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The Politics of Growth: Can Lobbying Raise Growth and Welfare?

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This paper analyzes the link between lobbying, market structure, growth, and welfare. We consider a setup where lobbyist firms undertake contributions to a policy-maker in exchange for profit increasing regulations, in a general equilibrium model of R&D driven growth. We find that, despite increasing concentration—which leads to higher prices and less varieties—lobbying may stimulate growth and increase welfare by means of an expansion in aggregate demand if its real costs are small. This conclusion is supported by a simple calibration exercise.

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1 Introduction

This paper models and explores the link between lobbying, market structure, growth, and welfare. Contrary to the remaining literature on the subject, lobbying is modeled explicitly, and not exogenously addressed through a lobbying technology. We consider a R&D driven growth model where the free-entry equilibrium is not Pareto efficient—a possibility that has already been discussed in the literature (Jones and Williams, 2000, de Groot and Nahuis, 2002). This framework leaves a role for lobbying, since the introduction of another distortion in an economy initially characterized by one or more distortions may positively affect efficiency and well-being, as posited by Lipsey and Lancaster (1956-57). We then show that lobbying increases market concentration relative to free-entry, is most likely to increase innovation and growth, but may or may not increase welfare. The key feature of the model is that lobbying erects barriers to entry; lower competition increases the return of one unit of R&D, thus leading to more innovation and higher growth. However, it also increases the mark-up pricing and decreases the number of varieties, thus having an ambiguous impact on welfare. Most importantly, the change in welfare depends on the real resources that are lost due to lobbying.

Lobbying has recently become a multi-billion dollar industry in the U.S., totaling 3.49 billion dollars in 2009 according to the Center for Responsive Politics.¹ Every year, special interest groups—corporations, industry groups, labor unions, and single-issue organizations—spend billions of dollars to lobby the Congress and federal agencies, in an attempt to induce policy-makers in power to pay attention to their issues and influence decision making. In addition, billions of dollars are also spent by these special interests in campaign contributions every two years, when federal campaigns are held and elections to the Congress take place. For the 2008 elections, these amounted to 2.34 billion of U.S. dollars. Contributors expect that money transfers incurred during political campaigns are repaid back latter by the beneficiaries, in the form of favorable legislation, less stringent regulations, political appointments, government contracts, or tax credits, just to name a few. A large fraction of these expenditures is made by firms. As Djankov et al. (2002) point out, politicians can use regulations to create rents for incumbent firms, which can thus be extracted through lobbying, campaign contributions, or even bribes. These regulations may include, for instance, administrative burdens to register a business, legal barriers to

¹Data available on-line at <http://www.opensecrets.org>.

entry, non-transparent rules for penetrating a market or discrimination against foreign firms, as noted by Grossmann and Steger (2008). A key question is whether R&D-intensive industries spend more money in lobbying and are more concentrated than other industries. According to the Center for Responsive Politics, the U.S. pharmaceutical industry spent over 250 million dollars in lobbying, and the computers and internet industries about 120 million, in 2009. Figure 1 provides a more general picture, and shows that the relationship between average lobbying expenditures and average R&D is likely to be positive. Grossmann and Steger (2008) also register some evidence of anti-competitive activities in R&D-intensive industries, reporting, for instance, that most current regulations impede competition in the pharmaceutical industry in Switzerland. These authors have also established (theoretically) an unambiguously negative relationship between R&D and the number of entrants, suggesting that R&D-intensive firms engage in anti-competitive behavior by lobbying politicians to increase the cost of market entry.² A different perspective is provided by Aghion et al. (2005), who have established, both theoretically and empirically, an inverted-U relationship between competition and innovation. However, they do not consider lobbying.

It is generally acknowledged in the literature that most rent-seeking activities have baneful implications, not only over economic growth, but also over welfare. In the pursue of profits, most firms undertake a variety of actions, such as lobbying, tax evasion, litigation, corruption, or even theft, which are individually profitable, but wasteful from the society's perspective. These activities are described by Baumol (1990) as "unproductive entrepreneurship," since they have the knack of reducing the set of resources applied on the real side of the economy, cutting down production, slowing down growth, and depressing welfare. However, as Grossmann and Steger (2008) argue, this is not necessarily the case for lobbying in R&D-intensive industries. In their paper, investing in entry barriers and in R&D are complementary activities, which may lead to an increase in growth and welfare. To illustrate their argument, they analyze the growth performance of South Korea. In this country, the product market is highly regulated, highly concentrated, and R&D intensity is as high as in the U.S.. It is believed that these characteristics were an important source of economic growth in the last 4 decades. To summarize, there is suggestive evidence that R&D-intensive industries spend more in lobbying, that those expenditures may

²On the opposite direction, several empirical studies (e.g. Blundell et al., 1999, Nickell, 1996, Geroski, 1995) found that innovation increases with competition.

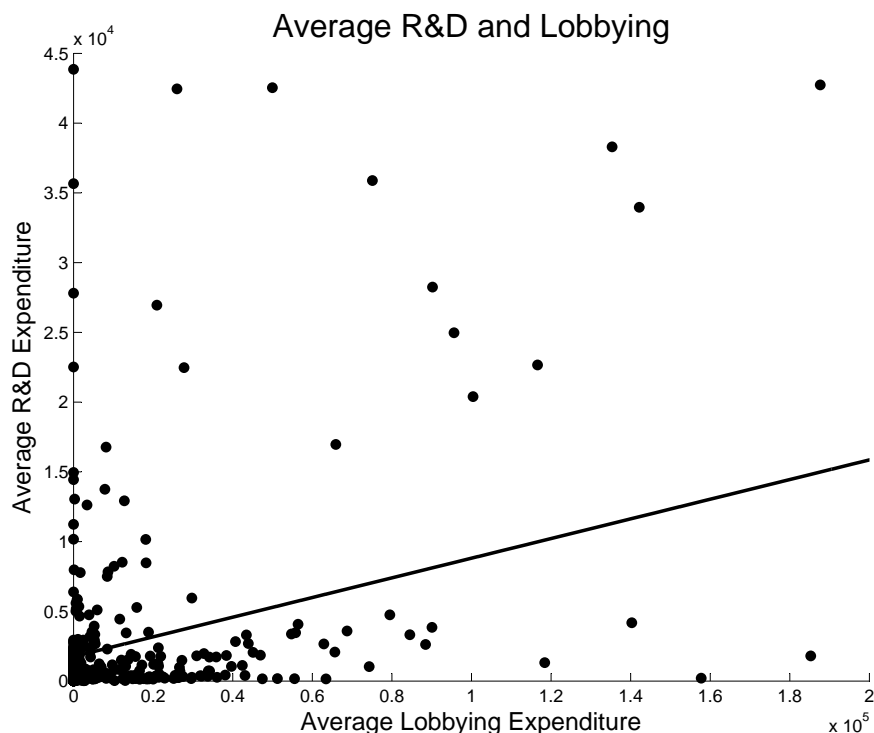


Figure 1: Scatter plot of lobbying on R&D.

The figure plots average lobbying on the x-axis against average R&D on the y-axis, but does not show outliers for scale reasons. Each point represents an industry-year, from 2002 until 2009. The data on R&D were collected from Bloomberg and matched with that on lobbying, collected from the Center for Responsive Politics (<http://www.opensecrets.org>). The scatter plot shows all industries, and not only R&D intensive industries. The line represents a simple OLS regression with no controls.

affect market structure, and that growth and welfare may change as a result.

We build on the general equilibrium framework of Peretto (1996), and consider an oligopolistic market with an endogenous number of firms, each producing a differentiated good and undertaking in-house R&D that generates higher quality products.³ These firms also participate in the political market. Here, we follow the classical contributions on electoral competition and special interest politics by Austen-Smith (1987), Baron (1994), and Grossman and Helpman (1996), and consider an office motivated policy-maker, who realizes that, in order to win elections, both votes and money are needed.

³To our knowledge, the link between market structure and R&D dates back to Schumpeter (1942). Applications to economic growth, however, are more recent. Peretto (1996) is the first to explore the linkage between market structure and innovation in the growth context.

This approach can be motivated in two ways. In the first, firms jointly form a lobby which represents their interests in the political market. This analysis follows Barnett (2006), Schuler et al. (2002), and Mizruchi (1989), who point out that firms may benefit from collective action, and has empirical support in Ozer and Lee (2009), who found no evidence for preference for individual action over collective action from R&D-intensive firms. The lobby uses the political market to attain what cannot be attained in the economic market, due to anti-trust regulations—the maximization of the joint profit of its members.⁴ Hence, we consider that the policy-maker and the lobby bargain over the number of R&D licences (or the number of active firms), making a case of “licences for sale.”⁵ This is the interpretation in which we focus throughout the paper. In the second interpretation, the legislator or policy-maker defines directly the level of competition, by imposing an upward limit on the number of licenses granted. Any given firm who wants to invest in R&D is compelled to make cash transfers to the decision maker. Obviously, one can see this as a market for R&D licences in exchange for bribes (where the government is a monopoly supplier, as in Shleifer and Vishny, 1993).⁶ A direct application of these arguments to economic growth can be found in Blackburn and Forgues-Puccio (2007), who consider that firms must acquire permits from corrupt public officials in order to pursue their private, growth enhancing activities.

We begin with a partial equilibrium analysis, where we show that, if the policy-maker regards contributions as “sufficiently important,” lobbying induces a decrease in the number of active firms as compared to the *laissez-faire* equilibrium. This policy may be growth enhancing, since the larger amount of profits to be disputed among firms may increase the value of one unit of R&D. However, the impact on welfare is negative, due to the increase in the mark-up pricing and the reduction in the number of varieties. We then move to a general equilibrium framework, where we let profits be paid back to households. Lobbying, by creating positive profits (that free-entry would have eliminated), generates extra income to households—dividends—therefore

⁴In addition, several empirical studies (e.g. Hart, 2003, Alt et al., 1999, Taylor, 1997) have shown that R&D-intensive firms invest more in political action.

⁵This last expression is inspired in Grossman and Helpman (1994), who have used the expression “protection for sale” to illustrate how politicians are willing to grant trade protection for domestic firms in exchange for political support.

⁶There is also a vast literature (for instance, Ales and Di Tella, 1999) emphasizing the relationship between market structure and corruption; and in particular Bliss and Di Tella (1997) observe that bureaucrats can directly limit the level of competition within the market in order to extract large levels of surplus, by creating regulations that limit the entry of new firms.

increasing the size of aggregate demand. Besides the direct impact on consumers' welfare, the increase in aggregate demand raises firms' incentives to invest in R&D, since the market size they can capture becomes larger. These adjustments balance against the negative effects of a reduction in the number of varieties, the increase in the mark-up pricing, and the real costs of lobbying, and hence the effects of lobbying on welfare are ambiguous.

One interesting byproduct of our analysis is the following. If lobbying improves welfare, then the free-entry equilibrium must be associated with some type of market failure, otherwise it would be Pareto efficient. This represents the negative externality on the returns to R&D imposed by entry. Since the gains from extra competition—a lower mark-up and a larger number of varieties—may not suffice to counterbalance the fall in the growth rate, the free-entry equilibrium may be characterized by excess entry. By restricting entry into the market, lobbying prevents a significant fall in the value of R&D, allowing the economy to correct, at least partially, this market failure. In this sense, lobbying acts like a patent, increasing the incentives to innovate. This comes at a cost, however—lobbying absorbs real resources that could have been used elsewhere.

