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Imperfect Information, Perceived Quality, and the Formation of Professional Groups*

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I. INTRODUCTION

A fundamental problem arises in the economics of those labour markets in which various individuals differ in the quality of the services they supply, as in the case of, say, the legal or medical profession. For members of such professional groups, characterized by their common attainment of some minimal entry requirement, are in the eyes of the imperfectly informed consumers to whom they provide services, "equally well qualified," and command a common fee.[1] But insofar as this implies that the less able earn a quasi-rent which reflects in part the superior abilities of their more able colleagues, it would seem intuitively obvious that the more able would find it preferable to separate themselves from their fellows, forming a smaller and more profitable coalition. Thus professional groups would vanish, and "certification" drive out "licensing."[2] In practice, however, the "cooperative" solution, involving the formation of a professional group, is typical.

In the present paper, we examine the empirically reasonable situation where consumers do not enjoy perfect information, but instead must learn of a profession's quality by experience, through patronising its members. What we establish is that, under such conditions, members of a larger profession may earn greater incomes than those of a smaller. Thus the optimal outcome under imperfect information involves cooperative behavior among those of differing ability. The mechanism through which this occurs operates through

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[1] For a caveat, however, see [1].

[2] The analysis of licensing solutions in markets with imperfect information on quality has been examined, for example, by Leland [2].

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the dispersion of beliefs among consumers as to the true quality of the profession; it is those consumers whose views of the profession are relatively favourable who patronise it. We here define a level of the "perceived quality" of a profession of a given size as follows: Ranking consumers in descending order of the quality they impute to the profession, and taking that number of consumers whose demand for services (one unit each) coincides with supply (one unit per professional), the "perceived quality" of the profession is here defined as that perceived by the "last" of this group of consumers. It is this quality which, in our model, serves to determine the market clearing price of professional services.

Our central result is that, so long as the flow of information is "sufficient," members of a profession of some positive size enjoy a higher level of income per head than can be achieved by any profession of smaller size.

It is worth stressing perhaps that this result does not depend on any assumption concerning possible bias in the prior beliefs of consumers; it would for example seem intuitively obvious that were consumers "sufficiently pessimistic," then an increase in information would serve to "reassure" them, so that "perceived quality" might be enhanced.

The effect which concerns us here is completely different to this. Irrespective of whether consumers' prior beliefs are pessimistic, optimistic or correct, it remains the case that some consumers will hear "relatively favourable" reports of the profession, and others "relatively unfavourable" reports. It is this *dispersion* of views among potential consumers which leads to our central result—which simply reflects the fact that, in the nature of things, it is predominantly those consumers who regard the profession more favourably who now proceed to patronise it.

The existence of such "increasing returns" to size offers an explanation for the formation of professional groups, composed of individuals of varying quality, to which entry is limited only through the requirement that a certain minimal standard be reached ("licensing")—a familiar phenomenon which is difficult to account for in the context of a model with perfect information.

The present study is part of a broader investigation of the economics of the self-regulating profession. Here, we shall confine ourselves strictly to this particular aspect of the problem, which is logically anterior to the investigation of questions concerning the size of profession which will actually be chosen, the viability of competing "para-professional" groups offering services of a different average quality, and the welfare properties of alternative market structures. These related questions have been explored in [3, 4]. For a survey of the literature, see [5].

II. The Informational Structure

We consider a profession each of whose members supplies exactly one unit (or, with trivial modification K units) of a particular service per unit time. We confine ourselves to the particular case where the service is either completed successfully, or not.[3]

We rank "workers," i.e., potential suppliers of this service, in decreasing order of failure rate, and we imagine entry to the profession to be restricted to those individuals whose failure rate is at most some given "qualifying" level. The "average" failure rate of members, being our measure of the quality of the profession, we denote as θ, which we take to be a continuously increasing function of L, the size of the profession.

The profession sells its services to a quite separate population of consumers, identical to each other in income and tastes. Consumers do not distinguish between different practitioners, and they differ from one another in their views as to the average quality of the services provided by the profession.

