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Endogenous market regulation in a signaling model of lobby formation

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Abstract

This paper aims at explaining industry protection in a context in which the government cannot observe the state of market demand. We develop an asymmetric information model and use the tools of contract theory in order to understand (i) how the level of industry protection is endogenously determined, and (ii) why some industries decide to engage in large lobbying costs to become politically active. Our model offers plausible explanations to phenomena such as the "loser's paradox", where weak industries receive the most protection although strong industries are the ones that spend more resources on lobbying activities. The model also allows for an analysis of the influence that lobbying costs have on the decision to organize actively as a lobby.

JEL codes: D72, D82, D86, L51.

Keywords: Asymmetric information; lobby formation; signaling.

1. Introduction

The importance of special interest groups in determining economic policy is beyond question. Lobbying activities by organized interest groups serve a double role. On the one hand, such activities attempt to *influence decision making* in favour of the interest group. On the other hand, they *provide useful information* to a policy maker regarding the likely consequences of specific public policies. This paper combines both aspects of lobbying to gain some understanding about the extent of regulation in the form of industry protection when regulatory outcomes are uncertain to the policy-maker.

There are many instances in which the state of market demand is not perfectly known to the policy-maker. Typically, in the sector of highly-qualified professional services (lawyers, doctors, architects), information about market demand is private to the firms (professionals). Small firms in competitive markets often join together to form associations (like the Chamber of Commerce) to lobby the legislator in order to obtain market protection (usually, through licensure or entry restrictions). Such demands are likely to exert influence on those politicians who are partly concerned with rent extraction (for instance through taxation on extraordinary profits). We consider a policy-maker *à la* Stigler[1], who faces incentives to regulate the market at the expense of consumer welfare. The level of protection that maximizes the policy-maker's utility depends on market conditions, but these conditions are frequently information private to the industry.

The informational setting assumed describes an adverse selection problem, that we analyze in a principal-agent framework[2]. By organizing as a lobby, the industry gains

[1] See Stigler (1971) and Pelzman (1976).

[2] This setting departs from the standard menu-auction approach, based on the theory of common agency (Bernheim and Whinston, 1986), which was first adapted to the study of lobbying in a context of trade regulation by Grossman and Helpman (1994) and that has been followed by many authors since then.

bargaining power to the extent that it can take the initiative in negotiations over protection (the industry then plays the role of the principal). However, if the industry is unorganized, it is the policy-maker who makes a regulatory proposal. We propose a regulatory framework in which a domestic production quota[3] (X) is imposed in exchange for a transfer to the policy-maker (Z). This transfer can be thought of as money seized from taxation on the extraordinary profits created by the quota.

The strategic interaction between the industry and the politician is described as a two-stage game. In the "organization stage" the industry decides whether to organize or not as a lobby. If the industry group is organized, it bears a fixed cost and lobbies in order to influence the politician's regulation (the industry pays a cost to play the role of a principal). If the industry group remains unorganized, it does not pay the fixed organization cost, but then it is not allowed to lead the negotiations about the degree of market intervention either. The "regulation stage" comes after the politician knows whether she is dealing with an organized lobby or with an unorganized interest group. At this stage, a regulatory policy pair (X, Z) is set up. The whole game is solved by backwards induction. First, we use the tools of contract theory to characterize the equilibrium regulatory policy that takes place at the regulatory stage. Then, assuming that the industry discounts the equilibrium outcome of the regulation stage, we analyze the industry's decision of organizing or not as a lobby (organization stage).

The asymmetric information approach undertaken in this paper allows for a number of

[3] Steel, autos, consumer electronic products, or agriculture are sectors typically subject to intervention through quotas. Licensure or other forms of entry restriction are also frequently used to regulate small businesses or professional sectors. However, the reason why we use a production quota as an instrument for market protection lies in its simplicity. We recognise that there are many other forms of market regulation, but considering quotas is hepful to visualize directly the impact on social welfare of governmental market intervention.

insights that relate lobby formation to the degree of market intervention. First, it provides an alternative rationale to the "loser's paradox" (Baldwin and Robert-Nicoud, 2007). The paradox consists in the fact that low demand industries receive relatively higher protection when compared to high demand industries, which are the ones that invest more resources in lobbying activities.[4]. When organization costs are moderate, there exists a separating equilibrium at the organization stage in which an industry organizes as a lobby if market demand is strong, and it remains unorganized when demand is weak. In this separating equilibrium, the lobbying decision of the interest group reveals private information: If the industry lobbies, the policy-maker infers high market demand; if the industry does not lobby, the policy-maker infers low market demand. This equilibrium outcome involves higher degree of protection on industries facing low demand, although the most resources spent on lobbying activities correspond to high demand industries.

Second, the model provides a theoretical explanation of the relationship between lobbying costs and lobby formation. If organization costs are low enough or high enough, there exist pooling equilibria at the organization stage in which either both types of industry become organized (costs are low) or neither of them do (costs are high). Comparing the degree of protection at equilibrium for different values of organization costs C yields the result that, if organization costs fall from moderate to low level, then virtually every type of industry organizes as a lobby, and the overall degree of market protection in-

[4] The empirical evidence regarding the excessive protection received by declining industries has been documented in Hufbauer and Rosen (1983), Hufbauer et. al (1986) or Ray (1991). Agriculture, textile or steel are among the most protected sectors. However, according to the data provided by the Center for Responsive Politics (www.opensecrets.org), the top five industries in lobbying expenditures are: Pharmaceutical and Health products, Insurance, Electric Utilities, Oil and Gas, and Telephone Utilities. In contrast, Agriculture, Textile and Steel are ranked 24th, 76th and 53th by lobbying expenditures respectively.

creases. The evidence recorded in Bradford (2000), using the same database as Trefler (1993), bornes out this prediction. Bradford (2000) finds that industries with lower transaction costs receive more protection. In our model, if all types of industries are organized, low demand industries signal their types by including in their policy proposals excessive (distorted) degrees of market protection.

Our paper borrows certain elements from the literature on: (i) policy influence, (ii) informative lobbying, and (iii) lobby formation. Next we briefly review some relevant contributions to the literature in each of these categories and identify the main differences with respect to our approach.

Since the pioneering work on pressure groups by Becker (1983), a host of models have attempted to provide a rationale to Becker's influence function which associates pressure by interest groups to government's policy choices. A major strand in this category is the approach whereby campaign contributions buy votes. In this vein, the menu-auction model developed in Grossman and Helpman (1994) (GH henceforth) provides a benchmark in which the "contributions for policy favors" scheme explains policy choices when lobbies compete for trade protection. Bennedsen and Feldman (2006), Dahm and Porteiro (2008) and Cotton (2009) among others, analyze the interaction of campaign contribution and information provision as means of influence. In our model, the level of market intervention (X) is attached to a monetary transfer from the industry to the policy-maker (Z). Unlike most of the literature, we do not analyze how Z influences X. Instead, we consider a regulatory policy pair (X, Z) as a binding contract. Although not explicitly enforceable, the commitment on fulfilling the terms of the contract may come from a repeated relationship, trust or simply reputation[5].

Informative lobbying is based on the existence of uncertainty between policy and

[5]For a survey of the arguments that support the hypothesis that politicians will not renege on agreements with interest groups, see Snyder (1992).

its consequences, and relies on the assumption that the lobby is better informed than the policy-maker. When the provision of information affects policy choices in favour of the lobby group there is room for strategic information transmission[6]. Potters and Van Winden (1992) analyze informational lobbying as a game in which the interest group has some private information and the policy-maker is aware of the strategic incentives of the interest group for truthful revelation. The information transmission problem can also be analyzed from a signaling perspective. In this line, Lohmann (1993,1995) highlights the informative role of monetary contributions in a signaling model in which competing reports and their accompanying contributions determine policy decisions. Our paper considers the informative power of contracts both in a signaling framework (when the lobby proposes regulatory policy) as in a screening framework (when it is the policy-maker the one who proposes regulation).

Most of the literature on lobby formation analyzes the incentives to form a lobby by comparing the benefits of common action with organization costs[7]. The latter are usually treated as a sunk investment, and the former depend on the specific features assumed in each model. Our approach complements the usual explanation of lobby formation as related to the extent of free riding by firms within the industry[8]. We adopt a similar view of lobby formation as Mitra (1999), and compare the (exogenous) costs with the benefits of organizing as a lobby. What is distinctive about our approach is that these benefits depend on the different regulations that emerge in equilibrium from the relationship of the industry with the policymaker. For high demand industries, the advantages of enjoying a Stackelberg leader position outweigh the information rents the industry may have obtained

[6] See, for instance Austen-Smith (1993).

[7] The importance of upfront costs in the decision of lobbying actively or not has been stressed in the literature. See for instance Bombardini (2008), Grossman and Helpman (2001), or Masters and Keim (1985).

[8] See, for instance, Pecorino (1998) and Magee (2002).

if they had accepted the government's regulatory proposal. The contrary occurs for low demand industries. With fixed costs of lobby formation, our model predicts higher degrees of lobby organization in high demand industries.

The present paper is very related in spirit to Magee (2002). This author proposes a model that combines endogenous lobby formation with endogenous trade protection. Magee's analysis extends the GH framework by allowing for bargaining between lobbies and policymakers. In Magee's paper, the amount of campaign contributions in exchange for protection is determined as the outcome of a Nash bargaining process. In order to emphasize the role played by asymmetric information, we consider a simple setting in which all bargaining power corresponds to the principal (i.e., the industry if organized, or the policy-maker otherwise). It is worth mentioning, though, that the distribution of bargaining power in our model turns out to be irrelevant in the determination of the level of market protection (it only affects the monetary transfer from the industry to the government).