Finally, we calibrate the model for the U.S. economy. For our benchmark calibration, the model predicts that lobbying results in a long-run growth rate about 0.4 percentage points higher as compared to free-entry. Whether welfare increases or not depends on the real costs of lobbying, which are directly related to contributions.

Related literature

Our paper joins two branches of literature: R&D based endogenous growth models featuring a relationship between market structure and innovation, and rent-seeking. While original models of R&D based growth (e.g. Barro and Sala-i-Martin, 1995, Grossman and Helpman, 1991, Romer, 1990) left market structure out of the analysis, recent papers (e.g. Peretto and Smulders, 2002, Vencatachellum, 1998, Smulders and Van der Klundert, 1997, Peretto, 1996, 1998, 1999a,b) have considered the interaction between innovation and market structure in models of endogenous growth. We build on Peretto (1996), since the absence of transitional dynamics and some particular features of his model allow us to introduce lobbying in an intuitive and tractable framework.

Classical works on the effects of rent-seeking on economic performance include Baumol (1990), Bhagwati (1982) and Krueger (1974). More recently, some atten-

tion has been devoted to the relationship between rent-seeking and technology adoption (e.g. Bellettini and Ottaviano, 2005, Krusell and Rios-Rull, 1996, Parent and Prescott, 1994, Murphy et al., 1991). The bottom line of these models is that rent-seeking erects barriers to technology adoption, hindering growth or leading to cycles of stagnation and growth. Some authors (Blackburn and Forgues-Puccio, 2007, Angeletos and Kollintzas, 2000) have also considered the effects of rent-seeking on R&D based models of endogenous growth, but they impose a constant market structure and model the political market through a standard rent-seeking technology—a black-box approach. Bliss and Di Tella (1997) consider the interaction between rent-seeking and market structure, but do not address growth issues.

Recently, Brou and Ruta (2007) have studied the effects of rent-seeking on growth and welfare, in a R&D based model of endogenous growth endowed with an endogenous market structure. However, their results depend on a rent-seeking technology whereby firms lobby the government in exchange for contributions, which are financed by taxing consumers.⁷ Moreover, the government in their model is a black-box which translates rent-seeking efforts into subsidies.

The article by Grossmann and Steger (2008) jointly analyzes the decisions of incumbent firms to invest in R&D and to lobby policy-makers to raise the rivals' (entrants) entry costs. They show that investing in entry barriers and R&D are complementary activities for incumbents, that lead to a decrease in the number of entrants. The resulting change in the economy's growth rate and welfare due to lobbying depends on the degree of knowledge spillovers. However, their model does not address any aspect of the political market, since it simply assumes that firms can make anti-competitive investments that restrict the number of entrants according to an exogenous technology. Moreover, the effects of a change in market structure on the behavior of firms—and consequently on growth and welfare—are not present, since there is only one incumbent firm per industry at all times.

Our paper differs from these literature in several directions. Firstly, we consider only one specific form of rent-seeking: lobbying/contributions. This restriction allows us to focus on the interaction between policy-makers and lobbyists, instead of assuming an exogenous rent-seeking technology—that is, we open the black-box. Secondly, our results depend on the real resources that are lost due to lobbying, and these are the outcome of a bargain between the lobby and the policy-maker. Finally, we give a

⁷This structure is designed to capture the effects of lobbying at the European level, since in the European Union organizations often receive financial support from the European Commission, while in the American system money flows in the opposite direction, from the private to the public sector.

special emphasis to the effects of lobbying on the determinants of welfare. In particular, we consider the effects of a change in market structure on the mark-up pricing and the number of varieties, and analyze how this adds to the direct effects of innovation on growth and welfare.

The rest of the article is organized as follows. The next section presents the benchmark model. Section 3 presents the goods market. Section 4 analyzes the free-entry equilibrium—our benchmark case. Section 5 introduces lobbying and puts forward the main results of the paper. In Section 6 we undertake a calibration exercise. Section 7 discusses our results and concludes.

2 The benchmark model

The model is set in continuous time. The (closed) economy is populated by a mass of 1 infinitely-lived and identical consumers; each of whom supplies inelastically one unit of labor. There are $N > 1$ oligopolistic firms;⁸ each of whom supplies one variety of a differentiated good using the available technology, and invests in Research and Development (R&D) in order to improve its state-of-the-art product.⁹

2.1 The demand side: consumer behavior

The representative household maximizes lifetime utility¹⁰

$$u(t) = \int_t^\infty \log(C(\tau)) \cdot e^{-\rho(\tau-t)} d\tau$$

subject to the intertemporal budget constraint

$$\int_t^\infty E(\tau) \cdot e^{-R(\tau)} d\tau \leq \int_t^\infty [w(\tau) + D(\tau)] \cdot e^{-R(\tau)} d\tau + A(t)$$

⁸In the main analysis we consider the number of firms, N , as a discrete variable, since our results below rely on strategic interaction between firms. However, in some steps N will be treated as a continuous variable, since this greatly simplifies the algebra of the model.

⁹Contrary to Peretto (1996, 1998), who considers cost-reducing technological progress, here, for convenience, we assume that firms invest in quality improvements over their state-of-the-art product. These two specifications are, however, formally equivalent (Spence, 1984, Tirole, 1988), so all our results carry through to the cost reduction case.

¹⁰This specification is used for analytical tractability and relaxed in Section 6, where we consider a CRRA utility function.

where $\rho > 0$ is the discount factor, $R(\tau) = \int_t^\tau r(s)ds$ is the average interest rate from time 0 to τ , D and A are per capita dividends and assets, respectively, and w stands for the wage rate. Finally, E denotes per capita expenditures and C stands for consumption. In the analysis below, we measure all variables in terms of the wage rate, and therefore set $w = 1$.

Let P_C denote the price index of consumption, with the property $E = P_C \cdot C$. The intertemporal maximization problem can then be readily solved, yielding the usual first-order condition

$$\frac{\dot{E}}{E} = r - \rho \quad (1)$$

Consumers aggregate goods, x_i , characterized by the state-of-the-art quality index, q_i , in a consumption bundle according to the Dixit and Stiglitz (1977) specification

$$C = \left[\sum_{i=1}^N (q_i \cdot x_i)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad (2)$$

where $\varepsilon > 1$ is the elasticity of substitution between two different varieties. Note that expenditures can alternatively be written as

$$E = \sum_{i=1}^N p_i \cdot x_i \quad (3)$$

Given the time path of expenditures in (1), the individual demand schedules can be found by maximizing (2), pre-multiplied by the price index P_C , subject to (3). This yields $x^D(p_i, q_i) = ES(p_i, q_i)/p_i$, where the new term¹¹

$$S(p_i, q_i) = \frac{p_i^{-(\varepsilon-1)} q_i^{(\varepsilon-1)}}{\sum_{j=1}^N p_j^{-(\varepsilon-1)} q_j^{(\varepsilon-1)}}$$

represents the market share captured by firm i . We normalize the starting quality level to unity, and so $q_i(t) = 1, \forall i$. As consumers are identical and population is normalized to one, the demand faced by each firm is equivalent to the individual

¹¹From this problem, we also obtain the price index of consumption

$$P_c = \left(\sum_{i=1}^N p_i^{(1-\varepsilon)} q_i^{-(1-\varepsilon)} \right)^{\frac{1}{1-\varepsilon}}$$

demand

$$X^D(p_i, q_i) = \frac{ES(p_i, q_i)}{p_i} \quad (4)$$

For later reference, note that the price elasticity of demand is $\xi(p_i, q_i) = \varepsilon - (\varepsilon - 1)S(p_i, q_i)$ and the quality elasticity of demand is $\zeta(p_i, q_i) = (\varepsilon - 1)[1 - S(p_i, q_i)]$.

2.2 The supply side: technology

Each firm produces output with technology

$$L_{X_i} = X_i + \phi \quad (5)$$

where X_i is the output produced by firm i that is sold to households, and L_{X_i} is labor used in production. The parameter $\phi > 0$ is a fixed and sunk cost of production, which can be interpreted as the labor required to keep the firm running. Lobbying policy-makers requires an amount of labor L_{Q_i} , endogenously determined. This represents the output produced by firm i that is used to buy the required licences to operate a business, therefore corresponding to in-kind contributions made by the firm. It can also be interpreted as the real cost of lobbying, since it is associated to production that is diverted from households. We discuss this interpretation in Section 7.

The firm's quality stock, q_i , which determines the quality embedded in the state-of-the-art product, is directly related to the firm's knowledge, z_i , according to $q_i = z_i^\theta$, where θ is the elasticity of quality with respect to R&D investment. The parameter z_i evolves according to

$$\dot{z}_i = L_{z_i} \cdot \left[z_i + \gamma \sum_{j \neq i}^N z_j \right] = L_{z_i} \cdot Z_i \quad (6)$$

where \dot{z}_i is the number of new patents produced in $d\tau$ units of time by a firm employing L_{z_i} units of labor in R&D. This technology exhibits overall increasing returns to scale and constant returns to scale in knowledge. The productivity in the R&D sector is a linear combination of both private and public knowledge, with $\gamma \in (0, 1)$ determining the share of private research that becomes publicly available.¹²

¹²As in Grossman and Helpman (1991), one can think that, when an innovator brings a new product into the market, researchers can costlessly disassemble and study all its attributes, and this knowledge can be readily used by firms to develop new blueprints, increasing the productivity of R&D by γ .

We assume, as in Peretto (1996), that knowledge diffuses across firms as workers move from one firm to the other. This implies that all firms have the same level of knowledge at all times, and so the equilibrium will be symmetric.

2.3 Free-entry and lobbying

The typical firm maximizes the net present value of cash flows

$$V_i(t) = \int_t^{\infty} \pi_i(\tau) \cdot e^{-R(\tau)} d\tau \quad (7)$$

where instantaneous profits are

$$\pi_i = p_i \cdot X^D(p_i, q_i) - (L_{X_i} + L_{z_i} + L_{Q_i})$$

through the choice of a price strategy, p_i , and a R&D strategy, L_{z_i} , subject to the technological constraints (5) and (6), and total demand (4), taking as given the number of firms, and the competitors' pricing strategies and R&D investments. For simplicity, we consider that entry entails zero costs and firms do not have any scrap value.

As in Peretto (1996), we consider a symmetric Nash equilibrium in open loop strategies. Accordingly, at time t firms commit to a time-path strategy in prices and R&D investment, while free-entry and exit or lobbying negotiations determine the equilibrium number of firms. Hence, we analyze a one-shot game played at t , which defines the future behavior of all variables in the economy.¹³

We compare the economy's growth rate and the present value of welfare under *laissez-faire* with the levels that prevail with lobbying. Under *laissez-faire*, *i.e.*, when the government has no influence over market structure and there is free-entry, entry and exit decisions determine the equilibrium number of firms. Hence, in equilibrium, instantaneous profits must be zero. With lobbying, negotiations follow a two stage process and take place at t , before firms commit to a time-path strategy and interact in the economic market. In the first stage, an efficient bargain between the policy-maker and a lobby, comprising all active firms, determines the equilibrium market structure. In the second stage, an asymmetric Nash bargain determines the distribution of surplus between the policy-maker and the lobby, and consequently L_{Q_i} .