Each consumer buys exactly one unit of the service per unit time, if and only if its price does not exceed some cut-off price. We take this cut-off price to be a function $p(\hat{\theta})$ of the consumer's estimate of the quality of the profession. The function $p(\hat{\theta})$ reflects consumer preferences; it is identical for all consumers, and is strictly decreasing.

Where consumers' perceptions as to the quality of services differ, so too do their cut-off prices. The profession of size L supplies exactly L units of service, and faces a downward sloping demand shedule. The market clearing price is that at which exactly L individuals are willing to pay that amount for a unit of its services. Equivalently, ranking the consumers in (decreasing) order of their estimates of θ, we may identify the estimate held by the Lth consumer as the "perceived quality" of the profession; equilibrium price is the cut-off price corresponding to this value of perceived quality.

If the profession aims to maximise the price of its services, and so the per capita income of its members, it then does so, equivalently, by maximizing its "perceived quality," thus defined.

We consider a population of N consumers. Each individual consumer has a finite lifetime of T periods; and N/T new consumers enter the market each period to replace the equal number of departing buyers. Thus the age distribution of consumers is rectangular on $[0, T]$.[4]

[3] As might be appropriate in the case of house conveyancing (escrow) by lawyers, a case of current interest from a policy standpoint in the UK. It is also not inappropriate for the medical profession, say.

[4] The extension to a general age distribution is trivial; in the integral (1) below the factor $1/T$ is simply replaced by a frequency distribution $f(T)$ of ages.

We characterise equilibrium in the model in terms of a stochastic stationary state in which a profession of given size L generates a sufficient flow of information to bring forth (just) the appropriate (expected) number of consumers L whose assessment of its quality warrants their paying the associated equilibrium price p for its services.

Each consumer on entering the market has no information as to the profession's quality; his subjective probability of its quality is given by some Bayesian prior probability density function to be specified presently. We assume that each period, he has some probability π of hearing of the outcome of each of the L units of service provided by the profession in that period. His prior p.d.f. is accordingly updated in the light of this information.

One feature of the model which is of course crucial, is that the consumer is limited by the structure of the preceding assumption to a finite (expected) number of "observations" of quality. Were information transmitted "from generation to generation" then his volume of information would become infinite over time, and in the long run every consumers' assessment of the quality of a profession would coincide with its true quality and the effects explored below would vanish. In practice, we argue that two factors work against this kind of outcome; firstly, the personnel of the profession, as well as the "state of the art" change over time, rendering historical information obsolete. Secondly, a profession planning to enter the market must succeed in achieving viability whithin a finite time, reflecting the time preferences, or the finite lifetimes, of its founding members. Rather than tackling these latter considerations explicitly, however, we have preferred here to introduce in a simple though slightly artificial manner the notion that information is limited.

We now proceed to consider the nature of the appropriate prior distribution of θ. Since the consumer will be assumed to be risk neutral, it is the expectation of θ which primarily concerns us. Since the observations of "success" versus "failure," are distributed according to a Bernouilli distribution, we assume a conjugate prior distribution,[5] being a Beta distribution with parameter a, b, where

$$\text{mean, } \mu(\hat{\theta}) = \frac{a}{a+b}, \qquad \text{and} \qquad \text{variance, } \operatorname{var}(\hat{\theta}) = \frac{ab}{(a+b)^2(a+b+1)}.$$

We allow that different consumers may have different priors; we represent their views via a (probability) measure $g(a, b)$ over R^2_+, and assume

[5] That the prior should have this form is apparently restrictive, but is less serious than might seem to be the case insofar as any given prior will, as the number of observations become large, converge to a posterior distribution which is of this form (for a comment see [6]).

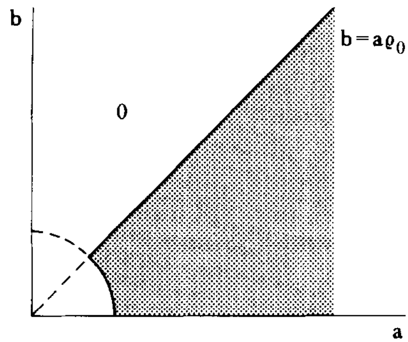

FIG. 1. The shaded area is the support of $g(a, b)$.

