theta - \gamma p)(\ln(1 - F(p)))^2(1 - F(p))^n dp. \]

Note that our assumption of positive marginal utility ensures that this will always be strictly negative. \( \square \)

B.2 Proposition 1

Proof. We are concerned with the zeros of \( \Delta(\theta, \gamma, q) \) for \( q \in (0, 1) \). We begin by noting two useful facts that relate a continuous function’s derivative to its number of zeros. Both are applications of Rolle’s Theorem: if \( g \) is a continuous, differentiable function on \([a, b]\) and \( g(a) = g(b) \), there exists a point \( c \in (a, b) \) such that \( g'(c) = 0 \). Thus:

- If a function \( g(q) \) on \([0, 1]\) has a unique \( q^* \) such that \( g'(q^*) = 0 \), there can be no more than two points, \( \hat{q} \) and \( \tilde{q} \) in \([0, 1]\), such that \( g(\hat{q}) = g(\tilde{q}) = 0 \).

- If a function \( g(q) \) on \([0, 1]\) has exactly two \( q^* \) such that \( g'(q^*) = 0 \) and both \( g(0) \) and \( g(1) \) share the same sign, there can be no more than two points, \( \hat{q} \) and \( \tilde{q} \) in \((0, 1)\), such that \( g(\hat{q}) = g(\tilde{q}) = 0 \).

We apply these two facts to derivatives of Equation 4 to prove the claim. In particular, we must look at the 4th derivative.

Note that \( \Delta(\theta, \gamma, q) = -c < 0 \) for \( q \) at 0 or 1 (i.e. one bid request is strictly preferred to two bid requests when there is a degenerate price distribution). This is because both \( \int_p^M \frac{g(M-r)u(w-\theta-\gamma p)}{2(1-q)(p-r)^2} dp \) and \( \int_p^M \frac{g^2(M-r)(M-r)u(w-\theta-\gamma p)}{2(1-q)^2(p-r)^3} dp \) approach \( u(w - \theta - \gamma M) \) as \( q \to 1 \), and both approach \( u(w - \theta - \gamma r) \) as \( q \to 0 \). Thus, the extra quote request incurs a cost of \( c \) but does not improve the expected price.
Define \( \beta_0(q) \equiv \frac{(1-q)^2}{q} \Delta(\theta, \gamma, q) \). Note that \( \beta_0(q) = 0 \) if and only if \( \Delta(\theta, \gamma, q) = 0 \), and share the same sign for all \( q \). The first derivative of \( \beta_0(q) \) w.r.t \( q \) is:

\[
\beta'_0(q) \equiv \frac{1-q}{q^2} \left( \int_0^M \frac{q^2(M-r)^2u(w-\theta-\gamma p)}{2(1-q)(p-r)^3} \, dp + (1+q)c - u(w-\theta-\gamma p) \right).
\]

As \( q \to 0 \), this derivative approaches \( \infty \) because the first term in parenthesis approaches the third, leaving \( c \) inside; meanwhile, the term outside the parenthesis grows without bound. For the same reason, as \( q \to 1 \), the derivative approaches 0 from above; that is, there exists an \( \epsilon > 0 \) such that \( \beta'_0(q) > 0 \) for all \( q \in [1-\epsilon, 1) \).

The second derivative of \( \beta_0(q) \) is:

\[
\beta''_0(q) \equiv \frac{2((1-q)q(M-r))\gamma u'(w-\theta-\gamma p) - (2-q)^2c}{(2-q)^2q^3}
\]

At both \( q = 0 \) and 1, this derivative is strictly negative. Let \( \beta_2(q) \equiv \frac{q^2}{2} \beta''_0(q) \), which shares the same zeros and the sign for each \( q \) as \( \beta''_0(q) \). Its derivative is:

\[
\beta'_2(q) = \frac{(M-r)\gamma}{(2-q)^4} \left( (2-q)(2-3q)u'(w-\theta-\gamma p) - 2(1-q)q(M-r)\gamma u''(w-\theta-\gamma p) \right).
\]

Note that \( \beta'_2(0) = (M-r)\gamma u'(w-\theta-\gamma r) > 0 \) and \( \beta'_2(1) = -(M-r)\gamma u'(w-\theta-\gamma M) < 0 \). Indeed, since \( u'' < 0 \), \( \beta'_2(q) > 0 \) for all \( q < \frac{2}{3} \).

