REGULATING NATIONAL FIRMS IN A COMMON MARKET

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Abstract

We consider the regulation of national firms in a common market. Regulators can influence the production of national firms but they incur in a positive cost of public funds. First, we show that market integration is welfare improving if and only if the efficiency gains compensate for the negative public finance effect (related to business stealing). We also show that supranational competition can have very different consequences on the rent seeking behaviour of firms, depending on cost correlation and ex-ante technological risk. Finally, we characterize the global optimum and show how it can be sustained in a decentralized bargaining solution.

JEL Code: L43, L51, F15.

Keywords: regulation, competition, market integration, cost of public funds.

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1 Introduction

Historically, monopoly regulation has been a response to market failures, such as increasing returns to scale and externalities. In most countries, government intervention took the form of the creation of public monopolies. More recently, the poor performance of public enterprises, associated with soft budget constraints and lack of incentives, has motivated widespread reforms introducing partial privatization and liberalization. These interventions were aimed to stimulate productivity and to decrease prices through the creation a more competitive environment. Recent econometric works on privatization give mixed results about the effects on efficiency and prices.[1] For liberalization, there is some evidence it increases productive efficiency, but the effect on prices is still debated.[2] One of the problems is that, even after liberalization, in all these industries high concentration persists, due to residual economies of scale and barriers to entry. In markets where the national leaders stay dominant, the competitive pressure can be increased through market integration. When the boundaries of the market are enlarged, competition can take place even if the efficient scale of the firm is large. For instance, the process of economic integration in the European Union has fostered competition in regulated markets. Firms are allowed to provide services in all member states and exclusion of competitors from other member States is no longer permitted. However, regulated industries usually provide services of general interest which have special treatment under the law. Member States are free to impose obligations to the firms and to offer compensation for that, in particular for the provision of universal service. It is common to find markets in which the former monopoly is subject to ex ante regulation, in which the government influences the market behavior of the firm (public or regulated) and some transfers are paid in order to preserve the universality of the service. In this context, the introduction of competition and the removal of barriers to trade raise special issues, which are the object of our analysis. A crucial point is that market integration removes barriers to trade, while regulation acts at the national level. On the one hand, competition reduces the ability of the regulator to control the national market and to induce the preferred Ramsey-type tariffs. On the other hand, integration can increase national welfare through the foreign profits of the national firm and in some cases it also helps to reduce the rent captured by regulated firms.

There are several examples of regulated markets which have been progressively exposed to

[1] For instance, Boylaud and Nicoletti (2000), studying reforms in telecommunications, find no evidence that the change in ownership structure matters. Domah and Pollit (2001) and Zhang, Parker, and Kirkpatrick (2002), studying the reforms in electricity in developed and developing countries respectively, reject the hypothesis that privatization per se leads to increasing efficiency or decreasing prices.

[2] The idea that the efficiency gains related to reforms are not necessarily transmitted into price have been confirmed by several empirical works on the liberalization of the electricity sector. For instance, the panel data analysis of Green and Newbery (1998), Domah and Pollit (2001) and Hattori and Tsutsui (2003) find that reforms have been associated with increasing prices.

competition and in particular to foreign competition.[3] In telecommunications, the process of liberalization and market integration is probably the most advanced. The bigger providers operate at the European level and they have reciprocally challenged their monopoly position in the home country. Some of the main players are public or mixed-public firms, others are completely privatized firms. For instance, in the UK, British Telecom has been fully privatized from 1987. In continental Europe the situation is different. In September 2004, French State still held 42.2 percent of the capital of France Telecom and around 80 percent of the workers were civil servants (Berne and Pogorel, 2004). Similarly, the German operator Deutsche Telecom is only partially privatized. Even if the privatization process goes on, the role of governments in this industry will remain important because of universal service obligations and price regulation. Moreover, direct government intervention seems to be the rule in case of crisis, sometime conflicting with the general antitrust and non discrimination policies. An example is the intervention of the French government in favor of France Telecom, which has been under scrutiny of the EU Commission under the legislation on State aids. Other regulated industries are by far less competitive than telecommunications, but still market integration and the removal of barriers to trade put some competitive pressure on the incumbents. An example is postal service. Here the extent of effective competition is lower, but efforts are made at the EU level to increase market integration. As a reaction, in the last years, many UPS have bought private parcels operators to consolidate their presence in other member states. In the same way, energy markets are progressively integrated. Market integration is developed in Northern countries, independently of the more general process of integration at the EU level. Norway and Sweden have liberalized their markets, allowing neighbor operators to enter the national market. The incumbent public monopolies have been privatize to a very small extent, but foreign competitors are allowed to serve the market. In the same way, European directives promote the formation of an European market for energy through liberalization and interconnection. The situation is similar for transports. In this case, every national leader has market power in its country. For railways, public ownership and government funding are widespread, due to the social value of the industry and the persistent economies of scale. For this reason, the industry is quasi-monopolistic in most of the countries. Nevertheless, competition is allowed and the European institutions are trying to develop a common transport policy for the integrated market. For airlines, the process of privatization is more pervasive. However, government direct participation remains. For instance, the French government controls 44 percent of Airfrance, which represents 81 percent of the merged entity Airfrance-KLM. Moreover, the recent crisis of the industry in the early 2000s has shown that, direct government intervention takes place whenever the national carrier encounters a major threat. Even in the United States, government officers

[3]Most of the regulated industries are network industries. In the present paper we focus on competitive issues neglecting interconnection problems. This is equivalent to assuming that interconnection is priced at its marginal cost, normalized to zero.

are usually in favor of rescuing airlines, creating barriers to exit and soft budget constraints (the government does not allow firms to fail). Thus air transport is in general characterized by a heavily regulated environment with soft budget constraints (government subsidies). Even when the degree of deregulation increases, the attribution of slots in the airports tends to maintain market power of the national leader. Finally, in spite of the attempts to make the market more competitive in the last years we have assisted to an increase of concentration at the EU level, with important mergers such as British Airways-Iberia or Airfrance-KLM. The market appears to be concentrated at the European level. This calls for public intervention in order to reduce distortion related to market power.

The present work studies of the optimal regulation of national firms in a common market. In a common market, the regulation of the former monopoly becomes regulation of the "national champion". We adopt a model of quantity regulation à la Baron and Myerson (1982). Each regulator sets the quantity produced by the national firm screening across types through a menu of contracts setting the quantity and a lump sum transfer. Quantities are chosen simultaneously. The presence of competition in the integrated market affects the contract between the regulator and the national firm. The main results are the following. Under complete information, when the cost of public funds is positive, competition is welfare enhancing if and only if the variable costs of the two firms are different enough. In this case, the high cost country benefits from price reduction and the low cost country from export revenues. When the costs are close, the (negative) public finance effect prevails. Competition is not very beneficial to consumers (small price effect) and it harms the national firm, and hence tax payers, through business stealing. At the non cooperative solution, the subsidy paid by at least one government increases (or the tax revenue decreases). The subsidy to the relatively inefficient national firm is a way to counterbalance the market power of the foreign provider. The welfare effects are robust and do not depend on the hypothesis of complete information. However, under asymmetric information, market integration has an additional impact on the seeking behavior of the regulated firm. We show that cost correlation is crucial to determine the impact of competition on the rents captured by regulated firm. If shocks are uncorrelated, the rent increases at least for low cost types. If correlation is high, the rent generally decreases, except possibly for very inefficient types.
Once we have shown the potential welfare reducing effect of market integration, we consider the possibility of cooperation between regulators. In a progress of regional integration, regulators can try to achieve collective gains. As a benchmark, we first look to the global maximizing solution. This is the utilitarian solution which maximizes global welfare as given by the sum of the two national welfare. At this solution the country with the less efficient technology is in general a loser of the integration process, even if its own consumers enjoy a lower price. For this reason the efficient solution cannot emerge in a non cooperative framework without side transfers.