(i) For some $\rho_0 > 0$, $g(a, b) = 0$ for $b > a\rho_0$ (i.e., $a/(a+b) \leqslant \theta_0 = 1/(1+\rho_0)$).

(ii) $g(a, b) = 0$ in a neighbourhood of $(0, 0)$.

It is immediate from an examination of the above expressions for mean and variance that (i) simply requires that the mean be bounded below by some value $\theta_0 = 1/(1+\rho_0) > 0$, while (ii) ensures that the variance of the prior distributions be bounded above. Property (i) merely requires that no consumer initially believes the failure rate to be zero; while property (ii) requires that consumers have some degree of confidence in their prior beliefs.[6] Our assumption on $g(a, b)$ are illustrated in Fig. 1. The updating rule for the expected quality θ now takes the form (see [7]).

$$\mu(\hat{\theta}) = \frac{a+s}{a+b+r},$$

where r represents the number of units of service of whose outcome the consumer hears, and s is the corresponding number of these which were "failures." We have of course that the expected value of s is $r\theta$ for any given r where θ is the true quality of the profession.

In order that a consumer's estimate shall be less than or equal to $\hat{\theta}$, his vector of observations (r, s) should be such that

$$\frac{a+s}{a+b+r} \leqslant \hat{\theta},$$

i.e., a consumer who has made r observations must have observed a number of failures $s \leqslant [(a+b+r)\hat{\theta} - a]$, where $[.]$ denotes the integral part. The

[6] That is, they do not, on hearing their first report, abandon them in favour of a value of zero or unity.

number of observations r is given by a Poisson distribution with parameter $\pi\tau L$ in that we assume the consumer "hears of" the unit of service provided by any one of L professionals in each of τ periods with (small) probability π.

Let $F(L, \hat{\theta}, a, b)$ represent the (expected) number of consumers with prior (a, b) whose estimate of the profession's failure rate is at most $\hat{\theta}$. Then, writing $\min\{r, [(a+b+r)\hat{\theta} - a]\}$ as $c(r, \hat{\theta}, a, b)$,

$$F(L, \hat{\theta}, a, b) = \frac{Ng(a, b)}{T} \int_0^T \sum_{r=0}^{\infty} \frac{(\pi\tau L)^r}{r!} \times e^{-\pi\tau L} \sum_{s=0}^{c(r,\hat{\theta},a,b)} \binom{r}{s} \theta(L)^s (1-\theta(L))^{r-s}\, d\tau, \qquad (1)$$

where we have used the fact that each of the r observations made has probability $\theta(L)$ of being a failure, so that s is distributed binomally. (We note that $\sum_s$ equals zero if c is negative.)

The function F refers of course to a consumer with a given prior (a, b). Summing over our distribution $g(a, b)$ of priors, we define

$$R(L, \hat{\theta}) = \iint F(L, \hat{\theta}, a, b)\, g(a, b)\, da\, db. \qquad (2)$$

We note that our assumptions on $g(a, b)$ imply immediately that

$$R(L, \hat{\theta}) = \iint_{a/(a+b) \geqslant \theta_0} F(L, \hat{\theta}, a, b)\, g(a, b)\, da\, db,$$

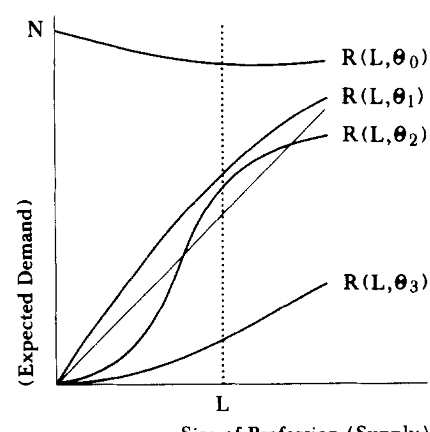

FIG. 2. The family of functions $R(L, \hat{\theta})$ for $\theta_3 < \theta_2 < \theta_1 < \theta_0$.