Taking the temporal horizon of the policy-maker to be the same as the remaining

¹³Considering feedback strategies would be more realistic because they are subgame perfect, but it is impossible to solve the model in that case.

economic agents, and assuming an identical discount factor, the utility of the policy-maker is

$$u^{pol}(t) = (1 - \lambda) \int_t^\infty \log(C(\tau)) \cdot e^{-\rho(\tau-t)} d\tau + \lambda \int_t^\infty \Psi(\tau) \cdot e^{-\rho(\tau-t)} d\tau \quad (8)$$

where $\Psi(\tau) \geq 0$ is the total amount of instantaneous contributions. To keep the model tractable, we only consider contribution schedules that are steady over time, *i.e.*, $\Psi(\tau) = \Psi$. Since transitional dynamics are absent from the model and market structure is determined at t , only the knowledge of the present value of contributions, and not their distribution over time, is needed to solve the model. The first part of (8) is the utility of the representative individual multiplied by the weight the policy-maker assigns to the welfare of voters.¹⁴ This formulation is common in the literature (Grossman and Helpman, 1996, Austen-Smith, 1987) and captures the intuition that both popular policies and money are needed to win elections. Campaign contributions can be used to influence voters' perceptions about candidates' positions (either through media and political debates, or by increasing the collection of information). The weights are a simple shortcut to represent more complex scenarios as, for example, political transparency or the level of democracy (Aghion et al., 2007), the number of uninformed voters who are highly responsive to campaign expenditures (Grossman and Helpman, 1996, Baron, 1994), or the number of swing voters who are highly responsive to changes in platforms by political parties (Person and Tabellini, 2000). The second part of (8) can also be interpreted as the response of the policy-maker to an instantaneous lobbying expenditure of $\Psi(\tau)$. Figure 2 summarizes the interactions between agents in an economy with lobbying.

3 The goods market

We first analyze the equilibrium under *laissez-faire*. The political market is reintroduced in Section 5. The current value Hamiltonian for the firm's problem is

$$H_i^{cv} = (p_i - 1) \cdot \frac{ES_i}{p_i} - (L_{z_i} + \phi) + \mu_i \cdot L_{z_i} \left[z_i + \gamma \sum_{j \neq i}^N z_j \right]$$

¹⁴As all individuals are identical, the utility of the representative individual can be thought of as the utility of the median voter.

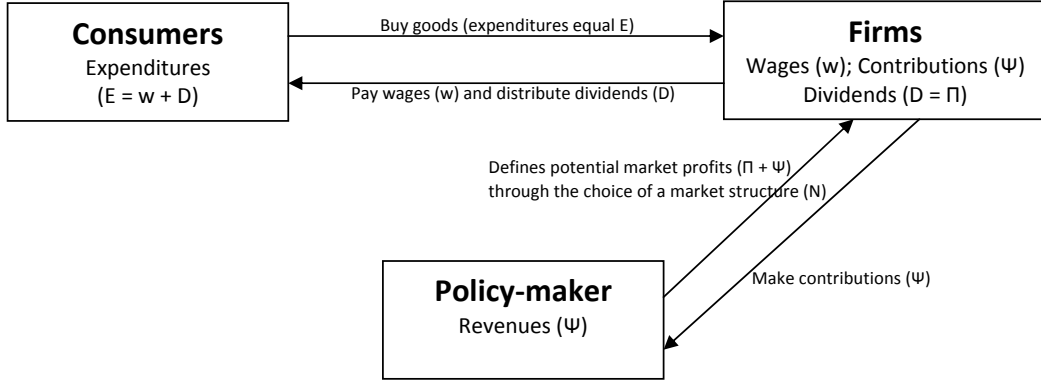


Figure 2: Diagram with the interaction between economic agents.

where the co-state variable, μ_i , measures the value of a marginal unit of knowledge, *i.e.*, the value of the patent. The firm's knowledge capital, z_i , is the state variable, and R&D investment, L_{z_i} , and the price, p_i , are the control variables.

As usual, with a CES demand, the optimal price is a mark-up over the marginal cost

$$p_i = \frac{\xi_i}{\xi_i - 1} \quad (9)$$

where ξ_i is the price elasticity of demand defined previously. The optimal R&D strategy when $0 < L_{z_i} < 1$ implies that the marginal revenue from one unit of R&D matches its marginal cost

$$1 = \mu_i \cdot \left[z_i + \gamma \sum_{j \neq i}^N z_j \right] = \mu_i \cdot Z_i \quad (10)$$

The differential equation in the co-state variable yields the no-arbitrage condition

$$r = \theta \frac{p_i - 1}{p_i} \cdot \frac{ES_i}{z_i} \cdot \frac{\zeta_i}{\mu_i} + L_{z_i} + \frac{\dot{\mu}_i}{\mu_i} \quad (11)$$

where ζ_i is the quality elasticity of demand introduced previously. Equation (11) states that the rate of return of a riskless asset equals the return of the R&D project undertaken by the firm. Using the price strategy (9) and condition (10), (11) simplifies to

$$r = \theta ES_i \cdot \frac{\zeta_i}{\xi_i} \cdot \frac{Z_i}{z_i} + L_{z_i} + \frac{\dot{\mu}_i}{\mu_i} \quad (12)$$

Finally the transversality condition

$$\lim_{\tau \rightarrow \infty} \mu_i(\tau) \cdot z_i(\tau) \cdot e^{-R(\tau)} = 0$$

states that, at the end of the planning horizon, the firm's knowledge has no value.

3.1 The symmetric equilibrium

As in Peretto (1996), we focus solely on the symmetric equilibrium. Let the variables without subscripts represent industry averages. Then, the quality stock evolves over time according to

$$\frac{\dot{q}}{q} = \theta \cdot \frac{\dot{z}}{z} = \theta \cdot \sigma(N) \cdot L_z \quad (13)$$

where the new term $\sigma(N) = [1 + \gamma(N - 1)]$ represents the productivity of a R&D project applying one unit of labor. Note that $\sigma(N)$ is increasing in N , reflecting the positive R&D externality. Since the free-entry condition determines the equilibrium number of firms at each moment in time, profits are instantaneously eliminated by costless entry/exit. Following our previous notation, $Z = \sigma(N) \cdot z$, and hence we have $\dot{Z}/Z = \dot{z}/z$. Differentiating equation (10) with respect to time, using condition (13) and the facts $Z/z = \sigma(N)$ and $S = 1/N$ in a symmetric equilibrium, the no-arbitrage condition (12) reduces to¹⁵

$$r = \frac{E}{N\xi} \cdot \theta\zeta \cdot [1 + \gamma(N - 1)] - \gamma(N - 1) \cdot L_z \quad (14)$$

where the price and quality elasticities of demand are respectively

$$\xi = \varepsilon - (\varepsilon - 1) \frac{1}{N} \quad \text{and} \quad \zeta = (\varepsilon - 1) \frac{N - 1}{N}$$

Equation (14) allows us to identify the determinants of average R&D investment, and consequently economic growth. The term $E/N\xi$ represents the *gross-profit effect*, and is simply the gross profit of the firm for a given market share. The term $\theta\zeta$ is the *business-stealing effect*, and captures the increase in market share due to quality increasing R&D.¹⁶ Spillovers also have two distinct effects over R&D productivity, working on opposite directions. On the one hand, firms realize that their own R&D

¹⁵For simplicity, we omit some variables dependence when they are not relevant for the analysis.

¹⁶This terminology is based on Peretto (1996, 1998).

generates spillovers, which makes their competitors more productive. This is captured by the term $-\gamma(N-1)$. On the other hand, firms also benefit from the spillovers of other firms, which contribute positively to their productivity, by the amount $\gamma(N-1)$.

Observe that equation (14) can be rewritten as

$$L_z(N, E, r) = \frac{1}{\gamma} \left[\theta \zeta(N) \cdot \frac{E}{N \xi(N)} \cdot \frac{\sigma(N)}{(N-1)} - \frac{r}{N-1} \right] \quad (15)$$

delivering the optimal individual investment in R&D as a function of the number of firms, N , aggregate demand, E , and the interest rate, r , for an interior solution. The relationship between average R&D and the number of firms is analyzed in the following lemma.

Lemma 1. *Average R&D, L_z , is hump-shaped in the number of firms.*

Proof. See Appendix A.1. □

While the *gross-profit effect* implies that the returns to R&D are decreasing in N , since a higher number of firms entails a decrease in the market share and in the mark-up, which are translated into lower profits and hence lower incentives to invest in quality upgrades, the *business-stealing effect* implies that firms are willing to invest more as N increases, as the potential gain in market share due to R&D becomes higher. The *business-stealing effect* dominates when there are few firms, as the total amount of market profits that can be appropriated through R&D is higher, while the *gross-profit effect* predominates when N is large, because the amount of profits that can be captured through quality improvements becomes lower. This conclusion holds regardless of the spillover effects.

The following lemma analyzes the relationship between aggregate R&D, $\mathbf{L}_z(N, E, r) = NL_z(N, E, r)$, and the number of firms.

Lemma 2. *Aggregate R&D, \mathbf{L}_z , is hump-shaped in the number of firms if and only if the interest rate is sufficiently low.*

Proof. See Appendix A.2. □

Note that

$$\frac{\partial \mathbf{L}_z}{\partial N} = \frac{1}{\gamma} \left[-\theta(\varepsilon - 1) \cdot E \cdot \frac{\varepsilon - \gamma}{(N\varepsilon - (\varepsilon - 1))^2} + \frac{r}{(N-1)^2} \right]$$

can only take a negative sign for N large if the latter term does not dominate the former; otherwise \mathbf{L}_z is increasing everywhere in N . Intuitively, as the number of firms

grows large, R&D resources are spread across too many firms, who then decrease their R&D investments as they become unable to exploit economies of scale. The reduction in average R&D only offsets the increase in the number of R&D projects for sufficiently low values of the interest rate.

Finally, in a symmetric equilibrium instantaneous profits reduce to

$$\pi(N, E, r) = \frac{E}{N\xi(N)} - (L_z(N, E, r) + \phi) \quad (16)$$

In order to eliminate perverse effects of N on aggregate profits, we assume that the fixed cost is sufficiently large

Assumption 1.

$$\phi > \max \left\{ 0, -\frac{E(\varepsilon - 1)}{[N\varepsilon - (\varepsilon - 1)]^2} \left[1 - \frac{\theta(\varepsilon - \gamma)}{\gamma} \right] - \frac{r}{\gamma(N - 1)^2} \right\}$$

This assures that aggregate profits are decreasing in N , greatly simplifying the analysis below. This also implies equilibrium uniqueness with free-entry.

3.2 Growth and welfare

The growth rate in this economy is determined by the growth rate of consumption. Plugging in $x = E \cdot (\xi - 1)/(N\xi)$ in the consumption index (2), taking the logarithm, and simplifying, we obtain

$$\log C(\tau) = \frac{1}{\varepsilon - 1} \log N + \log \frac{\xi(N) - 1}{\xi(N)} + \log q(\tau) + \log E(\tau)$$

Differentiating the above equation with respect to time yields

$$g(N, E, r) = \theta \frac{1 + \gamma(N - 1)}{N} \cdot \mathbf{L}_z(N, E, r) + \frac{\dot{E}}{E} \quad (17)$$

which gives us the growth rate as a function of the number of firms in the market, N , expenditures, E , and the interest rate, r . In this economy, growth depends on how the average quality of all available brands evolves through time and on the usual intertemporal trade-off faced by consumers. Before proceeding, it is worth noting the determinants of average quality growth. The term $1 + \gamma(N - 1)$ captures the productivity of one unit of labor in a R&D project undertaken by the average firm,

and is composed of two effects: the direct effect on the quality of the product developed by the firm, and the positive R&D externality. This latter effect is increasing in N , since a higher number of firms allows the economy to appropriate a larger amount of spillovers. The term \mathbf{L}_z/N captures the resources applied to improve the average brand of the economy. The following lemma analyzes the shape of the growth rate.

