ECONOMICS WORKING PAPERS SERIES

Economics Working Paper 87

Quality of Professional Services under Price Floors*

Walter García-Fontes[†]
and
Massimo Motta[‡]

June 1994

UNIVERSITAT POMPEU FABRA

Balmes, 132
Telephone (343) 484 97 00
Fax (343) 484 97 02
08008 Barcelona
e- mail econwp@upf.es

Abstract

A market for professional services is modeled as a three–stage game, where first a regulator sets price floors, then professionals choose a level of investment in human capital that will affect the quality of the service offered and finally they compete in prices for the demand of heterogeneous consumers. We study the effects on social welfare of different levels of a price floor. We think of a price floor as an unavoidable imposition, either in the form of self–regulation by a professional association or as a regulatory device used by the authorities in a professional service market. Price floors can have two different effects: on the one hand they can benefit consumers by improving the price–quality mix offered in the market. On the other hand they may discourage investment on human capital by the professionals, or increase the scope for market power of some professionals by making the market unprofitable for low quality professionals. Our setting allows us to uncover the strategic effects of price floors on the behavior of the professionals. These strategic effects had not received former attention in the discussion on price floors. We show that under certain conditions price floors may lead to a welfare improvement. However, the results are so sensitive to parameter's values of specific markets, that a "laissez–faire" policy seems the most advisable course to follow.

1 Introduction

In many modern economies, the suppliers of professional services are exempted from proceedings against restrictive practices. Practices that for primary or manufacturing industries, as well as for the suppliers of commercial goods or services, would have been objected by antitrust authorities, are allowed in professional practice, for instance in medical, legal or educational services. These restrictive practices include entry restrictions in the form of *numerus clausus*, licenses, compulsory registration or certifications, but also price controls of different kinds, in the form of minimum assured prices or suggested prices for services. The public justification used to allow these sometimes called "Spanish practices" among the professions are the following. 1) The market for professional services is usually characterized by asymmetric information between the buyer and the seller of the service, since the latter owns an acquired skill of arcane nature for the buyer. 2) Very often professional services produce externalities on third parties that the regulator wants to take into account. For instance medical practice may have an important impact on insurance companies or the public sector, and legal practices contribute to the general maintenance of justice, which is a public good provided to the society at large. 3) Professional services are differentiated vertically by their level of quality, which is directly affected by the investment of the professional on the acquisition and maintenance of his or her own skills. As a consequence, the regulator sometimes tries to assure a minimum income to the professional so that he or she has the incentives to invest in human capital.

Usually these restrictive practices are forms of self regulation or impositions by professional associations on their members trying to assure a minimum quality standard of service, although very often subject to some governmental control or monitoring. Mattheus (1991) argues that professional ethics can be regarded both as an assurance for fair conduct but also as the vehicle by which restrictive practices can be implemented through professional associations or public regulation. He views public policy towards these practices as having to choose between two options. One option consists of a system of free competition, protecting consumers against malpractice cases. A second option is based on regulated competition, trying to assure the provision of a menu of services with adequate quality through a combination of entry restrictions, minimum quality standards or price orientations.

The effects of occupational licensing have been analyzed among others by Shapiro (1986) and Garcia-Fontes and Hopenhayn (1992). The latter show that licensing may have severe side effects due to the adverse selection that results from restricting the size of the market for professional services without perfect information on the pool of professionals that will remain in operation. Another way of affecting the quality mix of an industry is by means of minimum quality standards, which have been analyzed for instance by Leland (1979) and by Motta and Thisse (1993).

The use of price controls and their effects on social welfare when both price and quality strategies are available to firms has received instead less attention in the literature. It is well known that in a perfect competitive model with homogeneous products, price controls will lead to quantity rationing and this will affect social welfare negatively. For models of vertically differentiated products, the effects of price regulation on quality have been studied both in partial equilibrium, for instance White (1972) for the case of a regulated monopoly and perfect competition, and in general equilibrium under perfect competition, as in Anderson and Enomoto (1986 and 1987).

Price controls may have a strategic effect on the behavior of the professionals: if the suppliers of services have some market power, but some of them are restricted by a fix or binding price control, the market may perceive the restriction as a commitment to adhere to a particular conduct, constituting an implicit facilitating practice that may result in an increase in profits for all suppliers. This effect has been noticed by Eichberger and Harper (1987) in a duopoly model where the goods are close but imperfect substitutes. There is a similar effect of price restrictions in models that analyze the effects of most-favored clauses, for instance DeGraba (1987), who analyzes competition between national and local firms. Here the price restriction makes the firm with national scope a weak competitor in local markets.

In this work we present a model of vertical differentiation of a professional service duopoly. The regulator chooses price floors in a first stage. The professionals choose a level of service quality in the second stage and compete in prices in the third stage. They view the price floors as restrictions to their optimal behavior in the third stage, but these have also important strategic effects on their behavior in the second stage. Consistent with a usual result in the literature on vertical product differentiation, there is an asymmetric equilibrium where one of the professionals supplies a high quality service while the other professional supplies a low quality service. A price floor will be viewed by the high quality professional as a commitment by the low quality professional to reduce his aggressiveness in prices in the last stage of the game. This will have an initial negative impact on social welfare, since both suppliers will reduce their qualities and the price reduction will not be large enough to compensate for the welfare loss. As the price floor is raised the profits of the low quality professional will be reduced and eventually the market will be profitable for just one professional. At this point, where the profits of the low quality professional have been squeezed to zero, social welfare will be maximum, but an infinitesimal increase in the price floor will turn the market profitable for only one professional, and the consequent monopolized market will result in lower total social welfare. In short, the use of price floors has very sensitive outcomes and may be damaging for social welfare.

The paper is organized as follows. Section 2 presents the general model. In section 3 we describe the pricing decision, considering qualities as fixed. Section 4 studies the imposition of a price floor. Concluding comments are presented in section 5.

2 The model

We use a version of Mussa and Rosen's (1978) model, with fixed costs of quality. There are two professionals offering a service [1]. They face a fixed cost of producing one unit of the service at quality q equal to $F(q) = q^2/2$. This can be interpreted as follows: to obtain a quality of level q of their service they have to invest $q^2/2$ on human capital. Marginal costs of production of services are supposed to be constant (without loss of generality, we suppose they are equal to zero).

The market is modeled as a three–stage game. In the first stage the regulator chooses the level of a price floor in order to maximize total surplus: no intervention or a price floor $\underline{p}$ represent his or her set of choices. In the second stage each professional chooses a quality level q paying the corresponding fixed cost. Finally, in the third stage the professionals simultaneously choose prices p_1 and p_2 at which they are willing to supply their services. The solution concept is subgame perfect Nash equilibrium, and the game is solved backwards.

Consumers are assumed to have a utility function equal to $U = \theta q_i - p_i$, where θ is a taste parameter[2]. We assume that θ is continuously distributed on an interval $[0, \bar{\theta}]$. We also assume that the consumer buys at most one unit of services. In case of no purchase, the utility of the consumer would be zero (notice that the assumption of unit purchase seems realistic when dealing with professional services). Assuming that the professional 1 supplies the high quality and the professional 2 supplies

[1]The model obviously can be applied to any kind of firms competing on a differentiated product.

[2]It would be equivalent to assume that consumers differ on income, instead of tastes

the low quality ($q_1 > q_2$), the consumer θ_{12} indifferent between patronizing professional 1 or 2 is

$$\theta_{12}q_1 - p_1 = \theta_{12}q_2 - p_2,$$

that is $\theta_{12} = (p_1 - p_2)/(q_1 - q_2)$. On the other hand, the consumer with lowest reservation value served by the low quality professional can be defined by $0 = \theta_2 q_2 - p_2$, and hence $\theta_2 = p_2/q_2$. Therefore, the demands for high and low quality products are, respectively, $D_1 = \bar{\theta} - \theta_{12}$ and $D_2 = \theta_{12} - \theta_2$.