The paper is organized as follows. Section 2 introduces the model. Section 3 characterizes the optimal regulatory policy undertaken by the policy-maker when acting as a principal. Section 4 analyzes the optimal regulatory policy proposed by the industry, when organized as a lobby. In both sections the analysis comprises the cases of symmetric and asymmetric information. Section 5 considers the equilibrium outcomes in the previous sections to discuss the industry's incentives to lobby actively. Finally, Section 6 draws the main conclusions of the paper. The proofs of the main results are in the Appendix.

2. Model

2.1. The economy

We consider a competitive market for good x. The demand side of the market is given by n identical consumers whose preferences are represented by function $u(x_i, \theta)$, where x_i denotes individual $i's$ consumption of good x and θ is a utility shock, common to all consumers, interpreted as the state of market demand. This parameter may take two possible values: $\overline{\theta}$ (high demand) and $\underline{\theta}$ (low demand), with $\overline{\theta} > \underline{\theta}$. We refer to θ as the industry's type. Function $u(.)$ is continuous, differentiable, and we assume[9] $u' > 0$ and $u'' < 0$. Individual demand function is denoted as $x_i(p, \theta)$, and aggregate demand is $x(p, \theta) = nx_i(p, \theta)$, where $p = u'(x, \theta)$ stands for the price of good x. Market supply is provided by a perfectly competitive sector (industry) that produces good x at constant marginal cost c. The price that equates supply and demand is $p^* = c$. The competitive equilibrium output is then given by $x^*(\theta) = nx_i(c, \theta)$.

Now we consider the imposition of an effective production quota[10], denoted as X. Market intervention leads to price $\widehat{p} = u'(\widehat{x}, \theta) > c$, where $\widehat{x} = \frac{X}{n}$ denotes individual equilibrium consumption under quota X. Social welfare under quota X is given by:

$$w(X, \theta) = s(X, \theta) + \pi(X, \theta), \tag{2.1}$$

where $s(X, \theta)$ and $\pi(X, \theta)$ denote, respectively, consumers' surplus and industry's profits. These are given by $s(X, \theta) = nu(\frac{X}{n}, \theta) - u'(\frac{X}{n}, \theta)X$ and $\pi(X, \theta) = \left[u'(\frac{X}{n}, \theta) - c\right] X$. Social welfare evaluated at the competitive output $x^*(\theta)$ is denoted as $w^*(\theta)$. From the properties

[9] The derivatives are taken with respect to good x.

[10] There are many examples of competitive markets intervened through production quotas: Licensing in professional sectors, the Common Agricultural Policy implemented in the EU, some types of environmental regulations, etc. The choice of a competitive scenario finds empirical support in Bombardini and Trebbi (2012), who show that firms in competitive markets are more likely to form industry groups.

assumed on the shape of the individual's utility function, it follows that, across the relevant range for quota X (i.e., $0 < X < x^*(\theta)$), function $s(X,\theta)$ is strictly increasing and strictly convex in X and function $w(X,\theta)$ is strictly increasing and strictly concave in X.

We assume that function $\pi(X,\theta)$ has an inverted U-shape and is strictly concave in X. Furthermore, we assume (i) $\pi(X,\overline{\theta}) > \pi(X,\underline{\theta})$ and (ii) $\pi'(X,\overline{\theta}) > \pi'(X,\underline{\theta})$. The latter condition is a version of the well-known Spence-Mirrlees "Single-Crossing Property" for signaling games. If the production quota increases, profits decrease more in an industry facing weak demand than they do in an industry of strong demand[11]. In other words, industries of type $\underline{\theta}$ benefit relatively more from output restrictions than industries of type $\overline{\theta}$. This differential effect across industries is the key to obtain a separating equilibrium *à la* Spence (Spence, 1973).

2.2. Industry and policy-maker's objective functions

The policy-maker is interested in creating rents through market intervention. Let us denote by Z a transfer to the policy-maker in exchange for production quota X. The transfer Z can be thought of as money seized by taxation (on profits), in-kind donations of service and property, or contributions to political campaigns. A *regulatory policy* is a pair (X, Z), which we treat as a binding contract, i.e., it is verifiable and credible. Credibility on the regulatory policy might come from a repeated relationship between the regulator and an industrial sector with the power to (informally) enforce the terms of the intervention.

The policy-maker's objective function is given by

$$w(X,\theta) + \gamma Z, \tag{2.2}$$

[11] This is true for a certain range of quotas. As it will become apparent in next sections, the profit function is decreasing in X in the relevant interval of possible quotas.

where $\gamma > 0$ is the relative weight of transfer Z with respect to social welfare. This function is similar to a *political support function* (Hillman, 1982), which includes some preference for the industry's profits (in our case, the rents extracted from these profits) and also depends on the social welfare costs of industry protection[12].

In the spirit of Stigler (1971) and Peltzman (1976), the regulator is an actor that makes her own demands to the private sector. If the regulator is an office-motivated incumbent facing elections, the rent Z can be utilized to obtain electoral advantage. For instance, Z can be redistributed through rent transfers to identified groups of voters with "vote-buying" purposes[13]. Transfer Z is usually identified with campaign financing, as in Baron (2006) and Grossman and Helpman (1994). In these papers, campaign contributions are made *before* policy favors are implemented. However, in Magee, Brock and Young (1989), contributions are made *after* policies are announced, with the purpose of affecting the probability that the preferred candidate is elected. In our model, an amount Z of funds is attached to output restriction X.

All industries are organized to some extent. However, organizations differ in the type of advocacy resources they possess. For simplicity, we consider a setting in which an industry is organized if it incurs in fixed cost C, and it is not organized otherwise. This

[12] In our model, parameter γ represents the weight that the government places on the transfer from the industry relative to social welfare. According to most estimates of the GH model in the literature, the value of γ is relatively small. See, for instance, Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000). A more recent estimation by Tovar (2011) finds that, if endogenous lobbying costs are incorporated in the trade protection model, the weight of contributions relative to social welfare increases with respect to previous empirical studies. See also Footnote 5 in Le Breton and Salanie (2003), for different estimates of the weight the policy-maker puts on campaign contributions with respect to social welfare goals.

[13] In a companion paper, Candel-Sánchez and Perote-Peña (2012) explore this possibility using a probabilistic voting model with rent distribution à la Lindbeck and Weibull (1987).

is the approach usually undertaken in empirical studies about lobbying and protection[14]. In the view of Posner (1975), these upfront costs are resources lost to society through rent seeking activities. As Kerr et al (2013) state: "such costs could include: the initial costs of searching for and hiring the right lobbyists; educating these new hires about the details of the firm's interests; developing a lobbying agenda; researching what potential allies and opponents are lobbying for; and investigating how best to attempt to affect the political process (e.g., in which policy makers to invest)".

The industry pays the cost C to develop and improve its access to the government, for instance by hiring and maintaining in-house lobbyists, in order to gain some advantage in the bargaining over policies. Full time lobbyists work for the interest group and present policy proposals to legislators or bureaucrats. If the industry lobbies actively, we simply assume that it takes the leading role in the negotiation over regulatory policy. Using the terminology introduced in Baghwati (1982), the industry engages in DUP (directly unproductive, profit-seeking) activities to obtain some advantage to communicate policy proposals to the government. In case the industry remains unorganized, the regulator is the principal. Organizing as a lobby allows the industry to enjoy the strategic advantage of a Stackelberg leader.

The industry's payoffs are given by:

$$\pi(X, \theta) - Z - \nu C, \tag{2.3}$$

with $\nu = 1$ $(= 0)$ meaning that the industry is (not) organized as an active lobby.

2.3. Timing of events and information structure

The state of market demand is known to the industry, but not to the regulator. This may occur when the sectorial structure is too complex to infer from observable variables the

[14] See, for instance Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), or Tovar (2011).

state of demand, or in situations where the market is so volatile that only firms within the industry possess accurate and up-to-date information about the state of demand. In competitive sectors of professional services, such as doctors, lawyers and architects, market demand is best assessed within the industry. When dealing with environmental regulation, policy-makers regulate industries through taxes, quotas, etc., but they are usually uncertain about these industries' demand and profitability conditions.

In order to clarify the strategic interactions of our dynamic incomplete information game we now describe the timing and information structure of the game:

Stage 0. The state of market demand is realized. The industry observes θ. The regulator only knows that $\theta = \overline{\theta}$ with probability q and $\theta = \underline{\theta}$ with probability $1 - q$.

Stage 1 (Organization stage) The industry decides whether to lobby actively ($v = 1$) or not ($v = 0$). After observing v, the regulator updates beliefs on the industry's type. If the action v is revealing (a separating equilibrium), the following stages of the game take place in a symmetric information framework. If the action v is not revealing (a pooling equilibrium), the next stages are analyzed in a context of asymmetric information.

Stage 2 (Regulation stage) At this stage, there are two possibilities:

Stage 2a. If $v = 0$, the policy-maker offers a regulation (X_r, Z_r) to the industry. Then, the industry either accepts or rejects the proposal[15]. If the proposal is rejected, the market is liberalized. This maximizes social welfare but does not result in payment from the industry.