Lemma 3. *The growth rate, g , is hump-shaped in the number of firms if aggregate R&D is also hump-shaped, but it is not necessarily hump-shaped if aggregate R&D is everywhere increasing in the number of firms.*

Proof. See Appendix A.3. □

Lemma 3 follows from the analysis of the following derivative

$$\frac{\partial g}{\partial N} = \theta \left[-\frac{1-\gamma}{N^2} \mathbf{L}_z + \frac{1+\gamma(N-1)}{N} \frac{\partial \mathbf{L}_z}{\partial N} \right]$$

The lifetime utility of the representative individual as a function of N and the general equilibrium variables E and r is

$$U(N, E, r) = \frac{1}{\rho} \left[\frac{1}{\varepsilon-1} \log N + \log \frac{\xi(N)-1}{\xi(N)} + \frac{g(N, E, r)}{\rho} + \log E \right] \quad (18)$$

Equation (18) captures three effects through which a decrease in market concentration affects welfare.¹⁷ The first is a love for variety effect—a larger number of varieties makes consumers better off. The second is a competition effect, which reflects the lower mark-up pricing. Finally, the growth rate determines the increase in the flow utility over time. As the growth rate may be hump-shaped in the number of firms, it need not be the case that lifetime utility increases with N .

In order to make our own point for welfare improving lobbying, let us assume that (18) increases with N .

Assumption 2.

$$\frac{1}{\rho} \left[\frac{1}{\varepsilon-1} \frac{1}{N} + \frac{1}{(N-1)[N\varepsilon - (\varepsilon-1)]} + \frac{1}{\rho} \frac{\partial g(N, E, r)}{\partial N} \right] > 0, \quad \forall N, E, r$$

¹⁷In what follows, we use the terms utility and welfare interchangeably where it leads to no confusion to refer to equation (18).

A necessary and sufficient condition is that the growth effect does not dominate the love for variety effect and the competition effect for any N . This ensures that the *laissez-faire* equilibrium is welfare maximizing for given E . Our results would become stronger if utility is hump-shaped in N . For future reference, note that an increase in expenditures affects utility directly, and indirectly through the growth rate.

4 Equilibrium with no lobbying: the benchmark case

In this section, we fully characterize the equilibrium of the economy under *laissez-faire*.

Industry equilibrium

With no lobbying and free-entry, the equilibrium number of firms is a jump variable that satisfies the free-entry condition at all times.¹⁸ In particular, whenever $V > 0$ there is entry, whereas for $V < 0$ there is exit. Differentiating equation (7) with respect to time and rearranging, we obtain the following perfect foresight no-arbitrage condition for the equilibrium in the capital market

$$rV = \pi + \dot{V}$$

This equation, together with the free-entry condition, $V = 0$, implies that instantaneous profits, $\pi(N, E, r)$, must equal zero at all times.¹⁹ Making use of (16), this can be summarized as

$$\frac{E}{N\xi(N)} = L_z(N, E, r) + \phi \quad (19)$$

Equation (19) determines the number of firms as a function of aggregate expenditures, E , and the interest rate, r , with L_z given by (15). Let $N^f(E, r)$ denote the solution to (19). Aggregate R&D then simplifies to

$$\mathbf{L}_z(N^f(E, r), E) = \frac{E}{\xi(N^f(E, r))} - N^f(E, r) \cdot \phi \quad (20)$$

¹⁸For analytical convenience, the rest of the analysis treats the number of firms as a continuous variable.

¹⁹Consequently, dividends in the consumers budget constraint must also be zero.

General equilibrium

Let E^f denote equilibrium expenditures. Observe that the labor market clearing condition implies

$$N^f(E^f, r) \cdot L_X(N^f(E^f, r), E^f) + \mathbf{L}_z(N^f(E^f, r), E^f) = 1 \quad (21)$$

where \mathbf{L}_z is defined in (20) and

$$L_X(N^f(E^f, r), E^f) = E^f \cdot \frac{\xi(N^f(E^f, r)) - 1}{N^f(E^f, r) \cdot \xi(N^f(E^f, r))} + \phi$$

Straightforward algebra allows us to write (21) as $E^f = 1$, and it follows that, in equilibrium, $\dot{E}/E = 0$. Finally, using (19) in (15), the expression for $\zeta(N)$ and $r = \rho$, we obtain the equilibrium number of firms under free-entry, N^{fe} , as the solution to

$$\frac{1}{N^{fe} \xi(N^{fe})} \left[1 - \frac{\theta(\varepsilon - 1)\sigma(N^{fe})}{\gamma \cdot N^{fe}} \right] + \frac{\rho}{\gamma \cdot (N^{fe} - 1)} = \phi$$

Existence is immediate, since profits are positive for sufficiently small values of N and negative for large values. Uniqueness is assured by Assumption 1, since this implies that profits are negatively related to N , given E and r .

Equilibrium growth and welfare

Finally, equilibrium growth is obtained after replacing N , E and r by their equilibrium values in (17). Letting $\mathbf{L}_z^f = \mathbf{L}_z(N^{fe}, E^f)$, the equilibrium growth rate in this economy under *laissez-faire* becomes

$$g^f = \theta \cdot \frac{1 + \gamma(N^{fe} - 1)}{N^{fe}} \cdot \mathbf{L}_z^f$$

Finally, welfare in equilibrium is

$$U^f = \frac{1}{\rho} \left[\frac{1}{\varepsilon - 1} \log N^{fe} + \log \frac{\xi(N^{fe}) - 1}{\xi(N^{fe})} + \frac{g^f}{\rho} \right]$$

In general, g^f does not define the maximum growth rate. However, the equilibrium number of firms is welfare maximizing given E . Figure 3 provides a graphical repre-

sensation for a hump-shaped growth rate.²⁰

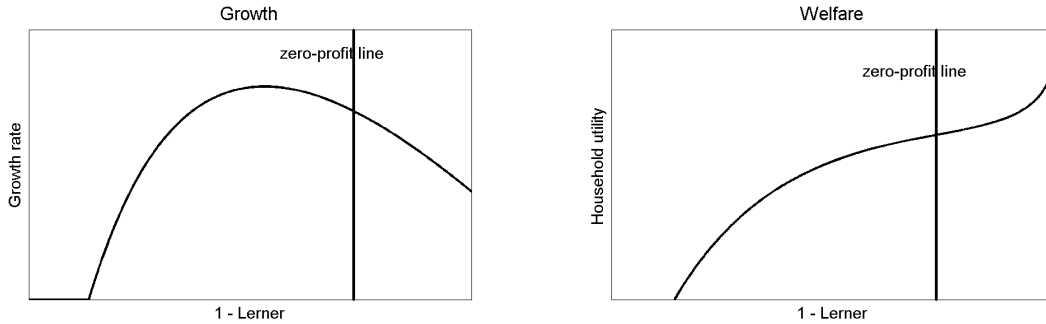


Figure 3: Welfare and growth under free-entry: the benchmark case.

For future reference, we state the following result.

Lemma 4. *An increase in concentration increases the growth rate above the free-entry equilibrium, given expenditures, if and only if:*

- (i) *the growth rate is hump-shaped;*
- (ii) *the free-entry equilibrium is on the decreasing part of the growth schedule;*
- (iii) *the decrease in the number of firms is sufficiently small.*

Proof. The first part of the proof is graphical. If (i), (ii) and (iii) are verified, then from the left graph of Figure 3, it is clear that a decrease in N increases growth. To prove the implication on the opposite direction, it is enough to show that if either (i), (ii) or (iii) are not verified, then growth decreases, which is immediate. \square

5 Lobbying and the political market

We now turn to the effects of lobbying on market structure, growth, and welfare. Since the policy-maker is usually perceived as a monopolist over R&D licences, we assume that he defines market structure directly. As a reference case, let us start by considering a benevolent policy-maker, who is solely concerned with the utility of the representative individual ($\lambda = 0$), but does not take into account how a change

²⁰Since the Lerner Index is more suggestive as a measure of concentration, we use its complement to plot this and the subsequent graphs.

in market structure affects equilibrium expenditures and consequently welfare.²¹ He solves

$$\begin{aligned} \max_N \quad & \frac{1}{\rho} \left[\frac{1}{\varepsilon - 1} \log N + \log \frac{\xi(N) - 1}{\xi(N)} + \frac{g(N, E, r)}{\rho} + \log E \right] \\ \text{s.t.} \quad & \frac{E}{N\xi(N)} - (L_z(N, E, r) + \phi) \geq 0 \end{aligned}$$

taking as given the general equilibrium variables of the economy, E and r .

Since $U(N, E, r)$ is increasing in N , the free-entry condition determines the equilibrium number of firms. Hence, the benevolent policy-maker does not interfere with market forces and all the analysis developed previously can be used to characterize this economy. On the contrary, a perfect foresighted benevolent social planner, who takes into account the general equilibrium interactions between N and E , may reduce the number of firms in order to maximize welfare. This situation may occur because equilibrium expenditures are negatively related to N —a decrease in market size increases profits and therefore dividends. While lobbying may increase welfare above the free-entry level, a benevolent social planner always achieves the maximum level of welfare, and lobbying cannot improve upon that situation.

5.1 Industry equilibrium with lobbying

It is instructive to begin our analysis by supposing that E is given. This allows us to gain some insights which will prove useful in the full-fledged analysis. For a given market structure, firms behave exactly as in the no-lobby economy in Section 3. However, the industry equilibrium is not defined by the usual zero-profit condition. The objective of this section is to present a simple model of lobbying where the lobby and the policy-maker bargain over the number of firms. This process defines the industry equilibrium, given the general equilibrium variables E and r .

More specifically, our focus lies on an efficient bargaining, which makes all players (weakly) better off as compared to the *laissez-faire* equilibrium. Consider that firms get organized in a lobby, whose objective is to maximize the joint surplus of its members, and let $\Pi(N, E, r)$ denote aggregate profits before contributions. Since one

²¹Implicit in this specification is the assumption that the general equilibrium effects of policy actions may be difficult to perceive and take into account in decision making. Thus, we consider that a benevolent policy-maker is not a benevolent social-planner, since he lacks some of the instruments that would be available to the latter.

unit of L_Q allows firms to produce one good, which is then used to lobby the policy-maker, L_Q corresponds to the average in-kind transfers made to the policy-maker. Hence $NL_Q = \Psi$, and²²

$$\Pi(N, E, r) = N \cdot \pi(N, E, r) + \Psi = \frac{E}{\xi(N)} - N(L_z(N, E, r) + \phi)$$

Then, the individual rationality constraints for the policy-maker and the lobby are, respectively

$$\begin{aligned} \text{IR}^P & : (1 - \lambda) \cdot [U(N, E, r) - U^f] + \lambda \cdot \frac{\Psi}{\rho} \geq 0 \\ \text{IR}^F & : \frac{\Pi(N, E, r)}{\rho} - \frac{\Psi}{\rho} \geq 0 \end{aligned}$$

where we have used the fact that profits are 0 in an equilibrium with free-entry. In order for both to be satisfied, we must have

$$\Psi \in \left[\frac{1 - \lambda}{\lambda} \cdot \rho [U^f - U(N, E, r)], \Pi(N, E, r) \right]$$

This condition states that a successful bargaining is only feasible if the policy-maker is largely concerned with political contributions relative to social welfare. Since, due to Assumption 1, aggregate profits are decreasing in N , the IR^F constraint implies that market concentration must increase as a result of lobbying. Note that the expected benefit from participating in the lobby is positive for any firm, since exit from the market has the same economic value of the free-entry outcome. Hence, lobbying makes no firm worse off. A negotiation is feasible if and only if there exists a $N' < N^{fe}$ such that

$$\frac{\lambda}{1 - \lambda} > \rho \cdot \frac{U^f - U(N', E, r)}{\Pi(N', E, r)}$$

²²We do not provide a theory of lobbying formation here. We simply assume that firms are able to overcome their rivalry and get organized in order to improve their bargaining power, ignoring any issues that might be induced by the possibility of free-riding. One can think that firms not represented in the lobby cannot obtain licences from the policy-maker or face greater difficulties in obtaining these licences, due to a lack of bargaining power.