3 The price stage

Professionals maximize profits in the third period subject to the regulatory constraints[3]:

$$\max_{p_1} = p_1 D_1$$

$$\max_{p_2} = p_2 D_2$$
$$\text{subject to } \underline{p} \leq p_2.$$

It is easy to check that both profit functions are strictly concave in the own prices, so that the Kuhn–Tucker conditions for a constrained maximum adopt a very simple form: they imply that for the low quality professional the constraint will be binding if the first derivative of its profit function evaluated at $\underline{p}$ is negative, since in this case increasing its price will reduce its profit. This is shown in Figure 1.

Consider the first derivatives of the profit functions:

$$\frac{\partial \pi_1}{\partial p_1} = \bar{\theta} - \frac{2p_1 - p_2}{q_1 - q_2}, \tag{1}$$

$$\frac{\partial \pi_2}{\partial p_2} = \frac{p_1 - 2p_2}{q_1 - q_2} - \frac{2p_2}{q_2}, \tag{2}$$

[3]The price restriction imposed on the professionals can be thought as involving an infinitely large penalty in case of violation, so that it is always respected if binding. It is interesting to include the penalty as another regulatory tool, but we chose to keep the model simple by assuming a very large penalty.

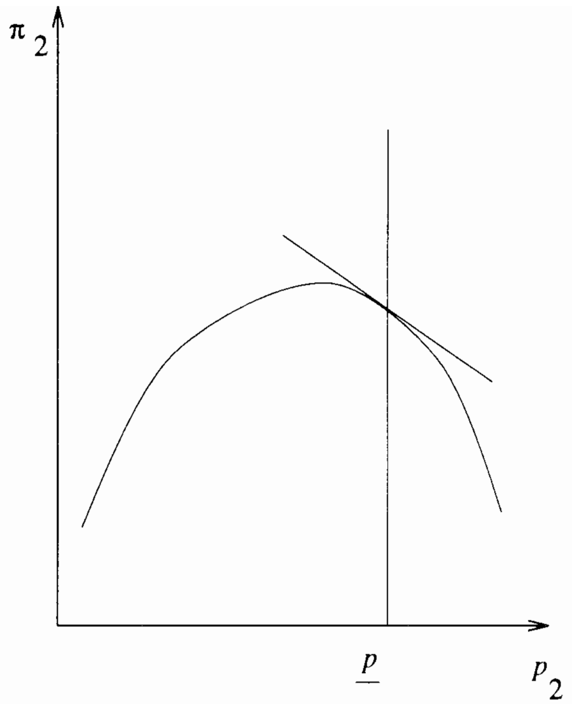

Figure 1: Kuhn–Tucker conditions for a binding price floor

The Kuhn–Tucker condition for a price floor to become binding can be obtained in terms of (2) by solving for p_1. Hence, in the price stage these are the reaction functions:

$$R_1(p_2) = \frac{\bar{\theta}(q_1 - q_2) + p_2}{2}$$

$$R_2(p_1) = \begin{cases} \underline{p} & \text{if } p_1 < \dfrac{2\underline{p}q_1}{q_2} \\ \dfrac{p_1 q_2}{2q_1} & \text{if } p_1 \geq \dfrac{2\underline{p}q_1}{q_2} \end{cases}$$

By solving the system of equations for the unconstrained case we can obtain the equilibrium prices when the price floor is not binding, which are given here for future reference:

$$p_1^* = \frac{2q_1\bar{\theta}q_1 - q_2}{4q_1 - q_2},$$

$$p_2^* = \frac{q_2\bar{\theta}q_1 - q_2}{4q_1 - q_2}.$$

When will the price floor be binding? Call k_1 the critical value of p_1 so that $\underline{p}$ becomes binding for professional 2

$$k_1 = \frac{2\underline{p}q_1}{q_2},$$

That is, if $p_1 < k_1$ then the low quality professional is constrained by the price floor and chooses $\underline{p}$, otherwise he will choose his best response to p_1. In Figure 2. we represent the reaction functions. In the first case,

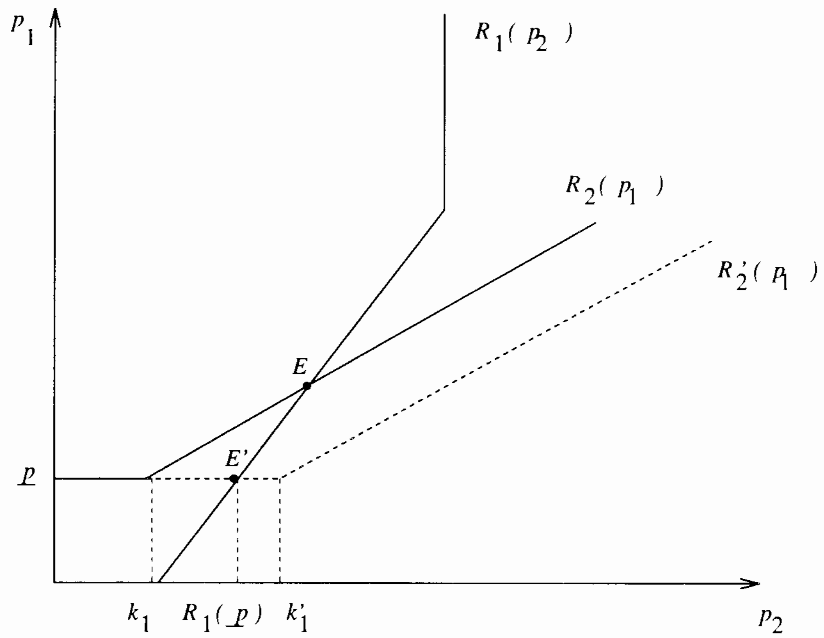

Figure 2: Critical value for $\underline{\text{p}}$ to become binding for professional 2

represented by a reaction function for 2 equal to $R_2(p_1)$, we have that $k_1 \leq R_1(\underline{p})$. In this case the price floor does not affect the behavior of the professionals and therefore we have an interior equilibrium in point E. In the second case, represented by a reaction function for 2 equal to $R_2'(p_1)$, we have that $k_1 > R_1(\underline{p})$ and the price floor binds the behavior of the professionals. In this last case, the equilibrium price for 1 is $R_1(\underline{p})$. Therefore the critical value for the price floor to become binding can be obtained by solving $k_1 \leq R_1(\underline{p})$, that is:

$$\frac{\bar{\theta}(q_1 - q_2) + \underline{p}}{2} \leq \frac{2\underline{p}q_1}{q_2},$$

and solving for $\underline{p}$:

$$\underline{p} \geq \frac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2}.$$

Notice that the critical value coincides with the equilibrium price of the unconstrained game. Think for instance of professional 2. If the minimum price is less than the equilibrium price, and professional 1 is adopting her best response, then it is optimal for professional 2 to adopt his best response, and the minimum price is not binding. But if it is higher than the equilibrium price, given that prices are strategic complements he will adopt the minimum possible price.