Each decentralized cooperative solution has to pay back the negative impact of business stealing on public finance and the costs related to restructuring. This idea that it could be necessary to sustain the losers of the liberalization process is consistent, for instance, with the practical experience of the introduction of the National Competition Policy (NCP) in Australia. NCP was introduced in 1995: at the time, the government commissioned a public enquiry on the impact of the new Policy on the different communities and social groups. This was explicitly aimed to evaluate the need for structural adjustment policies towards the losers of the liberalization process.

In the context of the European Union, the Structural Funds are the instrument used to reduce disparity in development and in particular *"developing infrastructure, (...) targeting the development of trans-European networks in the area of transport, telecommunications and energy"* (EC 1260/99). Our result suggests that cooperation in the form of transfers should be used in order to provide funding for infrastructure and restructuring policies. In the absence of these resources, it is reasonable to expect countries to overprotect national firms. Cooperation with transfers may avoid other less desirable form of subsidies (state aids to inefficient national producers).

1.1 Related literature

The literature concerning the interactions between regulation and market integration is not very developed. Brainard and Martimort (1996, 1997) analyze trade policies in an integrated market. These papers focuses on the strategic effect of export subsidies, under asymmetric information between the regulator and the national firm. Governments pay subsidies to national firms competing in a third country. Under asymmetric information, the optimal policy stresses a trade off between strengthening the position of the national firm and minimizing the information rent, which is socially costly. The interaction of regulatory policies reduces the cost of the information rent. The consumers in the home market are unaffected, except for the fact that rent seeking behavior of the regulated firm is not desirable due to the existence of a positive cost of public funds. In this kind of models, contrary to what happens in regulation models, market power is not detrimental to consumer welfare, since it is exerted only on *foreign consumers*. Combes, Caillaud, and Jullien (1997) develop Brainard and Martimort's framework adding to the problem domestic production and national consumers. They use a common market model, in which states may subsidize domestic producers. The regulatory instrument is a quantity subsidy (associated with a lump sum tax on profits). Following the approach of Brainard and Martimort, they look at the strategic effect of subsidy policies and find that it is optimal to allow for subsidies in this kind of market (as opposed to the general rule which prevents state aids to firms). They don't consider the fiscal effect of competition, which arises whenever the public funds are costly. With no budget constraint for the government, in their case market integration

is always welfare improving (for both countries). However, the public finance aspect of monopoly regulation is an important one. Traditionally, monopoly Ramsey pricing has constituted a way to raise funds in order to cover fixed costs or subsidize consumption of less favored groups of consumers. As Armstrong and Sappington (2005) notice, competition can *"complicate the regulatory policy undermining preferred tax structures"*. Similarly, Laffont and Tirole (2000), discussing pro-competitive reforms in telecommunications, argue that competition, limiting the scope for cross subsidies, may induce an increase in the transfers paid to the industry. When other sources of taxation are distortive or limited by budget concerns, this can induce relevant deadweight losses. Adding a positive cost of public funds we obtain strikingly different results in the welfare analysis with respect to the existing literature.

Another approach to the problem of regulation in integrated markets, is given in Calzolari (2004) Calzolari and Scarpa (2007). The former looks at the interaction between the policies of different regulators. In this model, there is only one multinational firm operating in two different countries. The paper deals with the capacity of multinational firm to benefits from lack of coordination of the regulators of different countries. In contrast, we look at the interaction between regulators of different national firms which compete in a common market. Calzolari and Scarpa (2007) considers the optimal regulation of a firm which is a monopoly at home but competes abroad with a foreign firm. It is a model of regulation with transfers, but public funds are not costly. For this reason, if the marginal costs are constant (no externality of the foreign production of the regulated firm on production for the internal market), the pricing rule in the regulated market does not change with competition. The regulatory policy is affected only if there are economies (or diseconomies) of scale. Interestingly, the model shows that allowing a private firm to operate in a foreign market *increases* the price distortion related to asymmetric information. As the firm also operated in the foreign market, it can earn an additional rent on foreign activities. This model does not consider the case in which the regulator has to deal with entry of a foreign operator in the home market. Yet economic integration is a process of reciprocal opening of the market to foreign competitors. Adding this aspect to the picture, we give different insights on the impact of market integration and in particular on the behavior of the information rent.

1.2 Plan of the paper

The paper will proceed as follows. In Section 2 the basic model is presented. Section 3 analyzes the case of complete information: it characterizes the equilibrium of the model and the impact of market integration on welfare. Section 4 considers the case of asymmetric information. In Section 5 we present the global maximizing solution, which would be imposed by a welfare maximizing supranational regulator. We also show how this globally efficient solution can be obtained as a decentralized cooperative solution through Nash-Bargaining between regulators.

Section 6 concludes.

2 The model

There are two countries, $i \in \{1, 2\}$. The demand in each country is given by:

$$q_i = \varphi_i(d - p)$$

Where φ_i the size of country i and p the price.[4] The slope and the intercept of the demand function are the same in the two countries, but we allow for countries of different size. φ_i can be interpreted as the size of the country in terms of population and/or the level of development. In fact, demand in sectors such as electricity, telecommunication, transport, postal services has not the same characteristic in developed and less developed countries. Regulator i maximizes the welfare of country i, given by the sum of consumer surplus and the profit of the national firm. The presence of a positive λ_i captures the idea that public funds are raised through distortive taxation (in this sense, λ_i can be interpreted as the shadow price of the government budget constraint). Paying a positive subsidy to a regulated firm in order to expand production creates distortions in other sectors. Conversely, when the transfer is negative (tax on profits), it helps to reduce distortive taxation elsewhere. Typically, the revenues of the regulated firms in profitable segments are used to cross subsidize network expansion, public investment or subsidized access in non profitable segments. The assumption of costly public funds is a way of capturing the general equilibrium effects of sectoral intervention: raising revenue incurs administrative costs or creates distortions elsewhere in the economy.

2.1 Closed economy

As a benchmark, we consider the closed economy case. We use a standard monopoly regulation framework à la Baron and Myerson (1982). The regulator maximizes the expected welfare under close economy, W_i^C, subject to the participation and incentive constraints of the firm. Welfare is given by:

$$W_i^C = S(q) - p(q)\ q - (1 + \lambda_i)\ t + \Pi_i \tag{1}$$

The participation constraint takes the form:

$$\Pi_i = t + (d - \frac{q_i}{\varphi_i} - \theta_i)q_i + U_i \geq 0$$

[4]This specification allows to obtain simple analytical expressions for the quantities, price and welfare. The results can be extended to more general demand functions.