The utility possibilities frontier is given by the solution of the following problem

$$\begin{aligned} \max_{\Psi, N} \quad & (1 - \lambda) \cdot [U(N, E, r) - U^f] + \lambda \cdot \frac{\Psi}{\rho} \\ \text{s.t.} \quad & \Pi(N, E, r) - \Psi = \bar{\Pi} \\ & \Pi(N, E, r) \geq 0 \end{aligned}$$

which states that agents will negotiate a market structure such that each surviving firm is left with a profit of $\bar{\Pi}/N > 0$. Plugging in the first constraint into the objective function and defining $\lambda' = \lambda(1 - \lambda)^{-1}$ as the relative weight of political contributions to social welfare in the policy-maker's utility function, the problem can be restated as

$$\begin{aligned} \max_N \quad & U(N, E, r) - U^f + \frac{\lambda'}{\rho} \cdot [\Pi(N, E, r) - \bar{\Pi}] \\ \text{s.t.} \quad & N \in [1, N^{fe}] \end{aligned} \tag{22}$$

Note that the objective function of problem (22) corresponds to (8) when written in terms of N , E and r . Let $U^{pol}(N, E, r)$ denote this function. In the subsequent analysis, we assume that $U^{pol}(N, E, r)$ is strictly quasiconcave in N , so that the first-order condition below is sufficient to characterize the equilibrium market structure, given E and r . In Appendix B we use numerical simulations to take into account the possible existence of multiple local maxima in problem (22). The first-order condition for an interior solution is

$$\left. \frac{\partial U}{\partial N} \right|_{N=N^p} + \frac{\lambda'}{\rho} \cdot \left. \frac{\partial \Pi}{\partial N} \right|_{N=N^p} = 0 \tag{23}$$

where $N^p = N^p(\lambda, E, r)$ defines the negotiated market structure as a function of the political weight given to contributions, λ , expenditures, E , and the interest rate, r . It states that the policy-maker restricts the number of firms until the marginal cost in individual utility matches the marginal gain from contributions. Given E and r , both players walk out of the bargain better off, at the expense of households. We can therefore put forward the following result.

Proposition 1. *When expenditures are given, lobbying*

- (i) *increases market concentration;*
- (ii) *may raise the growth rate;*

(iii) reduces household utility;

when compared to the laissez-faire equilibrium.

Proof. Part (i) follows directly from the discussion above. Since individual welfare is increasing in N given E , (i) immediately implies (iii). As regards to part (ii) note that growth increases if and only if the 3 conditions stated in Lemma 4 are satisfied: the growth rate is hump-shaped in N , the free-entry equilibrium is on the decreasing part of the growth schedule, and the decrease in N is sufficiently small. This latter condition is satisfied if λ is sufficiently small. \square

This result is illustrated in Figure 4, for the case of a hump-shaped growth rate. Lobbying may foster growth relative to the perfect foresight general equilibrium under *laissez-faire*, since a higher concentration increases the total amount of gross profits in the market that can be disputed through quality based R&D. However, consumers have a lower number of varieties and face a higher price level, which lead to a decrease in utility, despite the higher growth rate. If growth decreases, then these three effects would work in the same direction, contributing simultaneously to a decrease in welfare.

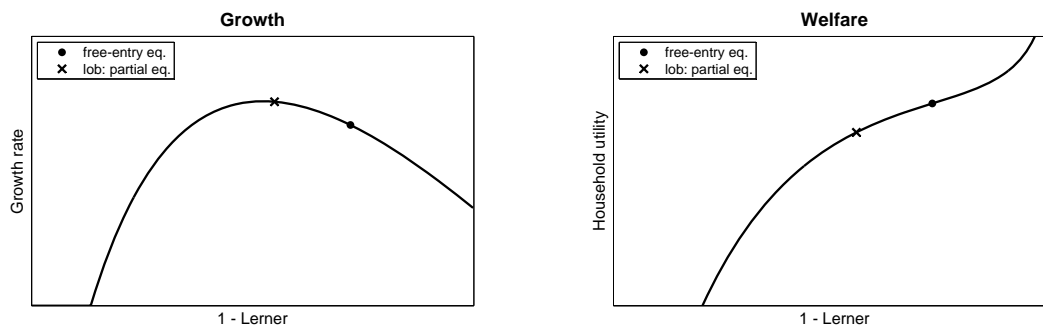


Figure 4: The effect of lobbying on growth and welfare, partial equilibrium ($E = 1$, $r = \rho$).

Regardless of the shape of the growth rate, a large preference for contributions generates an excessively concentrated market, in which there are little or no incentives to invest in product innovation. In the limit, a completely voracious policy-maker ($\lambda = 1$) sets $N^p = 1$ —with a sole active firm in the market, there are no incentives to innovate, and the growth rate comes down to zero. To see this, start by observing that profits are maximal in a monopolistic market. Hence, through (23), as λ approaches 1, N^p also converges to 1, and it follows that the growth rate (17) yields a corner solution at 0.

For future reference, note that N^p is decreasing in λ

$$\frac{\partial N^p}{\partial \lambda} = -\frac{1}{\rho \cdot (1 - \lambda)^2} \frac{\partial \Pi}{\partial N} \cdot \left(\frac{\partial^2 U}{\partial N^2} + \frac{\lambda}{\rho \cdot (1 - \lambda)} \frac{\partial^2 \Pi}{\partial N^2} \right)^{-1} < 0$$

The intuition is that a higher λ makes contributions more important to the policy-maker, who will therefore increase concentration in the industry. The relationship between N^p and E is unclear.

5.2 Letting E vary: the full-fledged analysis

5.2.1 Labor market clearing

We now reintroduce the labor market clearing condition and the first-order condition from the consumer's intertemporal maximization problem. When bargaining, the policy-maker and the lobby take the level of expenditures as given. However, any shift in concentration changes individual decisions undertaken by firms, creating a disequilibrium in the labor market that needs to be corrected through an adjustment in per capita expenditures. In turn, as expenditures jump to a new level, the number of firms that results from the political process must also change, since the marginal incentives summarized in (23) are shifted with E . This story implies that, in a steady-state with lobbying and fully rational players, the equilibrium market structure must satisfy the labor market clearing condition

$$N^p(\lambda, E^p, \rho) [L_X(N^p(\lambda, E^p, \rho), E^p) + L_Q] + \mathbf{L}_z(N^p(\lambda, E^p, \rho), E^p, \rho) = 1 \quad (24)$$

Equation (24) states that, in the full-fledged equilibrium, given equilibrium expenditures E^p , the policy-maker restricts the number of firms to $N^{pe} = N^p(\lambda, E^p, \rho)$, and given that there are N^{pe} firms in the market, equilibrium expenditures are E^p . Hence, E^p is a fixed point of (24). Note that, since expenditures are a jump variable, it follows that $r = \rho$.

Unlike the free-entry case, equation (24) may not define a unique equilibrium. Observe that an increase in E presents two opposing effects over labor demand: a direct effect, due to an expansion in production and innovation, and an indirect effect, due to a change in the number of firms. Since these effects may work in opposite directions for different levels of expenditures, labor demand may not be monotonic in E . Additionally, the existence of a fixed point is also not assured. In Appendix B we

use numerical simulations to analyze these issues in greater detail. Here, we assume that labor demand is increasing in E .²³

Assumption 3.

$$\underbrace{N^p \frac{\partial L_X}{\partial E} + \frac{\partial \mathbf{L}_z}{\partial E}}_{>0} + \underbrace{\frac{\partial N^p}{\partial E}}_{?} \underbrace{\left[L_X + N^p \frac{\partial L_X}{\partial N^p} + \frac{\partial \mathbf{L}_z}{\partial N^p} \right]}_{>0} > 0$$

The expression between brackets is positive, since labor demand, L^D , can be written as $L^D = E + \Psi - \Pi(N, E, r)$, and hence $\partial L^D / \partial N = -\partial \Pi / \partial N > 0$. Using the expression for profits and rearranging, we can express aggregate R&D alternatively as

$$\mathbf{L}_z(N, E, r) = \frac{E}{\xi(N)} - N\phi - \Pi(N, E, r) \quad (25)$$

Let $\Pi^p = \Pi(N^{pe}, E^p, \rho)$. Plugging (25) in the labor market clearing condition, using the equilibrium market structure and the fact that $r = \rho$, we obtain $E^p = 1 + \Pi^p - \Psi$. Since, by the IR^F constraint, $\Pi^p \geq \Psi$, we must have $E^p \geq 1$. The intuition for this result works as follows. Lobbying originates a decrease in the number of firms as compared to free-entry, allowing them to achieve a positive level of profits. Part of these profits (Ψ) is given to the policy-maker as contributions, while the remaining ($\Pi^p - \Psi$) is distributed as dividends to consumers. Expenditures are higher because the income of consumers has increased, by the amount $\Pi^p - \Psi$.²⁴

Finally, note that the composition of labor demand has changed. In particular, if aggregate R&D is hump-shaped, the free-entry equilibrium is on the decreasing part of the R&D schedule, and λ is not large, then \mathbf{L}_z must increase. Since labor supply is constant, the labor applied in production must be lower. In any other case, \mathbf{L}_z would be positively affected by the increase in E , but negatively affected by the fall in N , and the final balance is unclear.

5.2.2 Steady-state contributions and asymmetric Nash bargaining

The efficient bargain determines the number of firms that maximizes the joint surplus of the policy-maker and the lobby. Here, we analyze the distribution of surplus in

²³Despite this, the results provided in this subsection are also applicable for the case of multiple equilibria.

²⁴Note that this is different than saying that consumers are able to afford more goods. An increase in concentration also raises the price they have to pay for each good.

order to determine the change in growth and welfare.

The total amount of surplus generated by the bargain is simply the increase in aggregate profits before contributions. Consider that this surplus is distributed according to an asymmetric Nash bargaining (Binmore et al., 1986). Hence,

$$D = \Pi^p - \Psi = \alpha \Pi^p$$

and

$$\Psi = (1 - \alpha) \Pi^p \quad (26)$$

where α is the share of surplus obtained by the lobby. It remains to determine the range of admissible values for α . Using the IR^P constraint, we can establish the minimum necessary compensation that must be given to the policy-maker such that he accepts a change in the market structure

$$\Psi \geq \underline{\Psi} = \frac{\rho \cdot [U^f - U^p]}{\lambda'} \quad (27)$$

The policy-maker may not be reimbursed in equilibrium, since, as we show below, lobbying may increase welfare above U^f . Using (26) and (27), we obtain

$$\alpha \in \left[0, \min \left\{ 1, 1 - \frac{\rho}{\lambda'} \frac{U^f - U^p}{\Pi^p} \right\} \right]$$

5.2.3 Equilibrium growth and welfare

Let $\mathbf{L}_z^p = \mathbf{L}_z(N^{pe}, E^p, \rho)$ denote equilibrium R&D. Equilibrium growth and welfare are, respectively

$$g^p = \theta \cdot \frac{1 + \gamma(N^{pe} - 1)}{N^{pe}} \cdot \mathbf{L}_z^p$$

and,

$$U^p = \frac{1}{\rho} \left[\frac{1}{\varepsilon - 1} \log N^{pe} + \log \frac{\xi(N^{pe}) - 1}{\xi(N^{pe})} + \frac{g^p}{\rho} + \log E^p \right]$$

5.3 Lobbying, growth, and welfare

The following result analyzes the effects of lobbying in our economy.