The function $R(L, \hat{\theta})$, which represents the (expected) number of individuals who estimate the quality of the profession as $\hat{\theta}$ or better, is illustrated in Fig. 2. The perceived quality of a profession of size L is given by the lowest value of θ for which demand is at least equal to supply, L, i.e., the smallest value θ^* for which $R(L, \theta^*)$ lies above the 45° line (i.e., individual professionals bid price down to the market clearing level).

III. The Perceived Quality of the Profession

We now proceed to state the properties of the functions $F(L, \hat{\theta}, a, b)$ and $R(L, \hat{\theta})$ defined above in two Lemmas, whose proofs are given in Section II. The first lemma characterises the values of F and R, while the second refers to their derivatives with respect to L, at the point $L = 0$.

Lemma 1.

$$\begin{aligned} F(0, \hat{\theta}, a, b) &= Ng(a, b), && \hat{\theta} \geqslant \frac{a}{a+b}, \\ &= 0, && \hat{\theta} < \frac{a}{a+b}. \end{aligned}$$

Remark. This result is of course obvious since for $L = 0$ no information is generated, and consumers' estimates of quality are simply their priors. Thus among consumers with prior (a, b) the number having $\hat{\theta} < a/(a+b)$ is zero, and "all of them," i.e., $Ng(a, b)$, have $\hat{\theta} \geqslant a/(a+b)$.

Writing $\hat{\rho} = 1/\hat{\theta} - 1$ so that $\hat{\theta} = 1/(1+\hat{\rho})$, we see that F takes the value zero on the area below the ray $b = a\hat{\rho}$. Comparing this with our assumption on $g(a, b)$, (Fig. 1) we have immediately

Corollary. *For any $\hat{\theta} < \theta_0$, $R(0, \hat{\theta}) = 0$.*

Lemma 2.

$$\begin{aligned} F_L(0, \hat{\theta}, a, b) &= 0; && \frac{a+1}{a+b+1} \leqslant \hat{\theta}, && \text{(A1)} \\ &= -\frac{\pi NT}{2}\theta(0)\, g(a, b); && \frac{a}{a+b} \leqslant \hat{\theta} < \frac{a+1}{a+b+1}, && \text{(A2)} \\ &= \frac{\pi NT}{2}(1 - \theta(0))\, g(a, b); && \frac{a}{a+b+1} \leqslant \hat{\theta} < \frac{a}{a+b}, && \text{(A3)} \\ &= 0; && \hat{\theta} < \frac{a}{a+b+1}. && \text{(A4)} \end{aligned}$$

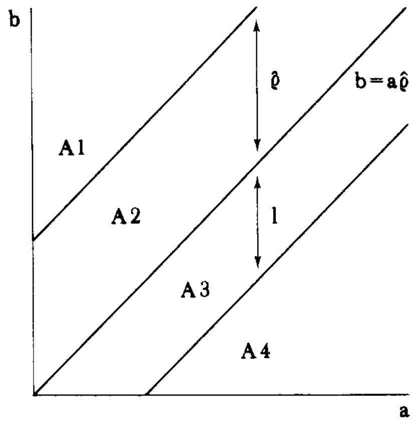

FIG. 3. The regions of Lemma 2, for a given $\hat{\theta}$.

The four regions specified by the sets of inequalities here, and labelled (A1)–(A4), respectively, are illustrated in Fig. 3. Again writing $\hat{\rho} = 1/\hat{\theta} - 1$, $\hat{\theta} = 1/(1+\hat{\rho})$, the ray $b = a\hat{\rho}$ divides (A2) from (A3). The boundary between (A2) and (A1) is obtained by shifting this ray *vertically* upwards, through a distance $\hat{\rho}$, and the boundary between (A3) and (A4) via a downward *vertical* shift of unity. From our definition (2) of $R(\hat{\theta}, L)$ we have immediately from Lemma 2 that

$$R_L(0, \hat{\theta}, a, b) = -(\pi NT/2)\,\theta(0) \iint_{A_2} g(a,b)\,da\,db$$

$$+ (\pi NT/2)(1-\theta(0)) \iint_{A_3} g(a,b)\,da\,db.$$

Now as $\hat{\theta} \to 0$, so that $\hat{\rho} \to +\infty$, the three boundaries separating (A1)–(A4) converge towards the vertical through the origin, whence from our assumption on $g(a, b)$ (Fig. 1) we have the immediate