These critical values define two possible regions, represented in Figure 3. At region I, the equilibrium prices are determined by the price

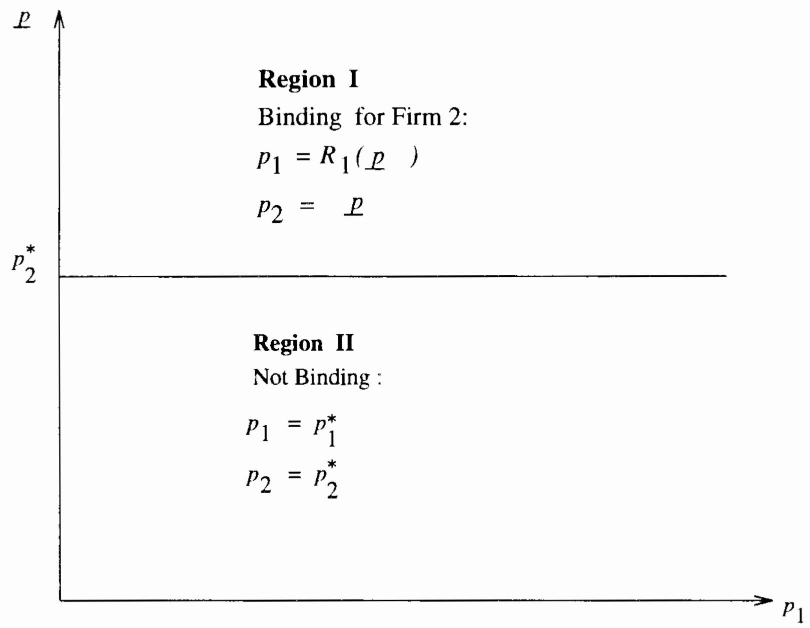

Figure 3: Solutions for the third stage

restriction and the reaction funcions, while at region II the equilibrium is interior and the equilibrium prices correspond to the solution of the system of first order conditions. In Table 1 we summarize the results of the model for the third stage.

In the next section we describe the second stage of the game, considering different levels of the price floors imposed by the government.

Table 1: Gross equilibrium profits and prices for the third stage

	p_1^*	p_2^*	Gross Profits 1	Gross Profits 2
Region I	$\frac{\bar{\theta}(q_1 - q_2) + \underline{p}}{2}$	$\underline{p}$	$\frac{(\bar{\theta}(q_1 - q_2) + \underline{p})^2}{4(q_1 - q_2)}$	$\underline{p}\left(\frac{\bar{\theta}(q_1 - q_2)}{2(q_1 - q_2)} - \frac{\underline{p}}{q_2}\right)$
Region II	$\frac{2q_1\bar{\theta}(q_1 - q_2)}{4q_1 - q_2}$	$\frac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2}$	$\frac{4q_1^2\bar{\theta}^2(q_1 - q_2)}{(4q_1 - q_2)^2}$	$\frac{q_1 q_2\bar{\theta}^2(q_1 - q_2)}{(4q_1 - q_2)^2}$

We first present the equilibrium prices and qualities for the unregulated case, which are obtained in Motta (1993)[4]:

$$p_1^* = 0.107662\,\bar{\theta}^3, \qquad p_2^* = 0.0102511\,\bar{\theta}^3,$$

$$q_1^* = 0.253311\,\bar{\theta}^2, \qquad q_2^* = 0.0482383\,\bar{\theta}^2.$$

These are useful for future reference.

4 Price floors

According to Table 1 these are the profit functions in the quality stage for professional 1 and professional 2:

$$\pi_1(q_1, q_2) = \begin{cases} \dfrac{4q_1^2\bar{\theta}^2(q_1 - q_2)}{(4q_1 - q_2)^2} - \dfrac{q_1^2}{2} & \text{if } \underline{p} \leq \dfrac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2} \\[2ex] \dfrac{(\bar{\theta}^2(q_1 - q_2) + \underline{p})^2}{4(q_1 - q_2)} - \dfrac{q_1^2}{2} & \text{if } \underline{p} \geq \dfrac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2} \end{cases}$$

$$\pi_2(q_1, q_2) = \begin{cases} \dfrac{q_1 q_2\bar{\theta}^2(q_1 - q_2)}{(4q_1 - q_2)^2} - \dfrac{q_2^2}{2} & \text{if } \underline{p} \leq \dfrac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2} \\[2ex] \underline{p}\left[\dfrac{\bar{\theta}(q_1 - q_2) - \underline{p}}{2(q_1 - q_2)} - \dfrac{\underline{p}}{q_2}\right] - \dfrac{q_2^2}{2} & \text{if } \underline{p} \geq \dfrac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2} \end{cases}$$

[4]These values, as well as the values presented in the next sections, are numerical approximations, obtained by solving the model numerically.

These profit functions are continuous[5]. This can be shown by substituting:

$$\underline{p} = \frac{q_2\bar{\theta}(q_1 - q_2)}{4q_1 - q_2}$$

into the second portion of $\pi_1(q_1, q_2)$ and $\pi_2(q_1, q_2)$.

Let us denote as (q_1^c, q_2^c) the pair of equilibrium qualities for the constrained game. Let us also denote $\bar{q}_1^c$ as the best response of professional 1 in the unconstrained region if professional 2 adopts his contrained equilibrium quantity q_2^c:

$$\underset{q_1}{\text{Argmax}} \;\; \frac{4q_1^2\bar{\theta}^2(q_1 - q_2^c)}{(4q_1 - q_2^c)^2} - \frac{q_1^2}{2}.$$

Define equivalently $\bar{q}_2^c$ as the quality that solves the equivalent problem for professional 2, for given q_1^c and $\underline{p}$.

We define a *constrained equilibrium* as a pair of qualities (q_1^c, q_2^c) and the associated prices, that, for a given price floor $\underline{p}$, satisfy the following conditions:

1. $$\underline{p} \geq \frac{q_2^c\bar{\theta}(q_1^c - q_2^c)}{4q_1^c - q_2^c} \tag{3}$$

2. If

$$\underline{p} \leq \frac{q_2^c\bar{\theta}(\bar{q}_1^c - q_2^c)}{4\bar{q}_1^c - q_2^c} \tag{4}$$

then

$$\frac{\bar{\theta}^2(q_1^c - q_2^c) + \underline{p}}{4q_1^c - q_2^c} - \frac{(q_1^c)^2}{2} \geq \max_{q_1}\left\{\frac{4q_1^2\bar{\theta}^2(q_1 - q_2^c)}{(4q_1 - q_2^c)^2} - \frac{(q_1)^2}{2}\right\}. \tag{5}$$

3. If

$$\underline{p} \leq \frac{\bar{q}_2^c\bar{\theta}(q_1^c - \bar{q}_2^c)}{4q_1^c - \bar{q}_2^c} \tag{6}$$

then

$$\underline{p}\left[\frac{\bar{\theta}(q_1^c - q_2^c) - \underline{p}}{2(q_1^c - q_2^c)} - \frac{\underline{p}}{q_2^c}\right] - \frac{(q_2^c)^2}{2} \geq \max_{q_2}\left\{\frac{q_1^c q_2\bar{\theta}^2(q_1^c - q_2)}{(4q_1^c - q_2)^2} - \frac{(q_2)^2}{2}\right\}. \tag{7}$$

[5] Profits functions may have a kink when the condition is satisfied with equality.

Condition (3) implies that in a constrained equilibrium we have to be in the constrained price region (Region I of Figure 3). Condition (4) says that if professional 1 can set a quality such that she moves to the unconstrained region, then condition (5) has to hold implying that what she gets by deviating is less than what she gets from staying at the constrained equilibrium. When (6) holds a similar deviation is precluded for professional 2 by condition (7).