Where θ_i is the constant marginal cost of firm i. The underlying assumption is that firms have a constant marginal cost θ_i. [5] We can assume they also sustain a fixed cost K, which measures the economies of scale in the industry. This cost is considered as sunk and does not enter the participation constraint of the firms. U_i is the information rent left to the firm under the optimal contract. Under asymmetric information, regulators do not observe the cost of the regulated firm and they leave some rent to the firm in order to maintain incentives.
We consider a direct revelation mechanism in which firm i reports its cost and Regulator i offers a menu of contracts $\{q_i(\theta_i), t(\theta_i)\}$ to firm i (the revelation principle assures this is without loss of generality). The regulator maximizes expected welfare under participation and incentive compatibility (truthful revelation) constraints of the firm. The solution of this problem is standard (Baron and Myerson, 1982; Laffont and Tirole, 1993).
We define the virtual cost of firm i as:

$$\theta_i^v = \theta_i + \gamma_i$$

Where γ_i is measure the distortion related to asymmetric information. Due to asymmetric information, the managers of the firm are able to inflate the report on the cost and get some information rent.

Assumption 1 *The marginal cost θ_i follows a cumulative distribution function $F(\theta_i)$, $i \in \{1, 2\}$, on the support $[\underline{\theta}, \overline{\theta}]$. The distribution is known by the regulator.*

The rent of the regulated firm can be written:

$$U_i^C = \int_{\theta_i}^{\overline{\theta}} q_i(\theta) \mathrm{d}\theta \tag{2}$$

Under Assumption 1 and taking into account (2), at the optimal contract γ_i takes the following form:

$$\gamma_i = \gamma^C = \begin{cases} 0, & \text{under complete information;} \\ \frac{\lambda_i}{1+\lambda_i} \frac{F(\theta_i)}{f(\theta_i)}, & \text{under asymmetric information.} \end{cases}$$

To avoid bunching, we make the following assumption, which assures that the solution is monotone in θ_i:

Assumption 2 *(Monotone hazard rate property) The hazard rate $\frac{F(\theta_i)}{f(\theta_i)}$ is non decreasing in θ_i.*

The optimal price and quantity are a function of the virtual cost θ_i^v.

[5] In our linear specification, expanding or reducing production in response to market integration has no impact on the unit cost. The effects of different specifications of the marginal cost are left to further research.

$$q_i^C = \frac{\varphi_i\,(d-\theta_i^v)(1+\lambda_i)}{1+2\lambda_i} \tag{3}$$

$$p(q_i^C) = d - \frac{q_i}{\varphi_i} = \frac{\lambda_i\,d + \theta_i^v(1+\lambda_i)}{1+2\lambda_i}$$

Assumption 3 *Production is always socially desirable:*

$$d > \overline{\theta}_i^v$$

When public funds are not costly (i.e. $\lambda = 0$), the regulator maximizes consumer gross surplus net of production cost. The result is marginal cost pricing at the virtual cost. When $\lambda_i > 0$ the price is raised above the cost with a rule which is proportional to the elasticity of demand:

$$\frac{p(q_i) - \theta_i^v}{p(q_i)} = \frac{\lambda_i}{1+\lambda_i}\frac{1}{\varepsilon_i}$$

and $\varepsilon_i = \frac{(1+\lambda_i)\theta_i^v + \lambda_i\,d}{(d-\theta_i^v)(1+\lambda_i)}$. Under complete information, this corresponds to a Ramsey tariff, which represents the first best solution. Under asymmetric information, there is a downward distortion of the quantity for all types except the most efficient. The regulated monopoly price is *above* marginal cost. This means that the equilibrium t is negative (lump sum tax) and it helps to repay the fixed costs or reduce distortions in other sectors of the economy (through cross subsidies). Total welfare is obtained by replacing the optimal price and quantity in equation (1). In the following Section we compare this level of welfare with the one obtained in the case of market integration.

2.2 Common market

We now suppose that the market is open. For simplicity, we take a perfectly integrated market in which demand is given by:

$$p = d - \frac{q_1 + q_2}{\varphi_1 + \varphi_2}$$

This assumption turns out not to be crucial for the results. Perfect market integration avoid corner solutions. However, the results are robust when considering a segmented market of two countries with independent demands and nonzero transportation costs: this alternative specification gives qualitatively similar results (details are available on request to the author).[6]

[6] Another simplifications is that we are assuming that expanding production in order to cover part of the foreign market does not change the cost structure of the firms. This is equivalent to assuming that firms can expand production to the foreign market at a small (fixed) cost, here normalized to zero. In the case of decreasing returns to scale, the impact of integration would be of the same nature, though smaller in magnitude.

Each of the two regulators maximizes home welfare. Regulator i maximizes the surplus of national consumers plus the profits of the national firm. Welfare of country i is thus given by:

$$W_i^O = d\,\frac{\varphi_i(q_i+q_j)}{\varphi_i+\varphi_j} - \frac{1}{2}\frac{\varphi_i(q_i+q_j)^2}{(\varphi_i+\varphi_j)^2} - \left(d - \frac{q_i+q_j}{\varphi_i+\varphi_j}\right)\frac{\varphi_i(q_i+q_j)}{\varphi_i+\varphi_j} + \left(d - \frac{q_i+q_j}{\varphi_i+\varphi_j} - \theta_i\right)q_i - \lambda_i t_i \quad (4)$$

where $\frac{\varphi_i}{\varphi_i+\varphi_j}$ is the share of country i on total demand. Regulator i maximizes the expected welfare of country i. The participation constraint takes the form:

$$\Pi_i = t_i + (d - \frac{q_i+q_j}{\varphi_i+\varphi_j} - \theta_i)\,q_i \geq 0$$

In this model, we do not allow the regulator of country i to contract with firm j. This is equivalent to assuming that there is incomplete regulation in each jurisdiction. For simplicity, one can think to the case in which the national firm is public. Even in the case of privatized firms, asymmetric regulation is used in practice in many liberalized market and have been already analyzed in the literature.[7] Without loss of generality, we adopt the following notation:

Assumption 4 $\varphi_1+\varphi_2=2$, $\varphi_1=x$, $\varphi_2=2-x$, $0<x<2$

In the symmetric case $x=1$. In the asymmetric case, $x>1$ means that country 1 is the bigger one.

3 Common market under complete information

In this section we consider the case of complete information (i.e. $\gamma_i \equiv 0$, $\theta_i^v = \theta_i$). Regulator i maximizes national welfare under the participation constraint of the firm. The first order condition of the problem is:

$$d\,(1+\lambda_i) - d\,\frac{x}{2} - \theta_i\,(1+\lambda_i) - q_i\,(1-\lambda_i-\frac{x}{4}) - \frac{1}{2}\,q_2\,(1-\lambda_i-\frac{x}{2})$$

We start studying the symmetric case (i.e. $\lambda_1=\lambda_2=\lambda$ and $x=1$), which gives all the main insights of the model. Afterwards, we assess the impact of asymmetries (heterogeneity between countries).

3.1 The symmetric case

We derive the the optimal quantities and price in the symmetric case. They are given by:

$$q_i^O = \frac{2\,d\,(1+\lambda) - \theta_i(3+4\lambda) + \theta_j(1+2\lambda)}{2+3\lambda}\,,\ i,j\in\{1,2\},\ i\neq j \quad (5)$$

$$p^O = \frac{(\theta_1+\theta_2)(1+\lambda) + d\,\lambda}{2+3\lambda}$$

[7] See for instance Caillaud (1990); Biglaiser and Ma (1995).