Let \( \beta_3(q) \equiv \frac{(2-q)^4}{2(1-q)q(M-r)\gamma u'(w-\theta-\gamma p)} \beta'_2(q) = \frac{(2-q)(2-3q)}{(1-q)q} - (M-r)\gamma a(w-\theta-\gamma p) \), which shares the same zeros and the sign for each \( q \) as \( \beta'_2(q) \). Its derivative is:

\[
\beta'_3(q) = -\frac{1}{(1-q)^2} - \frac{4}{q^2} = \frac{2(M-r)^2\gamma^2}{(2-q)^2} a'(w-\theta-\gamma p).
\]

Note that \( -(2-q)^2 \left( \frac{1}{(1-q)^2} + \frac{4}{q^2} \right) \) has its maximum value of \( -32 \) occurring at \( q = \frac{2}{3} \). Thus, our assumption ensures that \( (2-q)^2 \beta'_3(q) < 0 \) (and hence \( \beta'_3(q) < 0 \)) for all \( q \).

Thus, \( \beta_3(q) \) is strictly decreasing, is negative at \( q = 1 \), and positive for \( q < \frac{2}{3} \), so there is a unique \( \hat{q} \in \left( \frac{2}{3}, 1 \right] \) such that \( \beta_3(\hat{q}) = 0 \). Moreover, \( \hat{q} \) is the unique solution in \( [0, 1] \) for \( \beta'_2(q) = 0 \). Recalling that \( \beta_2(q) < 0 \) for both \( q = 0 \) and 1, then are no more than two solutions to \( \beta_2(q) = 0 \). Since \( \beta_2(q) \) has the same zeros as the \( \beta'_0(q) \), the latter also has at most two zeros.
\( \beta'_0(q) \) is positive near \( q = 0 \) and 1, and \( \beta''_0(q) \) has no more than two zeros. Hence \( \beta'_0(q) \) has at most two zeros. By the same token, \( \beta_0(q) \) is negative at \( q = 0 \) and 1, so it has no more than two zeros. But \( \beta_0 \) and \( \Delta \) share the same zeros, establishing our result.

### B.3 Lemma 3

**Proof.** First, we establish that \( \frac{\partial \Delta}{\partial \gamma} > 0 \) (people are more willing to request two quotes as their coinsurance rises). The derivative of \( \Delta \) with respect to \( \gamma \) is:

\[
\frac{\partial \Delta}{\partial \gamma} = \int_p^M \frac{pq(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} u'(w - \gamma p - \theta) dp
\]

\[
= \int_p^{(M-r)q+r} \frac{pq(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} u'(w - \gamma p - \theta) dp
\]

\[
+ \int_{(M-r)q+r}^M \frac{pq(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} u'(w - \gamma p - \theta) dp
\]

The first integrand is negative throughout its range, while the second integrand is positive. Thus, we can establish a lower bound by substituting for \( u' \) at its largest value in the interval for the first term, and its smallest value for the second term. Since \( u'' < 0 \), this occurs at \( (M - r)q + r \) in both cases.

\[
\frac{\partial \Delta}{\partial \gamma} > u'(w - \gamma((M - r)q + r) - \theta) \int_p^{(M-r)q+r} \frac{pq(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} dp
\]

\[
+ u'(w - \gamma((M - r)q + r) - \theta) \int_{(M-r)q+r}^M \frac{pq(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} dp
\]

\[
= \frac{q(M - r)(-2(1 - q) + \ln(\frac{2-\theta}{q}))}{2(1 - q)^2} u'(w - \gamma((M - r)q + r) - \theta)
\]

For all \( q \in [0, 1] \), \( \frac{q(M - r)(-2(1 - q) + \ln(\frac{2-\theta}{q}))}{2(1 - q)^2} \geq 0 \); thus, \( \frac{\partial \Delta}{\partial \gamma} > 0 \).

