McDonald's or the Michelin Guide? Revealing Quality Through Private-sector Certi…cation

Erik Durbin¤

November 1999

Abstract

In markets where buyers cannot observe the quality of sellers' goods, there may be a role for intermediation. A certi…cation intermediary is an agent that gathers information about seller quality and reports it to buyers. This paper examines the choice of such an intermediary between selling guidebooks to buyers, privately informing them about seller quality, and selling certi…cates to the sellers, publicly certifying the quality of their goods.

I …nd that the intermediary will choose to sell guidebooks when the di¤erence between high and low quality is large and when high quality is relatively rare (or di¢cult to provide). Furthermore, I show that there is a complementarity between certi…cation and the production of quality. Markets may fail to form as the result of a coordination failure, in which high-quality sellers do not enter the market because there is no one to certify their quality, and certi…ers are not credible as a result of the lack of high-quality sellers.

¤Olin School of Business, Washington University. Email: durbin@olin.wustl.edu. I thank Kyle Bagwell, Prajit Dutta, Eiichi Miyagawa, and Andrew Newman for helpful comments and suggestions. All remaining errors are my own.

1. Introduction

Why do markets function e¢ciently in some economies, and not at all in others? One answer has to do with how buyers and sellers deal with asymmetric information. Agents will not enter a market if they cannot trust potential trading partners. Participants in well-functioning markets thus rely on a range of institutions, from formal legal rules to social norms, to protect them from opportunistic behavior. In the absence of these institutions, individuals may be forced to rely on non-market forms of exchange, such as reciprocal trade, that are less e¢cient but leave them less vulnerable to being cheated.

In this paper I look at a speci…c type of institutional response to asymmetric information: a private, pro…t-maximizing intermediary that provides quality information to buyers. When buyers are unable to observe the characteristics of sellers' products, both buyers and (high-quality) sellers have an interest in communicating information about product quality. The premise of my paper is that this creates incentives for an independent third party to provide reports about the seller's quality. A "certi…cation intermediary" (CI) is an agent that is able to inspect the seller's good and credibly report its quality to the buyer.

Intermediaries of this type play a prominent role in developed economies. Industrial labs such as Underwriters Laboratories test and certify the quality of consumer and industrial products; credit rating agencies such as Moody's and Standard & Poor's report on the credit quality of borrowers; accountants certify the accuracy of a …rm's …nancial statements; publications such as Consumer Reports rate the quality of retail products and services. There are also institutions that play a less obvious role as certi…ers. Franchise chains such as McDonald's and Holiday Inn certify the quality of their franchise holders, and in a similar way retailers often certify the quality of products they carry.[1] Temporary employment agencies certify the capabilities of the workers that they refer to employers. Banks and other …nancial intermediaries inspect the quality of investment products on

[1] This is clearly not the only role played by franchises or middlemen, but it is often an important one. For models of middlemen as certi…ers see Biglaiser (1993) and Li (1998).

the behalf of investors.[2]

As the above examples illustrate, certi…cation intermediaries can take many forms. This paper focuses on one aspect of the CI's institutional form, namely which side of the market pays the intermediary. One possibility is the guidebook: the intermediary sells information to buyers about seller quality. Another possibility is the certi…cate: the intermediary charges a fee to the seller in exchange for public certi…cation of the good's quality. Most certi…ers fall into one of these two categories. Apart from actual guidebooks, examples where buyers pay for information include publications such as Consumer Reports and credit bureaus like TRW or Equifax. Examples of sellers paying for certi…cation include credit rating agencies like Moody's or Standard & Poor's, as well as middlemen and franchises such as McDonald's or Holiday Inn.

I explain how the certi…er's choice between certi…cates and guidebooks depends on two parameters, which are the distribution of quality and the importance of quality. I …nd that the CI chooses to sell guidebooks when the di¤erence between high and low quality is large, and when high quality is relatively rare. The certi…er's choice is driven by the way that prices reveal information. When the CI sells guidebooks to buyers, he will not fully reveal the information that he collects. This is because, once some buyers are informed, prices act as a signal of quality to uninformed buyers. When the CI sells more guidebooks, producing more informed consumers, prices become a more informative signal and therefore lower the value of the guidebooks. This e¤ect is strongest when the di¤erence between high and low quality is small, since in this case it is more tempting for low-quality sellers to choose a fully revealing price.

The pro…tability of guidebooks also depends on how uncertain buyers are about quality. For example, if almost all sellers have high quality, the amount a buyer would pay for a guidebook is relatively low, since it is unlikely to make a di¤erence in his decision. With certi…cates, however, this e¤ect is not present: the amount sellers will pay to be

[2] Megginson & Weiss (1991) consider the role of venture capitalists in certifying the quality of projects to the IPO market; Gande et al (1997) consider the certifying role played by banks underwriting public debt o¤erings.

certi…ed depends on the importance buyers attach to quality, not on the frequency of high-quality goods. If the cost of certi…cation is high enough, the CI will in fact play a parasitic role, in which both high- and low-quality sellers are worse o¤ than they would be in the intermediary's absence.

Since I am concerned with a market in which buyers are unable to trust the seller, it is important to ask why they are better able to trust the CI. Though I assume away the possibility of a moral hazard problem in inspecting the good, there is the possibility that the CI will collude with the seller to misrepresent the product's quality. This problem can be solved if, when falsely certifying a product, the CI loses credibility with buyers and thus loses future income. If the CI is "larger" than sellers, this type of reputation mechanism will be more e¤ective for him than for individual sellers. This largeness can come either from interacting with more buyers, or from interacting with them more often. For example, a roadside motel may see very little repeat business, since its customers are generally just passing through the area. A chain of motels, on the other hand, would receive much more "repeat business:" even though customers seldom return to the same motel, they are likely to encounter other hotels in the same chain. Likewise, companies "go public" only once, and would therefore have an incentive to misrepresent the quality of their project in making a public o¤ering. Investment banks, however, underwrite securities frequently, and therefore have reason to cultivate a reputation for honestly appraising the value of new issues.

The implication of the credibility constraint is di¤erent for sellers of guidebooks and sellers of certi…cates. With certi…cates, credibility depends principally on the frequency of high-quality sellers. When high quality is rare, it is more tempting to cheat by certifying low-quality sellers. For guidebooks, credibility depends mainly on the importance of quality.

An important reason to look at certi…cation intermediaries is to understand their role in how markets develop. In developing and transition economies, information problems play a substantial role. Sheppard (1995) emphasizes that the lack of reliable information

about potential business partners is a serious difficulty for private enterprise in Russia. For example, suppliers are unwilling to extend short-term credit to potential customers. One reason is that there are no credit rating agencies and no source of reliable information on other firms' histories. Inspection agencies such as SGS also play a vital role in international trade. Fafchamps (1996) reports that the lack of such an inspection service in Ghana leaves exporters vulnerable to claims of low quality on the part of their customers, which will discourage firms from entering the export sector.

Understanding how these institutions develop can also help us to understand how new markets are established in developed economies. For example, internet commerce is widely seen to have great potential as a retail marketplace. However, the potential for fraud in anonymous electronic transactions is substantial. It seems likely that internet commerce will not succeed in the absence of some mechanism that allows individual customers to trust the merchant that is selling on-line.[3]

The need to maintain incentives for honest reporting means that we will not see the first-best outcome even when intermediaries can freely compete. This is because, in order to deter collusion, the CI must attach positive value to buyers' trust. Maintaining a reputation is only worthwhile if the reputation can be translated into future profits. If he were both trusted and making zero profits when honest, there would be nothing to prevent him from accepting bribes in exchange for certification.

This effect will mean that there is a complementarity between seller investment in quality and certification of quality. When high-quality sellers are frequent, it is relatively easy for certifiers to maintain credibility. This means either that certificates will be inexpensive or that guidebooks will be more informative. In either case the value of being certified is higher, which in turn means that sellers are more likely to find it worth investing in quality. This emphasizes the potential for multiple equilibria: inefficient certification means that few sellers invest, meaning that efficient certification is not

[3] For a discussion of the role of third-party intermediaries in internet commerce (from the perspective of optimal regulation), see Froomkin (1996).

pro…table. When high quality is rare, the CI can only be credible if he charges a high price for certi…cation, which in turn means that there are low incentives for the seller to invest.

There is a growing literature that has addressed some other aspects of certi…cation intermediaries. Lizzeri (1999) and Albano & Lizzeri (1998) focus on the disclosure policy of the CI. In these papers there is a large number of possible seller types, and the central question is how much information the CI will choose to reveal. The CI will generally not …nd it optimal to reveal all information to buyers, and in some cases can make the most pro…t by providing a completely uninformative signal. In contrast, my paper considers a model with only two seller types, which makes the disclosure problem simple and allows us to focus on the certi…er's choice of institutional form.

Biglaiser (1993) and Biglaiser & Friedman (1994) consider how "middlemen" play the role of certifying the unknown quality of sellers. In Biglaiser (1993), middlemen invest in developing expertise that enables them to screen out low-quality products, and in Biglaiser & Friedman (1994), the fact that middlemen sell several di¤erent products enables them to credibly commit to carrying only high-quality goods, thus mitigating the moral hazard problem faced by individual sellers. My paper will follow these in using reputation to explain the certi…er's credibility: the middleman is willing to screen out low-quality goods because otherwise buyers will not trust them in the future. Li (1998) also considers the role of middlemen in assuring quality, in a model of search where agents sometimes postpone trade because they cannot assess the quality of their trading partner's good. These papers start with the question of why middlemen exist, and demonstrate that quality certi…cation can be an answer. My paper begins with intermediation, and asks what form it will take.

The problem addressed in my paper is also closely related to the literature on auditing, which considers a principal-agent framework where the principal has the opportunity to hire an auditor to report on the e¤ort choice of the agent.[4] My problem is similar; the

[4] The problem of "heirarchical agency" is introduced in Tirole (1986). For a recent example see Khalil

CI plays a role similar to that of an auditor reporting on the choice of the seller. The difference is that the auditing problem is one of mechanism design: the principal attempts to design a contract based on the auditor's report (and other observable variables) that creates the correct incentives for the agent. In my model, players cannot write contracts based on the report of the CI; rather, the information revealed by the CI becomes part of the equilibrium prices and demand in the market.

The remainder of the paper is organized as follows. Section 2 outlines the basic model. Section 3 describes the equilibrium prices charged by sellers, taking as given the seller's investment policy and the certification policy of the CI. Section 4 describes the optimal policy of a monopolist certifier and what this means for the seller's surplus. Section 5 considers the case of competition in the certification market. Section 6 considers the case where sellers invest in quality and demonstrates the complementarity between certification and investment in quality, and Section 7 concludes.

2. Model

2.1. Buyers and sellers

There is a single seller and a continuum of buyers of measure one. The good produced by the seller has an associated quality level, $Q \in \{L, H\}$, which is unknown to the buyers. For now I will assume that quality is decided by nature; the seller's quality is H with probability μ and L with probability $(1 - \mu)$; I later endogenize the distribution of quality by considering the case where the seller makes an unobservable investment in the quality of her good. The seller can produce an unlimited amount of the good at zero marginal cost. Buyers cannot observe the seller's quality, but μ is common knowledge.