For any level of λ, the lowest cost firm has the largest market share. When $\lambda = 0$, the quantity produced by firm i is reduced with respect to closed economy whenever the foreign firm is more efficient ($\theta_j \leq \theta_i$). In this case, the former monopoly leave some space to the more efficient competitor to let consumers enjoy lower prices. If $\lambda > 0$, leaving market shares to the competitor make it more difficult to finance distortive taxation (reducing net profits of firm i). Regulator i is willing to reduce the business stealing effect caused by competition with the foreign firm and quantity is reduced *less* often. In particular, the quantity produced by firm i decreases with respect to a closed economy if and only if:

$$\theta_j < \frac{\theta_i \left[1 + 5\,\lambda\,(1+\lambda)\right] - \left[d\,\lambda\,(1+\lambda)\right]}{(1+2\,\lambda)^2} < \theta_i, \quad \forall \lambda > 0$$

The fiscal effect related to the cost of public funds can induce the regulator to *expand* the quantity produced when confronted with a *more efficient* foreign competitor in order to reduce the scale of entry of the foreign firm. From the point of view of the national market, when $\lambda > 0$ "entry" takes place if and only if the foreign firm is *strictly* more efficient than the national producer. Similarly, the behavior of the price is closely related to the value of the cost of public funds. When $\lambda = 0$ the price is equal to the average marginal cost. Then, compared to the closed economy case, price is higher for the low cost country and smaller for the high cost one. The less efficient country finances the losses of its firm in order to expand the total quantity and reduce the price. When $\lambda > 0$ the price may decrease even if the competitor is *less* efficient than the domestic firm. In particular, this is the case whenever:

$$\theta_1 < \theta_2 < \frac{\theta_1(1+\lambda) + \lambda\,d}{1+2\lambda}$$

In addition, looking at consumer surplus, some conclusions can be drawn. For $\theta_2 > \frac{\theta_1(1+\lambda)+\lambda\,d}{1+2\lambda}$ the price in the integrated market lays in between the prices in the separated economies. This means that the price may increase for consumers located in the country with the more efficient technology. In this case, consumers would oppose market integration, while the national firm gains from it. On the contrary, in the less efficient country consumer would enjoy a lower price, but the national firm and thus tax-payers loose from integration. Market integration has distributive effects and may generate winners and loser in both countries. For this reason consumers may oppose market integration even in countries in which total welfare increases with integration. Conversely, a welfare maximizer regulator would promote market integration in cases in which consumers loose from it.

The net welfare effect of market integration is more difficult to asses. When a firm is relatively efficient, it gains form market opening, due to export profits. On the other hand, if λ is positive and the difference in marginal cost is small, the negative fiscal effect outweighs the efficiency gain.

Proposition 1 *Under complete information, for $\lambda = 0$, market integration increases welfare in both countries. For any λ strictly positive, market integration increases welfare in both countries if and only if the difference in the marginal costs is large enough.*

Proof: Let $\Delta W = W_i^O - W_i^C$ be the welfare gain of country i going from closed economy to market integration. Market integration is preferred to autarchy whenever $\Delta W \geq 0$, or:

$$\theta_i - \theta_j \geq \frac{\lambda(d - \theta_j)[B(\lambda) + C(\lambda)]}{D(\lambda)} \tag{6}$$

$$\theta_i - \theta_j \leq \frac{\lambda(d - \theta_j)[B(\lambda) - C(\lambda)]}{D(\lambda)} \tag{7}$$

Where $B(\lambda) = 3+\lambda(9+7\lambda)$, $C(\lambda) = (2+3\lambda)\sqrt{(1+2\lambda)(3+4\lambda)}$, $D(\lambda) = 3+\lambda(19+\lambda(37+23\lambda))$. If $\lambda = 0$, the RHS of both inequalities are equal to zero and market integration is always welfare improving with respect to a closed economy. If $\lambda > 0$,the RHS of inequality (6) is always positive under Assumption 3. Thus the inequality is satisfied if the relative *inefficiency* of firm i is big enough. Conversely, the RHS of inequality (7) is always negative. Then the inequality is satisfied if the relative *efficiency* of firm i is big enough. We conclude that, when the cost of public funds is positive, countries mutually benefit from market integration if and only if the cost differential is big enough.

The public finance effect can be important in practice, since government are not free to correct market distortions at no cost and the cost of public funds is in general positive (estimated around 0.3 in developed countries and larger for developing ones, see for instance Snow and Warren, 1996). Whenever they devote funds to an industry to promote universal service or to reduce the effects of monopoly power, they have to raise these fund trough distortive taxation or divert funds from other socially valuable activities. Competition, through business stealing, reduces the capability of performing taxation by regulation. Nevertheless, we have shown that competition can be beneficial for two reasons:

1. If the foreign firm is significatively *less* efficient than the national firm, the benefits from increased profit (due to the possibility of serving also foreign demand) increase total welfare.

2. If the foreign firm is significatively *more* efficient than the national firm, the inefficient country can benefit from the reduction in price caused by competition, which enhances consumer welfare.

In order to illustrate the result given in Proposition 1, we adopt the following notation: the cost difference between the two producers is expressed as $\Delta = \theta_j - \theta_i$. If $\Delta > 0$, country i has the more efficient technology. When $\lambda = 0$, an increase in Δ increases the welfare gains

identically in the low cost and high cost country. The result is driven by the efficiency gains related to the reallocation of production among the two countries. When public funds are not costly, the regulators can prevent inefficient business stealing expanding the production of the national firm: this has no cost because the information rent is not an issue in this case (if public funds are not costly, a subsidy to the regulated firm is a pure transfer and has no impact on welfare, both under complete and asymmetric information). When $\lambda > 0$, the welfare gains shift downwards and to the left. As a result, the intercept (corresponding to $\Delta = 0$) is negative, which means that if $\theta_1 = \theta_2$ both countries loose from integration. For $\Delta \neq 0$ the welfare gains of the two countries are asymmetric. For the most efficient one ($\Delta > 0$) the gains are strictly increasing. For the less efficient ($\Delta < 0$) they have U-shape. The welfare gains are first decreasing and then increasing. Eventually, for $|\Delta|$ big enough, the welfare gains are positive in both countries. Figure 1 illustrates the welfare gains for $\lambda = 0$ and $\lambda > 0$ respectively.[8]

Figure 1: Welfare Gains: $W_1^O - W_1^C$, Complete Information.