Proposition 2. *Assume an equilibrium with lobbying exists, and that labor demand is increasing in expenditures. Then, in the full-fledged equilibrium, lobbying*

(i) increases market concentration;

(ii) may increase the growth rate;

(iii) may increase household utility if α is sufficiently high;

when compared to the laissez-faire equilibrium.

Proof. Part (i) follows directly from the bargain and the labor market clearing condition. Note that, if $N^{pe} > N^{fe}$, then $E^p < 1$, and profits would be negative in an equilibrium with lobbying. For part (ii), observe that the change in the growth rate is

$$g^p - g^f = \underbrace{g(N^{pe}, 1, \rho) - g(N^{fe}, 1, \rho)}_{?} + \underbrace{g(N^{pe}, E^p, \rho) - g(N^{pe}, 1, \rho)}_{\geq 0}$$

The first term is the change in the growth rate due to the fall in the number of firms, and the last term is the direct effect of E on g . Consider that the growth rate is hump-shaped in N , the free-entry equilibrium is on the decreasing part of the growth schedule, and λ is not large. Then, from Proposition 1 and using (i) we immediately obtain that the sign of the first term is positive. Since $\partial g / \partial E > 0$, growth increases in the full-fledged equilibrium. If at least one of these conditions is not satisfied, then we immediately obtain that the sign of the first term is negative and the final effect is unclear. For part (iii), observe that the change in household utility is

$$U^p - U^f = \underbrace{U(N^{pe}, 1, \rho) - U(N^{fe}, 1, \rho)}_{< 0} + \underbrace{U(N^{pe}, E^p, \rho) - U(N^{pe}, 1, \rho)}_{\geq 0}$$

Since utility is increasing in N , (i) implies that the sign of the first term is negative. Since $\partial U / \partial E > 0$, utility increases if the latter term dominates the former. Since, using (26), equilibrium expenditures can be written as $E^p = 1 + \alpha \Pi^p$, this can only occur for sufficiently high values of α . \square

On the overall, we identify three classes of effects: the partial equilibrium effect, for E given, the general equilibrium effect of a change in the number of firms due to the

increase in expenditures, and the direct general equilibrium effect of a change in E

$$\begin{aligned}
U^p - U^f &= \underbrace{U(N^p(\lambda, 1, \rho), 1, \rho) - U(N^{fe}, 1, \rho)}_{\text{Partial eq. } (<0)} + \\
&+ \underbrace{U(N^{pe}, 1, \rho) - U(N^p(\lambda, 1, \rho), 1, \rho)}_{\text{General eq.-N } (?)} + \underbrace{U(N^{pe}, E^p, \rho) - U(N^{pe}, 1, \rho)}_{\text{General eq.-E } (\geq 0)}
\end{aligned}$$

Note additionally that we can combine the first two classes of effects with the love for variety effect, the competition effect, and the growth-N effect. Since E affects utility directly and indirectly through the growth rate, we can divide the latter class in a growth-E effect and in an expenditure effect

$$U(N^{pe}, E^p, \rho) - U(N^{pe}, 1, \rho) = \underbrace{\frac{g^p - g(N^{pe}, 1, \rho)}{\rho^2}}_{\text{Growth-E}} + \underbrace{\frac{\log(E^p)}{\rho}}_{\text{Expenditure}}$$

This information is summarized in Table 1. Note that it is not the shift in the number of firms that may drive the increase in welfare, but a higher E . Lobbying leads some firms to leave the market, therefore increasing concentration and reducing labor demand, given expenditures—this generates the partial equilibrium effects analyzed before. In the general equilibrium, labor market clearing requires an increase in E . Since the number of firms responds endogenously to this adjustment, concentration in the market changes, but the direction of this change depends on $\partial N^p / \partial E$, and so its effects are undetermined. However, the combined outcome of these two classes of effects on welfare is negative, as $N^{pe} < N^{fe}$. Finally, the increase in the size of demand fosters economic growth and enlarges the number of goods consumers can buy for the same number of firms. Welfare increases if the positive effect of E on utility dominates the negative effect of N . Since $E^p = 1 + \alpha \Pi^p$, this can only occur if the real costs of lobbying are small, *i.e.* if the share of dividends on total profits before contributions (α) is sufficiently high. Figure 5 illustrates the result when growth and welfare increase, for $\partial N^p / \partial E < 0$ sufficiently high α .

5.4 The inefficiency of the free-entry equilibrium

If lobbying may improve welfare upon the *laissez-faire* equilibrium, then free-entry must be associated with some type of market failure. With free-entry, an entrant firm does not take into account its impact on the profits of incumbent firms. Since

Table 1: The impact of lobbying on welfare: decomposition of effects.

Effects	Number of firms (N)			Expenditures (E)		Welfare
	Variety	Compet.	Growth-N	Growth-E	Expendit.	
Partial Eq.	–	–	+/-*			–
General Eq.	?**	?**	?**	+	+	+
Welfare	–	–	+/-*	+	+	?

*The Growth-N effect is positive if the growth rate is hump-shaped in N , the free-entry equilibrium is on the decreasing part of the growth schedule, and λ is not large. Otherwise, the Growth-N effect is negative. **These effects go in the same direction of the partial equilibrium if $\partial N^p/\partial E < 0$, and in the opposite direction otherwise.

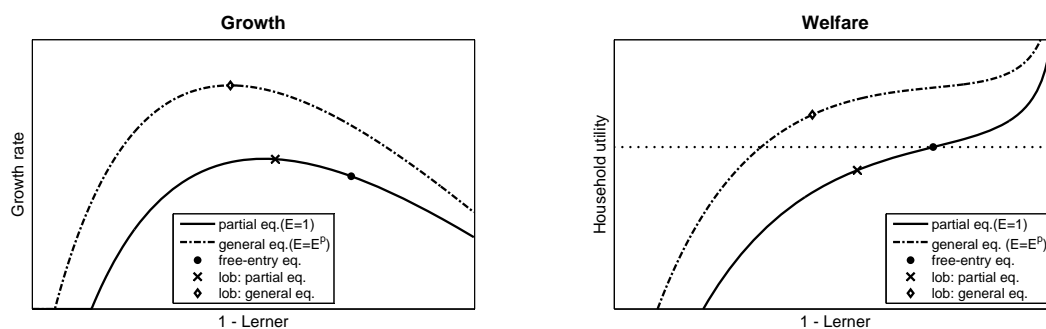


Figure 5: The effect of lobbying on growth and welfare, general equilibrium.

entry leads to a decrease in the demand faced by each firm, directly through N and indirectly through a fall in E , the value of one unit of R&D may decrease for N large, inducing firms to revise downwards their investments. Hence, the *laissez-faire* equilibrium may be characterized by excess entry, as excess competition resiliently hampers growth.²⁵ This adjustment, together with a fall in consumer's income, may overcome the usual gains from competition—lower mark-ups and more variety.

By taking into account total contributions, the policy-maker is indirectly internalizing the R&D externality caused by excess entry. If the fraction of surplus the society has to pay to the policy-maker is sufficiently small, the economy may achieve a higher growth path, which, together with the expansion in households income, boosts welfare. In this sense, lobbying acts much like a patent, increasing the appropriation of returns from R&D.

²⁵The idea that a decentralized economy may undertake too little R&D has already been separately explored in the literature in different contexts (see, for instance, Jones and Williams, 2000 and de Groot and Nahuys, 2002).

6 A calibration exercise

In this section, we calibrate the model for the U.S. economy. In order to undertake this exercise, we consider a constant relative risk aversion (CRRA) flow utility, so that we can take into account a significant branch of the literature which suggests that the elasticity of marginal utility is greater than unity.

6.1 Extending the model: the CRRA specification

The typical household maximizes

$$u(t) = \int_t^\infty \frac{C(\tau)^{1-\sigma} - 1}{1-\sigma} e^{-\rho(\tau-t)} d\tau; \quad \sigma > 1$$

subject to the usual budget constraint. The first-order condition is

$$\frac{\dot{E}}{E} = \frac{r - \rho}{\sigma} + \frac{\sigma - 1}{\sigma} \frac{\dot{P}_C}{P_C} \quad (28)$$

The demand schedules are the same as before, as well as the characterization of the goods market and the growth function. The partial equilibrium is also as before, except that, in the case of lobbying, the policy-maker's utility function takes into account the new lifetime utility of households

$$U(N, E, r) = \frac{[N^{1/(\varepsilon-1)} E (\xi(N) - 1) / \xi(N)]^{1-\sigma}}{(1-\sigma)g(N, E, r) - \rho}$$

Free-entry

With free-entry, the labor market clearing condition still implies an equilibrium value for expenditures of unity. Since P_C is a quality weighted price index, it evolves over time according to the symmetric of the growth rate, *i.e.* $\dot{P}_C/P_C = -g(N, E, r)$. Intuitively, goods are becoming cheaper over time as compared to the services they provide, and hence the price of the consumption basket must be falling at the rate quality is increasing. Combining this with (28), and using $E^f = 1$, the equilibrium interest rate, r^f , is the fixed point of the following equation

$$r^f = \rho + (\sigma - 1)g(N^f(1, r^f), 1, r^f)$$

Some numerical exercises show that existence is not always assured, but for the calibrated parameters the issue of non-existence does not arise. Using the equilibrium values for r and E , we can immediately obtain the equilibrium market structure, growth, and welfare.

Lobbying

With lobbying, the equilibrium pair (E^p, r^p) must solve simultaneously the labor market clearing condition

$$N^p(\lambda, E^p, r^p) [L_X(N^p(\lambda, E^p, r^p), E^p) + L_Q] + \mathbf{L}_z(N^p(\lambda, E^p, r^p), E^p, r^p) = 1$$

and

$$r^p = \rho + (\sigma - 1)g(N^p(\lambda, E^p, r^p), E^p, r^p) \quad (29)$$

Again, existence and uniqueness are not guaranteed, but, if an equilibrium exists, it is numerically possible to recover the equilibrium values for expenditures and the interest rate, and subsequently the equilibrium number of firms, growth and welfare. Steady-state contributions are determined as in Section 5.

6.2 Calibration of the model

Several parameters in our model have close real-world counterparts and so they can be calibrated directly from the data. For this purpose, we follow related studies of numerical R&D models. Others, however, require a more indirect approach. Since lobbying and campaign contributions comprehend billions of dollars every year, we take our benchmark calibration to be representative of an outcome with lobbying. Thereafter, we proceed backwards, identifying what would be the outcome with no lobbying. Finally, we compare the long-run economic performance between both situations.

Matched empirical facts

We calibrate the model such that the equilibrium interest and growth rates match the U.S. empirical data. This implies that some parameters of the model must be calibrated internally. The long-term interest rate (r^p) is set to 7 percent, which is the estimated average real rate of return on the stock market over the past century

(Mehra and Prescott, 1985, Jones and Williams, 2000).²⁶ The growth rate (g^p) is set to 2.1 percent, which is the estimated growth rate of consumption per capita for the post-war period, as reported in Comin (2004). This value is also comprised within the GDP per capita growth rates reported in the literature for the same period of time, which range from 1.7 to 2.3 percent, depending on the data source and on the time span considered. We admit a range of values for the R&D employment intensity (L_2^p) between 12 and 15 percent, consistent with the data provided by the National Science Foundation for high-intensity R&D sectors.²⁷

A typical calibration

In accordance with the literature (e.g. Strulik, 2007, Funke and Strulik, 2000), we set the benchmark value for the elasticity of marginal utility (σ) to 2. According to condition (29), this implies an intertemporal discount factor of 0.049.