Similarly, \( \frac{\partial \Delta}{\partial \theta} < 0 \) (people become less willing to request two quotes as their
premium rises):

\[
\frac{\partial \Delta}{\partial \theta} = \int_p^M \frac{q(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} u'(w - \gamma p - \theta) dp
\]

\[
< u'\left(w - ((M - r)q + r)\gamma - \theta\right) \int_p^{(M-r)q+r} \frac{q(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} dp
\]

\[
+ u'\left(w - ((M - r)q + r)\gamma - \theta\right) \int_{(M-r)q+r}^M \frac{q(M - r)(p - (M - r)q - r)}{2(1 - q)^2(p - r)^3} dp
\]

\[= 0.\]

The last equality holds because the two integrals evaluate to \(\frac{1}{4}\) and \(-\frac{1}{4}\), respectively.

**Claim 1:** Note that \(\Delta\) is a continuously differentiable function with respect to \(\theta\), \(\gamma\), and \(q\). By the Implicit Correspondence Theorem (Mas-Colell, 1990, p. 49), \(Q(\theta, \gamma)\) is a closed, upper hemi-continuous correspondence.

**Claim 2(a):** Recall from the proof of Proposition 1 that \(\Delta(\theta, \gamma, q) < 0\) at \(q = 0\) and 1. If there are exactly two dispersed price equilibria, \(\hat{q} < \tilde{q}\) for \((\theta, \gamma)\), \(\frac{\partial \Delta}{\partial q}\) will be strictly positive for \(\hat{q}\) and strictly negative for the \(\tilde{q}\). The derivatives \(\frac{\partial \Delta}{\partial q}\), \(\frac{\partial \Delta}{\partial \gamma}\), and \(\frac{\partial \Delta}{\partial \theta}\) are all continuous, so small changes in \((\theta, \gamma)\) will still result in two dispersed price equilibria with small changes in \(q\).

**Claim 2(b):** If there is a unique dispersed price equilibria at \((\theta, \gamma)\), \(\Delta(\theta, \gamma, q) < 0\) for everywhere except where it touches (tangentially) the horizontal axis.

Since \(\frac{\partial \Delta}{\partial \gamma} > 0\) and \(\frac{\partial \Delta}{\partial \theta} < 0\), a small increase in \(\gamma\) or a small decrease in \(\theta\) will increase \(\Delta\) for all \(q\), so that two dispersed price equilibria emerge near the original unique equilibrium \(q\). A decrease in \(\gamma\) or increase in \(\theta\), however, will decrease \(\Delta\) and ensure that no \(q \in (0, 1)\) can satisfy \(\Delta(\theta, \gamma, q) = 0\). Thus \(Q(\cdot)\) is only lower hemi-continuous on the restricted domain \([0, \theta] \times [\gamma, 1]\).

### B.4 Proposition 2

**Proof.** In the proof of Proposition 1, we establish that \(\frac{\partial \Delta}{\partial \gamma} > 0\) near \(q = 0\) and 1, with no more than two zeros. As a consequence, if \(\hat{q} < \tilde{q}\) and \(\Delta(\theta, \gamma, \hat{q}) = \Delta(\theta, \gamma, \tilde{q}) = 0\), then \(\frac{\partial \Delta(\theta, \gamma, \hat{q})}{\partial \gamma} < 0\) and \(\frac{\partial \Delta(\theta, \gamma, \tilde{q})}{\partial \gamma} > 0\).

In the proof of Lemma 3, we establish that \(\frac{\partial \Delta}{\partial \gamma} > 0\). Hence, by the implicit function theorem applied to \(\Delta(\theta, \gamma, q) = 0\), \(\frac{\partial \hat{q}}{\partial \gamma} = -\frac{\partial \Delta(\theta, \gamma, \hat{q})}{\partial \Delta(\theta, \gamma, \hat{q})} < 0\) in equilibrium, while \(\frac{\partial \tilde{q}}{\partial \gamma} > 0\). 