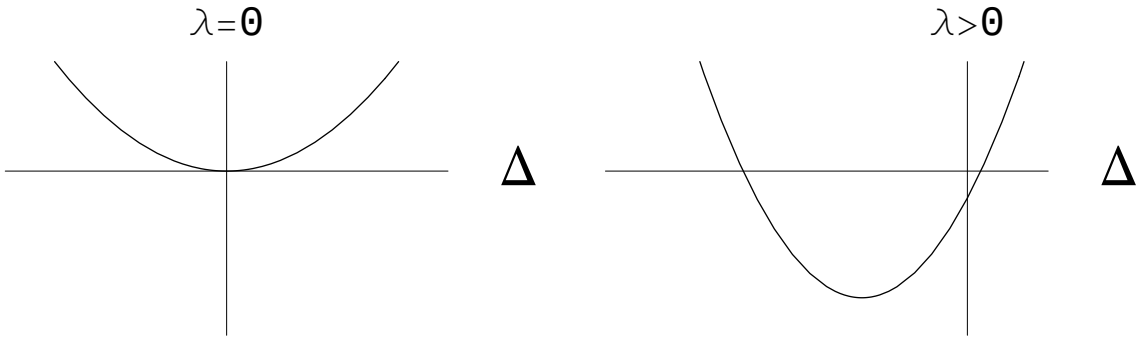


Figure 3.1 shows the value of the cost parameters for which the difference between welfare in the integrated market W^O is lower than the one under closed economy W^C. This happens whenever $\theta_i \geq \theta_j$ and $\theta_i \simeq \theta_j$. This result suggests that countries with big cost differences should be in favor of market integration, which is mutually beneficial. One possible example is the integration of electricity markets between France (low cost region) and neighbor countries (Italy, Spain). The cost of production is very different between countries and both can benefit from market integration.[9]

[8]The results illustrated in the figure hold for all $\lambda > 0$, as one can easily verify analytically.

[9]For the Nord Pool the situation is apparently different, since there is not a big difference in generation costs, at least on average. Nevertheless, as Ward, Allen and Davis (2002) notice, the success of the Pool is strictly related to the complementarity of fuel sources: *the significant hydro capacity of Norway (100 %) and Sweden (50 %) can, in wet years, provide cheap electricity beneficial to other markets; the significant thermal capacity of Denmark (85 %) and Finland (55 %) can provide "dry-year" reserve for the hydro countries.*

3.2 Asymmetries between countries

We turn now to the asymmetric case. The impact of asymmetries is summarized in the following propositions:

Proposition 2 *Assume $\lambda_1 = \lambda_2 = \lambda$ and, without loss of generality, let country 1 be the bigger one (i.e $x > 1$). The result in Proposition 1 holds. Moreover, increasing asymmetry from $x = 1$, gains form trade decrease.*

$$\frac{\partial (W_1^O - W_1^C)}{\partial x} < 0$$

The smaller country gains more (or looses less) from market integration.

Proof: see Appendix 1.

As in Combes, Caillaud, and Jullien (1997) the gains from trade are larger for the country with the smallest market. We now study the case of asymmetric cost of public funds:

Proposition 3 *Let $x = 1$ and consider a local increase in λ_i, which implies that country i's tax system becomes relatively inefficient. By continuity, the result in Proposition 1 holds. Moreover, there exist a threshold value $\tilde{\theta} \leq \theta_j$ such that, for all $\theta_i > \tilde{\theta}$, gains form trade in country i decrease with respect to the symmetric case.*

$$\left.\frac{\partial (W_i^O - W_i^C)}{\partial \lambda_i}\right|_{\lambda_i = \lambda_j = \lambda} < 0\,, \quad \forall \theta_1 > \tilde{\theta}$$

Proof: see Appendix 2.

The result of Proposition 3 helps to qualify the result obtained in Proposition 2. The gains from economic integration *decrease* with the size of the country but generally *increase* with the relative efficiency of the public sector. If the smaller economy is a less developed one, with tighter budget constraint (here summarized by a large cost of public funds) and not very efficient technology ($\theta_1 > \tilde{\theta}$), this reduces its gains. The problem of raising funds to cover fixed investment is particularly severe in countries characterized by inefficient tax systems. As Laffont, 2005 explains discussing regulatory reforms in developing countries, taxation by regulation can play an important role in these countries. For this reason, market opening may be harmful to countries characterized by severe budget constraints if it is not accompanied by some other fiscal policy which can compensate for the loss of revenue of the national firms.

4 The impact of asymmetric information

In many markets the firms have private information about production costs. For this reason, second best regulation requires the payment of an information rent to the firms. In this context,

market integration and competition could constitute an instrument to improve the performance of regulated firms by reducing the burden of the rents paid by society to the regulated monopolies. As this section shows, this is not always the case. We make the assumption, usual in the regulation literature, that the distribution of θ_i is common knowledge. The realization of the costs, on the contrary, is private information of the firms. For simplicity, we assume that each firm is informed about the effect of the shocks on the two marginal costs.[10] The incentive compatibility constraint is modified. If costs are correlated, overstating its cost the domestic firm knows that the competitor is more efficient than it is believed by the regulator. Mimicking a higher cost the national firm is confronted with a higher anticipated response of the competitor. For this reason, the gains from mimicking a high cost are reduced. We assume that the national regulator and the national firm cannot write contracts contingent on the realization of foreign variables. This can depend on the fact that foreign variables are not verifiable.[11] For simplicity, we restrict the attention to the symmetric case. The extension to asymmetry can be obtained with the same technique adopted for the case of complete information illustrated in the Appendix 1 and 2. From the first order condition of firm i:

$$\frac{\partial \Pi_i}{\partial \theta_i} = -(1 - \frac{\partial p}{\partial \theta_i})q_j$$

where:

$$\frac{\partial p}{\partial \theta_i} = -\frac{1}{2}\frac{\partial q_j}{\partial \theta_i}$$

We have:

$$\frac{\partial q_j}{\partial \theta_i} = \frac{\partial q_j}{\partial q_i}\frac{\partial q_i}{\partial \theta_i} + \frac{\partial q_j}{\partial \theta_j}\frac{\mathrm{d}\theta_j}{\mathrm{d}\theta_i}$$

The first term in the RHS is equal to 0 (Cournot model). Moreover, the term $\frac{\mathrm{d}\theta_j}{\mathrm{d}\theta_i}$ is greater than 0 in case of positive correlation. In this case, the slope of the information rent will be reduced and the price is closer to efficiency. Consumers benefit from this indirect effect of competition, even if no explicit benchmark regulation is performed.

The regulator maximizes the expected welfare:

$$W_i^{AI} = E_{\theta_1,\theta_2}\ [S(q) - p(q)\ q - (1 + \lambda_i)\ t + \Pi_i]$$

subject to the constraints:

[10] This particular assumption does not influence the result. If the cost of the competitor was not known, the reaction function of the firm will depend on the expectation.

[11] If foreign variables were verifiable, competition could also open the possibility of yardstick competition. In this case, the regulator could write contracts contingent on the performance of the foreign firm. In this paper, we don't consider this possibility. However, in case of partial cost correlation, all the qualitative results would be preserved.

$$\begin{aligned}\Pi_i &= t + (d - \frac{q_i + q_j}{2} - \theta_i)q_i + U_i \ \geq \ 0 \\ \dot{U}_i &= -\left(1 + \frac{1}{2}\frac{\partial q_j}{\partial \theta_i}\right) q_i\end{aligned}$$

Then the information rent can be written:

$$U_i = \int_{\theta_i}^{\overline{\theta}} \left(1 + \frac{\partial q_j}{\partial \theta_i}\right) q_i \, \mathrm{d}\theta_i \tag{8}$$

The first order condition of this problem is:

$$E_{\theta_j|\theta_i} \ [4(d - \theta_i^v) - q_i(3 + 4\lambda_i) - q_j(1 + 2\lambda_i)] = 0 \tag{9}$$

Where we have:

$$\gamma_i = \gamma^O = \frac{\lambda}{1 + \lambda}\left[1 + \frac{1}{2}\frac{\partial q_j}{\partial \theta_i}\right]\frac{F(\theta_i)}{f(\theta_i)}$$

Thus the reaction function of Regulator i to the policy chosen by Regulator j is:

$$q_i^{AI} = \frac{4d - E_{\theta_j|\theta_i}[\theta_i^v - (1 + 2\lambda_i)q_j]}{3 + 4\lambda}$$

In order to get explicit results, we consider the two limit cases of uncorrelated costs and perfect correlation. These are limit cases which approximate the more general cases of high or low correlation between the variable production costs.