Stage 2b. If $v = 1$, the industry lobbies actively and makes the regulator a policy proposal (X_l, Z_l) who must either accept or reject. If the policy-maker rejects the lobby's

[15] This specification may be enriched by incorporating the fact that, within unorganized industries, some firms may accept the regulation proposed by the government while others could reject it. In order to have an analytically tractable structure for such an scenario, though, we would need to introduce some kind of heterogeneity across firms.

proposal, the market is liberalized: Social welfare achieves its maximum and the industry earns the normal (zero) profits in the market.

Observe that a signaling[16] process may occur: (i) at the time of deciding whether to organize as an active lobby or not (Stage 1); or (ii) when the industry, organized as a lobby, leads the negotiations and proposes the government a regulatory policy scheme (Stage 2b). A regulatory policy in Stage 2b can be a revealing signal of the industry's type. Notice, though, that a signaling process at this stage only makes sense if the industry's decision at Stage 1 has not revealed information on market conditions, i.e., in a pooling equilibrium at Stage 1.

We proceed to solve the game by backwards induction. Section 3 analyzes the equilibrium outcome of Stage 2.a, both under symmetric and asymmetric information. Section 4 studies the equilibrium of Stage 2.b., also under symmetric and asymmetric information. Finally, Section 5 deals with the equilibrium decision at Stage 1 of an industry of type θ.

3. The policy-maker's regulatory proposal ($v = 0$)

The policy maker faces incentives to undertake market intervention in order to extract some rents from the industry. In the next lines we characterize the optimal degree of intervention under both symmetric and asymmetric information about parameter θ. We conclude that the government sets up tighter quotas in industries facing low demand. This effect is exacerbated by asymmetric information.

[16] See Lohmann (1993) for a signaling model of lobbying in which individuals engage in costly political action. Instead, our approach considers the industry as the unit of analysis.

3.1. Symmetric information

We deal with a scenario in which the industry decides not to lobby actively ($v = 0$) at the organization stage, and such an action reveals the industry's type θ. The policy-maker sets up a regulatory policy (X_r, Z_r) to solve:

$$\begin{cases} Max_{\{X_r, Z_r\}} \; w(X_r, \theta) + \gamma Z_r \\ s.t. \; Z_r \leq \pi(X_r, \theta). \end{cases}$$

Transfer Z_r cannot exceed the extraordinary profits earned from market intervention, and the policy-maker's payoff is increasing in Z_r. Then, in equilibrium we have $Z_r = \pi(X_r, \theta)$. The problem reduces to selecting the quota X_r that maximizes $w(X_r, \theta) + \gamma\pi(X_r, \theta)$. Let $X_r^*(\theta)$ be such a quota. The optimal transfer is then $Z_r^*(\theta) = \pi(X_r^*(\theta), \theta)$. Observe that quota $X_r^*(\theta)$ lies in between the competitive market outcome $x^*(\theta)$ (the one that maximizes the social welfare) and the monopoly output $X_M(\theta)$ (the one that maximizes the industry's profits) provided that $\lim_{\gamma\to 0} X_r^*(\theta) = x^*(\theta)$ and $\lim_{\gamma\to\infty} X_r^*(\theta) = X_M(\theta)$.

The next proposition deals with the optimal degree of market intervention in this scenario.

Proposition 3.1. *In a context of symmetric information about the state of market demand, the optimal quota established by the regulator is such that* $X_r^*(\overline{\theta}) > X_r^*(\underline{\theta})$.

Proof. See Appendix. ■

Two observations must be made regarding the above results:

(i) Market intervention is expressed in absolute terms (i.e., when the production quota is not related to the size of the market). A better measure of the regulation strength would be using the quota as a proportion of market size. However, since our purpose is to highlight the influence of asymmetric information on market protection, it is not necessary to consider the quota in relative terms.

(ii) From the general conditions of the model we cannot deduce whether transfer $Z_r^*(\overline{\theta})$ is higher or lower than transfer $Z_r^*(\underline{\theta})$. While it is true that a higher quota, *ceteris paribus*, means less profits, it is also true that, for any given quota, the profits of a high demand industry are greater than those obtained by a weak demand industry. The sign of the net effect can only be determined under specific parameter restrictions.

3.2. Asymmetric information

When the industry does not incur organization costs C, and the decision $v = 0$ belongs to a pooling equilibrium at Stage 2, the policy-maker proposes a regulation in the absence of information about θ. First we show that in this framework the symmetric information policy proposals of the previous section are no longer optimal. Specifically, an industry with strong demand faces incentives to masquerade as low type provided that:

$$\pi(X_r^*(\underline{\theta}),\overline{\theta}) - Z_r^*(\underline{\theta}) = \pi(X_r^*(\underline{\theta}),\overline{\theta}) - \pi(X_r^*(\underline{\theta}),\underline{\theta}) > \pi(X_r^*(\overline{\theta}),\overline{\theta}) - Z_r^*(\overline{\theta}) = 0.$$

The regulator seeks to maximize expected utility by offering a menu of self-selective policy pairs. Let $(\overline{X}_r, \overline{Z}_r)$ be the proposal designed for type $\overline{\theta}$ and $(\underline{X}_r, \underline{Z}_r)$ the one designed for type $\underline{\theta}$. We deal with a *screening* problem with two sets of constraints: First, both contracts should be accepted by each type of industry (participation constraints (a) and (b)); secondly, no industry should ever prefer the contract intended to be chosen by the other type rather than his own (incentive constraints (c) and (d)).

The program to be solved is:

$$\left\{ \begin{array}{ll} Max_{\{(\overline{X}_r,\overline{Z}_r),(\underline{X}_r,\underline{Z}_r)\}} & q\left[w(\overline{X}_r,\overline{\theta}) + \gamma\overline{Z}_r\right] + (1-q)\left[w(\underline{X}_r,\underline{\theta}) + \gamma\underline{Z}_r\right] \\ s.t. & \left\{ \begin{array}{lcll} \pi(\overline{X}_r,\overline{\theta}) - \overline{Z}_r & \geq & 0 & (a) \\ \pi(\underline{X}_r,\underline{\theta}) - \underline{Z}_r & \geq & 0 & (b) \\ \pi(\overline{X}_r,\overline{\theta}) - \overline{Z}_r & \geq & \pi(\underline{X}_r,\overline{\theta}) - \underline{Z}_r & (c) \\ \pi(\underline{X}_r,\underline{\theta}) - \underline{Z}_r & \geq & \pi(\overline{X}_r,\underline{\theta}) - \overline{Z}_r & (d) \end{array} \right. \end{array} \right.$$

The solution to this optimization program is provided in the Appendix. Observe, though, that the program may not be appropriate for all parameter constellations. For instance, if the proportion of high types, q, approaches one, then it can be optimal for the principal to offer just one contract: the symmetric information contract for the high types. The contract $\left(X_r^*(\overline{\theta}), Z_r^*(\overline{\theta})\right)$ would only be accepted by the high demand industries, which then would not earn information rents. Furthermore, there is no transfer to be paid by low demand industries provided that the market in these sectors remains unregulated.

The following proposition summarizes the most interesting implications of the screening problem depicted above:

Proposition 3.2. *The optimal menu of contracts* $\left\{(\overline{X}_r, \overline{Z}_r), (\underline{X}_r, \underline{Z}_r)\right\}$ *is such that* $\overline{X}_r = X_r^*(\overline{\theta})$, $\underline{X}_r < X_r^*(\underline{\theta})$, $\overline{Z}_r < Z_r^*(\overline{\theta})$, *and* $\underline{Z}_r > Z_r^*(\underline{\theta})$.

Proof. See Appendix. ■

The results in Proposition 3.2 deserve some comments:

(i) Compared to the case of symmetric information, the production quota designed for weak demand industries is tighter than the one established under symmetric information, but the transfer to the policy-maker is higher than before. The rationale of the distortion on the regulatory policy designed for the low type is to avoid a mimicking behavior on the part of the high demand industry.

(ii) Since the quota for the high type industry is not distorted, the relative degree of market intervention for high type industries is the same as in the symmetric information case. However, relative market intervention becomes stronger for low demand industries, as long as $\frac{\underline{X}_r}{x^*(\underline{\theta})} < \frac{X_r^*(\underline{\theta})}{x^*(\underline{\theta})}$. We conclude that asymmetric information, on average, leads to stronger market protection.

4. The lobby regulatory proposal ($v = 1$)

When firms decide to lobby actively, they increase their ability to communicate policy proposals to the policy-maker. We capture this effect by assuming that the industry lobby acts as a Stackelberg leader in the negotiations over the policy pair (X, Z). Next we analyze the optimal policy proposals made under symmetric and asymmetric information about θ. As in the cases analyzed in the preceding section, sectors facing weaker demand call for lower production quotas, and relative market intervention is intensified when information on θ is private to the industry.

4.1. Symmetric information

When decision $v = 1$ has been observed at the organization stage by the policy-maker and this decision belongs to a separating equilibrium, the lobby proposes regulatory policy $(X_l^*(\theta), Z_l^*(\theta))$ to solve the following program:

$$\begin{cases} Max_{\{X_l,Z_l\}} & \pi(X_l,\theta) - Z_l - C \\ s.t. & w(X_l,\theta) + \gamma Z_l \geq w^*(\theta). \end{cases}$$

The government that accepts the policy proposed by a lobby must have utility at least equal to the utility achieved in case the market is liberalized. Let $X_l^*(\theta)$ be the quota that solves the above program. The constraint is saturated at equilibrium, and then $Z_l^*(\theta) = \frac{1}{\gamma}\left[w^*(\theta) - w(X_l^*(\theta),\theta)\right] > 0$.