Each buyer demands at most a single unit of the good. Buyers value goods of quality Q at v_Q, with $v_H > v_L > 0$. For simplicity, I will set $v_L = 1$.

& Lawarée (1998)

Buyers and sellers are risk-neutral. The payo¤ for buyers is

$$u^B = [v_Q - p]d_i;$$

where d_i is the probability that buyer i purchases the good and p is the price charged by the seller. The payo¤ for the seller is

$$u^S = pD;$$

where $D = \int_0^1 d_i$ is expected demand for the good. Note that if the seller has no way to signal that she has high quality, then price must be the same for high- and low-quality goods.

The assumption of a single seller and many buyers implies that there is no competition among sellers. An alternative assumption that would not change the outcome is that there are several sellers, but that products are highly di¤erentiated, so that sellers do not compete for customers. The assumption that sellers do not compete means that buyers have no bargaining power, and makes the problem much more tractable.

It is important to the model that sellers do not face much repeat business, which seems most reasonable for services that are performed rarely, or mostly for tourists. Examples would include management consulting, or hotels or restaurants in a resort area. Another example is an investment problem, where potential investors cannot observe the quality of an entrepreneur's project.

2.2. Certi…cation intermediaries

We now introduce a "certi…cation intermediary" (or CI). This is an agent or …rm that is able to observe the quality of the seller and make reports to the buyers. I will assume that observation of the product's quality is costless to the CI. In Sections 3 and 4 I assume that the intermediary is a monopolist, and in Section 5 I consider the case of competition among intermediaries.

I assume that the intermediary is the only way for the seller to communicate the quality of her good; that is, there is no signalling mechanism apart from the intermediary.

Part of this is the assumption that the cost of producing high- and low-quality goods is the same, so that payo¤s for both types of sellers are the same. We could alternatively suppose that the intermediary o¤ers the least costly form of signaling. Even when some signalling mechanism is present, it is generally wasteful. The CI, then, may be able to o¤er a more e¢cient mechanism than that which is otherwise available. In other words, we could describe the model as one in which the signalling mechanism is not provided by an exogenously given technology, but by an endogenously arising institution.

A central assumption of my model is that the CI earns money by following one of two fee strategies: either charging a fee to buyers for access to the information (sell guidebooks), or to the seller for reporting the information (sell certi…cates). Relaxing this assumption does not change the main results: in cases where the CI chooses guidebooks, the more general model predicts that the CI will make a larger portion of his revenues from buyers. We do not in fact see this "mixed" form of CI much in the world; sellers of guidebooks often make a point of not accepting any payments from those that they inspect. One possible explanation involves issues of credibility that lie outside my current model: from the buyer's perspective, it may be impossible to distinguish bribes from legitimate fees. In this case, refusing any payment from sellers may be the best way for the CI to convince buyers that his interests are independent of the seller's interests.

I assume the intermediary can freely observe the seller's quality; this means that I ignore any possible moral hazard problem on the part of the intermediary. In some cases, the ability to identify quality is not much of an issue; for example, a movie critic need only view a …lm once. In other cases, such as determining the failure rate of a …re alarm or the authenticity of a gem, a considerable investment in testing equipment or expertise may be necessary.[5] If gathering information is costly and observable, then the results

[5] Another possibility is that the CI does not generate information, but acts as a conduit for information generated by many buyers who do not communicate with one another. Biglaiser & Friedman (1994) discuss the possibility that a middleman who sells to many customers has the chance to receive reports from them on the quality of the products that he sold. Klein (1997) considers a credit agency that receives reports from retailers about the repayment history of the customers to whom they extend

of the model will not be affected, but if this cost is unobservable then we need to be concerned with the possibility of the CI shirking.

It is important to emphasize the importance of the assumption that sellers have only two possible quality levels. Because there are only two possible types, I assume that the CI report, r, will take on only one of two values: $r \in \{h, l\}$. This makes the model much more tractable: with a large number of quality levels, as in Lizzeri (1999), the CI's choice of a map from types to reports is a much more difficult problem. Simplifying the "disclosure problem" by restricting the number of types allows us to focus on other aspects of how the market for certification is organized.

A strategy for the CI, P, is given by $\{t; m; r(Q)\}$ where

- $t \in \{C, G\}$ is a decision of whether to sell guidebooks to buyers ($t = G$) or sell certificates to sellers ($t = C$),
- $m \in [0, 1]$ is the proportion of buyers who observe the report, and
- $r(Q)$ is the CI's report as a function of the seller's quality.

"Honest" certification would consist of $r(H) = h$ and $r(L) = l$. I will not allow for a mixed strategy on the part of the certifier. It turns out that pure strategies are played in equilibrium even if we allow for mixed strategies, and so I will stick to pure strategies to simplify the notation.

2.3. Timing

The timing of the problem is as follows:

Stage 1. Nature chooses seller quality and CI chooses (and announces) a strategy P.

Stage 2. Seller decides whether to apply for certification and buyers decide whether to purchase signals from CI.

---

credit.

Stage 3. CI makes announcement, and based on the announcement, market price & demand are determined.

Notice that the CI chooses a strategy before learning the type of the seller; once P is chosen, reports and fees cannot be changed. In other words, I assume that the CI's announced policy is credible. Later I introduce the possibility of renegotiating payments and reports between stage 2 and 3, so that buyers need to worry about the credibility of the CI.

To solve the model, I will …rst …nd the equilibrium of the …nal stage, where the seller chooses a price and buyers form beliefs given the report of the CI. I will then …nd the equilibrium choices of certi…cation policy with a monopoly CI (Section 4) and with competition (Section 5).

3. Pricing Game

This section considers a smaller game in which there is no CI, but there some fraction of the buyers who are "informed," meaning that they know the quality of the seller's product. The reason for considering this game is that it will describe how equilibrium prices and payo¤s are determined in the larger game once the CI has revealed quality information to the buyers. The presence of informed buyers means that prices may in themselves act as a signal, as in models by Chan and Leland (1982) or Wolinsky (1983). The di¤erence (as we will see in later sections) is that with the CI as the only source of information, the number of informed buyers is endogenously determined. It is important to examine how information is revealed through prices in order to be able to describe the CI's decision about how much information to reveal directly.

It is important to note that in my model prices signal quality only due to the presence of informed buyers, and not due to di¤erences in the cost functions of the two types of seller, as in models such as that of Bagwell and Riordan (1991). This means that in the absence of any informed consumers, price could not in any way signal quality. In reality, producers of di¤erent quality levels are likely to have di¤erent marginal costs,

so that we would expect cost-based signalling to be possible. Here, the fact that high- and low-quality sellers have the same costs allows us to isolate the CI's role in revealing information.

Suppose that a fraction m of the buyers know the quality of the good. De…ne the beliefs of uninformed buyers about the value of the seller's good as $b(p) \in [1; v_H]$. Assuming that buyers buy when indi¤erent, demand for the seller's good will be given by

$$D(p; b(p)) = mI[p \cdot v_Q] + (1 - m)I[p \cdot b(p)];$$

where $I[:]$ represents the indicator function. The …rst term in the expression is the demand of informed buyers, who will buy as long as the price is less than or equal to the actual value of the good. The second term is the expected demand of the uninformed, who buy as long as long as the price of the good is less than or equal to the expected value of the good given its price. A sequential equilibrium of the pricing game is described by buyer beliefs $b(p)$ and a pricing strategy for the seller $p^*(Q)$ such that

$$p^*(Q) \in \arg\max_p pD(p; b(p)) \tag{3.1}$$

$$b(p^*) = E[v_Q | p = p^*(Q)] \tag{3.2}$$

(3.1) says that the seller is maximizing her utility given her certi…cation status and the demand function, which depends in turn on the number of uninformed buyers and their beliefs. (3.2) says that uninformed buyer beliefs are rational at equilibrium prices.

The presence of informed buyers means that the price charged by the seller may reveal her type. As usual, I de…ne an separating equilibrium as one in which $p(H) \neq p(L)$ with probability one, and a pooling equilibrium as one in which $p(H) = p(L)$ with probability one. I also allow partial pooling, in which the probability that $p(H) = p(L)$ is strictly between zero and one (that is, at least on type of seller plays a mix between separating and revealing prices). The following proposition shows that when the number of informed buyers is large enough, we must have a separating equilibrium, in which high- and low-quality sellers choose di¤erent prices. This is important because in order for guidebooks to

be profitable, there must be at least partial pooling. A separating equilibrium means that prices reveal quality entirely, so that there is no reason for buyers to pay for information. The fact that separation occurs when many buyers are informed means that a guidebook seller will optimally limit the number of guidebooks that he sells.

Proposition 3.1. Define $m_P = \min\{\frac{\gamma}{v_H}; \frac{\gamma - 1}{\gamma}\}$, and $m_S = \frac{v_H - 1}{v_H}$. An equilibrium with complete pooling exists if and only if $m \leq m_P$, and an equilibrium with partial pooling exists if and only if $m < m_S$.

Proof.

1. Complete pooling. Necessity. Suppose we have complete pooling at a price $\hat{p}$. From (3.2) we must have $b(\hat{p}) = \gamma$. This implies we must have $\hat{p} \leq \gamma$; otherwise the seller would make zero profits, and she could do better by setting $p = 1$ and selling to everyone. If $\hat{p}$ is the optimal choice of a high-quality seller, it must be that she cannot do better by charging v_H and selling only to informed buyers. This implies $\hat{p} \geq mv_H$, or $m \leq \frac{\hat{p}}{v_H} \leq \frac{\gamma}{v_H} \leq m_P$. For $\hat{p}$ to be the optimal choice of low-quality sellers, it must be that they cannot do better by charging 1 and selling to all buyers, that is, $(1 - m)\hat{p} \geq 1$, or $m \leq \frac{\hat{p} - 1}{\hat{p}} \leq \frac{\gamma - 1}{\gamma} \leq m_P$.

   Sufficiency. Consider $p(H) = p(L) = \gamma$. Let $b(p) = 1$ for all $p \neq \gamma$. Demand for a high-quality seller is given by 1 for $p = \gamma$ or $p \leq 1$, and m for $p \in (1; v_H]$ and $p \neq \gamma$. The only relevant prices for the high-quality seller are thus γ and v_H; $p = \gamma$ will offer higher profits if $\gamma \geq mv_H$, or $m \leq \frac{\gamma}{v_H} \leq m_P$.

2. Partial pooling. Necessity. For a low-quality seller to be indifferent between charging 1, and getting profits of 1, or charging $p(H)$, getting profits of $(1 - m)p(H)$, we must have $p(H) = \frac{1}{1-m}$. If $m \geq m_S = \frac{v_H - 1}{v_H}$, we have $p(H) \geq v_H$. But if a low-quality seller is choosing $p(H)$ with positive probability, this means $p(H) > E[v_Q | p = p^{-}(H)]$, so that demand at this price is zero.