We will analyze now the imposition of a price floor that is in a neighborhood of the unconstrained equilibrium price for professional 2. To obtain an analytical solution, we propose a price floor of the form $\underline{p} = k\, l(k)\, h(k)\, \bar{\theta}^3$, where k is an arbitrary parameter and the price floor is expressed in term of this parameter. We then solve for $l(k)$ and $h(k)$. With this price floor we conjecture solutions of the form $q_1^c(k) = h(k)\, \bar{\theta}^2$ and $q_2^c(k) = h(k)\, l(k)\, \bar{\theta}^2$, solving for $h(k)$ and $l(k)$ from the first order conditions. The results are summarized in the following proposition:

Proposition 1 *Let k be a non–negative real number. Then there exist functions $l(k)$ and $h(k)$ such that if a price floor is imposed of the form*

$$\underline{p} = k\, l(k)\, h(k)\, \bar{\theta}^3,$$

and if $k > 0.217091$, we have the following constrained equilibrium for the quality stage:

$$q_1^c = h(k)\, \bar{\theta}^2, \qquad q_2^c = h(k)\, l(k)\, \bar{\theta}^2,$$

where

$$h(k) = \frac{(1 - l(k))^2 - k^2 l(k)^2}{4(1 - l(k))^2},$$

$$l(k) = \frac{1}{3(k^2 - 1)} \left[\frac{1 - 13k^2 + 28k^4}{D} + D - 2 - 2k^2 \right],$$

$$D = [1 - 6k^2 + 75k^4 - 134k^6 - (1 - k^2)\sqrt{k^2 - 13k^4 + 92k^6 - 148k^8}]^{1/3}.$$

Proof: See Appendix.

Proposition 1 gives closed-form solutions for all the relevant variables of the model. Despite the involved appearance of these solutions we will show later that they are very easy to analyze in terms of different values of k, which is equivalent to perform comparative statics on the value of the price floor.

The imposition of a price floor has a strategic effect on the behavior of both professionals, even if the price floor is not binding. This is analyzed in the following proposition:

Proposition 2 *Even if the choice of the qualities and prices corresponding to the unconstrained equilibrium are available, the professionals will deviate and set lower qualities if a price floor such that* $0.0099701 < \underline{p} < 0.0102511$ *is set.*

Proof: When will the price floor be equal to the unconstrained equilibrium price of the low quality professional? We can find this value of the price floor by finding k^* that solves the following equation:

$$\underline{p} = k^* \ h(k^*) \ l(k^*) \ \bar{\theta}^3 = 0.0102511 \ \bar{\theta}^3 = p_2^*.$$

This equation is solved for a value $k^* = 0.219196$, which is higher than the value of k where the price floor becomes binding (0.217091). The value of $\underline{p}$ associated with this value of k is 0.0099701. ■

The finding that a price floor modifies the equilibrium choice of the professionals even though the floor is higher than the price chosen at the unconstrained equilibrium is surprising. However, there is a simple intuition behind it. Suppose we are at the unconstrained situation. How would the low quality professional respond if the high quality professional sets a quality slightly below the equilibrium quality? His best response would consist of reducing his quality (qualities are strategic substitutes) which implies a reduction in his price (prices are strategic substitutes). It is obvious that this would imply lower profits for both professionals, resulting in professional 1 not lowering her quality. But if the low quality professional is constrained by the price floor, the reduction in his quality cannot be followed by a reduction in his price. He would still find it profitable to reduce his quality, but his price is fixed by the constraint. Now professional 1 would find it profitable to reduce her quality and hence her price, since this would not be matched whith an optimal price cut by professional 2. This result hinges on the strategic substitutiveness of both prices and qualities.

Another interesting feature of the price floor is that for some high enough level of it the market will be profitable for only one professional, that would be then a monopolist offering a single quality. This will happen when the profit of the low quality professional under the restricted equilibrium is equal or less than 0. The higher the price floor, the higher, by definition, the price that professional 2 should charge. But to keep costumers at a higher price, professional 2 must provide them with higher quality. This has a double negative effect on the profits he can earn: firstly, it brings him closer to the quality offered by his rival, rendering price competition tougher. Secondly, it implies a lower investment in human capital, i.e. it implies higher fixed costs. As a result the profits of professional 2 decrease with the increase in the price floor, and eventually they become negative after certain value of k, which we denote k^m. We summarize this result in the following proposition:

Proposition 3 *For a price floor $\underline{p} > 0.0234$ the market will be profitable for only one professional who will offer the monopoly price and quality.*

Proof: In order to find the critical price floor we have to find k^m that solves the following equation:

$$\underline{p}\left[\frac{\bar{\theta}(q_1^c(k^m) - q_2^c(k^m)) - \underline{p}}{2(q_1^c(k^m) - q_2^c(k^m))} - \frac{\underline{p}}{q_2^c(k^m)}\right] - \frac{q_2^c(k^m)}{2} = 0.$$

This equation is satisfied for a value $k^m = 0.297544$. So if we set a price floor $\underline{p} = k^m h(k^m) l(k^m) = 0.0234$ or higher, then the low quality professional will not be able to earn positive profits and will have to leave the market. The high quality professional will be able to set monopoly profits, constrained on the price floor, which will eventually become binding. ■

From Proposition 1 it is possible to numerically approximate the equilibrium qualities, prices, profits, consumer and total surplus for each possible value of k. The results are summarized in Table 2 .

Notice that all the variables are linear multiplicative functions separable on two components: a) $\bar{\theta}$ raised to some power and b) functions of k (or constants). The separability mentioned above allows us to study the behavior of functions $h(k)$ and $l(k)$ whose expressions are known. Ignoring the part involving $\bar{\theta}$, we can get a very clear picture of the behavior of the relevant variables of the model, for any possible value of the price floor (any possible value of k).

The comparative statics effects on qualities and prices chosen, as well as on profits of the professionals, are presented in Figure 4. In this Figure we plot the value of the relevant variables for all possible values of k. All of them show two discontinuities: the first one is associated with the value of k where the price floor becomes binding, and the second one is associated with k^m, the value of the price floor where the market becomes profitable for only one professional. We draw two vertical lines,

Table 2: Equilibria with a price floor

	Value of the price floor				
	Unconstrained equilibrium		Constrained equilibrium		Monopoly solution
	$\underline{p} < 0.00997$ $(k < 0.21709)$		$0.00997 < \underline{p} < 0.02340$ $(0.21709 < k < 0.29754)$		$\underline{p} > 0.02340$ $(k > 0.29754)$
Professional	1	2	1	2	1
Quality $q_1(k)$ $q_2(k)$	$0.2533\bar{\theta}^2$	$0.0482\bar{\theta}^2$	$h(k)\bar{\theta}^2$	$h(k)l(k)\bar{\theta}^2$	$0.2500\bar{\theta}^2$
Price $p_1(k)$ $p_2(k)$	$0.1077\bar{\theta}^3$	$0.0103\bar{\theta}^3$	$\frac{h(k)}{2}[1-(1-k)l(k)]\bar{\theta}^3$	$kl(k)h(k)\bar{\theta}^3$	$0.1250\bar{\theta}^3$
Profit $\pi_1(k)$ $\pi_2(k)$	$0.0244\bar{\theta}^4$	$0.0015\bar{\theta}^4$	$\frac{h(k)}{4[1-l(k)]}[1-(1-k)l(k)^2\bar{\theta}^4$	$h(k)l(k)\left(\frac{1-(1+k)l(k)}{2[1-l(k)]}-k\right)\bar{\theta}^4$	$0.0312\bar{\theta}^4$
Lowest Consumer $\theta_2(k)$	$0.2125\bar{\theta}$		$\frac{p_2(k)}{q_2(k)}$		$0.2500\bar{\theta}$

Table 2: Equilibria with a price floor (Continued)