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B.5 Lemma 4

Proof. The derivative $\frac{\partial EU}{\partial \theta} < 0$ is obvious, since $\theta$ unambiguously reduces wealth. Regarding $\gamma$, this derivative is:

$$\frac{\partial EU}{\partial \gamma} = -\rho \int_p^M \frac{pq^2(M-r)^2u'(w-\theta-\gamma p)}{2(1-q)(p-r)^3}dp < 0$$

in a dispersed price equilibrium and $\frac{\partial EU}{\partial \gamma} = -\rho Mu'(w-\theta-\gamma M)$ in a degenerate equilibrium.

The derivative w.r.t. $q$ is only relevant in a dispersed price equilibrium (since it is 0 otherwise). The derivative is:

$$\frac{\partial EU}{\partial q} = \rho \left( c - \frac{2 - q}{(1-q)q}u(w-\theta-\gamma p) + \int_p^M \frac{(2 - q)q(M-r)^2u(w-\theta-\gamma p)}{2(1-q)^2(p-r)^3}dp \right)$$

We then use the equilibrium condition (Eq. 4) to substitute for $c$, obtaining:

$$\frac{\partial EU}{\partial q} = \frac{(2 - q)\rho}{(1-q)q} \left( \int_p^M \frac{q^2(M-r)(2M-r-p)u(w-\theta-\gamma p)}{2(1-q)^2(p-r)^3}dp - u(w-\theta-\gamma p) \right)$$

The integrand is always positive, and hence we can place an upper bound by replacing $u(w-\theta-\gamma p)$ with its maximal value on the interval when $p = \bar{p}$. But then the integral evaluates to $u(w-\theta-\gamma \bar{p})$, so $\frac{\partial EU}{\partial q} < 0$.

\[\square\]

B.6 Proposition 3

Proof. We proceed by examining profits for any $(\gamma,q)$ pair (whether it constitutes an insured search equilibrium or not). We find that $q = 1$ and $\gamma = 0$ provides the globally maximal profit. Note that $\tilde{Q}(\theta,0) = 1$, since there is never incentive to request multiple quotes under full insurance. For partial insurance contracts, the following applies regardless of which $q$ is selected by $\tilde{Q}(\theta,\gamma)$.

Let $\theta(\gamma,\Pi_f, q) = \rho(1-\gamma)(r + q(M-r)) + \Pi_f$, and define the consumer surplus
from being insured as:

\[
S(\gamma, \Pi_I, q) \equiv (1 - \rho) (u(w - \theta) - u(w)) + \rho \int_p^M \frac{q(M - r)}{2(1 - q)(p - r)^2} (u(w - \theta - \gamma p) - u(w - p)) \, dp,
\]

where the arguments of \( \theta \) are omitted for notational simplicity.

Note that this takes the difference between the expected utility of requesting one quote when insured versus uninsured. Of course in equilibrium, an insured household obtains the same utility from requesting one or two quotes. An uninsured agent, on the other hand, would typically request more and receive higher utility; thus the \( \Pi_I \) which solves \( S(\gamma, \Pi_I, q) = 0 \) is an upper bound on what the monopolist may charge (though it is the exact monopolist profit when \( q = 0 \) or 1).

First, consider how \( \Pi_I \) responds to a change in \( \gamma \) (while holding \( q \) fixed), which we examine through implicit differentiation.

\[
\frac{\partial S}{\partial \Pi_I} = - \left( (1 - \rho) u'(w - \theta) + \rho \int_p^M \frac{q(M - r)}{2(1 - q)(p - r)^2} u'(w - \theta - \gamma p) \, dp \right) < 0
\]

\[
\frac{\partial S}{\partial \gamma} = \rho(1 - \rho)((M - r)q + r)u'(w - \theta) + \rho \int_p^M \frac{q(M - r)(\rho((M - r)q + r) - p)}{2(1 - q)(p - r)^2} u'(w - \theta - \gamma p) \, dp
\]