   Sufficiency. Consider $p(H) = \frac{1}{1-m}$. At this price, a low-quality seller will be indifferent between charging 1 and selling to everyone, and charging $p(H)$ and

selling to the $(1 - m)$ uninformed buyers. If $\frac{1}{1-m} < v_H$, then there is some ε such that if low-quality sellers choose $p(H)$ with probability less than ε, we will have $E[v_Q | p = p^*(H)] \cdot v_H$.

Proposition 1.1. establishes a key element of the pricing game: when there are more informed buyers, the likelihood of separation will be greater. Intuitively, the seller chooses whether to target the informed or the uninformed side of the market. The larger the informed side of the market, the more tempting it is to choose a price that targets the informed and thus reveals quality. This is true of all sequential equilibria. Before describing the equilibria in more detail, I show that in equilibrium a high-quality seller will play a pure strategy.

Lemma 3.2. Define $\hat{p}$ as follows:

$$\hat{p} = \max\{p | p \cdot b(p)\}$$

In equilibrium, $p(H) = \hat{p}$ with probability one.

Proof. Note first that I need to show or assume that $\hat{p}$ exists.

(1) Suppose $\hat{p} = v_H$. This implies that $D(p', C) = 1 \; 8p' \cdot \hat{p}$. Any price higher than $\hat{p}$ would yield demand of 0. So $\hat{p} = v_H$ is uniquely optimal for the seller.

(2) Suppose $\hat{p} < v_H$. since $D(p', C) = 1 \; 8p' \cdot \hat{p}$, there is no reason for a certified seller to choose a price lower than $\hat{p}$. This means that if a certified seller is not choosing $\hat{p}$ with probability one, she must be choosing some price $\tilde{p} > \hat{p}$ with positive probability. Since $D(p', NC) = 0 \; 8p' \; 2 \; (\hat{p}, v_H]$, there is no reason for an uncertified seller to choose a price higher than $\hat{p}$. Since only certified sellers will choose $\tilde{p}$, we must have $b(\tilde{p}) = v_H$; contradicting the definition of $\hat{p}$. ■

In other words, in equilibrium a certified seller must be charging a price at which all buyers demand the good. If some buyers were to demand the good while others did not, it must be the informed that demand it. But charging a price that only the informed would pay must reveal high quality.

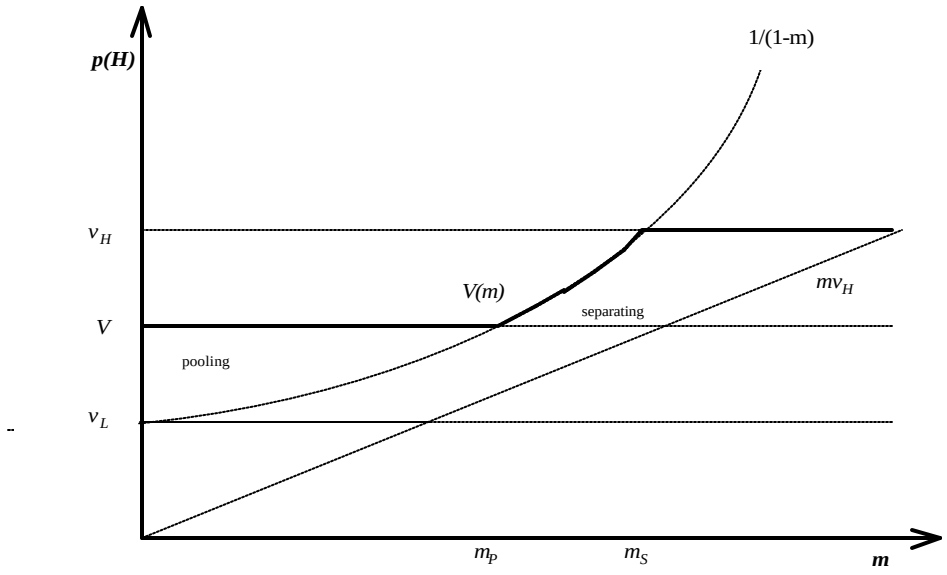

Figure 3.1: Equilibrium prices given the number of informed buyers.

Figure 1 illustrates the potential equilibria in terms of p(H) and m. A pooling equilibrium exists for any p(H) 2 $[\frac{1}{1 i m}; \hat{V}]$. Such an equilibrium could be supported by beliefs of the form b(p(H)) = $\hat{V}$, b(p^0) = 1 for p^0 6= p(H). A separating equilibrium exists for p(H) 2 $[mv_H; \frac{1}{1 i m}]$ (and p(H) 2 (1; vH]). Such an equilibrium is supported by beliefs of the form b(p(H)) = p(H), b(p^0) = 1 for p^0 6= p(H). Finally, a partial pooling equilibrium can exist with p(H) = $\frac{1}{1 i m}$.

To make more speci…c predictions we will need a more precise description of the equilibrium. I will next make assumptions su¢cient to imply a unique equilibrium of the pricing game.

Assumption (A1). $p^¤(Q) = E[v_Q | p = p^¤(Q)]$:

Assumption (A2). v_H · 4:

(A1) says that in equilibrium the price charged by the seller is equal to the expected value of her good. The price that a high-quality seller will charge under this assumption, which I de…ne as $\hat{V}$(m), is denoted by the heavy line in Figure 1.[6] When m is small,

[6] Restricting attention to perfect sequential equilibria, as de…ned by Grossman and Perry (1986), will

(A1) selects the equilibrium with complete pooling at a price equal to $\hat{v}^1$. When m is close to one, (A1) implies that a high-quality seller will choose a price equal to v_H, and a low-quality seller a price of 1. For values of m between m_P and m_S, (A1) implies partial pooling, with a low-quality seller mixing between p = 1 and p = p(H). The probability that a low-quality seller will choose p(H) is just large enough so that the expected value of the good is equal to its price. If we de…ne z as this probability, then z must satisfy

$$p(H) = \frac{\mu v_H + z(1 - \mu)}{\mu + z(1 - \mu)}.$$

(A2) is necessary to guarantee that, for all m, an equilibrium exists with buyers playing a pure strategy. If (A2) is false, there is a value of m such that if there is any pooling, high-quality sellers will want to choose $p = v_H$, and if sellers choose this price, low-quality sellers will want to pool, which cannot be an equilibrium.

In the equilibrium described here, the price charged by high-quality sellers changes continuously in the number of informed buyers. This will mean that the problem faced by a guidebook-seller is "smooth:" a slight increase in the number of informed buyers implies a slight increase in the amount of information revealed by prices. As we will see, this will imply a slight decrease in the amount a buyer would be willing to pay to become informed.

I will next turn to the equilibrium strategies in the larger game, in which the CI determines the number of informed buyers. In Section 4 I describe the equilibrium when the CI is a monopolist, and in Section 5 I consider the case of competing certi…ers.

4. Monopoly intermediary

This section considers the optimal policy of a monopoly intermediary. I begin by assuming that the CI can commit to reporting honestly, and examine the CI's choice between

imply the that a high-quality seller follows the same strategy as that implied by (A1). However it allows a larger set of strategies for a low-quality seller when $m \in (m_P; m_S)$.

guidebooks and certi…cates. I then consider how the possibility of collusion restricts the CI's choice of strategy.

4.1. CI sells guidebooks

When the CI makes money by selling guidebooks, his pro…ts depend on the number of guidebooks sold, m, multiplied by the price each buyer pays for the guidebook. We have seen from the previous section that as m increases, more information is revealed through prices, which will in turn lower the value of guidebooks. This means that the CI faces a trade-o¤ between selling more guidebooks and maintaining a high price per guidebook.

To …nd out how much a buyer would be willing to pay for a guidebook, consider the expected surplus to an uninformed buyer (one without the guidebook) from purchasing the good. De…ne z(m) as the probability that an uncerti…ed seller will charge the same price as a certi…ed seller (so z = 1 implies complete pooling). Before the price has been set, the expected surplus can be expressed as

$$\mu[v_H - V(m)] + z(m)(1-\mu)[1 - V(m)] + (1-\mu)[1 - z(m)][1-1] \qquad (4.1)$$

The …rst term is the expected surplus given that the good is of high quality. The second term is the expected loss from overpaying for the good; that is, the loss incurred when the good is of low quality but that the seller chooses the same price as a high-quality seller. The third term is the expected surplus given that the good is low quality and the seller chooses the low price, in which case the buyer knows the quality exactly. Assumption (A1) from the previous section implies that the …rst two terms cancel out, so that the expected surplus of an uninformed buyer is zero.

An informed buyer will be able to distinguish between high- and low-quality goods. This means that he will not buy the good when the price is high and quality is low. The informed buyer's expected surplus is given by

$$\mu[v_H - \hat{V}(m)] + (1-\mu)[1 - z(m)][1-1] \qquad (4.2)$$

The amount that a buyer would be willing to pay for a guidebook is given by the difference between the expected surplus of informed and uninformed buyers. Define as $x(m)$ the price that the CI charges for the report. x is given by the difference of (4.2) and (4.1) as

$$x(m) = z(m)[1 - \mu][\hat{V}(m) - 1] \tag{4.3}$$

where $\hat{V}(m)$, as defined in Section 3, is given by

$$\hat{V}(m) = \begin{cases} \overline{V} & m \leq m_P \\ \frac{1}{1-m} & \text{if } m \in (m_P; m_S) \\ v_H & m \geq m_S \end{cases};$$

and z is the probability that an uncertified seller will mimic a certified seller.

(4.3) is increasing in z: the more likely is pooling, the more buyers will pay for a guidebook. This makes clear the trade-off between the value of the CI's information and the amount of information that he sells. z is decreasing in m: the more informed buyers there are, the greater will be the incentive for the seller to choose a separating price. So if the CI increases m (sells more guidebooks), this will decrease z and thus decrease x. When enough buyers are informed that we have complete separation ($z = 0$), then information about the quality of an individual seller is freely available (that is, revealed by the price). That means $x = 0$ and the CI will make no money. Thus we must have at least partial pooling when the CI sells guidebooks.

The guidebook-seller's problem is

$$\max_m m\mu[v_H - \frac{1}{1-m}];$$

where we have made use of the implication of Assumption (A1) that $z(m)[1 - \mu][\hat{V}(m) - 1] = \mu[v_H - \hat{V}(m)]$ and that $\hat{V}(m) = \frac{1}{1-m}$.

The following lemma gives the CI's optimal strategy as a function of the parameters v_H and μ.

Lemma 4.1. Assume (A1) and that the CI sells guidebooks. The optimal choice of m will be given by

$$m(v_H; \mu) = \begin{cases} m_P & \text{if } v_H \geq \frac{(1-\mu)^2}{\mu^2} \\ \frac{\sqrt{v_H}-1}{\sqrt{v_H}} & \text{if } v_H < \frac{(1-\mu)^2}{\mu^2} \end{cases}; \tag{4.4}$$

and profits for the CI will be given by

$$\pi(v_H;\mu) = \begin{cases} \frac{\mu^2(1-\mu)(v_H-1)^2}{\mu(v_H-1)+1} & \text{if } v_H > \frac{(1-\mu)^2}{\mu^2} \\ \mu(\sqrt{v_H}-1)^2 & \text{if } v_H < \frac{(1-\mu)^2}{\mu^2} \end{cases}; \tag{4.5}$$

Proof. See appendix.