4.1 Uncorrelated costs

We start considering the case of uncorrelated marginal costs. More precisely, we assume that costs are distributed over the same support and have equal mean, but they are subject to idiosyncratic shocks. In this case, market opening has no direct impact on the rent extraction problem. In fact, with uncorrelated shocks, $\frac{\partial q_j}{\partial \theta_i} = 0$. The slope of the information rent is unaffected and still depends on the hazard rate of the characteristic of the regulated firm. However, the quantity is not the same under complete and asymmetric information. In particular, the presence of a competitor allows the regulator to reduce the quantity of the regulated firm with a lower impact on the price with respect to monopoly (because the quantity produced by the competitor is not affected by a reduction of the regulated quantity). This may reduce the social burden of the rent, giving a new value to competition. From the system of the two first order condition, we obtain:

$$q_i^{AI} = \frac{2(1 + \lambda)[d(3 + 4\lambda) - 2\theta_i^v(2 + 3\lambda) + E\theta^v(1 + 2\lambda)]}{(2 + 3\lambda)(3 + 4\lambda)} \tag{10}$$

Where $E\theta^v = \int_{\underline{\theta}}^{\overline{\theta}} \theta_i^v dF(\theta_i) = \int_{\underline{\theta}}^{\overline{\theta}} \theta_j^v dF(\theta_j)$ is the expected virtual cost in the case of no correlation. The price is given by

$$p^{AI} = d - \frac{q_1^{AI} + q_j^{AI}}{2}$$

When $\lambda = 0$ (and thus $\theta_i^v = \theta_i$), the price is equal to:

$$p^{AI}|_{\lambda=0} = \frac{2(\theta_1 + \theta_2) - E_\Theta\ \theta}{3}$$

In this case, the expected price $E_\Theta P$ is equal to the expected marginal cost $E\theta^v$. For $\lambda > 0$, the general expression of the price is:

$$p^{AI} = \frac{\lambda}{2+3\lambda} d + \frac{1+\lambda}{3+4\lambda}(\theta_1^v + \theta_2^v) + \frac{12(1+\lambda)(1+2\lambda)}{(2+3\lambda)(3+4\lambda)} E\theta^v$$

The results are similar to the one obtained in Section 3 for the case of complete information. They hold here for the expected price. When λ increases from zero, the regulators suffer from the adverse fiscal effect, as under complete information. The slope of the rent is not affected by the presence of competition, due to the hypothesis of independence of the marginal costs. The total rent can increase or decrease, depending on the behavior of the optimal quantity. In order to solve analytically for the value of the information rent, we make the following Assumption.

Assumption 5 *The common marginal cost θ is uniformly distributed over the interval $[\underline{\theta}, \overline{\theta}]$.*

The following result holds:

Proposition 4 *Under asymmetric information and uncorrelated marginal costs distributed as in Assumption 5, the information rent of firm i decreases if and only if:*

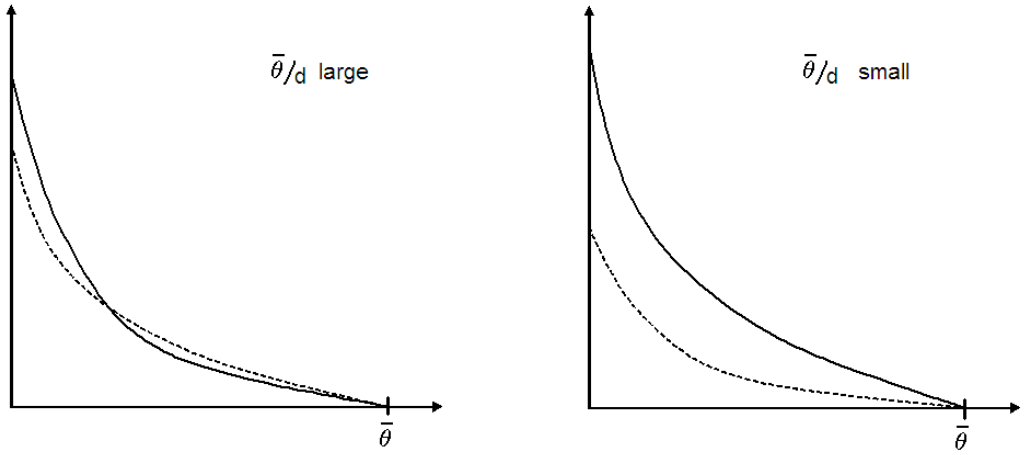
$$\theta_i \geq \frac{\lambda(3+4\lambda)[2\,d\,(1+\lambda) - (\overline{\theta} + 2\lambda)] + 2\underline{\theta}(1 + 3\lambda(2 + \lambda(5+4\lambda)))}{(1+2\lambda)(2+3\lambda)(1+4\lambda)} \tag{11}$$

Proof: see Appendix 4.

When $\lambda = 0$, the rent decreases for each θ_i. When λ is strictly positive, the larger is d the more difficult is to satisfy inequality (11). When d is large enough (i.e. $d \geq \tilde{d} = \frac{(1+2\lambda)^2\underline{\theta} + \lambda\overline{\theta}(3+4\lambda)}{\lambda(1+\lambda)(3+4\lambda)}$), the inequality is never satisfied and the information rent *increases* for all types. For d small, the rent increases for low θ_i and decreases for high θ_i. The minimal admissible value of d satisfying Assumption 3 is $d = \overline{\theta}^v$. When d is closed to this minimal value, the ex ante technological uncertainty (related to the variance of θ_i) is large. When the national firm is very inefficient, the regulator expects the competitor to be relatively efficient. The quantity q_i is reduced and the information rent decreases. On the contrary, when firm i is very efficient, its production is increased with respect to monopoly and thus the rent is increased. As in Calzolari and Scarpa (2007), a rent is also paid on the foreign activity and the burden of the information rent is

larger when the firm competes in the integrated market. In Figure 4.1 the information rent under closed and open economy is represented for the case of d large (i.e. $d > \tilde{d}$) and small (i.e. $d = \overline{\theta}^v$) respectively. The dotted line represents the rent under closed economy and the solid line the information rent in the case of an integrated market.

Figure 2: The Information Rent: Uncorrelated Costs.



Computing now the welfare effect of market integration in the case of uncorrelated marginal costs, we find the following result.

Proposition 5 *Under asymmetric information and uncorrelated marginal costs, market integration decreases welfare for $\theta_i = \theta_j^v$. Welfare increases in both countries if and only if $|\theta_i - \theta_j^v|$ is big enough.*

Proof: See Appendix 3.

The difference in welfare is negative whenever the difference between the national marginal cost and the foreign virtual cost is small. As in the case of complete information, market integration increase welfare only in the case in which the two technologies are different enough. We now turn to the case of correlation between marginal costs.