Contrary to most models of endogenous growth that consider the case of monopolistic competition, the elasticity of demand in our model depends on the equilibrium number of firms, and so the elasticity of substitution between two different varieties (ε) cannot be directly obtained through empirical estimates of the mark-up pricing. Therefore, we set a reasonable value for ε , and require, *ex-post*, that the equilibrium mark-up is comprised within an acceptable range; otherwise we re-calibrate the value of ε . The literature is not unanimous as regards to the mark-up, providing different values depending on the type of products considered. Some empirical estimates suggest lower values for the mark-up, ranging up to 40 percent (e.g. Basu, 1996), while others hint slightly higher values, which can exceed 70 percent (e.g. Roeger, 1995, Funke and Strulik, 2000). Consistent with this, we define an acceptable range for p , $1.4 \leq p \leq 1.6$. After some trial and error, we found that a value of $\varepsilon = 6$ performs quite well, frequently providing a price level within this interval.

Another parameter which has to be recovered through a similar method is the quantity of labor associated to overhead expenditures per firm (ϕ), since only the total amount, $N^{pe}\phi$, can be retrieved from the data. Depending on whether one classifies the costs of certain activities as fixed or variable, and on the time span considered, the labor allocated to overhead activities in the manufacturing sector ranges from 10

²⁶As Jones and Williams (2000) note, since the interest rate in R&D driven models is also the rate of return to R&D, it cannot be calibrated to the risk-free rate on T-bills.

²⁷Since our model represents a R&D economy, it is natural to consider statistics of R&D-intensive industries to determine the R&D employment intensity.

Table 2: Parameter values used in calibration.

	Parameter	Value
Interest rate	r^p	0.07
Growth rate	g^p	0.021
Marginal elasticity of substitution	σ	2
Elasticity of substitution between varieties	ε	0.6
Spillovers	γ	0.7
Quality-R&D elasticity	θ	0.18
Fixed cost	ϕ	0.07
Discount factor	ρ	0.049

to 20 percent of total labor, according to the statistical database of the International Labor Organization. Consistent with this, we set ϕ at 0.07, which yields a value for $N^{pe}\phi$ within this range.

Retrieving γ , θ and λ

The elasticity of quality with respect to R&D (θ), the level of spillovers (γ), and the preference for contributions (λ) have to be calibrated simultaneously. The first two parameters are pre-determined, while λ is set so that equilibrium growth is 2.1 percent. The acceptable range for θ lies between 0.15 and 0.20—for values above this interval it is not possible to match the empirical growth rate for any λ , while values below this interval do not replicate U.S. empirical facts on R&D, regardless of spillovers. Given this range for θ , we can numerically find a lower bound for γ as a function of θ , $\gamma(\theta)$, with $\gamma'(\theta) > 0$, above which the labor allocated to R&D is within the specified interval. For our benchmark, we set $\theta = 0.18$ and $\gamma = 0.7$, which is compatible with a R&D labor share around 13.5 percent. Table 2 summarizes our benchmark calibration.

6.3 Results

The results are summarized in Table 3 and in Figure 6, for the case in which the policy-maker receives no contributions ($\alpha = 1$).²⁸ For the calibrated model, we estimate a free-entry growth rate of 1.73 percent, almost 0.4 percentage points below the empirical value. This outcome is mainly motivated by the 2 percentage points difference in labor allocated to R&D between the two situations. With lobbying,

²⁸Since welfare increases, the policy-maker may not receive any contributions in equilibrium.

industry profits represent about 5 percent of the total income of workers.²⁹ When compared to free-entry, concentration is slightly larger, as well as the mark-up. Additionally, lobbying presents a welfare gain of 3.5 percent in consumption equivalent terms, sustained through lower consumption at time 0, but higher consumption later on. These results are qualitatively robust to every suitable sensitivity analysis that we undertook.

Table 3: Calibration results for the case in which the policy-maker receives no contributions in equilibrium.

	Parameter	Lobbying	Free-entry
Preference for contributions	λ	0.444	—
Expenditures	E	1.052	1.000
Wage	w	1.000	1.000
Dividends	D	0.052	—
Contributions	Ψ	0.000	—
1 - Lerner Index		0.698	0.731
Mark-up	$p - 1$	0.433	0.367
R&D labor share	\mathbf{L}_z	0.136	0.115
Share of labor used in production	$N \cdot L_X$	0.865	0.885
Share of variable costs	$N \cdot X$	0.734	0.731
Share of fixed costs	$N \cdot \phi$	0.130	0.154
Interest rate	r	0.070	0.066
Growth rate	g	0.021	0.017
Utility gain (%)		2.48	—
Consumption equivalent gain (%)		3.5	—
Consumption gain at t (%)		-2.96	—
Consumption gain after 10 years (%)		0.78	—
Consumption gain after 25 years (%)		6.53	—
Consumption gain after 50 years (%)		16.83	—

In the most natural case, however, a fraction of surplus should be allocated to the policy-maker. Table 4 and Figure 7 present the results for a case in which the policy-maker gets 30 percent of the surplus generated by the bargain. The Lerner Index and R&D labor intensity are now slightly lower and the mark-up slightly higher as compared to the previous results. The values for the interest rate and growth rate are the same and thus we omit them from the table. However, in this case, there are no gains from lobbying—the lower level of expenditures is enough to offset all the gains from lobbying that we just described and presented in Table 3. This outcome is due

²⁹The projected ratio of profits to total wages can be seen as conservative, since this ratio systematically exceeds this value for the U.S. economy.

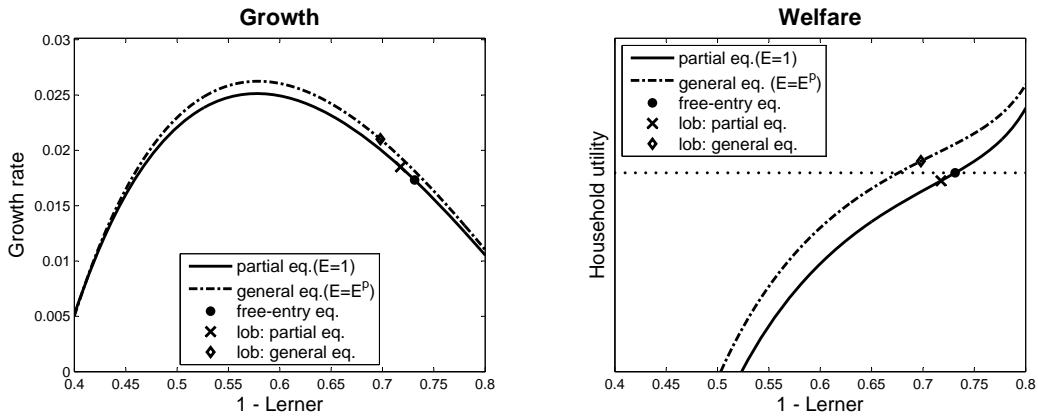


Figure 6: Calibration results for the case in which the policy-maker receives no contributions in equilibrium.

to the real costs of lobbying—about 1.8 percent of wages—which cannot be used in production or R&D activities.

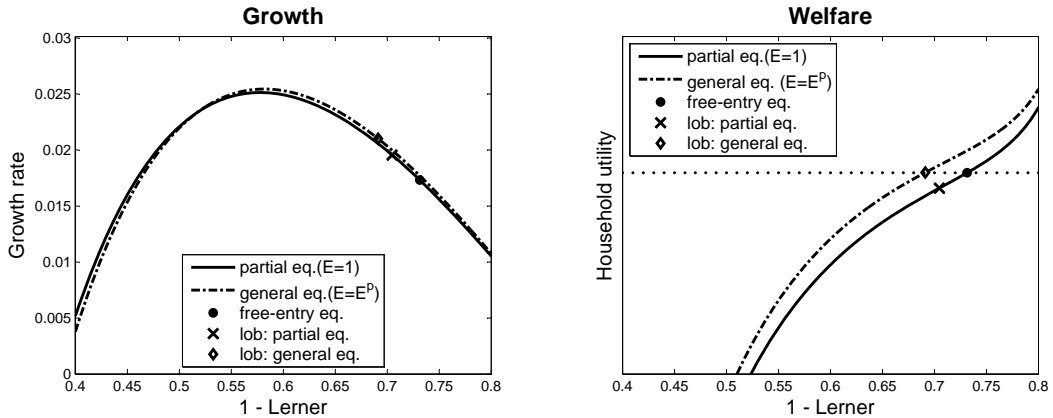


Figure 7: Calibration results for a case in which the policy-maker receives positive contributions in equilibrium.

7 Concluding remarks and discussion

This paper analyzes the link between lobbying, market structure, growth, and welfare, in a general equilibrium model of endogenous growth. The interaction between policy-makers and lobbyists firms is explicitly modeled and a special focus is given to the impact of lobbying on the determinants of welfare. We conclude that lobbying,

Table 4: Calibration results for a case in which the policy-maker receives positive contributions in equilibrium.

	Parameter	Lobbying	Free-entry
Distribution of surplus (fraction)			
Firms (households)	α	0.700	—
Policy-maker	$1 - \alpha$	0.300	—
Preference for contributions	λ	0.465	—
Expenditures	E	1.042	1.000
Wage	w	1.000	1.000
Dividends	D	0.042	—
Contributions	Ψ	0.018	—
1 - Lerner Index		0.691	0.731
Mark-up	$p - 1$	0.447	0.367
R&D labor share	\mathbf{L}_z	0.135	0.115
Share of labor used in production	$N \cdot L_X$	0.847	0.885
Share of variable costs	$N \cdot X$	0.720	0.731
Share of fixed costs	$N \cdot \phi$	0.127	0.154
Utility gain (%)		0.00	—
Consumption equivalent gain (%)		0.00	—
Consumption gain at t (%)		-5.22	—
Consumption gain after 10 years (%)		-1.65	—
Consumption gain after 25 years (%)		3.96	—
Consumption gain after 50 years (%)		14.02	—

by increasing profits, generates extra income to households—dividends—increasing the size of aggregate demand. Besides the direct impact on consumers' welfare, the increase in aggregate demand may raise firms' incentives to invest in R&D, since the market size they can capture becomes larger. These adjustments balance against the negative effects of a reduction in the number of varieties, the increase in the mark-up pricing, and contributions. We conclude that the answer to the question posed in the title is positive: lobbying may in fact increase welfare, as long as the real cost of lobbying is low.

This paper is build under a set of standard assumptions. We use the endogenous growth model of Peretto (1996), since it establishes a link between market structure and innovation. Although it would be interesting to study the effects of lobbying in a more general context and in different types of models, our framework provides a simple and tractable analysis, emphasizing the mechanisms through which lobbying may affect growth and welfare. Lobbying is introduced through a standard framework, which does not explain how policy-platforms are chosen, but captures the outcome of those policy-platforms. While a complete setup would be desirable, this shortcut

allows us to focus on the essential, which is the role of lobbying on economic growth and welfare.