Lemma 4.1 establishes two important facts about guidebooks. First, CI profits are higher for higher values of v_H and for intermediate values of μ. Higher values of v_H are good for the CI because when there is a greater difference between high- and low-quality goods, information about quality is more valuable to buyers. Intermediate values of μ are best for the CI because they imply the "most uncertainty" about the quality of the good. If high quality is very rare or very common, then there is correspondingly little chance that the guidebook will make a big difference to the buyer.

Second, the CI chooses partial pooling when μ is small. This happens because when high quality is unlikely, the cost of maintaining complete pooling is greatest. When there is complete pooling, an uncertified seller sells only to uninformed buyers, and has the option of lowering her price and selling to all buyers. When μ is small, the pooling price is close to 1, so the cost of lowering her price is small. This means that for the seller to prefer the pooling price, there must be very few informed buyers. In this case it is more profitable for the CI to allow some separation, which lowers the price he can charge for the information, because it allows him to sell more guidebooks.

4.2. CI sells certificates

I assume that when the CI sells certificates, he bargains with the seller over the fee. Denote the bargaining power of the CI by $\bar{\beta} \in [0;1]$. The CI will keep this fraction of the surplus the seller receives from certification. An alternative assumption is that there exists an alternative, costly signalling technology, and that the CI can make a take-it-or-leave-it offer to the seller. In this case, $\bar{\beta}$ reflects the efficiency of the alternative signal; a low $\bar{\beta}$ corresponds to an inexpensive alternative.

The value of certification to the seller is clearly increasing in the number of informed buyers. This means that with certificates the CI chooses $m \geq m^S$. If all buyers learn the results of the report, each seller will be willing to pay $v_H - 1$ to be certified. Thus the expected profits of the CI will be

$$\bar{\mu}[v_H - 1]. \tag{4.6}$$

Notice that, unlike the case where the CI sells guidebooks, when the CI sells certificates profits are increasing in μ. Even when low-quality sellers are very rare, the CI's report determines whether the seller receives a high or low price. This highlights the potential for a "parasitic" role on the part of the intermediary, based on his ability to collect information rents from the seller.

4.3. Optimal CI strategy with commitment

In deciding whether to sell guidebooks or sell certificates, the CI will simply compare the profits earned by following the optimal policy in each case. The following proposition describes the CI's optimal policy in terms of the parameters.

Proposition 4.2. *Suppose (A1) and (A2). Given v_H and μ, the optimal CI policy is given by the following:*

1) If $v_H > (\frac{1-\mu}{\mu})^2$ and $v_H > 1 + \frac{\bar{\mu}}{\mu[(1-\mu)-\bar{\mu}]}$ and $\mu < 1 - \bar{\mu}$, then the CI sells guidebooks and $m = m^P$ (complete pooling).

2) If $v_H < (\frac{1-\mu}{\mu})^2$ and $v_H > (\frac{1+\bar{\mu}}{1-\bar{\mu}})^2$, then the CI sells guidebooks and $m = \frac{\sqrt{v_H}-1}{\sqrt{v_H}}$ (partial pooling).

3) If $\mu \geq 1 - \bar{\mu}$, or $v_H < (\frac{1+\bar{\mu}}{1-\bar{\mu}})^2$; or $v_H > (\frac{1-\mu}{\mu})^2$ and $v_H < 1 + \frac{\bar{\mu}}{\mu[(1-\mu)-\bar{\mu}]}$, then the CI sells certificates and $m \geq m^S$ (separation).

Proof. See Appendix.

Figure 2 illustrates this result. The area marked "F" represents parameter values for which the CI sells certificates, "G_{cp}" represents selling guidebooks with complete pooling,

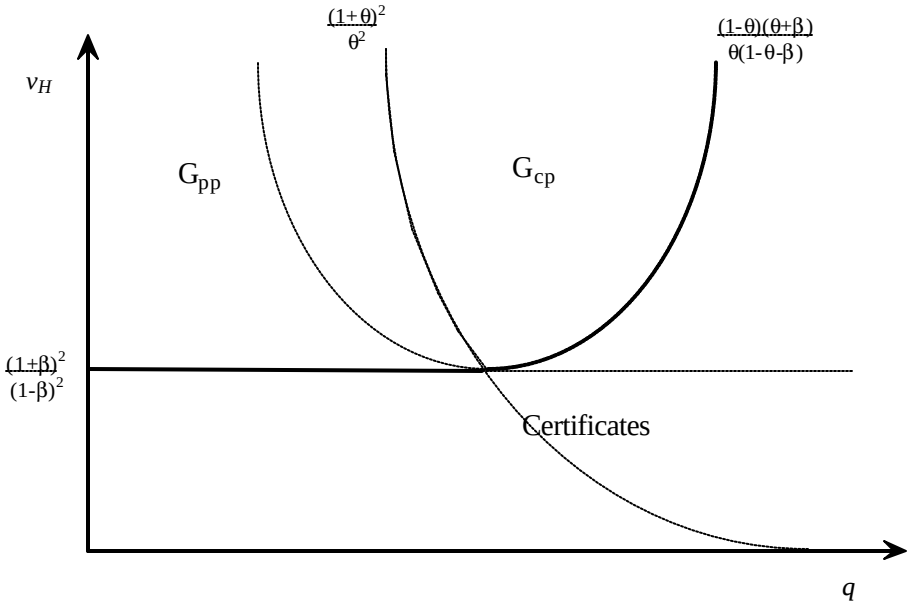

Figure 4.1: Optimal Choice of a Monopoly CI

and "G_{pp}" represents selling guidebooks with partial pooling. We see that the CI chooses to sell franchises when μ is large and when v_H is small.

This means that for guidebooks to be more pro…table, quality must be both important and uncertain. When buyers attach a high importance to quality, the demand for both guidebooks and certi…cates will be high. But the di¤erence between high and low quality is particularly important for guidebooks, since it a¤ects how much information the CI can reveal without causing the seller to choose a separating price. When this di¤erence is small, it is less costly for low-quality sellers to reveal their quality. This means that the CI cannot sell many guidebooks without undermining their value.

Uncertainty drives the demand for guidebooks in a direct way. Buyers will not pay much for guidebooks unless there is a large probability that without consulting a guidebook they will overpay for the good. When high-quality sellers are very common, the chances are low that the guidebook will make a di¤erence for a given buyer, so the CI cannot charge a high price.

These results may help explain the patterns of certi…cation that we see in the restaurant and hotel industries. The di¤erence between high- and low-quality fast food is not as great as the di¤erence between high- and low-quality French cuisine, and the talents necessary for preparing a …ne meal are not as common as those necessary for cooking a hamburger. Thus we would expect fast food restaurants to be certi…ed by franchises (a type of certi…cate), while …ne restaurants are certi…ed by guidebooks.

In contrast to the guidebook case, when the CI sells certi…cates, pro…ts are always increasing in μ. Even when high quality is very common, it is the CI's report that determines whether the seller receives a high or low price. This means that it is quite possible that the CI makes both high- and low-quality sellers worse o¤ than they would be in the absence of the CI. The payo¤s of a high-quality seller, given franchises are given by $(1 - \bar{\ })v_H$. The CI plays this "parasitic" role if $(1 - \bar{\ })v_H < \hat{V}^1$, or $\bar{\ } > (1 - \mu)\frac{v_H - 1}{v_H}$.[7] With guidebooks a high-quality seller will always be weakly better o¤ than with no intermediary; however with complete pooling his payo¤ will be the same. In this case, guidebooks represent a transfer from low-quality sellers to the intermediary.

4.4. Repeated Interaction & Collusion

To now I have assumed that the CI is able to credibly commit to make an honest report; that is, while buyers cannot trust the seller, they completely trust the CI. In this subsection I consider explicitly the possibility that the CI will behave dishonestly. Speci…cally, the CI could collude with a low-quality seller, accepting a bribe in exchange for dishonest certi…cation.

The problem of establishing CI credibility is similar to the problem of collusion in the principal-agent model, as studied, for example, in Tirole (1986) and La¤ont & Martimort (1998). In these models, the principal hires a third party (an auditor) to report on the

[7] It is well known that the availability of a costly signalling mechanism can make all agents worse o¤ in a problem of asymmetric information; Lizzeri (1998) also points out that this extends to the case of a private-sector certi…er.

e¤ort choice of the agent. The principal faces the possibility that the auditor will collude with the agent to misrepresent the agent's true e¤ort choice. To prevent this, the auditor's contract must be designed so that he has no incentive to collude; this imposes an extra constraint on the set of possible solutions to the overall contracting problem.

Our problem is similar: the CI can be thought of as an "auditor" paid by the buyer to monitor the seller's quality claims. However, I do not look at a contractual solution to the problem. Because buyers are a large, dispersed group, they cannot write a contract with the CI that is contingent on his report. Instead, I rely on repeated interaction to give the CI a reason to refuse bribes. I assume that if the CI lies about the seller's quality, buyers will not attach any weight to the certi…er's report in the future. Given these beliefs, the CI will remain honest as long as the one-shot gain from accepting a bribe is outweighed by the loss of future pro…ts that results from losing the trust of buyers.

Repeated interaction could also give sellers the opportunity to maintain a reputation for quality. I assume that the CI is larger than the seller, in the sense that he interacts with the buyer more often. Recall the example of a hotel from the introduction. An individual hotel owner may never deal with a given customer more than once, whereas a hotel certi…er (either a franchise chain or a hotel guidebook) will on average interact with a customer much more often. This means that, for the CI, the ratio of potential future pro…ts from the customer to the value of cheating the customer in the current period is much greater. It is this greater ratio that makes it easier for the CI to commit to an honest policy.

To capture the idea that the CI sees the buyer more often than the seller does, I will assume that the certi…er is in…nitely-lived, while sellers operate for only one period. This is meant to approximate the case where there is a large number of sellers, each of whom interacts with a given buyer only rarely.

I consider an in…nitely repeated game in which there is a new seller every period, and each seller lives for only one period. The CI lives forever and discounts the future at the rate $\pm 2 (0;1)$.

The timing of the stage game is as follows:

1. Nature chooses seller's type (Q_t = H w/ prob. μ), and CI chooses a strategy P_t.
2. Sellers pay for certi…cates or buyers for guidebooks.
3. Report r_t is announced and pricing equilibrium happens.
4. All players (including future sellers) observe good's quality.

The assumption in step 4, that all players observe the quality of the good, is strong. A more reasonable story with similar results would be that all players in period t can observe price and demand in period $t - 1$. As long as some buyers live for more than one period, the price they are willing to pay will re‡ect their beliefs about the CI's policy, revealing what they observed in the past. If not all players can observe past actions, credibility will be more di¢cult for the CI to maintain, so in this sense we are looking at the most optimistic case.

Considering an in…nitely repeated game, of course, opens the door to a very large set of equilibria. I will limit this set by considering a particular speci…cation of beliefs that I think are intuitively plausible. I assume that buyers believe that the CI will make an honest report in the current period provided that 1) the CI has been honest in every period in the past, and 2) the CI strategy, if followed in the current and all future periods, will give the CI greater pro…ts than he could obtain by "cheating" in the current period and losing all future credibility.