Proposition 4.1. *In the context of symmetric information about the state of market demand, the optimal lobby's proposal is such that $X_l^*(\theta) = X_r^*(\theta)$ and $Z_l^*(\theta) < Z_r^*(\theta)$ for all $\theta = \overline{\theta}, \underline{\theta}$.*

Proof. See Appendix. ■

The optimal quota proposed by the lobby coincides with the quota proposed by the policy-maker in the previous section. However, the higher bargaining power of the industry when acting as a leader in the negotiation leads to a lower transfer to the policy-maker.

4.2. Asymmetric information

If the decision $v = 1$ has been taken by both types of industry, i.e., if we have a pooling equilibrium at the organization stage, the policy proposal made by the industry lobby can be a revealing signal at the regulation stage. In this case, the low type industry faces incentives to propose regulation[17] that reveals its type. The Spence-Mirrless condition $\pi'(X, \overline{\theta}) > \pi'(X, \underline{\theta})$ implies that reducing the production quota benefits more low demand industries, and this is the key to obtain a separating equilibrium à la Spence.

As long as we deal with a dynamic subgame of incomplete information, the concept of Perfect Bayesian Equilibrium (PBE) seems a natural one in this context. In particular, we use the concept of sequential equilibrium (Kreps and Wilson, 1982), which refines the PBE concept. We use a further refinement by restricting the beliefs off the equilibrium path to those that fulfill the Intuitive Criterion (Cho and Kreps, 1987). As a result, we are able to obtain a unique separating equilibrium at this stage.

In a separating equilibrium each type of lobby offers a different policy pair, and the policy-maker is able to correctly infer the state of market demand. Let $\mu(X_l, Z_l)$ be the probability assigned to the event that the industry is type $\underline{\theta}$ after observing (X_l, Z_l). A *sequential separating equilibrium* in this context includes proposals $\left\{(\overline{X}_l, \overline{Z}_l), (\underline{X}_l, \underline{Z}_l)\right\}$ with $(\overline{X}_l, \overline{Z}_l) \neq (\underline{X}_l, \underline{Z}_l)$ and beliefs such that $\mu(\underline{X}_l, \underline{Z}_l) = 1$ and $\mu(X_l, Z_l) = 0$ for all $(X_l, Z_l) \neq (\underline{X}_l, \underline{Z}_l)$. For these beliefs, each type of lobby proposes a different regulatory policy to obtain the highest possible payoff (sequential rationality), and beliefs are updated according to Bayes' rule from the equilibrium proposals (consistency).

[17] The informative power of contracts is analyzed, for instance, in Stadler (2001).

The next result highlights the most substantial implications of the regulatory policy proposals made at equilibrium.

Proposition 4.2. *The separating equilibrium proposals* $\left\{(\overline{X}_l, \overline{Z}_l), (\underline{X}_l, \underline{Z}_l)\right\}$ *are such that* $\overline{X}_l = X_l^*(\overline{\theta})$, $\overline{Z}_l = Z_l^*(\overline{\theta})$, $\underline{X}_l < X_l^*(\underline{\theta})$, *and* $\underline{Z}_l > Z_l^*(\underline{\theta})$.

Proof. See Appendix. ■

In equilibrium, a lobby representing an industry facing weak demand calls for stronger market intervention and receives a higher transfer from the policy-maker when compared to the full information pair. The policy-maker correctly infers that such distorted proposal could only have been sent by a low type industry.

By comparing the regulatory outcomes obtained when the industry lobbies with those obtained when the politician makes a regulatory proposal, we find that: (i) The degree of market protection increases (both in absolute and relative terms) when regulation takes place under asymmetric information; and (ii) the benefits enjoyed by the party which leads the negotiations affect the transfer to the politician, but not the strength of market intervention.

5. Incentives for lobby formation

In this section we study the incentives faced by the industry to organize as an active lobby, given the equilibrium outcomes expected from the last stage of the game. We show that it is possible that both types of industry select $v = 1$ or both select $v = 0$ (pooling equilibria at the organization stage). However, the most interesting case arises when the high demand industry chooses $v = 1$ and the low demand industry chooses $v = 0$. In a pooling equilibrium the regulator does not update (prior) beliefs about the industry's type. Then, if both types choose $v = 1$, the resulting regulatory scenario is that of lobbying under asymmetric information (in Subsection 4.2), while if both choose $v = 0$, we are in the screening framework in Subsection 3.2. However, in a separating equilibrium the regulator elicits information on the industry's type after observing the value of v. Therefore, regulation takes place in a symmetric information context. Specifically, if $v = 1$ ($v = 0$), the industry is in a scenario of lobbying (policy-maker's regulation) under symmetric information analyzed in Subsection 4.1 (3.1).

At the time of deciding whether to organize or not as a lobby, the industry takes into account the different regulatory scenarios arising after this decision. The equilibrium decision about v is obtained by backwards induction. Let function $\sigma : v \to [0, 1]$ represent the politician's beliefs on the industry's type after v is observed. In particular, $\sigma(v) = 1$ (0) means that the industry faces strong (weak) demand. In cases where the decision v does not allow for updating of beliefs, we have $\sigma(v) = q$.

5.1. Separating equilibrium

Let us consider a separating equilibrium in which type $\overline{\theta}$ selects $v = 1$, type $\underline{\theta}$ selects $v = 0$ and the policy-maker's beliefs are $\sigma(1) = 1$ and $\sigma(0) = 0$. In this separating equilibrium, if the industry lobbies the regulator, the production quota imposed is $X_l^*(\overline{\theta})$, because the industry must be of high type. If the industry is not organized, then the policy maker proposes a quota $X_r^*(\underline{\theta})$. From Propositions 3.1 and 4.1 we deduce that $X_r^*(\underline{\theta}) < X_l^*(\overline{\theta})$. This result is consistent with the relatively high levels of protection of senescent or declining industries documented in the literature[18]. Agriculture, for instance, has been a sector in decline for decades. The EU protects its farmers and growers through

[18] In Baldwin and Robert-Nicoud (2007), entry in the industry erodes the lobbying rents in expanding industries. However, in declining industries, sunk costs erode entry and make losers lobby harder. Persistence of protection in the course of industry decline is explained in Braillard and Verdier (1994), and a negative bias against growing industries is documented in Braillard and Verdier (1997).

its Common Agricultural Policy (CAP). The CAP contemplates, among many other regulatory instruments, the establishment of quotas for dairy products[19]. This protection policy creates rents in agriculture, in detriment of the consumers. Next we introduce the incentive constraints faced by the industry under the separating equilibrium beliefs.

The type $\overline{\theta}$ industry chooses $v = 1$ when

$$\pi(X_l^*(\overline{\theta}), \overline{\theta}) - Z_l^*(\overline{\theta}) - C \geq \pi(X_r^*(\underline{\theta}), \overline{\theta}) - Z_r^*(\underline{\theta}). \tag{5.1}$$

This condition establishes an upper bound on costs C.

Likewise, the type $\underline{\theta}$ industry chooses $v = 0$ when the following incentive condition holds:

$$\pi(X_r^*(\underline{\theta}), \underline{\theta}) - Z_r^*(\underline{\theta}) \geq \pi(X_l^*(\overline{\theta}), \underline{\theta}) - Z_l^*(\overline{\theta}) - C. \tag{5.2}$$

This condition determines a lower bound on C.

We refer to moderate organization costs as those that lie in between the bounds defined by inequalities (5.1) and (5.2).

Proposition 5.1. *When the lobby's costs of political action are moderate, a separating equilibrium in which only high demand industries organize as a lobby exists. In equilibrium, though, the most government support (stronger market intervention) is obtained by low demand industries.*

Proof. See Appendix. ■

Our result in Proposition 5.1 provides an alternative explanation to the "losers' paradox" identified in Baldwin and Robert-Nicoud (2007) whereby weak or declining industries

[19] See Jensen and Nielsen (2004) for an estimation of quota rents in EU dairy policy. These authors analyze the abolition of raw milk quota and estimate an output increase of 3% and a price decline of 22%.

receive more protection ($X_r^*(\underline{\theta}) < X_l^*(\overline{\theta})$) even when most resources invested in lobbying activities are spent by strong industries. Our approach provides a complementary explanation to this paradox. With moderate organization costs, the policy-maker (correctly) believes that strong industries are better off by taking the initiative in a bargaining process over protection than passively accepting the regulation coming from the policy-maker with screening purposes. Industries facing low demand, in turn, achieve a higher payoff under the policy-maker's symmetric information proposal than the one they would have obtained by lobbying actively.

5.2. Pooling equilibria

It is also worth analyzing the two extreme cases that emerge when organization costs are either very high or very low. Under these circumstances, two possible types of pooling equilibria[20] can be identified: (i) both types of industry choose $v = 1$, and (ii) both choose $v = 0$. The beliefs at any pooling equilibrium are $\sigma(1) = \sigma(0) = q$, and therefore regulation takes place in a context of asymmetric information.

In case (i), the low type industry obtains the payoff $\pi(\underline{X}_l, \underline{\theta}) - \underline{Z}_l - C$, and the high type industry obtains $\pi(\overline{X}_l, \overline{\theta}) - \overline{Z}_l - C$. From Propositions 3.1, 4.1 and 4.2 we deduce that $\underline{X}_l < \overline{X}_l$. If both types of industry lobby, the policy-maker is unable to infer the industry's type at the organization stage. However, the low demand industry calls for stronger protection. The output quota set up on low demand industries ($\underline{X}_l$) is even tighter than the separating equilibrium quota $X_r^*(\underline{\theta})$ of the previous subsection, and this effect is caused by asymmetric information.