COROLLARY. *For $\hat{\theta}$ sufficiently small, $R_L(0, \hat{\theta}) = 0$.*

In order to complete our series of preliminary results, we wish to introduce the notion that the volume of information generated by the consumers' reports of their experience is "sufficiently great." We shall do this by holding constant π, the probability that any particular consumer hears of a certain unit of service, while requiring that the size of the total population of potential consumers be sufficiently large: thus a sufficiently large (expected) number of potential consumers hear of the unit of service provided.

LEMMA 3. *For any* $L > 0$ *and any* $\hat{\theta}$, *there exists* $N(\hat{\theta}, L)$ *such that for all* $N > N(\hat{\theta}, L)$

$$R(L, \hat{\theta}) > L,$$

i.e., the perceived quality of the profession is at least $\hat{\theta}$.

Proof. We first note from the definition of $c(r, \hat{\theta}, a, b)$ that for r sufficiently large, $c(r, \hat{\theta}, a, b) > 0$. Hence the integrand in (1) does not vanish. Thus, from (1), (2), R is positive and proportional to N whence our result follows.

We may now combine the foregoing results to deduce our central proposition.

Choose any value of $\hat{\theta} < \theta_0$ sufficiently small so that $R(0, \hat{\theta}, a, b) = R_L(0, \hat{\theta}, a, b) = 0$. This is possible by virtue of the Corollaries to Lemmas 1, 2. Now from Lemma 3, for any $L > 0$ we can find N such that the perceived quality of the profession is at least $\hat{\theta}$.

But since $R(0, \hat{\theta}, a. b) = R_L(0, \hat{\theta}, a, b) = 0$, we have that $R(L, \hat{\theta}, a, b) < L$ in a neighbourhood of the origin. Thus a profession of arbitrarily small size can not achieve this level of perceived quality.

From this our central result follows. For, taking now this fixed value of N, there exists a minimum size to which the profession must expand in order to achieve a level of perceived quality $\hat{\theta}$.

We have established

PROPOSITION. *If information is transmitted with fixed positive probability* π *to each consumer in a sufficiently large population* N, *then there exists an* $L > 0$ *such that the perceived quality of a profession of size* L *is strictly better than that achieved at any smaller size of profession.*

Moreover, since equilibrium is determined as the cutoff price for the marginal consumer whose estimate of $\hat{\theta}$ defines our "perceived quality," as noted in Section II, we have

COROLLARY. *Under the conditions of the Proposition, there exists a size* $L > 0$ *such that the associated equilibrium price of services is strictly greater than that attained by any smaller profession.*

Thus, if the aim of the self regulating profession is to maximise income per member—being the price per unit of their services, where each member supplies a fixed volume of these services— then the profession will not choose to shrink below a certain size. Thus, under imperfect information, so long as a sufficient flow of information is generated as to the quality of services, a rationale appears for the formation of professional groups (licensing), whose members enjoy an income which reflects inter alia the average quality of the various practitioners.

IV. Summary and Conclusions

We have aimed here to develop a rationale for the formation of professional groups, which rests on the notion of imperfect information among consumers concerning the quality of services offered. We have shown how, so long as a sufficient flow of information is generated, "large" professions may earn a higher price for their services than can be earned by a profession of smaller size—even though the true quality of the profession is enhanced by shrinking. Our argument rests on the idea that consumers differ in their views as to the quality of the profession, and it is those consumers whose views as to its quality are relatively favourable who predominantly purchase its services. More information can in the present context lead to a greater dispersion of views in the very special sense that it may increase the number of consumers willing to patronise the profession at a given price.