	Value of the price floor		
	Unconstrained equilibrium	Constrained equilibrium	Monopoly solution
	$\underline{p} < 0.00997$ ($k < 0.21790$)	$0.00997 < \underline{p} < 0.02340$ ($0.21790 < k < 0.29754$)	$\underline{p} > 0.02340$ ($k > 0.29754$)
Marginal Consumer $\theta_{12}(k)$	$0.4755\bar{\theta}$	$\frac{p_1(k) - p_2(k)}{q_1(k) - q_2(k)}$	–
Producer Surplus $PS(k)$	$0.0260\bar{\theta}^4$	$\pi_1(k) + \pi_2(k)$	$0.1250\bar{\theta}^4$
Consumer Surplus $CS(k)$	$0.0432\bar{\theta}^4$	$\int_{\theta_2(k)}^{\theta_{12}(k)}[\theta q_2(k) - p_2(k)]d\theta + \int_{\theta_{12}(k)}^{\bar{\theta}}[\theta q_1(k) - p_1(k)]d\theta$	$0.0312\bar{\theta}^4$
Total Surplus $TS(k)$	$0.0691\bar{\theta}^4$	$CS(k) + PS(k)$	$0.1562\bar{\theta}^4$

one associated with the value of k corresponding to a price floor equal to the unconstrained price of the low quality professional, k^*, and the second one associated with k^m. The figure illustrates that the price floor becomes binding at a value of k lower than the value corresponding to the unconstrained equilibrium price level of the low quality professional, as discussed above. This has an initial effect of reducing the quality and the price of both professionals. As the price floor increases, the high quality professional finds it profitable to reduce the price and the quality of her service. The best response of the low quality professional consists of increasing the quality and price of his service.

On the other hand, in Figure 5 we complete the picture by simulating the comparative statics effects of a price floor on welfare.

These simulations are a nice illustration of the conflict of interests between professional associations and consumer associations. Professional associations would be interested in setting a price floor exactly binding, where producer surplus is maximized. Consumer associations, instead, would be interested in setting a price floor marginally lower than k^m, where still both qualities are offered, but the profits of the low quality producer have been squeezed to zero.

The professionals will have an incentive to ask for a price floor lower than the socially optimal level, since producer surplus is maximized at the lowest binding price floor. It is in this sense that the model presented in this paper illustrates the political process that very often develops at markets for professional services. The interests of the professionals are usually represented by associations with strong political influence. These associations lobby for the imposition of orientative prices, which according to our result may be too low to have a positive impact on social welfare, and may even lower total welfare.

These results support the suggestions of Stigler's (1971) seminal work on the political process of regulation. Any industry composed by oligopolistic producers may actively solicit government regulation, since it may help the producers to coordinate oligopolistic outcomes.

This analysis shows that, in the context of the current model, regulatory policy based on price floors is very sensitive. If the price floor is set at a binding level but too low, total surplus can be reduced compared to the unregulated environment. On the other hand, total surplus is at its maximum when the profit of the low quality professional is brought down to zero, but if the regulator has not enough information about the professional services market and makes the operation of the low quality professional not profitable, it will cause the market to be monopolized and total surplus will fall. The monopolist will provide a higher single

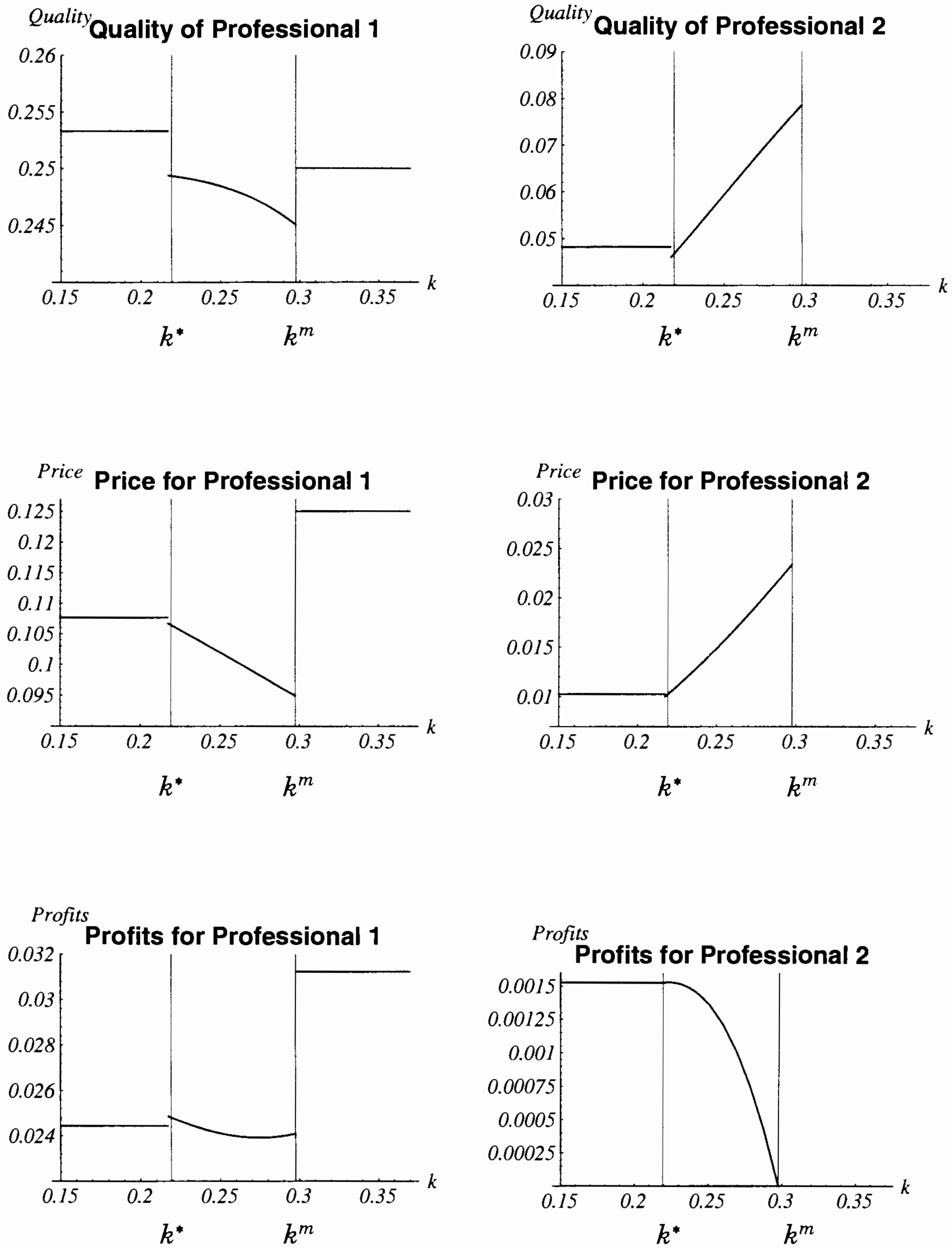

Figure 4: Simulations of the effects of a price floor ($\bar{\theta} = 1$) on quality, prices and profits.