The action $v = 1$ is optimal for both types of industry when the following conditions

[20] From the point of view of the whole game, the pooling equilibria may only take place in the organization stage. In the regulation stage there always exist separating equilibria in both the screening and signaling scenarios analyzed.

hold:

$$\pi(\underline{X}_l, \underline{\theta}) - \underline{Z}_l - C \geq \pi(\underline{X}_r, \underline{\theta}) - \underline{Z}_r = 0, \tag{5.3}$$

and

$$\pi(\overline{X}_l, \overline{\theta}) - \overline{Z}_l - C \geq \pi(\overline{X}_r, \overline{\theta}) - \overline{Z}_r > 0. \tag{5.4}$$

These two inequalities are more (less) likely to hold the lower (higher) is the cost C.

Proposition 5.2. *If C is "low enough" there exist pooling equilibria in which both types of industry decide to lobby actively. If C is "high enough", there exist pooling equilibria in which neither type is organized as an active lobby.*

Proof. See Appendix. ■

It is worth mentioning that the pooling equilibria just described fulfill Cho and Kreps' Intuitive Criterion. Consider, for instance, the equilibrium in which no industry lobbies because organization cost C is prohibitively high. In this case, deviating to $v = 1$ is equilibrium dominated for both types. Since the cost C the industry must pay to gain a Stackelberg leader position is very high, no type of industry will find it beneficial to send the message $v = 1$, whatever are the beliefs this deviation may induce on the regulator. Similarly, in the case where cost C is very low, deviating to $v = 0$ is also equilibrium dominated for both types. Therefore, beliefs q and $1 - q$ are reasonable even if the policymaker observes out-of-equilibrium actions.

We derive stronger protection levels in sectors where organization costs are either high or low. In both cases, the organization decision does not allow the policy-maker to infer market demand, and regulation takes place in an asymmetric information context. If the costs of lobbying are high, all types of industry remain inactive and a self-selective menu of policy proposals designed by the policy-maker leads to excessive protection on low demand industries ($\underline{X}_r < X_r^*(\underline{\theta})$). On the other hand, if organization costs are low enough, both types of industry become active lobbies, and industries facing low demand call for inefficiently strong output restrictions ($\underline{X}_l < X_l^*(\underline{\theta})$).

In sectors where the cost of active lobbying are too high, we should expect that firms do not lobby regardless the size of their market demand. For instance, industries composed of a large number of employees and/or firms are especially vulnerable to Olson's free-riding on collective action in their contributions to the lobby (Olson, 1965)[21]. On the contrary, industries with more concentrated interests are more likely to lobby through general business associations regardless of how competitive their markets are. Think, for instance, in the EU farm lobby[22], which reputedly has been able to influence The Common Agricultural Policy (CAP) since its very foundation at a very high welfare cost to European consumers and taxpayers. For instance, the CAP establishes production quotas on milk, grain, wine, and sugar (Lohmann, 2003). In the United States, there is also a long history of agricultural interests, for instance the American Farm Bureau Federation.

6. Concluding remarks

The paper provides a view of lobbying activities as the equilibrium strategies of a signaling game. We introduce and solve a general model that endogenizes the industry organization decision, the negotiation for protection with the government and its final market regulation. Our model abstracts from several real world aspects of lobbying, such

[21] Some important aspects that influence the organization and common action of lobbies are relative to their internal structure. In particular, the size of the group and its consequences with respect to the free rider problem are critical elements in explaining the emergence of lobbies.

[22] Copa (European farmers) and Cogeca (European agri-cooperatives) bring together 60 EU farmers' organizations and 35 EU agricultural cooperative organizations, respectively.

as competition for influence, the effects of caps in campaign contributions, the decision of lobbying legislators vs. bureaucrats, the free rider problem in lobby formation, the degree of market concentration, or the study of lobbying under different market structures. In return of these restrictions, we tackle together the issues of policy influence, information disclosure and lobby formation.

We explicitly consider a bargaining setup in which a lobby organized for political action is the player that takes the initiative in the negotiation of the degree of market protection, which means being the first to propose a take-it-or-leave-it regulatory policy to the policy-maker. In our approach, policymakers are active players in the contributions-for-regulation game.

The optimal regulatory policy is characterized in four different scenarios, arising from the combination of the informational setup (symmetric vs. asymmetric information) with the negotiation setup (either the lobby or the regulator makes the regulatory policy proposal). The industry internalizes the equilibrium outcome in each scenario and then decides whether to incur or not the cost of lobbying actively. After observing the industry's decision, the policy-maker makes an inference on the state of demand/profits faced by such industry.

There is a common feature of regulatory policy that is independent of which player leads the negotiations: Regulation is more intense under asymmetric information, i.e., when a pooling equilibrium takes place at the organization stage. The reason is that regulatory policy proposals must be somehow "distorted" (with respect to their symmetric information values) in order to achieve separation of the types at the regulation stage. In contrast, if organization costs are moderate, a separating equilibrium at the organization stage leads to a symmetric information regulatory framework characterized by a generally lower degree of market protection.

Our analysis provides an explanation to the "loser's paradox" (Baldwin and Robert-Nicoud, 2007) based on the existence of asymmetric information between the industry and the policymaker. Our model also helps explaining the negative relationship between lobbying costs and market protection (Bradford, 2000). The decrease in organization costs (from moderate to low) implies that the equilibrium at the organization stage changes from separating to pooling, thus increasing overall market protection. Finally, our approach complements the usual theories on lobby formation by considering that the benefits of forming a lobby depend on the equilibrium regulatory outcomes after the organization decision is made.

7. Appendix

Proof of Proposition 3.1: We rewrite the condition $\pi'(X, \overline{\theta}) > \pi'(X, \underline{\theta})$ for all X as

$$u'(\frac{X}{n}, \overline{\theta}) - u'(\frac{X}{n}, \underline{\theta}) > \left[u''(\frac{X}{n}, \underline{\theta}) - u''(\frac{X}{n}, \overline{\theta})\right] \frac{X}{n}.$$

The left hand side of the above inequality is positive. We now multiply the right hand term into brackets by $\frac{\gamma}{1+\gamma}$, which is in between zero and one, to obtain:

$$u'(\frac{X}{n}, \overline{\theta}) - u'(\frac{X}{n}, \underline{\theta}) > \frac{\gamma}{1+\gamma} \left[u''(\frac{X}{n}, \underline{\theta}) - u''(\frac{X}{n}, \overline{\theta})\right] \frac{X}{n}.$$

We add and subtract c to the left hand side of the above expression, multiply both sides of the inequality by $1 + \gamma > 0$ and reorder the expression to obtain:

$$\gamma u''(\frac{X}{n}, \overline{\theta})\frac{X}{n} + (1+\gamma)\left[u'(\frac{X}{n}, \overline{\theta}) - c\right] > \gamma u''(\frac{X}{n}, \underline{\theta})\frac{X}{n} + (1+\gamma)\left[u'(\frac{X}{n}, \underline{\theta}) - c\right].$$

Provided that $\pi'(X, \theta) = u'(\frac{X}{n}, \theta) + u''(\frac{X}{n}, \theta)\frac{X}{n} - c$ and $s'(X, \theta) = -u''(\frac{X}{n}, \theta)\frac{X}{n^2}$ for all θ, we write the above inequality as:

$$ns'(X, \overline{\theta}) + (1+\gamma)\,\pi'(X, \overline{\theta}) > ns'(X, \underline{\theta}) + (1+\gamma)\,\pi'(X, \underline{\theta}).$$

That is, we have $w'(X,\overline{\theta}) + \gamma\pi'(X,\overline{\theta}) > w'(X,\underline{\theta}) + \gamma\pi'(X,\underline{\theta})$ for all X. The condition that characterizes a maximum is $w'(X,\theta) + \gamma\pi'(X,\theta) = 0$ for $\theta = \overline{\theta},\underline{\theta}$, and function $w(X,\theta) + \gamma\pi(X,\theta)$ is strictly concave. Therefore $X_r^*(\overline{\theta}) > X_r^*(\underline{\theta})$, as we wanted to prove.

■

Proof of Proposition 3.2:

Constraints (c) and (b) imply constraint (a) since:

$$\pi(\overline{X}_r,\overline{\theta}) - \overline{Z}_r \geq \pi(\underline{X}_r,\overline{\theta}) - \underline{Z}_r > \pi(\underline{X}_r,\underline{\theta}) - \underline{Z}_r \geq 0.$$

Therefore, the participation constraint for the high type industry is redundant.