Thus, for any distribution of estimates as to its quality among its potential customers, it is the "more favourable" tail of this distribution which determines the price at which sufficient demand is forthcoming to match the (inelastic) supply of services offered (a multiple of its size).

Our proposition reflects the fact that as a larger profession generates more information than a smaller, the level of demand for its services, at any given price, is enhanced.[7]

Our central proposition demonstrates that, so long as the flow of information is adequate, that this effect is sufficiently strong to lead to a fall in the equilibrium price of the profession as it contracts below a certain size—even though such a contraction, consequent on a rise in entry standards—involves an improvement in the "true" quality of the profession.

Appendix

We provide here the proofs of Lemmas 1 and 2.

Proof of Lemma 1. Let $L=0$ in the defining Eq. (2) for $F(L, \hat{\theta}, a, b)$. Then the only term under the summation which may be non-zero is that for $r=0$, viz.

$$\sum_{s=0}^{c(r,\hat{\theta},a,b)} \binom{0}{s} \theta(0)^s(1-\theta(0))^{r-s}.$$

Now $c(0, \hat{\theta}, a, b) \leqslant 0$ and the sum vanishes except when $c(r, \hat{\theta}, a, b)=0$, i.e.,

[7] This is reminiscent of the fact that a rise in the *variance* of the price of a stock leads to a rise in the option price. We are grateful to a referee for pointing this out.

$[(a+b)\hat{\theta}-a] \geqslant 0$, or when $\hat{\theta} \geqslant a/(a+b)$ and then the sum equals unity, whence

$$F(0, \hat{\theta}, a, b) = \frac{Ng(a, b)}{T} \int_0^T d\tau = Ng(a, b). \qquad \text{Q.E.D.}$$

Proof of Lemma 2. The derivative of F at $L=0$ is obtained by integrating the derivative of the integrand at $L=0$. Noting that all terms in L, L^2, etc., vanish, the only non-vanishing terms in the summation are (differentiating and setting $L=0$),

$$-\pi\tau \sum_{s=0}^{c(0,\hat{\theta},a,b)} 1 + \pi\tau \sum_{s=0}^{c(1,\hat{\theta},a,b)} \binom{1}{s} \theta^s (1-\theta)^{r-s}.$$

(i) For $\hat{\theta} < \dfrac{a}{a+b+1}$: $c(0, \hat{\theta}, a, b) < 0, c(1, \hat{\theta}, a, b) < 0$ whence

$$F_L(0, \hat{\theta}, a, b) = 0.$$

(ii) For $\dfrac{a}{a+b+1} \leqslant \hat{\theta} < \dfrac{a}{a+b}$: $c(0, \hat{\theta}, a, b) < 0, c(1, \hat{\theta}, a, b) = 0$,

$$\left(\text{since } \hat{\theta} < \frac{a+1}{a+b+1}\right),$$

and so $F_L(0, \hat{\theta}, a, b) = \dfrac{Ng(a, b)}{T} \displaystyle\int_0^T \pi\tau(1-\theta(0))\, d\tau$

$$= \frac{N\pi T}{2}(1-\theta(0))\, g(a, b).$$

(iii) For $\dfrac{a}{a+b} \leqslant \hat{\theta} < \dfrac{a+1}{a+b+1}$: $c(0, \hat{\theta}, a, b) = 0$, $c(1, \hat{\theta}, a, b) = 0$ and so

$$F_L(0, \hat{\theta}, a, b) = \frac{Ng(a, b)}{T} \int_0^T -\pi\tau\theta(0)\, d\tau$$

$$= -\frac{N\pi T}{2}\theta(0)\, g(a, b).$$

(iv) For $\dfrac{a+1}{a+b+1} \leqslant \hat{\theta}$: $c(0, \hat{\theta}, a, b) = 0$, $c(1, \hat{\theta}, a, b) = 1$ whence

$$F_L(0, \hat{\theta}, a, b) = 0. \qquad \text{Q.E.D.}$$

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