4.2 Perfectly correlated costs

We consider the opposite limit case of perfect correlation $\theta_i = \theta_j = \theta$. We have:

$$\gamma_i = \gamma^{PC} = \frac{\lambda}{1+\lambda}\left[1+\frac{\dot{q}}{2}\right]\frac{F(\theta)}{f(\theta)}$$

This is the case in which the rent reducing impact of competition is maximized. In fact, when costs are perfectly correlated, the regulated firm anticipates that, overstating its cost, it will compete with a foreign firm which is more efficient than expected by the national regulator. The reaction of the competitor reduce the gains form overstating the cost and then the slope of the information rent. Also in this case, we solve for the case of θ distributed as in Assumption 5. The first order condition becomes:

$$2d(1+\lambda) - 2\theta(1+2\lambda) - \lambda(\theta - \underline{\theta})\dot{q} + 2\lambda\underline{\theta} - q(2+3\lambda) = 0$$

This differential equation has a linear solution of the form:

$$q = \frac{2d(1+\lambda) - \theta(2+3\lambda) + \lambda\underline{\theta}}{2+3\lambda} \tag{12}$$

so that $\dot{q} = -1$.
The following result holds.

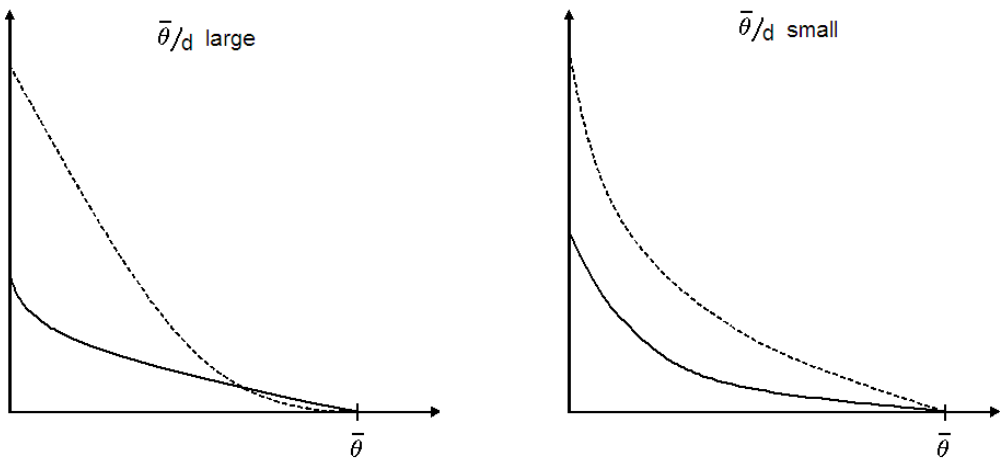
Proposition 6 *Under asymmetric information and perfectly correlated marginal costs distributed as in Assumption 5, the information rent of firm i decreases if and only if:*

$$\theta \leq \frac{4d(1+\lambda)^2 - (1+2\lambda)(2+3\lambda)\overline{\theta} + (1+2\lambda)(2+3\lambda)\underline{\theta}}{(1+2\lambda)(2+3\lambda)} \tag{13}$$

Proof: see Appendix 4.

When $\lambda = 0$, the rent decreases for each θ_i. When λ is strictly positive, the larger is d the easier is to satisfy inequality (13). For $d \geq \tilde{d}' = \frac{(\theta+\overline{\theta})(1+2\lambda)(2+3\lambda)-2\lambda(3+4\lambda)\underline{\theta}}{4(1+\lambda)^2}$, the inequality is always satisfied and the rent *decreases* for all types. When d is small (i.e. $\overline{\theta}/d$ is large), it is the rent of the least efficient types which possibly increases with respect to monopoly. The reason is the following. When shocks are perfectly correlated, the regulator cannot exploit a sampling effect. However, competition, reducing the slope of the information rent, allows to reduce the quantity distortion required for maintaining incentives. In the case of very inefficient types, for which under monopoly the downward distortion of the second best quantity is large, the rent can increase with respect to regulated monopoly.
Figure 4.2 shows the difference in the information rent under closed and open economy for d large (i.e. $d \geq \tilde{d}'$) and small (i.e. $d = \overline{\theta}^v$) respectively. The dotted line represents the rent under closed economy and the solid line the information rent in the case of an integrated market.
Computing the difference between welfare in a closed economy and under market integration we obtain the result illustrated in the following Proposition.

Figure 3: The information rent: correlated costs.



Proposition 7 *Under Assumption 5, for $\lambda = 0$ welfare in the two countries is not affected by integration. For $\lambda > 0$, $d > \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$ there always exists a value $\hat{\theta} \in (\underline{\theta}, \overline{\theta})$ such that $\forall \theta > \hat{\theta}$ closed economy is preferred to market integration. For $d < \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$ welfare always increases with integration.*

Proof: see Appendix 4.

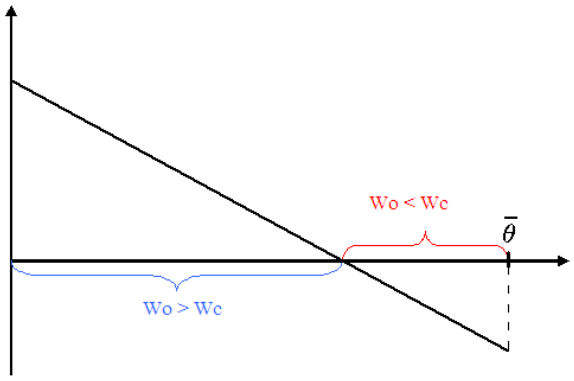
The result is illustrated in Figure 4.2 for $\lambda > 0$ and $d > \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$.

The intuition for this result is that, for the most efficient types, the rent reducing effect of competition is very important and induces and increase in total welfare. For the least efficient types, the business stealing effect prevails. The necessary condition $d > \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$ states that this negative effect occurs when demand is steep and the ex ante technological risk $\overline{\theta}/d$ is low.

4.3 Concluding remarks on the impact of asymmetric information

Competition is in general thought to put constraints on the regulated firm and limit its capability of capturing information rents. The analysis above show that this is not always the case and the direction of the effect depends crucially on the stochastic structure considered. When shocks are uncorrelated, the information rent tends to increase, at least for the more efficient types. On the contrary, with high correlation, the rent generally decreases (though it may increase for very inefficient firms). Both scenarios could be empirically relevant, depending on the industry

Figure 4: Min $[W^{NC} - W^{M}, 0]$: correlated costs.



considered. Variations of the information rent would transmit to the transfer paid to the regulated firm (or the tax extracted). When the rent is reduced, the transfer decreases and this has an additional impact on total welfare increases. Conversely, an increase in the rent has an adverse impact on the welfare gains as compared to the case complete information. The analysis above shows that, when considering the net impact of market integration on total welfare, the main insights of the basic model are preserved under asymmetric information. In particular, when the costs are not correlated all the qualitative results of Section 5 apply. When correlation is high, market integration is more valuable. Still, there may exist values of the parameters for which a closed market is preferred to market integration.