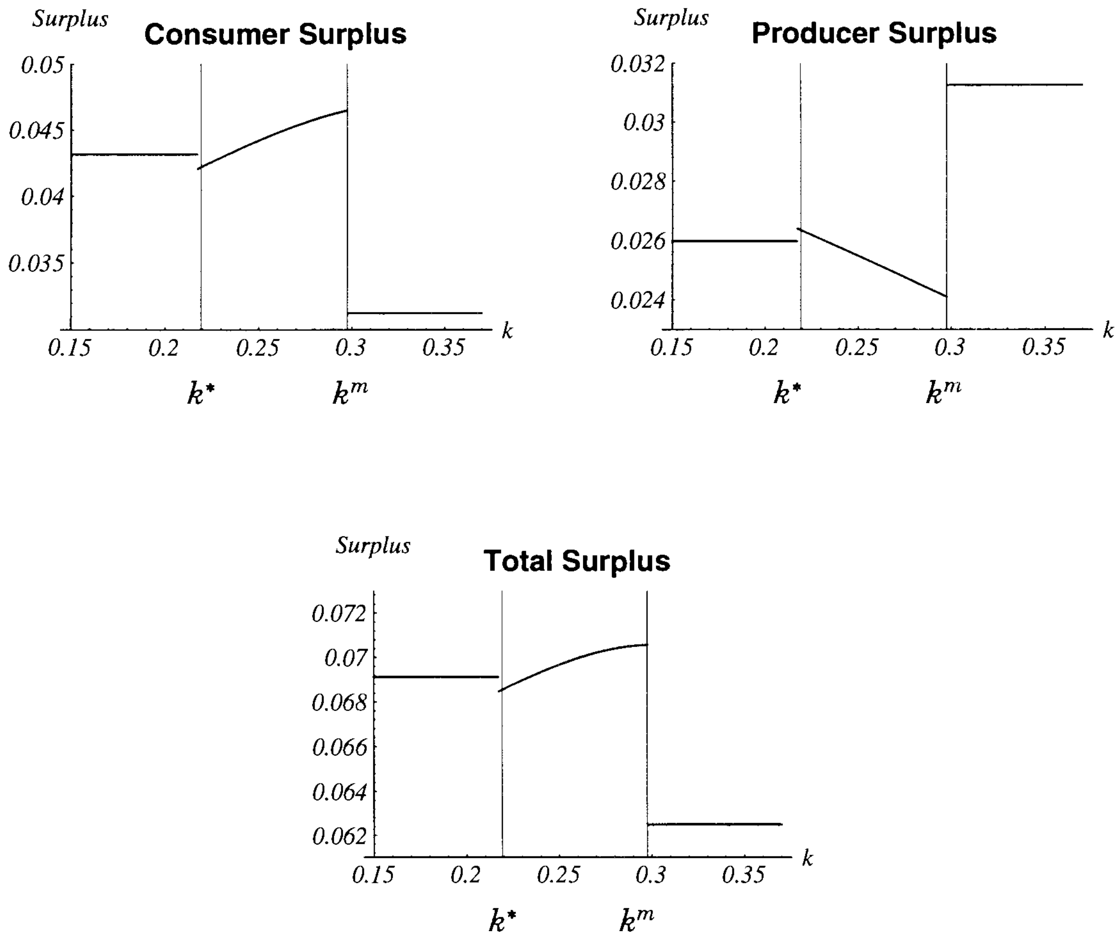

Figure 5: Simulations of the effects of a price floor ($\bar{\theta} = 1$) on consumer welfare, producer welfare and total welfare.

quality but at a higher price[6].

The results of this section are likely to carry over to models with more than two professionals, since the working force behind it is based on the strategic effects of the regulatory constraint and the general features of the vertically differentiated model.

5 Conclusion

We have analyzed the effects of price floors in a model of professional services with heterogeneous consumers. The model, despite its simplicity, highlights the strategic effects that have to be considered in order to analyze the welfare impact of price floors. It is shown that social welfare can be improved using the price control to squeeze the profits of the low quality producer and increase the average quality of the market. But if the price floor is set up at a higher level than necessary, the concentration will increase in the market and social welfare will fall.

We have also shown that if the regulator relies on the suggestions of professional associations to determine the level of the price floor, a too low price floor will be set, since it is in the interest of the producers to set a price floor which is exactly binding. At this point total surplus will be lower than in the absence of price floors. This result illustrates the conflict of interests which is likely to be present in most professional services markets.

On the whole our analysis suggests that it would not be an adequate policy to impose price restrictions. It is true that under some controls (more particularly price floors) it is possible to improve social welfare, but this outcome is highly sensitive to small changes in the price imposed by the authorities. Furthermore, if the regulatory bodies rely on the information provided by professional associations, the price floor fixed would imply a lower average quality, lower consumer surplus and lower total welfare in the market involved. Therefore, it would seem advisable to recommend a "laissez–faire" policy and avoid price interventions.

[6]Although beyond the scope of the paper, it may be interesting to study the combination of a price floor and a subsidy. The latter would guarantee that the low quality professional would not exit the market.

References

ANDERSON, R. K. AND CARL E. ENOMOTO (1986), "Product quality and price regulation: A general equilibrium analysis, " *Economica*, 53:87–95.

——— (1987), "Product quality regulation: a general equlibrium analysis, " *Canadian Journal of Economics*, 20(4):735–749.

DEGRABA, P. J. (1987), "The effects of price restrictions on competition between national and local firms, " *Rand Journal of Economics*, 18(3):333–347.

EICHBERGER, J. AND IAN HARPER (1987), "Price and quantity controls as facilitating devices, " *Economics Letters*, 23:223–228.

GARCIA-FONTES, W. AND HUGO HOPENHAYN (1992). "Entry restrictions and the determination of quality, " Economics Working Paper 10, Universitat Pompeu Fabra.

LELAND, H. E. (1979), "Quacks, lemmons, and licencing: A theory of minimum quality standards, " *Journal of Political Economy*, 87(61):1328–1346.

MATTHEUS, R. C. O. (1991), "The economics of professional ethics: should the professions be more like business?, " *Economic Journal*, 101:737–750.

MOTTA, M. (1993), "Endogenous quality choice: price vs. quantity competition, " *Journal of Industrial Economics*, 41:113–131.

MOTTA, M. AND JACQUES-FRANÇOIS THISSE (1993), "Minimum quality standards as an environmental policy: Domestic and international effects, " Unpublished manuscript.

MUSSA, M. AND S. ROSEN (1978), "Monopoly and product quality, " *Journal of Economic Theory*, 18:301–317.

SHAPIRO, C. (1986), "Investment, moral hazard and occupational licencing, " *Review of Economic Studies*, 13:843–862.

STIGLER, G. J. (1971), "The theory of economic regulation, " *Bell Journal of Economics*, 2:3–21.

WHITE, L. J. (1972), "Quality variation when prices are regulated, " *Bell Journal of Economics*, 3:425–436.

Appendix

Proof of Proposition 1

The first order conditions are:

$$\pi_1'(q_1,q_2)=\begin{cases}\dfrac{4q_1(4q_1^2-3q_1q_2+2q_2^2)\bar{\theta}^2}{(4q_1-q_2)^3}-q_1 & \text{if } \underline{p}\le\dfrac{q_2\bar{\theta}(q_1-q_2)}{4q_1-q_2}\\[2ex] \dfrac{\underline{p}^2q_1^2-2q_1q_2+q_2^2-\underline{p}^2}{4(q_1-q_2)^2}-q_1 & \text{if } \underline{p}\ge\dfrac{q_2\bar{\theta}(q_1-q_2)}{4q_1-q_2}\end{cases}$$

$$\pi_2'(q_1,q_2)=\begin{cases}\dfrac{q_1^2(7q_2-4q_2)\bar{\theta}^2}{(4q_1-q_2)^3}-q_2 & \text{if } \underline{p}\le\dfrac{q_2\bar{\theta}(q_1-q_2)}{4q_1-q_2}\\[2ex] \dfrac{\underline{p}^2(2q_1^2-4q_1q_2+q_2^2)}{2(q_1-q_2)^2q_2^2}-q_2 & \text{if } \underline{p}\ge\dfrac{q_2\bar{\theta}(q_1-q_2)}{4q_1-q_2}\end{cases}$$

From the unconstrained equilibrium we know that a solution if the condition is not binding is given by (q_1^*,q_2^*).