By the assumption that \( \rho \leq \frac{1}{2} \), \( \rho((M - r)q + r) < r + \frac{(M - r)q}{2 - q} = p \) for all \( q \). Thus, the last integrand is always negative. Since \( u'(w - \gamma p) > u'(w - \theta) \) for all \( p \), we may substitute as follows:

\[
\frac{\partial S}{\partial \gamma} < \rho(1 - \rho)((M - r)q + r)u'(w - \theta) + \rho \int_p^M \frac{q(M - r)(\rho((M - r)q + r) - p)}{2(1 - q)(p - r)^2} u'(w - \theta) \, dp
\]

\[
= \frac{q(M - r)\rho \left( 1 - q - \ln \left( \frac{2 - q}{q} \right) \right)}{1 - q} u'(w - \theta)
\]

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Since $1 - q \leq \ln \left( \frac{2 - q}{q} \right)$ for all $q \in [0, 1]$, $\frac{\partial S}{\partial \gamma} < 0$.

Thus, implicit differentiation gives us that $\frac{\partial \Pi_I}{\partial \gamma} = -\frac{\partial S}{\partial \Pi_I} < 0$. In other words, for any $q$, profits are maximized by setting $\gamma = 0$.

Next, let $\gamma = 0$ and examine how $\Pi_I$ responds to changes in $q$. $S$ simplifies to:

$$S(0, \Pi_I, q) \equiv u(w - \theta) - (1 - \rho)u(w) - \rho \int_p^M \frac{q(M - r)}{2(1 - q)(p - r)^2} u(w - p) dp.$$

As before, $\frac{\partial S}{\partial \Pi_I} < 0$. The derivative with respect to $q$ is:

$$\frac{\partial S}{\partial q} = \rho \left( \frac{u(w - p) - \int_p^M \frac{q(M - r)}{2(1 - q)(p - r)^2} u(w - p) dp}{(1 - q)q} - (M - r)u'(w - \theta) \right).$$

Since the monopolist insurer extracts all household surplus, $\Pi_I$ is such that $S(0, \Pi_I, q) = 0$. We use this to substitute for the integral in $\frac{\partial S}{\partial q}$:

$$\frac{\partial S}{\partial q} = \frac{\rho u(w - p) - u(w - \theta) + (1 - \rho)u(w)}{(1 - q)q} - \rho(M - r)u'(w - \theta).$$

Since $u'' < 0$, $u(w) - u(w - \theta) > \theta u'(w)$. By the same token, $\rho \left( u(w - p) - u(w) \right) > -\rho p u'(w - p)$. Also, with $X \equiv \max\{\theta, p\}$, $-u'(w - X)$ is weakly less than both $-u'(w - p)$ and $-u'(w - \theta)$. Thus:

$$\frac{\partial S}{\partial q} > \frac{\theta u'(w) - \rho p u'(w - p)}{(1 - q)q} - \rho(M - r)u'(w - \theta)$$

$$> \frac{\theta u'(w) - \rho(p + (M - r)(1 - q)q) u'(w - X)}{(1 - q)q}.$$

By assumption, $\frac{u'(w - X)}{u'(w)} < \frac{\theta}{\rho(p + (M - r)(1 - q)q)}$. Hence, $\frac{\partial S}{\partial q} > 0$.

Thus, implicit differentiation yields $\frac{\partial \Pi_I}{\partial q} > 0$; the monopolist can charge a higher risk premium $\Pi_I$ when $q$ is higher. Thus, $(\gamma, q) = (0, 1)$ produces the globally maximal profit — strictly more than any other $(\gamma, q)$ pair (including all insured search equilibrium pairs).