This assumption on buyer beliefs amounts essentially to allowing the CI to choose the most pro…table equilibrium of the repeated game. While this is a strong assumption, it has the advantage of being the most favorable to the success of a CI. That is, if a CI cannot credibly operate under these assumptions, then he will not be able to operate under any other set of buyer beliefs.

These assumptions on buyer beliefs mean that the buyer is restricted to strategies that satisfy a "no-collusion constraint," which says that future payo¤s are high enough to outweigh cheating in the current period. De…ne W(r) as expected payo¤s to a seller receiving report r from the CI. This allows us to describe the "value of certi…cation" to a

seller. The difference between the payoffs of a certified and uncertified seller, $W(h) - W(l)$, represents the most that a seller would be willing to pay to become certified. This is the largest bribe that a low-quality seller would pay for a false report, and it therefore defines the highest possible payoff that the CI can receive by cheating. For the CI's policy to be incentive-compatible, it must be that, when his policy calls for not certifying the seller ($r = l$), he prefers the continuation payoffs of staying in business to the largest bribe the seller would offer.

Assumption Suppose that the CI announces strategy P in period s. Buyers believe that the CI's report in period s will be honest only if

$$r_t = Q_t \quad \forall t < s$$

and

$$\sum_{t=1}^{\infty} \delta^t \pi(P) \geq W(h) - W(l) \qquad \text{(NC)}$$

where $\pi(P)$ is the CI's per-period payoff from following the strategy P.

(NC) says that the discounted value of continuation payoffs must be greater than or equal to the largest bribe that an uncertified seller would offer. The idea is that, if the CI would be willing to accept a bribe when his policy calls for not certifying the seller, then buyers will realize this, so that a report that the seller is certified will be ignored. Notice that the right-hand side of the constraint does not depend on the probability that the seller is of low quality. Even if low quality is very rare, it is precisely when a low-quality seller is discovered that it is important for honesty to be optimal.

For certificates, the value of certification to sellers is given by $(v_H - 1)$, while CI profits are given by $\pi(P^*) = \bar{\mu}(v_H - 1)$. Thus (NC) implies that certificates will be credible as long as

$$\frac{\delta}{1-\delta}\bar{\mu}(v_H - 1) \geq (v_H - 1), \text{ or } \mu \geq \frac{1-\delta}{\delta\bar{}}: \qquad \text{(NC}_C\text{)}$$

This constraint is illustrated by the vertical line in Figure 3. To the left of this line, a certificate will not be credible: when high-quality sellers are rare (μ is low), it is too

tempting for the CI to collude with low-quality sellers. Note that v_H does not affect the no-collusion constraint for a certificate seller. Although a larger v_H implies greater profits from being truthful, it also increases the payoffs to cheating, and by the same proportion.

(NC_C) can also be written $\delta \geq \frac{1}{1+\bar{\beta}\mu}$. As we would expect, the discount rate necessary to maintain honesty is lower when the bargaining power of the CI, $\bar{\beta}$, is larger. Note however that even if the CI keeps all of the surplus from certification ($\bar{\beta} = 1$), honesty is still not possible for $\delta < \frac{1}{1+\mu}$.

For guidebooks, the payoff of a certified seller is given by $\hat{V}(m)$, while the payoff of an uncertified seller is given by $(1 - m)\hat{V}(m)$. This means that the value of certification to the seller is $m\hat{V}(m)$ while CI profits are given by $m\mu(v_H - \hat{V}(m))$. It can be shown (see appendix) that the implication of the no-collusion constraint for this case is

$$v_H \geq \frac{(1-\mu)[\delta\mu + (1-\delta)]}{\mu[\delta(1-\mu) - (1-\delta)]}. \qquad (NC_G)$$

Figure 4.2 illustrates the implications of (NC) for the CI's choice between certificates and guidebooks. Compared to the case with commitment, there are two changes: first, there are parameters for which the CI cannot credibly operate. Second, there is a region in which, with commitment, the CI would have chosen certificates, but without commitment chooses guidebooks.

The no-collusion constraint impacts certificates and guidebooks in different ways. With certificates, the (NC) constraint does not depend on v_H. Larger values of v_H imply that the gains from colluding and the gains from honest reporting increase proportionately. With guidebooks, an increase in v_H increases the gains to cooperation by more than it increases the gains to collusion.

For $\delta > \frac{1}{1+\bar{\beta}}$ (necessary if certificates are credible for some μ), the statement that "guidebooks are more profitable" is more restrictive than the statement that "guidebooks are credible." This means that there is a region where the CI would like to choose certificates, but since these are not feasible he chooses guidebooks instead. The shaded region represents those parameter values for which guidebooks are chosen even though

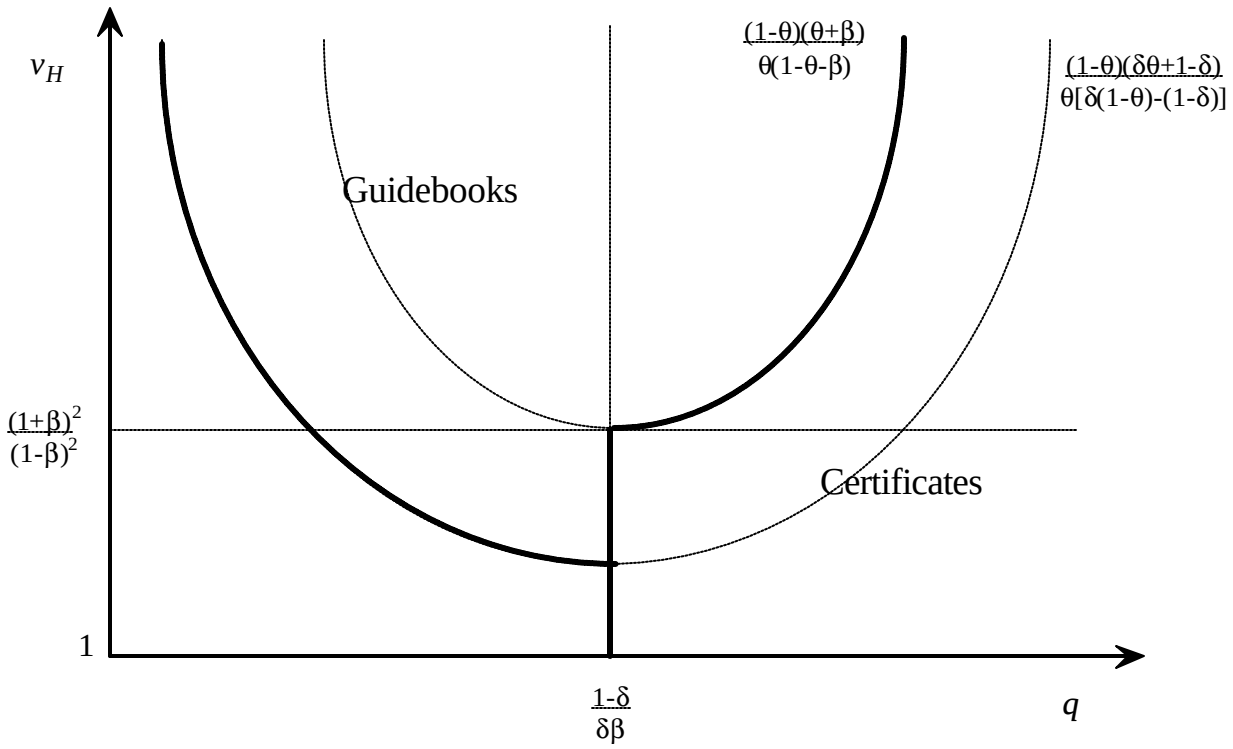
v_H
(1-θ)(θ+β)
θ(1-θ-β)
(1-θ)(δθ+1-δ)
θ[δ(1-θ)-(1-δ)]
Guidebooks
(1+β)²
(1-β)²
Certificates
1
1-δ
δβ
q

Figure 4.2:

certi…cates, if feasible, would be more pro…table. When μ is low, so that high-quality sellers are rare, the value of future business is not great enough to make honest certi…cation incentive-compatible. It is too tempting to collude with a low-quality seller, so that the CI cannot credibly sell certi…cates. It may be possible for the CI to credibly sell guidebooks instead, because the payo¤s to cheating are not as large relative to the payo¤s to honesty.

5. Competing Intermediaries

Next I consider the case of competition in the market for certi…cation. In general, competition is good for high-quality sellers: competing certi…ers will charge lower fees for certi…cates, or sell more guidebooks. However, even with competition, we do not get costless revelation of all information. This is because the no-collusion constraint means that an active CI must make positive pro…ts in equilibrium. This follows the basic logic of Klein & Le - er (1981), in which the authors point out that if repeated sales are to give a producer the incentive to provide quality products, then the producer must be receiving a price above production costs. To prevent the seller from misleading customers, future rewards must outweigh the present gains from cheating. If pro…ts from playing honestly are zero, then there can be no penalty for cheating customers. The same logic implies that, to prevent certi…ers from colluding with low-quality sellers and providing a false report, the CI must keep some of the surplus created by high-quality sellers. If a CI is making zero pro…ts, and buyers believe his report, then he will be able to make positive pro…ts by abusing this trust and accepting a bribe.

I assume that there is a large number of potential CIs (indexed by $j \in J = \{1; 2; ::: N\}$), each of whom lives forever and discounts the future at the same rate $\pm \in (0; 1)$. I partition the set of potential CIs into "active" and "inactive" CIs, J_A and J_I. Inactive CIs do not make a report and make zero pro…ts. Active CIs make reports that are subject to a no-collusion constraint similar to that in the previous section. The timing of the "stage game" is the same as with the monopolist, with all certi…ers choosing strategies

simultaneously.

The no-collusion constraint will be similar to that in the previous section, adjusted to accommodate the problem with many certi…ers. As before, I consider an equilibrium in which each CI's strategy must be collusion-proof: the long-run payo¤s that each CI receives must be high enough to outweigh the one-shot gains from accepting a bribe and reporting dishonestly. That is, for an equilibrium strategy $P^{\alpha} = \{P_1^{\alpha}; P_2^{\alpha}; ...P_N^{\alpha}\}$, we must have for all $j \in J_A$

$$\pm\frac{1}{4}_j(P^{\alpha}) \geq (1 - \pm)[W(h_j; P^{\alpha}) - W(l_j; P^{\alpha})] \qquad (NC^0)$$

As with monopoly, my assumption on buyer beliefs allows all strategies within this set that satisfy (NC^0). We can imagine each CI choosing a strategy at $t = 0$ which will be repeated forever, from among those that are credible.

The assumption on beliefs is in some ways more problematic here than with a monopoly CI. We need to worry about how each CI expects the others to respond to a given change in policy. Again I appeal to the idea that we are looking here at the most optimistic conditions for a credible CI to operate.