Suppose that the condition is binding. In this case we can solve the system of equations formed by the reaction functions. If we postulate a price floor $\underline{p}=k\ h\ l\ \bar{\theta}^3$ and solutions of the form $q_1^c=h\ \bar{\theta}^3$ and $q_2^c=h\ l\ \bar{\theta}^3$, the conditions become:

$$-h\bar{\theta}^2+\frac{[(1-l)^2-k^2l^2]\bar{\theta}^2}{4(1-l)^2}=0,$$

$$-hl\bar{\theta}^2+\frac{k^2(2-4l-l^2)\bar{\theta}^2}{2(1-l)^2}=0,$$

and solving for h and for l we find only one real solution equal to the solution presented in the statement of the proposition.

The proposed solution will be a constrained equilibrium if conditions (3), (4)-(5) and (6)-(7) are satisfied. We study these conditions in turn:

Condition (3): This condition is satisfied for $k\ge 0.214617$.

Conditions (4)-(5): Condition (4) is satisfied when $k<0.214998$, and condition (5) implies that $k>0.214809$.

Conditions (6)-(7): Condition (6) is satisfied when $k < 0.218719$ and (7) implies that $0.217091 < k < 0.229051$.

If we put all these restrictions on k together, we see that for values of the price floor such that $k > 0.217091$, the pair $(q_1^c(k), q_2^c(k))$ forms a constrained equilibrium. ■

RECENT WORKING PAPERS

1. Albert Marcet and Ramon Marimon
Communication, Commitment and Growth. (June 1991)
[Published in *Journal of Economic Theory* Vol. 58, no. 2, (December 1992)]

2. Antoni Bosch
Economies of Scale, Location, Age and Sex Discrimination in Household Demand. (June 1991)
[Published in *European Economic Review* 35, (1991) 1589-1595]

3. Albert Satorra
Asymptotic Robust Inferences in the Analysis of Mean and Covariance Structures. (June 1991)
[Published in *Sociological Methodology* (1992), pp. 249-278, P.V. Marsden Edt. Basil Blackwell: Oxford & Cambridge, MA]

4. Javier Andrés and Jaume Garcia
Wage Determination in the Spanish Industry. (June 1991)
[Published as "Factores determinantes de los salarios: evidencia para la industria española" in J.J. Dolado et al. (eds.) *La industria y el comportamiento de las empresas españolas (Ensayos en homenaje a Gonzalo Mato)*, Chapter 6, pp. 171-196, Alianza Economia]

5. Albert Marcet
Solving Non-Linear Stochastic Models by Parameterizing Expectations: An Application to Asset Pricing with Production. (July 1991)

6. Albert Marcet
Simulation Analysis of Dynamic Stochastic Models: Applications to Theory and Estimation. (November 1991), 2d. version (March 1993)
[Forthcoming in *Advances in Econometrics* invited symposia of the Sixth World Congress of the Econometric Society (Eds. JJ. Laffont i C.A. Sims). Cambridge University Press]

7. Xavier Calsamiglia and Alan Kirman
A Unique Informationally Efficient and Decentralized Mechanism with Fair Outcomes. (November 1991)
[Forthcoming in *Econometrica*]

8. Albert Satorra
The Variance Matrix of Sample Second-order Moments in Multivariate Linear Relations. (January 1992)
[Published in *Statistics & Probability Letters* Vol. 15, no. 1, (1992), pp. 63-69]

9. Teresa Garcia-Milà and Therese J. McGuire
Industrial Mix as a Factor in the Growth and Variability of States'Economies. (January 1992)
[Forthcoming in *Regional Science and Urban Economics*]

10. Walter Garcia-Fontes and Hugo Hopenhayn
Entry Restrictions and the Determination of Quality. (February 1992)

11. Guillem López and Adam Robert Wagstaff
Indicadores de Eficiencia en el Sector Hospitalario. (March 1992)
[Published in *Moneda y Crédito* Vol. 196]

12. Daniel Serra and Charles ReVelle
The PQ-Median Problem: Location and Districting of Hierarchical Facilities. Part I (April 1992)
[Published in *Location Science*, Vol. 1, no. 1 (1993)]

13. Daniel Serra and Charles ReVelle
The PQ-Median Problem: Location and Districting of Hierarchical Facilities. Part II: Heuristic Solution Methods. (April 1992)
[Forthcoming in *Location Science*]

14. Juan Pablo Nicolini
Ruling out Speculative Hyperinflations: a Game Theoretic Approach. (April 1992)

15. Albert Marcet and Thomas J. Sargent
Speed of Convergence of Recursive Least Squares Learning with ARMA Perceptions. (May 1992)
[Forthcoming in *Learning and Rationality in Economics*]

16. Albert Satorra
Multi-Sample Analysis of Moment-Structures: Asymptotic Validity of Inferences Based on Second-Order Moments. (June 1992)
[Forthcoming in *Statistical Modelling and Latent Variables* Elsevier, North Holland. K.Haagen, D.J.Bartholomew and M. Deistler (eds.)]

Special issue Vernon L. Smith
Experimental Methods in Economics. (June 1992)

17. Albert Marcet and David A. Marshall
Convergence of Approximate Model Solutions to Rational Expectation Equilibria Using the Method of Parameterized Expectations.

18. M. Antònia Monés, Rafael Salas and Eva Ventura
Consumption, Real after Tax Interest Rates and Income Innovations. A Panel Data Analysis. (December 1992)

19. Hugo A. Hopenhayn and Ingrid M. Werner
Information, Liquidity and Asset Trading in a Random Matching Game. (February 1993)

20. Daniel Serra
The Coherent Covering Location Problem. (February 1993)

21. Ramon Marimon, Stephen E. Spear and Shyam Sunder
Expectationally-driven Market Volatility: An Experimental Study. (March 1993)
[Forthcoming in *Journal of Economic Theory*]

22. Giorgia Giovannetti, Albert Marcet and Ramon Marimon
Growth, Capital Flows and Enforcement Constaints: The Case of Africa. (March 1993)
[Published in *European Economic Review* 37, pp. 418-425 (1993)]

23. Ramon Marimon
Adaptive Learning, Evolutionary Dynamics and Equilibrium Selection in Games. (March 1993)
[Published in *European Economic Review* 37 (1993)]

24. Ramon Marimon and Ellen McGrattan
On Adaptive Learning in Strategic Games. (March 1993)
[Forthcoming in *A. Kirman and M. Salmon eds.* "Learning and Rationality in Economics" Basil Blackwell]

25. Ramon Marimon and Shyam Sunder
Indeterminacy of Equilibria in a Hyperinflationary World: Experimental Evidence. (March 1993)
[Forthcoming in *Econometrica*]

26. Jaume Garcia and José M. Labeaga
A Cross-Section Model with Zeros: an Application to the Demand for Tobacco. (March 1993)

27. Xavier Freixas
Short Term Credit Versus Account Receivable Financing. (March 1993)

28. Massimo Motta and George Norman
Does Economic Integration cause Foreign Direct Investment? (March 1993)
[Published in *Working Paper University of Edinburgh* 1993:I]

29. Jeffrey Prisbrey
An Experimental Analysis of Two-Person Reciprocity Games. (February 1993)
[Published in *Social Science Working Paper 787* (November 1992)]

30. Hugo A. Hopenhayn and Maria E. Muniagurria
Policy Variability and Economic Growth. (February 1993)

31. Eva Ventura Colera
A Note on Measurement Error and Euler Equations: an Alternative to Log-Linear Approximations. (March 1993)