We call λ, μ and δ the Lagrange multipliers associated to inequalities (b), (c) and (d) respectively. The first order conditions of the maximization program are the following:

$$\frac{\partial L}{\partial \overline{X}_r} = qw'(\overline{X}_r,\overline{\theta}) + \mu\pi'(\overline{X}_r,\overline{\theta}) - \delta\pi'(\overline{X}_r,\underline{\theta}) = 0, \tag{7.1}$$

$$\frac{\partial L}{\partial \underline{X}_r} = (1-q)w'(\underline{X}_r,\underline{\theta}) + (\lambda+\delta)\,\pi'(\underline{X}_r,\underline{\theta}) - \mu\pi'(\underline{X}_r,\overline{\theta}) = 0, \tag{7.2}$$

$$\frac{\partial L}{\partial \overline{Z}_r} = q\gamma - \mu + \delta = 0, \tag{7.3}$$

$$\frac{\partial L}{\partial \underline{Z}_r} = (1-q)\gamma - (\lambda+\delta) + \mu = 0. \tag{7.4}$$

From (7.3), we obtain $\delta = \mu - q\gamma$. Substituting δ into (7.4) we find $\lambda = \gamma > 0$, implying that the acceptance constraint for the low type holds with equality. The inequalities in (c) and (d) and jointly with the assumption $\pi(X,\overline{\theta}) > \pi(X,\underline{\theta})$ for all X, allow us to write the following chain of inequalities:

$$\pi(\overline{X}_r,\overline{\theta}) - \overline{Z}_r \geq \pi(\underline{X}_r,\overline{\theta}) - \underline{Z}_r > \pi(\underline{X}_r,\underline{\theta}) - \underline{Z}_r \geq \pi(\overline{X}_r,\underline{\theta}) - \overline{Z}_r, \tag{7.5}$$

from which we derive:

$$\pi(\overline{X}_r,\overline{\theta}) - \pi(\overline{X}_r,\underline{\theta}) \geq \pi(\underline{X}_r,\overline{\theta}) - \pi(\underline{X}_r,\underline{\theta}). \tag{7.6}$$

Since function $\pi(X,\overline{\theta})-\pi(X,\underline{\theta})$ is strictly increasing in X, the inequality in (7.6) implies that $\overline{X}_r \geq \underline{X}_r$. Now observe that $\mu=0$ would imply $\delta<0$, by Eq. (7.3). Then, it holds that $\mu>0$, meaning that expression (7.5) holds with equality. If the third inequality were also an equality (i.e. if $\delta>0$), from Eq. (7.6) we would obtain $\overline{X}_r=\underline{X}_r$. Therefore, $\delta>0$ if and only if $\overline{X}_r=\underline{X}_r$.

In order to prove that $\overline{X}_r>\underline{X}_r$, we just need to show that $\overline{X}_r \neq \underline{X}_r$ provided that we already know that $\overline{X}_r \geq \underline{X}_r$. We proceed by contradiction. Suppose that $\overline{X}_r=\underline{X}_r$, i.e., that $\delta>0$. Then, Eq. (d) holds with equality. Since $\overline{X}_r=\underline{X}_r$, we must have $\overline{Z}_r=\underline{Z}_r$. If $\overline{X}_r=\underline{X}_r=X$ and $\overline{Z}_r=\underline{Z}_r=Z$, Eqs. (7.1) and (7.2) remain respectively as:

$$\begin{aligned} qw'(X,\overline{\theta})+\mu\pi'(X,\overline{\theta})-\delta\pi'(X,\underline{\theta}) &= 0, \\ (1-q)w'(X,\underline{\theta})+(\lambda+\delta)\,\pi'(X,\underline{\theta})-\mu\pi'(X,\overline{\theta}) &= 0. \end{aligned}$$

We plug $\mu=\delta+q\gamma$ from Eq. (7.3) into the first equation above, and $\lambda+\delta=\mu+\gamma(1-q)$ from Eq. (7.4) into the second, and solve both equations for δ and μ respectively. We obtain

$$\delta=\frac{-q\left[w'(X,\overline{\theta})+\gamma\pi'(X,\overline{\theta})\right]}{\pi'(X,\overline{\theta})-\pi'(X,\underline{\theta})}, \tag{7.7}$$

and

$$\mu=\frac{(1-q)\left[w'(X,\underline{\theta})+\gamma\pi'(X,\underline{\theta})\right]}{\pi'(X,\overline{\theta})-\pi'(X,\underline{\theta})}. \tag{7.8}$$

We know that $\delta>0$ by hypothesis and $\mu>0$ by Eq.(7.3). We also know that $\pi'(X,\overline{\theta})-\pi'(X,\underline{\theta})>0$. Therefore, Eqs. (7.7) and (7.8) imply respectively that $w'(X,\overline{\theta})+\gamma\pi'(X,\overline{\theta})<0$ and $w'(X,\underline{\theta})+\gamma\pi'(X,\underline{\theta})>0$, which cannot be true under our assumptions. Then, $\delta=0$.

As $\delta=0$, the incentive constraint for the industry of type $\underline{\theta}$ holds with strict inequality. Next we show that the menu of contracts $\left\{(\overline{X}_r,\overline{Z}_r),(\underline{X}_r,\underline{Z}_r)\right\}$ that solve the maximization program is characterized by the following equations:

$$\begin{aligned}\pi(\underline{X}_r,\underline{\theta})-\underline{Z}_r &= 0, &(7.9)\\ \pi(\overline{X}_r,\overline{\theta})-\overline{Z}_r &= \pi(\underline{X}_r,\overline{\theta})-\underline{Z}_r, &(7.10)\\ w'(\overline{X}_r,\overline{\theta})+\gamma\pi'(\overline{X}_r,\overline{\theta}) &= 0, &(7.11)\\ q\gamma\left[\pi'(\underline{X}_r,\overline{\theta})-\pi'(\underline{X}_r,\underline{\theta})\right] &= (1-q)\left[w'(\underline{X}_r,\underline{\theta})+\gamma\pi'(\underline{X}_r,\underline{\theta})\right] &(7.12)\end{aligned}$$

Eqs. (7.9) and (7.10) follow from $\lambda > 0$ and $\mu > 0$ respectively. Eq. (7.11) follows from Eq. (7.1) and $\delta = 0$. Finally, Eq. (7.12) follows from substituting $\mu = \delta + q\gamma$ into Eq. (7.2) and taking into account that $\delta = 0$.

Notice that Eq. (7.11) is the equilibrium condition in the symmetric information case. Then $\overline{X}_r = X_r^*(\overline{\theta})$. From Eqs. (7.9) and (7.10), and from the condition $\pi(X,\overline{\theta}) > \pi(X,\underline{\theta})$ for all X, we conclude that the industry of type $\overline{\theta}$ earns informational rents, since

$$\pi(\overline{X}_r,\overline{\theta})-\overline{Z}_r = \pi(\underline{X}_r,\overline{\theta})-\underline{Z}_r > \pi(\underline{X}_r,\underline{\theta})-\underline{Z}_r = 0.$$

Given that the production quota $\overline{X}_r$ coincides with the symmetric information quota, $X_r^*(\overline{\theta})$, the industry of type $\overline{\theta}$ obtains informational rents if and only if $\overline{Z}_r < Z_r^*(\underline{\theta})$. From Eq. (7.12) we have that $(1-q)\left[w'(\underline{X}_r,\underline{\theta})+\gamma\pi'(\underline{X}_r,\underline{\theta})\right] > 0$. Provided that function $w(X,\underline{\theta}) + \gamma\pi(X,\underline{\theta})$ is strictly concave and reaches its maximum at quota $X_r^*(\underline{\theta})$, the condition $w'(\underline{X}_r,\underline{\theta})+\gamma\pi'(\underline{X}_r,\underline{\theta}) > 0$ implies $\underline{X}_r < X_r^*(\underline{\theta})$.

Now we prove that $\underline{Z}_r > Z_r^*(\underline{\theta})$. Observe that $\underline{Z}_r = \pi(\underline{X}_r,\underline{\theta})$ and $Z_r^*(\underline{\theta}) = \pi(X_r^*(\underline{\theta}),\underline{\theta})$. Function $\pi(X,\underline{\theta})$ is concave and reaches a maximum at X_M (the monopoly output). Provided that $\underline{X}_r < X_r^*(\underline{\theta})$, we just need to prove that $\underline{X}_r > X_M$ in order to obtain $\pi(\underline{X}_r,\underline{\theta}) > \pi(X_r^*(\underline{\theta}),\underline{\theta})$. Suppose that $\underline{X}_r \leq X_M$. We show that in this case the regulator is not maximizing its utility. Consider $\underline{X}_r = X_M - z$, with $z \geq 0$. The value for the transfer is $\pi(X_M - z,\underline{\theta})$. Since function $\pi(X,\underline{\theta})$ has an inverted U shape, there exists $h \geq 0$ such that $\pi(X_M + h,\underline{\theta}) = \pi(X_M - z,\underline{\theta})$. Observe that with quota $X_M + h$ the regulator receives the same transfer, but the consumer surplus is higher, since $s(X, \underline{\theta})$ is strictly increasing in X and $X_M + h \geq X_M - z$. Therefore, any quota lower than the monopoly output cannot be part of the regulator's proposal. We conclude that $\underline{Z}_r > Z_r^*(\underline{\theta})$. ■

Proof of Proposition 4.1: The optimal quota proposed by a lobby is $X_l^*(\theta)$ such that $w'(X_l^*(\theta), \overline{\theta}) + \gamma \pi'(X_l^*(\theta), \overline{\theta}) = 0$. Then, $X_l^*(\theta) = X_r^*(\theta)$. On the other hand, the policy-maker's utility is higher under quota $X_r^*(\theta)$ than when the market is liberalized. Namely, $w(X_l^*(\theta), \theta) + \gamma Z_r^*(\theta) > w^*(\theta)$. From here, we obtain

$$Z_l^*(\theta) = \frac{1}{\gamma}\left[w^*(\theta) - w(X_l^*(\theta), \theta)\right] < Z_r^*(\theta).$$

■

Proof of Proposition 4.2:

We prove that the set of policy pairs $\left\{(\overline{X}_l, \overline{Z}_l), (\underline{X}_l, \underline{Z}_l)\right\}$ defined below together with beliefs $\mu(X_l, Z_l) = 1$ for $(X_l, Z_l) = (\underline{X}_l, \underline{Z}_l)$ and $\mu(X_l, Z_l) = 0$ for all $(X_l, Z_l) \neq (\underline{X}_l, \underline{Z}_l)$ constitute a sequential separating equilibrium of our signaling game that also satisfies the Intuitive Criterion (Cho and Kreps, 1987). The pair $(\overline{X}_l, \overline{Z}_l)$ is:

$$(\overline{X}_l, \overline{Z}_l) = \left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right),$$

and the pair $(\underline{X}_l, \underline{Z}_l)$ is the solution to the following equations system:

$$\underline{Z}_l = \tfrac{1}{\gamma}\left[w^*(\underline{\theta}) - w(\underline{X}_l, \underline{\theta})\right],$$
$$\pi(\underline{X}_l, \overline{\theta}) - \underline{Z}_l = \pi(\overline{X}_l, \overline{\theta}) - \overline{Z}_l.$$

First we show that any pair $(\overline{X}_l, \overline{Z}_l)$ different from $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ cannot be part of a separating equilibrium. We proceed by contradiction. Suppose that $(\overline{X}_l, \overline{Z}_l) \neq \left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ and that $(\overline{X}_l, \overline{Z}_l)$ belongs to a separating equilibrium. Then, by definition, $\mu(\overline{X}_l, \overline{Z}_l) = 0$, i.e., the policy-maker is sure that the lobby is of type $\overline{\theta}$ if the proposal is $(\overline{X}_l, \overline{Z}_l)$. This proposal is always accepted whenever $w(\overline{X}_l, \overline{\theta}) + \gamma \overline{Z}_l \geq w^*(\overline{\theta})$. However, if the policy pair $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ were also accepted, provided that this pair maximizes the lobby's payoff, then $(\overline{X}_l, \overline{Z}_l)$ could not belong to a separating equilibrium. Therefore, we just need to show that the policy $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ is always accepted, for any belief $\mu^* = \mu(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta}))$ that this policy may induce on the policy-maker. Namely, it must hold that:

$$\mu^* \left[w(X_l^*(\overline{\theta}), \underline{\theta}) + \gamma Z_l^*(\overline{\theta})\right] + (1 - \mu^*) \left[w(X_l^*(\overline{\theta}), \overline{\theta}) + \gamma Z_l^*(\overline{\theta})\right] \geq$$

$$\geq \mu^* w^*(\underline{\theta}) + (1 - \mu^*)\, w^*(\overline{\theta}).$$

Namely, the expected utility for the policy-maker in the pair $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ is higher than the expected utility of rejecting the lobby's proposal. Taking into account that the symmetric information pair $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ satisfies $w^*(\overline{\theta}) = w(X_l^*(\overline{\theta}), \overline{\theta}) + \gamma Z_l^*(\overline{\theta})$ we can simplify and write the above inequality as:

$$\mu^* \left[\gamma Z_l^*(\overline{\theta}) - w^*(\underline{\theta}) + w(X_l^*(\overline{\theta}), \underline{\theta})\right] \geq 0$$

As $\mu^* \geq 0$, it just need to be proven that $Z_l^*(\overline{\theta}) \geq \frac{1}{\gamma}\left[w^*(\underline{\theta}) - w(X_l^*(\overline{\theta}), \underline{\theta})\right]$. For this purpose, it is sufficient to show that for any quota X, the minimum transfer that induces the policy-maker to accept a proposal depends positively on type θ. Let this transfer function be $z(X, \theta) = \frac{1}{\gamma}\left[w^*(\theta) - w(X, \theta)\right]$. We can write it as:

$$z(X, \theta) = \frac{n}{\gamma}\left\{\int_{\frac{X}{n}}^{x_i(c,\theta)} \left[u'(x, \theta) - c\right] dx\right\}.$$

The inequality $z(X, \overline{\theta}) > z(X, \underline{\theta})$ holds provided that $u'(y, \overline{\theta}) > u'(y, \underline{\theta})$ for all y. Hence,

$$Z_l^*(\overline{\theta}) = z(X_l^*(\overline{\theta}), \overline{\theta}) > z(X_l^*(\overline{\theta}), \underline{\theta}) = \frac{1}{\gamma}\left[w^*(\underline{\theta}) - w(X_l^*(\overline{\theta}), \underline{\theta})\right],$$

so the pair $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ is always accepted, as we wanted to show. Therefore $(\overline{X}_l, \overline{Z}_l) = \left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$.

Next we characterize the pair $(\underline{X}_l, \underline{Z}_l)$. For this pair to be part of a separating equilibrium, the following conditions are necessary: (a) a lobby of type $\overline{\theta}$ is not interested in making the proposal $(\underline{X}_l, \underline{Z}_l)$; (b) if the policy-maker believes that the lobby is type $\underline{\theta}$, it accepts the pair $(\underline{X}_l, \underline{Z}_l)$; and (c) a lobby of type $\underline{\theta}$ is better off under the pair $(\underline{X}_l, \underline{Z}_l)$ than under $(\overline{X}_l, \overline{Z}_l) = \left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$, i.e., it does not face incentives to masquerade as a high type. Each one of these conditions can be represented by a set of policy pairs. Thus, we define the corresponding sets A, B and C as follows:

$$\begin{aligned} A &= \left\{(X_l, Z_l) \mid \pi(X_l^*(\overline{\theta}), \overline{\theta}) - Z_l^*(\overline{\theta}) \geq \pi(X_l, \overline{\theta}) - Z_l\right\}, \\ B &= \{(X_l, Z_l) \mid w(X_l, \underline{\theta}) + \gamma Z_l \geq w^*(\underline{\theta})\}, \\ C &= \left\{(X_l, Z_l) \mid \pi(X_l, \underline{\theta}) - Z_l \geq \pi(X_l^*(\overline{\theta}), \underline{\theta}) - Z_l^*(\overline{\theta})\right\}. \end{aligned}$$

The policy proposal $(\underline{X}_l, \underline{Z}_l)$ is the solution to the program:

$$\begin{cases} Max_{\{X_l, Z_l\}} & \pi(X_l, \underline{\theta}) - Z_l \\ s.t. & (X_l, Z_l) \in A \cap B \cap C. \end{cases}$$

Let λ, ρ and δ be the Lagrange multipliers associated to the constraints represented by sets A, B and C, respectively. We solve this program under the assumption that $\delta = 0$, and check later that the inequality in set C is not binding for the pair that solves the program. The pair $(\underline{X}_l, \underline{Z}_l)$ that solves the program fulfills the following F.O.C.:

$$\frac{\partial L}{\partial \underline{X}_l} = \pi'(\underline{X}_l, \underline{\theta}) - \lambda \pi'(\underline{X}_l, \overline{\theta}) + \rho \pi'(\underline{X}_l, \underline{\theta}) + \rho s'(\underline{X}_l, \underline{\theta}) = 0, \tag{7.13}$$

$$\frac{\partial L}{\partial \underline{Z}_l} = -1 + \lambda + \gamma \rho = 0. \tag{7.14}$$

From equation (7.14) we deduce that it is not possible that both λ and ρ are equal to zero. In particular, we prove next that both are positive, implying that the constraints represented by sets A and B hold with equality. Suppose that $\rho = 0$. Then, necessarily $\lambda = 1$ by Eq (7.14). But in this case, equation (7.13) remains as $\pi'(\underline{X}_l, \underline{\theta}) - \pi'(\underline{X}_l, \overline{\theta}) = 0$, which is a contradiction with our assumptions. Suppose now that $\lambda = 0$. Again by equation (7.14) it must be that $\rho = \frac{1}{\gamma}$. Substituting $\lambda = 0$ and $\rho = \frac{1}{\gamma}$ into Eq (7.13) yields

$w'(\underline{X}_l,\underline{\theta})+\gamma\pi'(\underline{X}_l,\underline{\theta})=0$, thus implying $\underline{X}_l = X_l^*(\underline{\theta})$. However, in that case the lobby of type $\overline{\theta}$ will propose the quota $X_l^*(\underline{\theta})$ instead of $X_l^*(\overline{\theta}) = \overline{X}_l$, so a separating equilibrium would not exist. We conclude that λ, $\rho > 0$, so the pair $(\underline{X}_l, \underline{Z}_l)$ is characterized by Eqs. (7.13) and (7.14) together with the constraints in sets A and B holding with equality. Substituting the value of λ obtained from Eq. (7.14) into Eq. (7.13) yields:

$$(1+\rho)\left[\pi'(\underline{X}_l,\underline{\theta})-\pi'(\underline{X}_l,\overline{\theta})\right]+\rho\left[ns'(\underline{X}_l,\underline{\theta})+(\gamma+1)\,\pi'(\underline{X}_l,\overline{\theta})\right]=0.$$

As $\pi'(\underline{X}_l,\underline{\theta})-\pi'(\underline{X}_l,\overline{\theta})<0$ by hypothesis, for the above equation to hold it must be true that

$$ns'(\underline{X}_l,\underline{\theta})+(\gamma+1)\,\pi'(\underline{X}_l,\overline{\theta})>0. \tag{7.15}$$

From the constraints in A and B we derive the following expression, that determines the value for $\underline{X}_l$:

$$ns(\underline{X}_l,\underline{\theta})+\pi(\underline{X}_l,\underline{\theta})+\gamma\pi(\underline{X}_l,\overline{\theta})+\gamma\left[\overline{Z}_l-\pi(\overline{X}_l,\overline{\theta})\right]-w^*(\underline{\theta})=0. \tag{7.16}$$