In the political market, firms make contributions to the policy-maker. Since there is no money in our economy, these are in-kind contributions, which require real resources to be produced. Hence, although in our model there is no corruption, time-consuming red tape, or other administrative hurdles needed to start operating a business (which, as Djankov et al., 2002 point out, are very important in reality), there is still a real cost of lobbying. We also consider that a policy-maker who does not care about contributions does not change the free-entry equilibrium, although that change could have a positive impact on welfare in the general equilibrium. One possible interpretation is that the policy-maker is not aware of the effects of his actions on the general equilibrium. Hence, lobbying is presented as a way to create the necessary incentives for market intervention, at a cost. If we had considered the opposite, *i.e.*, a policy-maker who understands that he can change the general equilibrium, then he would select the welfare maximizing allocation, and lobbying would always result in lower welfare. Finally, we do not address the stability of collective action. If the economy with lobbying experiences a parameter change and the number of firms in equilibrium decreases, no firm would want to exit the market voluntarily, since it is making positive profits. While this may destroy collective action, the problem is mitigated if one considers some redistributive mechanism within the lobby, such that those firms who exit the market are compensated.

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Appendices

A Proof of Lemmas 1 to 3

A.1 Proof of Lemma 1

We divide the proof in 3 steps. We first show that $\partial L_z/\partial N > 0$ for small N . Next, we show that $\lim_{N \rightarrow \infty} \partial L_z/\partial N$ converges to 0. Finally, we prove that $\partial L_z/\partial N < 0$ for large N . Simple calculations yield

$$\frac{\partial L_z}{\partial N} = \frac{1}{\gamma} \frac{\theta(\varepsilon - 1)E}{N(N\varepsilon - (\varepsilon - 1))} \left[\gamma - \frac{(1 + \gamma(N - 1))(2N\varepsilon - (\varepsilon - 1))}{N(N\varepsilon - (\varepsilon - 1))} \right] + \frac{r}{\gamma} \frac{1}{(N - 1)^2}$$

It is immediate to obtain

$$\left. \frac{\partial L_z}{\partial N} \right|_{N \rightarrow 1} = \frac{1}{\gamma} \theta(\varepsilon - 1)E(\gamma - \varepsilon - 1) + \frac{r}{\gamma \lim_{N \rightarrow 1} (N - 1)^2} = +\infty$$

and

$$\left. \frac{\partial L_z}{\partial N} \right|_{N \rightarrow +\infty} = \frac{\theta(\varepsilon - 1)E}{\lim_{N \rightarrow +\infty} N(N\varepsilon - (\varepsilon - 1))} + \frac{r}{\gamma \lim_{N \rightarrow +\infty} (N - 1)^2} = 0$$

where we have used the l'Hôpital's rule. Showing that $\partial L_z/\partial N < 0$ for large N is equivalent to show that

$$\frac{\theta(\varepsilon - 1)E(N - 1)}{N(N\varepsilon - (\varepsilon - 1))} \left[\frac{(1 + \gamma(N - 1))(2N\varepsilon - (\varepsilon - 1))}{N(N\varepsilon - (\varepsilon - 1))} - \gamma \right] > \frac{r}{N - 1} \quad (30)$$

The LHS of (30) simplifies to

$$\frac{\theta(\varepsilon - 1)E}{N(N\varepsilon - (\varepsilon - 1))} \left[(1 + \gamma(N - 1)) \frac{N - 1}{N} + \frac{(1 + \gamma(N - 1))\varepsilon(N - 1)}{N\varepsilon - (\varepsilon - 1)} - \gamma(N - 1) \right] \quad (31)$$

For large N , (31) converges to

$$\frac{\theta(\varepsilon - 1)E}{N(N\varepsilon - (\varepsilon - 1))} (2 + \gamma(N - 1)) > \frac{r}{N - 1}$$

where the inequality arises from the fact that $L_z > 0$.

A.2 Proof of Lemma 2

Simple calculations yield

$$\frac{\partial \mathbf{L}_z}{\partial N} = \frac{1}{\gamma} \left[-\theta(\varepsilon - 1) \cdot E \cdot \frac{\varepsilon - \gamma}{(N\varepsilon - (\varepsilon - 1))^2} + \frac{r}{(N - 1)^2} \right] \quad (32)$$

It is straightforward to show that $\lim_{N \rightarrow 1} \partial \mathbf{L}_z / \partial N = +\infty$ and $\lim_{N \rightarrow +\infty} \partial \mathbf{L}_z / \partial N = 0$. Equation (32) takes a negative sign when

$$r < \theta(\varepsilon - 1)E(\varepsilon - \gamma) \frac{(N - 1)^2}{(N\varepsilon - (\varepsilon - 1))^2}$$

Since $(N - 1)^2 / (N\varepsilon - (\varepsilon - 1))^2$ is increasing in N and varies between 0 and $1/\varepsilon^2$, \mathbf{L}_z is decreasing in the number of firms for large N if and only if

$$r < \theta(\varepsilon - 1)E \frac{\varepsilon - \gamma}{\varepsilon^2}$$

Otherwise, \mathbf{L}_z is increasing in N .

A.3 Proof of Lemma 3

Simple calculations yield

$$\frac{\partial g}{\partial N} = \theta \left[-\frac{1 - \gamma}{N^2} \mathbf{L}_z + \frac{1 + \gamma(N - 1)}{N} \frac{\partial \mathbf{L}_z}{\partial N} \right] \quad (33)$$

Using Lemma 2, it is straightforward to see that $\partial g / \partial N$ is positive for small values of N and negative for larger values if \mathbf{L}_z is hump-shaped in N . If \mathbf{L}_z is increasing in N , then the shape of the growth rate depends on the magnitude of $\partial \mathbf{L}_z / \partial N$ in (33).

B Additional insights on the full-fledged equilibrium

Here, we use numerical simulations to analyze the full-fledged equilibrium when U^{pol} is not quasiconcave and labor demand is not monotonic or continuous in E . Observe that U^{pol} depends on the balance of households utility and overall profits, and there is no reason why this balance should be monotonic in the number of firms. Our numerical results suggest that, in this case, problem (22) may have up to two local maxima. Since a shift in the parameters of the problem may change the location of the global maximum, $N^p(\lambda, E, r)$ may no longer be continuous in λ and E . Consequently, labor demand in (24) does not need to be continuous, and this influences the number of equilibria. Furthermore, for large values of λ , an equilibrium may not exist. We analyze the issues of multiplicity and non-existence separately.

Steady-state multiplicity

The number of equilibria in this economy is determined by the number of values of E that satisfy the labor market clearing condition in (24). Since labor demand does not need to be monotonically increasing in per capita expenditures, nor continuous, different values of E may lead to the same quantity of labor demanded by firms. Our numerical results suggest that the economy may have up to three distinct equilibria.

The case of two equilibria. A situation with two equilibria may arise if labor demand is not continuous in per capita expenditures, which, in turn, requires that $N^p(\lambda, E, \rho)$ is not continuous in E . In this case, as E is pushed upwards, gross-profits increase, but they tend to increase by a larger amount for higher levels of concentration. The policy-maker then discretely reduces the number of firms to a nearly monopolistic market. Hence, there exists a critical level of expenditures where the indirect effect of a fall in the number of firms predominates, and labor demand falls discontinuously at that point, but tends to be increasing in E thereafter. Therefore, the equilibrium condition in the labor market can be satisfied for, at most, two distinct levels of expenditures.

The case of three equilibria. A situation with three equilibria may arise if N^p is continuous, but $\partial N^p/\partial E$ is negative and very large in absolute terms. In this case, the fall in labor demand due to N overcomes the direct effect of per capita expenditures on L^D , at least for a small region of E . As N^p quickly converges to its lower bound, the effect of N on L^D dissipates, and only the effect of E remains. Hence, labor demand in the general equilibrium can present at most one region where it is decreasing in E , which implies that we may have, at most, three fixed points in equation (24).

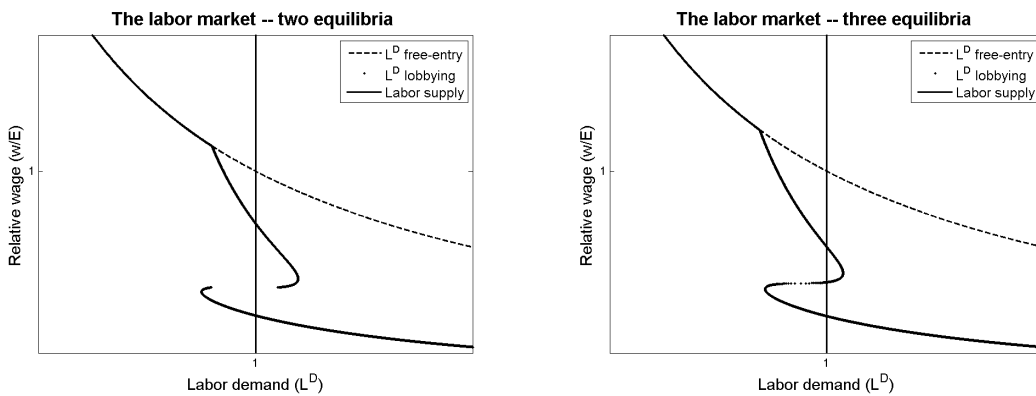


Figure 8: The labor market: multiple equilibria.

These two cases are illustrated Figure 8. The existence multiple equilibria leads to the crucial question of how the economy selects between them. Since N is a jump variable, all equilibria are feasible, and the selection between them depends exclusively on agents expectations about future entry, exit, price, investment and political contributions. However, none of these equilibria is predominantly superior in terms of welfare, *i.e.*, there does not exist one equilibrium that systematically dominates the others, or that systematically dominates free-entry. Hence, all the analysis developed previously can be extended to contemplate the current cases, as long as one considers the equilibrium represented therein as one of the possible three equilibria that may exist in the model.

Non-existence

The existence of an equilibrium in the labor market is not assured for large values of λ , since total labor demanded by firms may not suffice to attain full employment, no matter the level of expenditures. To understand this, consider $\partial N^p/\partial E < 0$ and recall

that, as E increases to correct disequilibriums in the labor market, the incentives of the policy-maker may change towards a reduction in N , which pushes aggregate labor demand in the opposite direction. If λ is large enough, then the market structure converges to the monopolistic case at a rate which may be sufficient to induce an excess labor supply for all values of per capita expenditures, as illustrated in Figure 9. In such situation, aggregate R&D approaches zero (as the maximization condition of firms originates a corner solution at $L_z = 0$), and so does total sales (as the price level converges to infinity), and therefore it follows that total labor demand converges to ϕ for finite E . A corollary of this is that there exists no general equilibrium with lobbying if the policy-maker is completely rapacious ($\lambda = 1$).

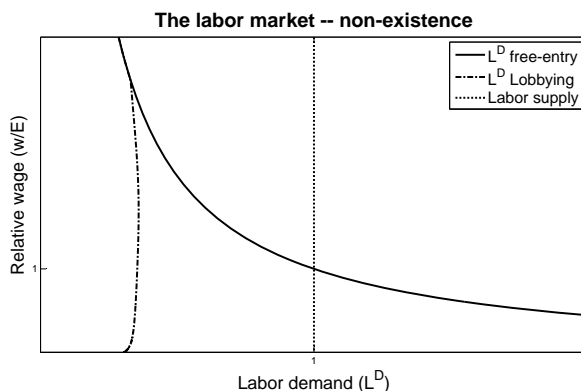


Figure 9: The labor market: non-existence of general equilibrium.

Finally, note that it is always possible to find an upper bound for λ below which an equilibrium is defined. Our equilibrium analysis in the main text assumed such condition, so that no non-existence problems arose.