Since we assume that any strategy that could be part of a truthful equilibrium is believed, competition will imply that we see the lowest CI pro…ts that are consistent with equilibrium.

$$\frac{1}{4}_j(P^{\alpha}) \geq \frac{1}{4}_j(P_j^0; P_{-j}^{\alpha}) \quad \forall P_j^0 \text{ such that } (NC^0) \text{ holds.}$$

This condition says that no CI has available a strategy that is credible (satis…es (NC^0)) and o¤ers him higher pro…ts.

In the next two subsections I will describe the implications of these assumptions for equilibria with certi…cates and with guidebooks. First, note that there cannot be both an active guidebook-seller and an active certi…cate-seller. Since the certi…cate-seller publicly reveals the seller's quality, there is no reason for buyers to pay for the guidebook. In a more realistic model there might be room for both to operate simultaneously, for example if di¤erent intermediaries certify di¤erent quality dimensions, or if the certi…er

could provide only an imperfect signal of quality.

5.1. certi…cate equilibria

With certi…cates, CIs compete by o¤ering lower fees to the seller. Thus the equilibrium will be characterized by the lowest fee that is still large enough to make honest reporting incentive-compatible.

First I will demonstrate that in equilibrium there can be only one active CI. Note that if two CIs are o¤ering di¤erent certi…cate fees, and both are credible, then the CI will choose the cheaper one. So if there is to be more than one active CI, each must be charging the same fee and the seller must choose each with positive probability. Let $°_j$ represent the probability that the seller chooses CI j. The no-collusion constraint will be

$$\frac{±}{1 ¡ ±} °_j ®_j ¹(v_H ¡ 1) ¸ (v_H ¡ 1) \qquad (NC^{0}_{F})$$

The left-hand side is the value of future business to the CI, and the right-hand side is the largest bribe that a low-quality seller would be willing to pay for a false certi…cation.

Suppose $°_j < 1$ and CI j o¤ers a slightly lower fee, $®_j ¡ "$. The seller would strictly prefer the lower fee, and so would be willing to choose CI j with probability 1 if the CI is credible. Since $°_j < 1$, there is an $"$ small enough that (NC^{0}_{F}) will be satis…ed. In other words, the minimum fee that satis…es (NC^{0}_{F}) is decreasing in the CI's market share. This means that if the seller is choosing each CI with positive probability, one CI could lower his fee slightly and capture the entire market, so that his policy is still credible. In essence, there will be only one CI because the no-collusion constraint is arti…cially strong when there are two.

The result that only one CI is active does not mean that he has monopoly power; it follows from the fact that, with a single active CI, that CI can a¤ord to o¤er a lower price while still satisfying the no-collusion constraint. The threat of "entry" by another CI means that the active CI charges the lowest fee that satis…es the no-collusion constraint. Note that if there were several sellers in each period, the result does not mean that all

sellers would be certified by the same CI. Rather, it says that each seller will be certified by one specific CI with probability one.

In an equilibrium with certificates it must be that no CI could change his fee and receive higher profits. This means that the fee charged will be the lowest that is consistent with (NC^0_F). Since (NC^0_F) binds for an active CI, the certificate fee will be given by $\alpha = \frac{1-\delta}{\delta\mu}$. If this is greater than one, certificates will never be credible. These results are summarized in Proposition 5.1 below.

Proposition 5.1. With competing intermediaries, a certificate equilibrium will exist if and only if $\mu \geq \frac{1-\delta}{\delta}$: There will be only a single active CI, and the certificate fee will be given by $\alpha = \frac{1-\delta}{\delta\mu}$.

Notice that as δ approaches one, the CI's fee approaches zero, as the value of future business becomes large relative to the current rewards of cheating. The fee is also decreasing in μ, since a greater proportion of certified sellers increases the average profits of the CI without changing the bribe that a low-quality seller would be willing to pay. The fee does not depend on v_H, since an increase in v_H increases both the value to cheating and to not cheating by the same proportion.

5.2. Guidebook equilibria

With guidebooks, the value of certification is less than with certificates (ignoring the certification fee), since not all buyers observe the CI's report. As discussed in the previous section, the largest bribe that a seller would be willing to pay CI j is given by $m_j\hat{V}(m)$, while the per-period payoff of an honest CI is $m_j x(m)$, where x is the price that the CI charges for information and $m = \sum_{i=1}^{n} m_i$ is the total number of guidebooks sold. For a guidebook-seller, (NC^0) implies

$$\delta m_j x(m) \geq (1-\delta) m_j \hat{V}(m)$$

or

$$\delta x(m) \geq (1-\delta)\hat{V}(m) \qquad (NC^0_G)$$

Note that (NC_G^0) depends only on the total number of guidebooks sold, not on the number of guidebooks sold by an individual CI. This means that, unlike with certi…cates, with guidebooks the number of active certi…ers and their relative market shares are indeterminate.

Recall that a monopolist guidebook seller chooses to limit m in order to maintain the value of the information he sells. If we have a large number of intermediaries, no individual CI will have a large enough incentive to lower m in order to increase the price of guidebooks, so m will increase to the point where a guidebook-seller is barely credible. This means that we can be sure that (NC_G^0) will bind.

To determine whether there is an equilibrium in which guidebooks are feasible, it is su¢cient to check whether (NC_G^0) is satis…ed for complete pooling ($m = m_P$). The left-hand side of (NC_G^0) is decreasing in m, and the right-hand side is increasing in m for $m > m_P$. Therefore if the condition fails for complete pooling, then it will never be satis…ed. Substituting for x(m) and $\hat{V}(m)$, this means that guidebooks will only be feasible if

$$\pm[\mu(v_H - \hat{V}^1) + (1 - \mu)(\hat{V}^1 - 1)] \geq (1 - \pm)\hat{V}^1$$

which can be rewritten as

$$v_H \geq \frac{(1-\mu)[\pm\mu + (1-\pm)]}{\mu[\pm(1-\mu) - (1-\pm)]}. \tag{5.1}$$

The condition for credibility is the same as for the monopolist. This is because under competition, the active CI is making at most what the monopolist makes, so the credibility constraint must be at least as strong. The boundary will be where, even under the monopoly strategy, the CI is barely credible.

Since we know that with guidebooks (NC_G^0) must bind, we can solve for m and the price charged by high-quality sellers. We …nd that

$$\hat{V}(m) = 1 + \frac{[\pm\mu(v_H - 1) - (1-\pm)]}{[\pm\mu + (1-\pm)]}. \tag{5.2}$$

Note that when $\pi = 1$, we will have complete separation, with $\hat{v}(m) = v_H$. When the credibility constraint (5.1) binds, we will have $\hat{v}(m) = \hat{v}$.

Because not all information is revealed through guidebooks, sellers would still be willing to pay to signal their quality to the uninformed. In order for guidebooks to be part of equilibrium, it must be the case that a credible certi…cate-seller cannot enter. A high-quality seller receives a price of $\hat{v}(m)$ with guidebooks, so the value of public certi…cation to a high-quality seller would be $v_H - \hat{v}(m)$. The no-collusion constraint for a certi…cate-seller would be

$$\pi\mu[v_H - \hat{v}(m)] \geq (1 - \pi)(v_H - 1):$$

Using (5.2), this reduces to

$$v_H \cdot 1 + \frac{\pi}{1 - \pi}\mu:$$

Proposition 5.2. With competing intermediaries, if $v_H \geq \frac{(1-\mu)[\mu\pi+(1-\pi)]}{\mu[\pi(1-\mu)-(1-\pi)]}$ and $v_H \geq 1 + \frac{\pi}{1-\pi}\mu$ then there is an equilibrium with guidebooks. The number of guidebooks sold will satisfy $\hat{v}(m) = \frac{\pi\mu v_H}{\pi\mu+(1-\pi)}$.

5.3. Equilibria with competition

Figure 4 illustrates which outcome we will expect as a function of parameter values. The conditions for feasibility are the same for both monopoly and competition. However, there is a range in which either certi…cates or guidebooks could be the equilibrium: given certi…cates, there is no way for a guidebook-seller to enter, and vice-versa.

Intuitively, the impact of competition is what we would expect given the decision between certi…cates and guidebooks: more of the surplus is going to the sellers. With certi…cates, the fees are lower, since CIs compete to attract high-quality sellers. With guidebooks, more buyers are informed, since the CI cannot restrict supply too much without encouraging the other CI to ful…l unmet demand. However, because of the simultaneity of the certi…ers' strategy choice, it may be that we get certi…cates with

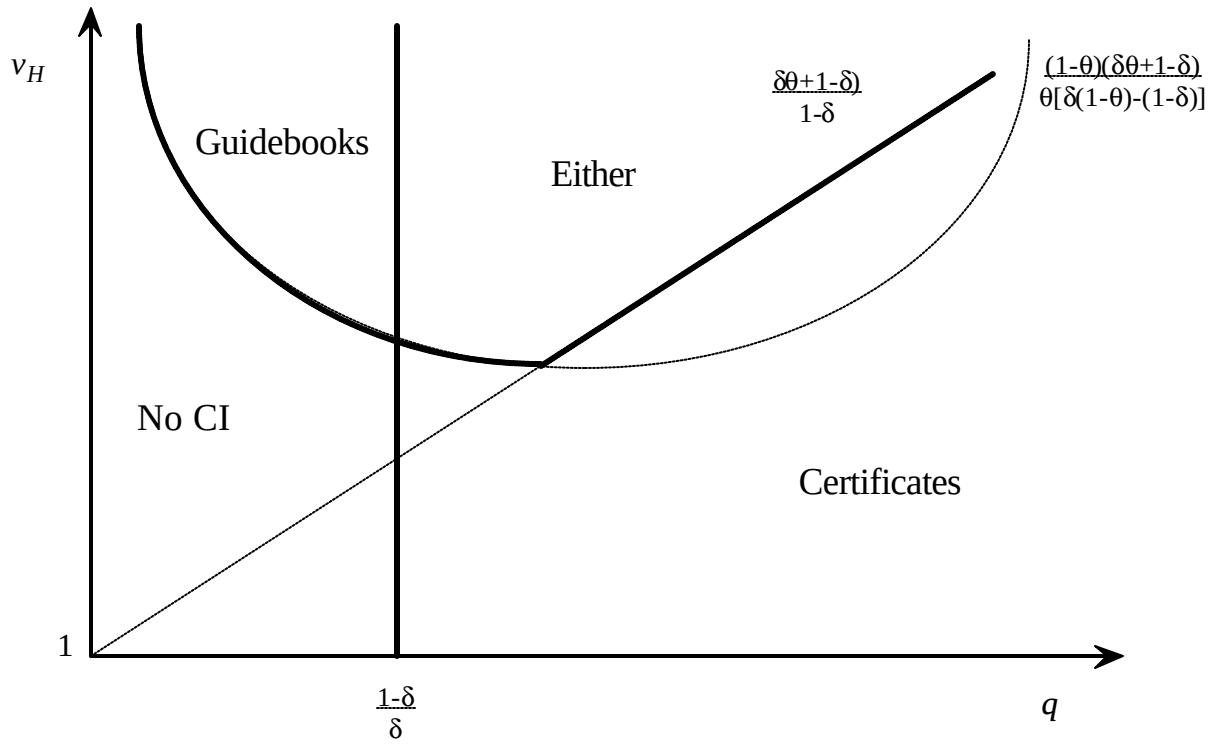

Figure 5.1: Equilibrium with Competing Intermediaries

competition when we would have gotten guidebooks with monopoly, and that the high-quality sellers prefer the guidebooks.