In the computations above, we neglected the fact that an uninsured agent would potentially request more quotes relative to when he is insured. Incorporating additional search only strengthens the result, though. Suppose $\Pi_I(\gamma, q)$ denotes the
solution to $S(\gamma, \Pi_I, q)$. In an insured search equilibrium, whenever $q < 1$, allowing additional search would raise the utility of the uninsured, $EU(0, 1, q)$, but not affect the utility of the insured, $EU(\theta, \gamma, q)$, who are already searching optimally. Thus the true surplus would be lower than $S(\cdot)$, and the true profit would be less than $\Pi_I(\cdot)$. However, when $q = 1$, all households request a single quote regardless of being insured or not, so $S(\cdot)$, and $\Pi_I(\cdot)$ depict the true surplus and profit.

Thus, if $\Pi^*_I(\gamma, q)$ were the true insurer profit when additional search is allowed, then $\Pi^*_I(\gamma, q) \leq \Pi_I(\gamma, q)$ for all $q$, and $\Pi^*_I(0, 1) = \Pi_I(0, 1)$. Thus full insurance is still the profit maximizing policy.

\section*{B.7 Lemma 5}

\textit{Proof.} For a given $q$, the expected price from a single quote request is:

$$\int_p^M \frac{q(M - r)p}{2(1 - q)(p - r)^2} dp = r + \frac{q(M - r) \ln \left(\frac{2-q}{q}\right)}{2(1 - q)}.$$ 

Similarly, the expected price after two quote requests is:

$$\int_p^M \frac{q^2(M - r)(M - p)p}{2(1 - q)^2(p - r)^3} dp = \frac{2(1 - q)(Mq + r - 2qr) - q^2(M - r) \ln \left(\frac{2-q}{q}\right)}{2(1 - q)^2}.$$ 

Fraction $\rho$ of the population incurs the loss. Of those, fraction $q$ search once, while $1 - q$ search twice. The insurance company pays $1 - \gamma$ of the price they are quoted. Thus, the expected profit is:

$$\Pi_I(\theta, \gamma) = \theta - (1 - \gamma)\rho \left[ q \left( r + \frac{q(M - r) \ln \left(\frac{2-q}{q}\right)}{2(1 - q)} \right) + (1 - q) \left( \frac{2(1 - q)(Mq + r - 2qr) - q^2(M - r) \ln \left(\frac{2-q}{q}\right)}{2(1 - q)^2} \right) \right]$$

$$= \theta - \rho(1 - \gamma)(r + q(M - r)).$$ 

\hfill \Box
B.8 Proposition 4

Proof. First, we establish that the partial derivative of $\Omega(\gamma, q)$ with respect to $\gamma$ is always negative:

$$\frac{\partial \Omega}{\partial \gamma} = \rho(1-\rho)((M-r)q+r)u'(w-\theta+\Pi_S)$$

$$+ \rho \int_p^M \frac{q(M-r)(\rho((M-r)q+r) - p)}{2(1-q)(p-r)^2} u'(w-\theta + \Pi_S - \gamma p) dp.$$

Note that this is nearly identical to $\frac{\partial S}{\partial \gamma}$ used in the proof of Proposition 3, differing only in the inclusion of $\Pi_S$ inside $u'(\cdot)$. Employing the same substitutions, we find:

$$\frac{\partial \Omega}{\partial \gamma} < \frac{q(M-r)\rho \left(1 - q - \ln \left(\frac{2-q}{q}\right)\right)}{1-q} u'(w-\theta + \Pi_S).$$

Since $1-q \leq \ln \left(\frac{2-q}{q}\right)$ for all $q \in [0,1]$, $\frac{\partial \Omega}{\partial \gamma} < 0$.

As a consequence, for any $q$, $\Omega(\gamma, q)$ is maximized at $\gamma = 0$. Note also that when $\gamma = 0$,

$$\Omega(0,q) = (1-\rho)u(w - \rho((M-r)q+r) + \rho(M-r)q)$$

$$+ \rho (u(w - \rho((M-r)q+r) + \rho(M-r)q) - (2-q)c)$$

$$= u(w - \rho r) - \rho(2-q)c.$$

Thus, $\Omega$ is globally maximized at $\gamma = 0$ and $q = 1$. Note that this is an insured search equilibrium, and is thus the welfare maximizing insured search equilibrium.

\[\square\]
References