32. Rafael Crespí i Cladera
Protecciones Anti-Opa y Concentración de la Propiedad: el Poder de Voto. (March 1993)

33. Hugo A. Hopenhayn
The Shakeout. (April 1993)

34. Walter Garcia-Fontes
Price Competition in Segmented Industries. (April 1993)

35. Albert Satorra i Brucart
On the Asymptotic Optimality of Alternative Minimum-Distance Estimators in Linear Latent-Variable Models. (February 1993)

36. Teresa Garcia-Milà, Therese J. McGuire and Robert H. Porter
The Effect of Public Capital in State-Level Production Functions Reconsidered. (February 1993)

37. Ramon Marimon and Shyam Sunder
Expectations and Learning Under Alternative Monetary Regimes: an Experimental Approach. (May 1993)

38. José M. Labeaga and Angel López
Tax Silumlations for Spain with a Flexible Demand System. (May 1993)

39. Daniel Serra and Charles ReVelle
Market Capture by Two Competitors: The Pre-Emptive Location Problem. (May 1993)
[Forthcoming in *Journal of Regional Science*]

40. Xavier Cuadras-Morató
Commodity Money in the Presence of Goods of Heterogenous Quality. (July 1993)
[Published in *Economic Theory* 4 (1994)]

41. M. Antònia Monés and Eva Ventura
Saving Decisions and Fiscal Incentives: A Spanish Panel Based Analysis. (July 1993)

42. Wouter J. den Haan and Albert Marcet
Accuracy in Simulations. (September 1993)
[Forthcoming in *Review of Economic Studies*]

43. Jordi Galí
Local Externalities, Convex Adjustment Costs and Sunspot Equilibria. (September 1993)
[Forthcoming in *Journal of Economic Theory*]

44. Jordi Galí
Monopolistic Competition, Endogenous Markups, and Growth. (September 1993)
[Forthcoming in *European Economic Review*]

45. Jordi Galí
Monopolistic Competition, Business Cycles, and the Composition of Aggregate Demand. (October 1993)
[Forthcoming in *Journal of Economic Theory*]

46. Oriol Amat
The Relationship between Tax Regulations and Financial Accounting: a Comparison of Germany, Spain and the United Kingdom. (November 1993)
[Forthcoming in *European Management Journal*]

47. Diego Rodríguez and Dimitri Vayanos
Decentralization and the Management of Competition. (November 1993)

48. Diego Rodríguez and Thomas M. Stoker
A Regression Test of Semiparametric Index Model Speciication. (November 1993)

49. Oriol Amat and John Blake
Control of the Costs of Quality Management: a Review or Current Practice in Spain. (November 1993)

50. Jeffrey E. Prisbrey
A Bounded Rationality, Evolutionary Model for Behavior in Two Person Reciprocity Games. (November 1993)

51. Lisa Beth Tilis
Economic Applications of Genetic Algorithms as a Markov Process. (November 1993)

52. Ángel López
The Comand for Private Transport in Spain: A Microeconometric Approach. (December 1993)

53. Ángel López
An Assessment of the Encuesta Continua de Presupuestos Familiares (1985-89) as a Source of Information for Applied Reseach. (December 1993)

54. Antonio Cabrales
Stochastic Replicator Dynamics. (December 1993)

55. Antonio Cabrales and Takeo Hoshi
Heterogeneous Beliefs, Wealth Accumulation, and Asset Price Dynamics. (February 1993, Revised: June 1993)

56. Juan Pablo Nicolini
More on the Time Inconsistency of Optimal Monetary Policy. (November 1993)

57. Lisa B. Tilis
Income Distribution and Growth: A Re-examination. (December 1993)

58. José María Marín Vigueras and Shinichi Suda
A Model of Financial Markets with Default and The Role of "Ex-ante" Redundant Assets. (January 1994)

59. Angel de la Fuente and José María Marín Vigueras
Innovation, "Bank" Monitoring and Endogenous Financial Development. (January 1994)

60. Jordi Galí
Expectations-Driven Spatial Fluctuations. (January 1994)

61. Josep M. Argilés
Survey on Commercial and Economic Collaboration Between Companies in the EEC and Former Eastern Bloc Countries. (February 1994)

62. German Rojas
Optimal Taxation in a Stochastic Growth Model with Public Capital: Crowding-in Effects and Stabilization Policy. (September 1993)

63. Irasema Alonso
Patterns of Exchange, Fiat Money, and the Welfare Costs of Inflation. (September 1993)

64. Rohit Rahi
Adverse Selection and Security Design. (February 1994)

65. Jordi Galí and Fabrizio Zilibotti
Endogenous Growth and Poverty Traps in a Cournotian Model. (November 1993)

66. Jordi Galí and Richard Clarida
Sources of Real Exchage Rate Fluctuations: How Important are Nominal Shocks?. (October 1993, Revised: January 1994)
[Forthcoming in *Carnegie-Rochester Conference in Public Policy*]

67. John Ireland
A DPP Evaluation of Efficiency Gains from Channel-Manufacturer Cooperation on Case Counts. (February 1994)

68. John Ireland
How Products' Case Volumes Influence Supermarket Shelf Space Allocations and Profits. (February 1994)

69. Fabrizio Zilibotti
Foreign Investments, Enforcement Constraints and Human Capital Accumulation. (February 1994)

70. Vladimir Marianov and Daniel Serra
Probabilistic Maximal Covering Location Models for Congested Systems. (March 1994)

71. Giorgia Giovannetti.
Import Pricing, Domestic Pricing and Market Structure. (August 1993, Revised: January 1994)

72. Raffaela Giordano.
A Model of Inflation and Reputation with Wage Bargaining. (November 1992, Revised March 1994)

73. Jaume Puig i Junoy.
Aspectos Macroeconómicos del Gasto Sanitario en el Proceso de Convergencia Europea. (Enero 1994)

74. Daniel Serra, Samuel Ratick and Charles ReVelle.
The Maximum Capture Problem with Uncertainty (March 1994)

75. Oriol Amat, John Blake and Jack Dowds.
Issues in the Use of the Cash Flow Statement-Experience in some Other Countries (March 1994)

76. Albert Marcet and David A. Marshall.
Solving Nonlinear Rational Expectations Models by Parameterized Expectations: Convergence to Stationary Solutions (March 1994)

77. Xavier Sala-i-Martin.
Lecture Notes on Economic Growth (I): Introduction to the Literature and Neoclassical Models (May 1994)

78. Xavier Sala-i-Martin.
Lecture Notes on Economic Growth (II): Five Prototype Models of Endogenous Growth (May 1994)

79. Xavier Sala-i-Martin.
Cross-Sectional Regressions and the Empirics of Economic Growth (May 1994)

80. Xavier Cuadras-Morató.
Perishable Medium of Exchange (Can Ice Cream be Money?) (May 1994)

81. Esther Martínez García.
Progresividad y Gastos Fiscales en la Imposición Personal sobre la Renta (Mayo 1994)

82. Robert J. Barro, N. Gregory Mankiw and Xavier Sala-i-Martin.
Capital Mobility in Neoclassical Models of Growth (May 1994)

83. Sergi Jiménez-Martin.
The Wage Setting Process in Spain. Is it Really only about Wages? (April 1993, Revised: May 1994)

84. Robert J. Barro and Xavier Sala-i-Martin.
Quality Improvements in Models of Growth (June 1994)

85. Francesco Drudi and Raffaela Giordano.
Optimal Wage Indexation in a Reputational Model of Monetary Policy Credibility (February 1994)

86. Christian Helmenstein and Yury Yegorov.
The Dynamics of Migration in the Presence of Chains (June 1994)

87. Walter García-Fontes and Massimo Motta.
Quality of Professional Services under Price Floors. (June 1994)