Let us define functions $f(x)=ns(x,\underline{\theta})+(\gamma+1)\,\pi(x,\overline{\theta})+K$, $h(x)=ns(x,\underline{\theta})+\pi(x,\underline{\theta})+\gamma\pi(x,\overline{\theta})+K$, and $g(x)=w(x,\underline{\theta})+\gamma\pi(x,\underline{\theta})+K$, with $K=\gamma\left[\overline{Z}_l-\pi(\overline{X}_l,\overline{\theta})\right]-w^*(\underline{\theta})$. Observe that functions $f(.)$, $h(.)$ and $g(.)$ are strictly concave in x and our assumptions on function π imply that $f(x)>h(x)>g(x)$ and $f'(x)>h'(x)>g'(x)$. Eqs. (7.15) and (7.16) can be expressed respectively as $f'(\underline{X}_l)>0$ and $h(\underline{X}_l)=0$. Note that $g'(X_l^*(\underline{\theta}))=0$. Let us define $\widetilde{y}$ and $\widetilde{z}$ such that $g(\widetilde{y})=0$, $g'(\widetilde{y})>0$, $f(\widetilde{z})=0$, and $f'(\widetilde{z})>0$. Clearly $\widetilde{y}<X_l^*(\underline{\theta})$ provided that $X_l^*(\underline{\theta})$ is the maximum of $g(.)$. From the properties of functions $f(.)$, $h(.)$ and $g(.)$ there exists $\widetilde{x}\in(\widetilde{z},\widetilde{y})$ for which $f'(\widetilde{x})>0$ and $h(\widetilde{x})=0$. It holds that $\widetilde{x}=\underline{X}_l$. As long as $\widetilde{y}<X_l^*(\underline{\theta})$ and $\underline{X}_l<\widetilde{y}$ we conclude that $\underline{X}_l<X_l^*(\underline{\theta})$.

In order to prove that $\underline{Z}_l>Z_l^*(\underline{\theta})$, recall that the acceptance constraints of the policy-maker are binding both under symmetric and asymmetric information. Then we have that $\underline{Z}_l = \frac{1}{\gamma}\left[w^*(\underline{\theta}) - w(\underline{X}_l, \underline{\theta})\right]$. From the properties of $w(.)$ and the fact that $\underline{X}_l < X_l^*(\underline{\theta})$ we obtain that $\underline{Z}_l > Z_l^*(\underline{\theta})$.

Now we check that the value for the Lagrange multiplier δ is zero. To see this, just notice that $(\underline{X}_l, \underline{Z}_l)$ is a maximum in set $A \cap B$, and that the pair $\left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ also belongs to $A \cap B$. Then, we have $\pi(\underline{X}_l, \underline{\theta}) - \underline{Z}_l > \pi(X_l^*(\overline{\theta}), \underline{\theta}) - Z_l^*(\overline{\theta})$, i.e., $\delta = 0$.

Finally, observe that the beliefs and strategies satisfy the so called Intuitive Criterion. The pair $(\underline{X}_l, \underline{Z}_l)$ is the only one that maximizes the lobby's utility in the set $A \cap B$. Hence, it is not "intuitive" that the policy-maker believes that the lobby is of type $\underline{\theta}$ when observing a pair $(\widetilde{X}_l, \widetilde{Z}_l)$ different from $(\underline{X}_l, \underline{Z}_l)$. Suppose that the set of proposals and beliefs $\left\{(\overline{X}_l, \overline{Z}_l), (\widetilde{X}_l, \widetilde{Z}_l)\right\}$, with $(\widetilde{X}_l, \widetilde{Z}_l) \in A \cap B$ and $\mu(\widetilde{X}_l, \widetilde{Z}_l) = 1$, $\mu(\overline{X}_l, \overline{Z}_l) = 0$ is a sequential separating equilibrium. If a lobby deviates from such an equilibrium, then it must be a lobby of type $\underline{\theta}$. The reason is that a lobby of type $\overline{\theta}$ have no incentives to deviate from $(\overline{X}_l, \overline{Z}_l) = \left(X_l^*(\overline{\theta}), Z_l^*(\overline{\theta})\right)$ for any beliefs that such a deviation induces on the policy-maker. Then, the pair $(\underline{X}_l, \underline{Z}_l)$ is the only one for which the described beliefs satisfy the Intuitive Criterion. ■

Proof of Proposition 5.1:

Let organization costs C be such that inequalities (5.1) and (5.2) in the main text hold. If the policy-maker's beliefs are $\sigma(1) = 1$ and $\sigma(0) = 0$, a separating equilibrium exist in which only industries facing strong demand get organized. For instance, consider the consumer's utility function $u(x_i, \theta) = \theta x_i - \dfrac{1}{2}x_i^2$ (this is the utility function (b) in Subsection 2.1 particularized to $A = 0$ and $b = 1$), and assume $c = 0$. The optimal quotas in each one of the regulatory frameworks considered are given by:

$$X_r^*(\overline{\theta}) = X_l^*(\overline{\theta}) = \overline{X}_r = \overline{X}_l = n\frac{1+\gamma}{1+2\gamma}\overline{\theta}, \tag{7.17a}$$

$$X_r^*(\underline{\theta}) = X_l^*(\underline{\theta}) = n\frac{1+\gamma}{1+2\gamma}\underline{\theta}, \tag{7.17b}$$

$$\underline{X}_r = X_r^*(\underline{\theta}) - \delta_r, \tag{7.17c}$$

$$\underline{X}_l = X_l^*(\underline{\theta}) - \delta_l, \tag{7.17d}$$

where

$$\delta_r = n\frac{q}{1-q}\frac{\gamma}{1+2\gamma}\left(\overline{\theta} - \underline{\theta}\right)$$

and

$$\delta_l = n\frac{\gamma}{1+2\gamma}\left\{\left[\frac{2}{\gamma}\underline{\theta}\left(\overline{\theta} - \underline{\theta}\right)\right]^{\frac{1}{2}} - \left(\overline{\theta} - \underline{\theta}\right)\right\}.$$

Functions δ_r and δ_l represent distortions with respect to the symmetric information quotas established on weak demand industries, both for the case of regulation proposed by the policy-maker (δ_r) as in the case of regulation proposed by the industry lobby (δ_l). Consider now the following parameters: $\gamma = 2$; $\underline{\theta} = 1$; $\overline{\theta} = 2$. The incentive conditions hold whenever $-\frac{2}{5}n \leq C \leq \frac{4}{5}n$.

Next we show that a separating equilibrium in which industries facing weak demand choose $v = 1$ and industries facing strong demand choose $v = 0$ does not exist. The beliefs supporting such an equilibrium would be $\sigma(1) = 0$ and $\sigma(0) = 1$, with the following incentive conditions:

$$\pi(X_l^*(\underline{\theta}), \underline{\theta}) - Z_l^*(\underline{\theta}) - C \geq \pi(X_r^*(\overline{\theta}), \underline{\theta}) - Z_r^*(\overline{\theta}), \tag{7.18}$$

and

$$0 = \pi(X_r^*(\overline{\theta}), \overline{\theta}) - Z_r^*(\overline{\theta}) \geq \pi(X_l^*(\underline{\theta}), \overline{\theta}) - Z_l^*(\underline{\theta}) - C. \tag{7.19}$$

The right hand side of inequality (7.18) must equal zero, as long as a negative payoff (earned by a low type industry when imposed a regulatory pair intended for high types) can always be avoided by rejecting the regulation. In inequality (7.19), the beliefs induced when the policy-maker observes $v = 1$ (the industry faces low demand), require the high type to make the symmetric information proposal of a low type.

We combine inequalities (7.18) and (7.19) to obtain the following chain of inequalities:

$$\begin{aligned}\pi(X_l^*(\underline{\theta}), \underline{\theta}) - Z_l^*(\underline{\theta}) - C &\geq \pi(X_r^*(\overline{\theta}), \underline{\theta}) - Z_r^*(\overline{\theta}) = 0 \\ &= \pi(X_r^*(\overline{\theta}), \overline{\theta}) - Z_r^*(\overline{\theta}) \geq \pi(X_l^*(\underline{\theta}), \overline{\theta}) - Z_l^*(\underline{\theta}) - C.\end{aligned}$$

A necessary condition for this separating equilibrium to exist is:

$$\pi(X_l^*(\underline{\theta}), \underline{\theta}) - Z_l^*(\underline{\theta}) - C \geq \pi(X_l^*(\underline{\theta}), \overline{\theta}) - Z_l^*(\underline{\theta}) - C.$$

However, this condition can never hold since it contradicts the assumption that, for any quota X, $\pi(X, \underline{\theta}) < \pi(X, \overline{\theta})$.

Proof of Proposition 5.2:

A pooling equilibrium in which both types of industry select $v = 1$ exist when the conditions (5.3) and (5.4) hold, jointly with beliefs $\sigma(1) = \sigma(0) = q$. Consider the consumer's utility function in the proof of Proposition 5.1. For the following set of parameters: $c = 0$; $q = \frac{1}{2}$; $\gamma = 2$; $\underline{\theta} = 1$; $\overline{\theta} = 2$ a pooling equilibrium in which both types of industry choose $v = 1$ exists when $C \leq \frac{1}{5}n$. Using a similar reasoning we find that a pooling equilibrium in which both choose $v = 0$ exists for $C \geq \frac{3}{5}n$.

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