6. Equilibrium seller investment

Up to now I have considered a model in which the typical ine¢ciencies arising from asymmetric information do not take place. Since sellers do not value their goods, exchange always takes place. And since sellers do not choose the quality of their good, the incentives to produce quality are not important. This means that certi…cation does not a¤ect the amount of social surplus, but only its distribution. To answer questions of how and when markets form, we would like to consider a case in which high-quality sellers will not enter the market in the absence of some way to communicate their quality. In this section I will assume that the seller chooses whether to invest in quality. In this case certi…cation plays a central role in e¢ciency. The seller will only be willing to make an investment in the quality of her good if buyers are informed about her investment. In the absence of an intermediary, all sellers receive the same price, so that even those who can inexpensively produce high quality will not have an incentive to do so. The amount of information revealed by the CI and the fee that the seller must pay for certi…cation will a¤ect investment incentives, and thus a¤ect social surplus.

I assume that the seller in period t can produce a high-quality good by incurring a …xed cost c_t, while no investment is necessary to produce a good of low quality. As before, once the quality of the good is determined the seller can produce an unlimited amount at zero marginal cost. The investment cost c_t is drawn at the beginning of the period from a distribution function $F(c)$. $F(c)$ is common knowledge, but the realized value of c_t is private information of the seller.

The timing of the game is as in the previous section. The only di¤erence is that in the …rst period, instead of nature choosing the seller's quality level, nature chooses c_t from $F(c)$, and the seller decides whether to invest in quality.

Since each period is identical, I will drop the time subscript. Equilibrium will consist

of a strategy for the sellers, $\{Q(c); p(Q)\}$, beliefs and demand functions for the buyers, $\{b(p); d(r; p)\}$, a partition of the CIs into active and inactive, and strategies for the active CIs, $P^{\alpha} = \{t; m; \beta\}$; such that for the sellers

$$Q = H \text{ if } \alpha \, pD(p; h) - cert.fee - c \geq pD(p; l)\}$$

$$p(r) = \max\{pD(p; r)\}$$

for the buyers

$$b(p) = E[v_Q | p; \mu]$$

$$d(p; r) = \begin{cases} I[p \leq b(p)] \text{ for uninformed} \\ I[p \leq v_Q] \text{ for informed} \end{cases}$$

and for the CIs

$$\pi_j(P^{\alpha}) \geq \pi_j(P_j^{0}; P^{\alpha}_{-j}) \quad \forall P_j^{0} \text{ such that } (NC^{0}) \text{ holds.}$$

$$\pm\pi_j(P^{\alpha}) \geq (1 - \pm)[W(h_j; P^{\alpha}) - W(l_j; P^{\alpha})] \qquad (NC^{0})$$

where μ is the probability that the seller is of high quality, given the policy $Q(c)$.

The difference here is that the strategies of the CIs affect the seller's incentives to invest. Note, however, that CIs do not take this into account when choosing a policy, so that their payoffs will depend on their strategies in the same way as in the previous section.

First I present a straightforward result. If it is optimal for a seller with costs c^{0} to invest in quality, then it will also be optimal for any seller with costs $c < c^{0}$. Thus we can describe the best response of the seller in terms of some c^{α} such that whenever the seller observes $c \leq c^{\alpha}$ she will choose to invest. The probability that the seller chooses high quality (μ from the previous section) will therefore be given by $F(c^{\alpha})$. Since the rest of the game is unchanged, the results of the previous section for player strategies will still hold, with $F(c^{\alpha})$ replacing μ.

The efficient outcome, which would result from full information, would be for sellers to invest whenever the cost of doing so is less than the marginal value of high quality

to buyers. This means that the optimal investment, c^{**}, is given by $c^{**} = (v_H - 1)$. The first-best will be achieved if there is no asymmetric information problem, that is if certification is free and accurate. However, as we saw in the previous section, in equilibrium certification will not be free - the certifier must be making some profits in order to maintain incentives for honest reporting. This implies that the equilibrium level of seller investment will always be less than the optimum; that is, $c^* \cdot (v_H - 1)$.

The incentive for a seller to invest will depend on how information is revealed; that is, it will depend on CI strategies. CI strategies, in turn, will depend on the probability of the seller investing in quality, $F(c^*)$. In fact, I will show that this relationship will be complimentary: when sellers invest in quality more frequently, credible certification becomes easier, which increases the value to sellers of investing in quality. This complementarity suggests the possibility of coordination failures, in which few sellers invest because certification is expensive, and certification is expensive because few sellers invest.

Recall that $W(r;\mu)$ is defined as the value to a seller of receiving report r, net of any certificate fee. The probability of a seller investing, μ, affects W because it determines either the certificate fee or the number of guidebooks sold. The optimal policy of the seller will be to invest in quality if the difference in payoffs of certified and uncertified sellers, $W(h;\mu) - W(l;\mu)$, is greater than or equal to the cost of investing in quality. This means that in equilibrium we will have $c^* = W(h;\mu) - W(l;\mu)$.

Combining this with the results of the previous section, we can characterize equilibrium seller investment in quality. For certificates, investment will be described by

$$W(h;\mu) - W(l;\mu) = (1 - \alpha)(v_H - 1) = c^* \tag{6.1}$$

where α is determined in the previous section to be

$$\alpha = \frac{1 - \pi}{\pi\mu}. \tag{6.2}$$

For guidebooks, the value of investment is given by

$$W(h;\mu) - W(l;\mu) = \phi(m) - 1 = c^* \tag{6.3}$$

and m is de…ned as in the previous section by

$$\hat{v}(m) - 1 = \frac{[\pm\mu(v_H - 1) - (1 - \pm)]}{[\pm\mu + (1 - \pm)]}. \tag{6.4}$$

To describe the equilibrium more completely, we need to specify the form of the distribution function F(c). First, I will show that there is a complementarity between the value of certi…cation and investment in quality. Then I will describe the equilibrium more precisely for the case where F(c) is the uniform distribution.

Proposition 6.1. The value of certi…cation, $W(h;\mu) - W(l;\mu)$, is increasing in μ for certi…cates. For guidebooks, $W(h;\mu) - W(l;\mu)$ is increasing in μ over those values of μ for which guidebooks are credible.

To see this, …rst consider certi…cates. Combining (6.1) and (6.2), we see that the value of certi…cation to sellers is given by

$$(1 - \frac{1 - \pm}{\pm\mu})(v_H - 1): \tag{6.5}$$

This is increasing in the proportion of certi…ed sellers μ. When μ increases, the no-collusion constraint is relaxed, so that the CI must receive a lower portion of the surplus to remain credible. This in turn increases the bene…ts to being certi…ed, so that a larger set of seller types will …nd it optimal to invest in quality.

With guidebooks, (6.3) and (6.4) imply that the value of certi…cation is given by

$$\frac{[\pm\mu(v_H - 1) - (1 - \pm)]}{[\pm\mu + (1 - \pm)]}; \tag{6.6}$$

which is again increasing in μ. When more sellers are certi…ed, certi…ed sellers receive a higher price, increasing the incentive for the seller to invest in quality. In fact there may be "more pooling" for higher values of μ (z may be increasing in μ), but this is outweighed by the fact that on average there is higher quality. The exception would be if μ becomes large enough to violate the (NC) constraint. When μ increases past this point guidebooks will not be credible, so that the value to being certi…ed by a guidebook-seller is zero.

The importance of Proposition 6.1 is that it implies we may have coordination failures. It may be that a Pareto-superior equilibrium, with relatively e¢cient certi…cation and frequent seller investment, is not achieved because for low levels of seller investment an e¢cient certi…cation strategy does not satisfy the no-collusion constraint.

I next work out the equilibrium conditions when the sellers' cost c is distributed uniformly on the interval $[0; \hat{c}]$. For certi…cates, combining (6.1) and (6.2) gives us

$$c^{\alpha} = (1 - \frac{\hat{c}(1 - \pm)}{\pm c^{\alpha}})(v_H - 1)$$

or

$$(c^{\alpha})^2 - (v_H - 1)c^{\alpha} + \frac{1 - \pm}{\pm}(v_H - 1)\hat{c} = 0:$$

This equation has real roots, and therefore a certi…cate equilibrium exists, if and only if

$$v_H \geq 1 + 4\frac{1 - \pm}{\pm}\hat{c}:$$

For guidebooks, combining (6.3) and (6.4) gives us

$$c^{\alpha} = \frac{\pm(v_H - 1)c^{\alpha} - (1 - \pm)\hat{c}}{\pm c^{\alpha} + (1 - \pm)\hat{c}}$$

or

$$\pm(c^{\alpha})^2 + [\hat{c}(1 - \pm) - \pm(v_H - 1)]c^{\alpha} + \hat{c}(1 - \pm) = 0$$

This equation has real roots, and therefore a guidebook equilibrium exists, if and only if

$$v_H \geq 1 + 2\sqrt{\frac{1 - \pm}{\pm} + \frac{1 - \pm}{\pm}}\hat{c}:$$

Figure 5 illustrates the certi…cate case. First, there in an equilibrium in which sellers never invest and, because of this, certi…ers cannot o¤er a credible strategy. With no high-quality sellers, certi…ers make no pro…ts, so that there would be no potential cost to losing buyers' trust. Even with positive seller investment, however, there are multiple equilibria. At (A), low seller investment means that to prevent collusion, the certi…er must charge a high fee. At this point, a hypothetical increase in the seller's cuto¤ value c^{α} would relax the no-collusion constraint, and lower the fee charged by the CI by more

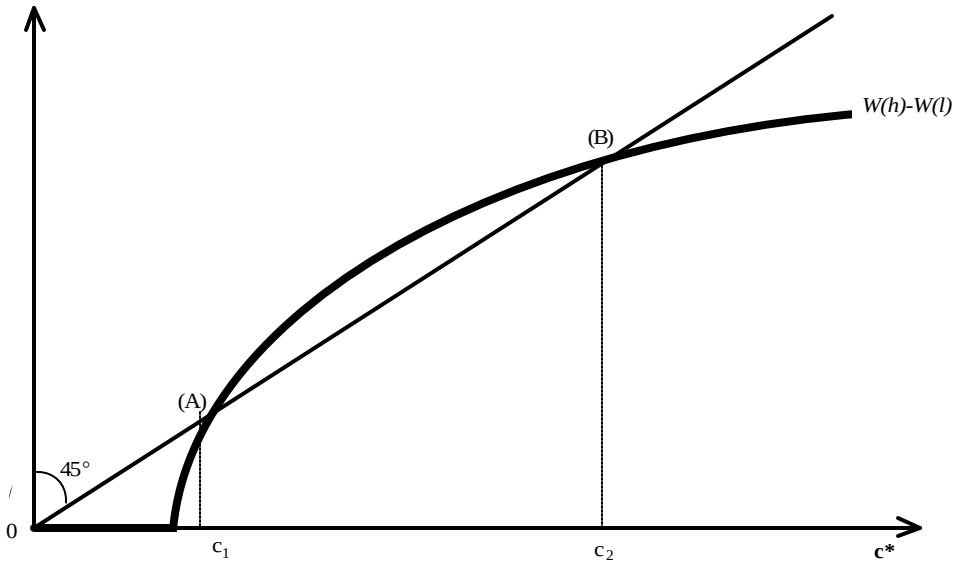

Figure V

Figure 6.1: Multiple equilibria when investment in quality is endogenous.

than c¤, meaning that the cuto¤ value would increase by even more. At (B), there is a new equilibrium with a higher level of seller investment and lower certi…cate fees.

The implication is that markets may fail to form as the result of a coordination failure. Even though the "technology" exists to transfer information about quality to buyers, and there are private incentives to do so, the scarcity of high-quality sellers in the market means that credible certi…cation cannot take place.

7. Conclusion

Asymmetric information plays a signi…cant role in the way exchange is organized. For an economy to enjoy the gains from trade that characterize anonymous markets, there must be some way for agents to trust their trading partners. Understanding the conditions under which such trust can be established is one of the most important steps toward understanding the process of economic development.

This paper focuses on how private-sector intermediaries can form part of the insti-

tutional structure that allows markets to function. Private institutions are only one of many types of institution that help markets to work. E¤ective courts are important to enforce contracts, and social norms may limit opportunistic behavior. Focusing on a pro…t-maximizing intermediary is convenient in that it allows us to endogenize the institutional form of the intermediary in a relatively straightforward way. The results here may have implications even for public intermediaries faced with similar credibility issues.

There are many possible extensions to the model presented here. One natural step would be to consider the role of competition between sellers. In the case where sellers invest in quality, competition will mean that sellers keep less of the surplus generated by such an investment. On the other hand, competition may drive uncerti…ed goods out of the market, thereby increasing the incentives of sellers to invest.

Another extension is to consider the possibility of shirking on the part of the CI. It is natural to suppose that buyers and sellers cannot observe whether the CI in fact inspected a product, and if inspection is costly we will have a moral hazard problem.

References

[1] Akerlof, George A. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," Quarterly Journal of Economics 84 (August 1970) pp. 488-500.

[2] Albano, Gian Luigi, and Lizzeri, Alessandro. "Strategic Certi…cation and Provision of Quality," Discussion Paper (1998).

[3] Bagwell, Kyle and Michael Riordan. "High and Declining Prices Signal Product Quality," American Economic Review 81(1) (1991) pp. 224-239.

[4] Biglaiser, Gary. "Middlemen as Experts," RAND Journal of Economics 24(2) (1993) pp. 212-223.

[5] Biglaiser, Gary and James Freidman. "Middlemen as Guarantors of Quality," International Journal of Industrial Organization 12 (1994) pp. 509-31.

[6] Chan, Yuk-Shee and Hayne Leland. "Prices and Qualities in Markets with Costly Information," Review of Economic Studies 49 (1982), pp. 499-516.

[7] Chemmanur, Thomas and Paolo Fulghieri. "Investment Bank Reputation, Information Production, and Financial Intermediation," Journal of Finance 49(1) (1994) pp. 57-79.

[8] De, Sankar and Prafulla Nabar. "Economic Implications of Imperfect Quality Certi…cation," Economics Letters 37 (1991) pp. 333-37.

[9] Fafchamps, Marcel. "The Enforcement of Commercial Contracts in Ghana," World Development 24(3) (1996) pp. 427-448.

[10] Froomkin, A. Michael. "The Essential Role of Trusted Third Parties in Electronic Commerce," Oregon Law Review 49 (1996).

[11] Gande, Amar, Manju Puri, Anthony Saunders and Ingo Walter. "Bank Underwriting of Debt Securities: Modern Evidence," Review of Financial Studies 10(4) (1997) pp. 1175-1202.

[12] Greif, Avner. "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition," American Economic Review 83(3) (1993) pp. 525-548.

[13] Grossman, Sanford and Martin Perry. "Perfect Sequential Equilibrium," Journal of Economic Theory 39, pp. 97-119 (1986).

[14] Khalil, Fahad and Jacques Lawarrée. "On Commitment and Collusion in Auditing," Discussion Paper (1998).

[15] Klein, Benjamin and Keith Le-er. "The Role of Market Forces in Assuring Contractual Performance," Journal of Political Economy 89(4) (1981) pp. 615-41.

[16] Klein, Daniel. “Promise Keeping in the Great Society: A Model of Credit Information Sharing,” in Daniel Klein, ed., Reputation: Studies in the Voluntary Elicitation of Good Conduct. Ann Arbor: University of Michigan Press (1997), 267-88.

[17] La¤ont, Jean-Jacques, and David Martimort. “Collusion and Delegation,” RAND Journal of Economics 29(2), Summer 1998, pp. 280-305.

[18] Li, Yiting. “Middlemen and Private Information,” Journal of Monetary Economics 42 (1998) pp. 131-59.

[19] Lizzeri, Alessandro. “Information Revelation and Certi…cation Intermediaries,” RAND Journal of Economics 30(2), Summer 1999, pp. 214-231.

[20] Megginson, William and Kathleen Weiss. “Venture Capitalist Certi…cation in Initial Public O¤erings,” Journal of Finance 46(3) (1991) pp. 879-903.

[21] Milgrom, Paul, Doulass North and Barry Weingast. “The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs,” Economics and Politics 2 (1990): 1-23.

[22] Sheppard, Marie. “Constraints to Private Enterprise in the FSU: Approach and Application to Russia,” in Lieberman, I. et al., Russia: Creating Private Enterprises and E¢cient Markets, Washington, D.C.: The World Bank, 1995.

[23] Silber, Norman I. Test and Protest: the In‡uence of Consumers Union. New York: Holmes & Meier Publishers, Inc., 1983.

[24] Tirole, Jean. “Hierarchies and Bureaucracies: on the Role of Collusion in Organizations,” Journal of Law, Economics, and Organization, 2(2) (1986) pp. 181-214.

[25] Viscusi, W. Kip. “A Note on ‘Lemons’ Markets with Quality Certi…cation,” Bell Journal of Economics (1978) 277-79.

[26] Wernerfelt, Birger. “Umbrella Branding as a Signal of New Product Quality: An Example of Signalling by Posting a Bond,” RAND Journal of Economics 19(3) (1988) pp. 458-66.

[27] Wolinsky, Asher. “Prices as Signals of Product Quality,” Review of Economic Studies 50 (1983), pp. 647-658.

8. Appendix

Lemma 4.1 Proof.

$$\frac{d\pi_{CI}}{dm} = \mu[v_H - \frac{1}{1-m}] - \frac{m\mu}{(1-m)^2}$$

$$\frac{d\pi_{CI}}{dm} = \mu v_H - \frac{\mu}{(1-m)^2}$$

$$\frac{d^2\pi_{CI}}{d^2m} = -\frac{2(1-m)\mu}{(1-m)^3} < 0$$

So the first order condition will be sufficient if the solution is interior; that is, if $\frac{d\pi_{CI}}{dm} > 0$ at $m = m_P$. Since $m_P = \frac{\sqrt{v}-1}{\sqrt{v}}$, this condition becomes

$$\mu v_H - \frac{\mu}{(1-\frac{\sqrt{v}-1}{\sqrt{v}})^2} > 0$$

$$v_H - \sqrt{v}^2 > 0$$

$$v_H > [\mu v_H + (1-\mu)]^2 = \mu^2 v_H^2 + 2\mu(1-\mu)v_H + (1-\mu)^2$$

$$0 > \mu^2 v_H^2 + [2\mu(1-\mu) - 1]v_H + (1-\mu)^2$$

$$v_H \in (\frac{1-2\mu(1-\mu)-(1-2\mu)}{2\mu^2}; \frac{1-2\mu(1-\mu)+(1-2\mu)}{2\mu^2})$$

$$v_H \in (1; (\frac{1-\mu}{\mu})^2)$$

If $v_H \geq \frac{(1-\mu)^2}{\mu^2}$, then $\frac{d\pi_{CI}}{dm}$ will always be negative and the CI will choose $m = m_P$, implying $z = 1$. If $v_H < \frac{(1-\mu)^2}{\mu^2}$, then the optimal m will be given by the first-order condition, which implies

$$m = \frac{\sqrt{v_H} - 1}{\sqrt{v_H}} \tag{8.1}$$

$$z = \frac{\mu}{1-\mu}\sqrt{v_H}$$

Substituting this into the expression for V (m) in (??) gives us

$$V(m) = \sqrt{v_H}.$$

■

Proposition 4.2 Proof. From Lemma 4.1, we know that when the CI sells guidebooks, he will prefer partial pooling to complete pooling if and only if $v_H < (\frac{1+\mu}{\mu})^2$. Thus we simply have to compare guidebook profits in each of these cases to profits when sellers pay.

When there is partial pooling, profits when sellers pay will be higher than profits when buyers pay if

$$\bar{\mu}(v_H - 1) > \frac{\mu(v_H - 1)^2}{(\sqrt{v_H} + 1)^2} \tag{8.2}$$

which reduces to

$$v_H < (\frac{1+\bar{\mu}}{1-\bar{\mu}})^2. \tag{8.3}$$

When there is complete pooling, profits when sellers pay will be higher than profits when buyers pay if

$$\bar{\mu}(v_H - 1) > \frac{\mu^2(1-\mu)(v_H - 1)^2}{\mu(v_H - 1) + 1} \tag{8.4}$$

If $(1-\mu) \geq \bar{\mu}$, then (8.4) reduces to

$$v_H < 1 + \frac{\bar{\mu}}{\mu[(1-\mu) - \bar{\mu}]}. \tag{8.5}$$

If $(1-\mu) < \bar{\mu}$; then (8.4) reduces to

$$v_H > \frac{(1-\mu)(2\mu + \bar{\mu})}{\mu[(1-\mu) - \bar{\mu}]}$$

which is always true for $(1-\mu) < \bar{\mu}$. ■

Derviation of (NC_G) Per-period profits for an honest guidebook-seller are given by $m\mu(v_H - \hat{v}(m))$, while profits from deviating are given by $m\hat{v}(m)$. So the constraint becomes

$$\frac{\pi}{1-\pi}\mu(v_H - \hat{v}(m)) \geq \hat{v}(m)$$

$$v_H \geq [\frac{1-\pi}{\pi\mu} + 1]\hat{v}(m)$$

The right-hand side is increasing in $\hat{v}(m)$, so if the inequality holds for $\hat{v}^1$ it will hold for all $\hat{v}(m)$. At $\hat{v}(m) = \hat{v}^1$ we have

$$v_H \geq [\frac{1-\pi}{\pi\mu} + 1][\mu(v_H - 1) + 1]$$

Which can be rewritten as

$$v_H - 1 = \frac{1 - \alpha}{\mu[\alpha(1 - \mu) - (1 - \alpha)]}$$

or

$$v_H = \frac{(1 - \mu)[\alpha\mu + (1 - \alpha)]}{\mu[\alpha(1 - \mu) - (1 - \alpha)]}.$$