5 Cooperation between regulators

We are now interested in the possibility of solving the problem arising from the lack of coordination between the the two regulators. The welfare reducing effect of market opening is related to the fact that each regulator does not take into account the impact of its policy on foreign consumer and taxpayers. When considering a process of regional market integration, we can imagine that some cooperation will emerge among regulators. In fact, member countries seem concerned with the opportunity of introducing some form of harmonization of the domestic policies. In such a situation, considering only the Nash-Cournot solution is restrictive, since it rules out any possible role for cooperation between institutions.

We now consider the case of cooperation between countries. As a first step we focus on the the solution chosen by a global welfare maximizing social planner. The supranational social planner has no national preferences and maximizes the total welfare of the integrated market. This theoretical benchmark describes a process of integration in which the two countries are fully integrated, even on a fiscal point of view. For a concrete example one can think to German reunification. The East and West economic systems have been unified under the same government (full unification of regulatory bodies and fiscal system).
We consider the solution in the complete information case. As we have seen, the results are qualitatively similar to the case in which there is asymmetry of information but cost are correlated. After characterizing the global optimum, we will move to the decentralized cooperative equilibrium.

5.1 Global welfare maximizing solution

The supranational utilitarian social planner maximizes the sum of welfare of the two countries. In this linear model, the global optimum prescribes shut down of the less efficient firm. Then the optimal solution has the following characteristics:

- Only the most efficient firm produces.
- If, without loss of generality, we assume that firm 1 is the most efficient firm ($\theta_1 < \theta_2$), total quantity is equal to:

$$q^* = 2\, q_1^C(\theta_1) \tag{14}$$

  Where $q_1^C(\theta_1)$ is the regulated monopoly quantity of country 1 in the case of closed economy.

The less efficient firm shuts down and the more efficient covers all the market. This result arises because there is not segmentation of demand, no entry costs, constant marginal costs and an homogeneous products. This simplifying assumption aims to illustrate the fact that productive efficiency induces to reduce the quantity produced by one firm on efficiency grounds (in the model to zero, but this is just a simplification).
Global welfare in the case of coordination is greater than the sum of the two welfare in decentralized solution. In fact, both regulators suffer from the fact that they take uncoordinated decision and they could do better sharing the gains form coordination. A supranational welfare maximizing social planner, would share the surplus generated with production equally among the taxpayers. In our symmetric model, each country would thus get a tax revenue equal to:

$$\tau = -\frac{1}{2} t_1 = \frac{(d-\theta_1)^2\, \lambda\, (1+\lambda)}{2\, (1+2\,\lambda)^2} \tag{15}$$

In the global maximization problem a central benevolent government imposes a policy to the unified market. This captures somehow the kind of integration which occurred in the case of the German reunification. In the process of reunificaiton, two regions with an important productivity gap have been merged under the same government. At the beginning of the reunification process, the physical productivity of East Germany was estimated to be about 1/3 of that in the West (Czarnitzki, 2005). As Röller and Hirchhausen (1996) point out, the particularity of the East German case was that restructuring and privatization were managed by the same institution. State aid has accompanied the restructuring process. The provision of public goods and governmental services were just redistributed within the state sector: eastern Germany railways and telecommunications became part of the western German counterparts. As Siegmund (1997) notices, the budget constraint of the privatization agency *"could be made politically soft because mainly Western German taxpayers were paying and will pay for the losses".*

This framework seems not particularly suitable to describe the EU case, in which each country has an independent regulator and cooperation has to mediate among the possibly diverging objective. For this reason, as we show in the following, in the absence of a unified fiscal system, allowing for transfers between the formerly separated regions is a way to *reduce* the inefficiencies generated by market integration.

5.2 Decentralized solution: Nash Bargaining

As seen in Section 3, the global welfare maximizing solution does not emerge from the decentralized decisions of the two regulators. One of the reasons is that profits are not shared between countries. Moreover, in general countries cannot commit ex ante to a certain profile of production. In this case, the globally efficient solution has to rely on ex post bargaining between the two countries. In the real world, there is in general no court to punish deviation from an agreement of this kind. An important exception for the case of the EU is agriculture, where agreement on "quotas" of production are enforced with fines to producers. This is indeed an exception, in other markets it is difficult to imagine the creation of a EU policy with quotas of production for telecommunications, transport or energy. Nevertheless, regulators can cooperate in order to reduce the negative impact of each other policies. Our model suggests that they should do it. To consider this possibility, we compute the cooperative equilibrium in which countries bargain on the gains from coordination. The global optimum can be obtained as a cooperative Nash bargaining solution between the two countries. This implies the existence of side payments between the countries. In particular, one possible decentralized solution is the symmetric Nash Bargainingh solution, sustained with a side transfer T.

$$(W_1^* - W_1^N)(W_2^* - W_2^N) \tag{16}$$

Where

$$W_1^* = W_1(q_1^*, q_2^*) - (1+\lambda)T$$

$$W_2^* = W_2(q_1^*, q_2^*) + (1+\lambda)T$$

In our symmetric model, this is equivalent to sharing in halves the gains from cooperation.[12] W_i^N is welfare in country i in the non cooperative solution, T is the transfer from country 1 to country 2.

Proposition 8 *At the cooperative solution, the optimal transfer from country 1 to country 2 is given by:*

$$T^* = \tau - \frac{W_1^N - W_2^N}{2\,(1+\lambda)}$$

where τ is the fiscal revenue of country 1 at the global maximizing solution (Equation (15)).

Proof: The expression for T^* is obtained maximizing the Nash product with respect to T.

The transfer T is equal to the fiscal revenue τ *reduced* by a term proportional to the difference in the outside option of the two regulators, represented by the Nash-Cournot equilibrium. Substituting for the values of W_i^N and τ:

$$T^* = \frac{2\,d^2\,\lambda(2+\lambda(5+3\lambda)) - (2\,d\,-\theta_1-\theta_2)(\theta_2-\theta_1)(1+2\lambda(1+\lambda(1+\lambda)))}{2(1+2\lambda)^3(2+3\lambda)} - \frac{(2\,d\,-\theta_2)\lambda\theta_2(1+\lambda)}{(1+2\lambda^2)}$$

For $\lambda = 0$, T^* is always negative:

$$T^*|_{\lambda=0} = -\frac{(2\,d-\theta_1-\theta_2)\;(\theta_2-\theta_1)}{4} < 0$$

When $\lambda = 0$, the regulator maximizes net consumer welfare. She just cares about finding the cheapest provider (for country 2, the foreign firm). The problem is that the regulator in the high cost country cannot control production of the more efficient firm in order to induce it to internalize the effect of its policy on the foreign consumers. The regulator is willing to pay a transfer in order to induce the foreign firm to increase the production (this transfer is indeed a substitute for the possibility of paying a subsidy to the foreign firm for increasing the quantity). The increase in consumer surplus obtained this way is greater than the one it gets financing losses of an inefficient national firm (as it happens at the Cournot Nash equilibrium, as shown in Section 3). For $\lambda > 0$, the public finance effect intervenes. The regulator is not just interested

[12] In case of asymmetric bargaining power, the gains from cooperation would be shared differently, but the qualitative insights are not affected.

in getting the service at the minimal marginal cost. Raising funds to cover fixed costs or other public projects becomes important. In this case, T^* is maximal for θ_2 converging to θ_1 and it decreases with an increase in the difference in the marginal costs. Moreover, the slope of T^* increases in d (i.e. T^* becomes less steep when d increases). We have the following result:

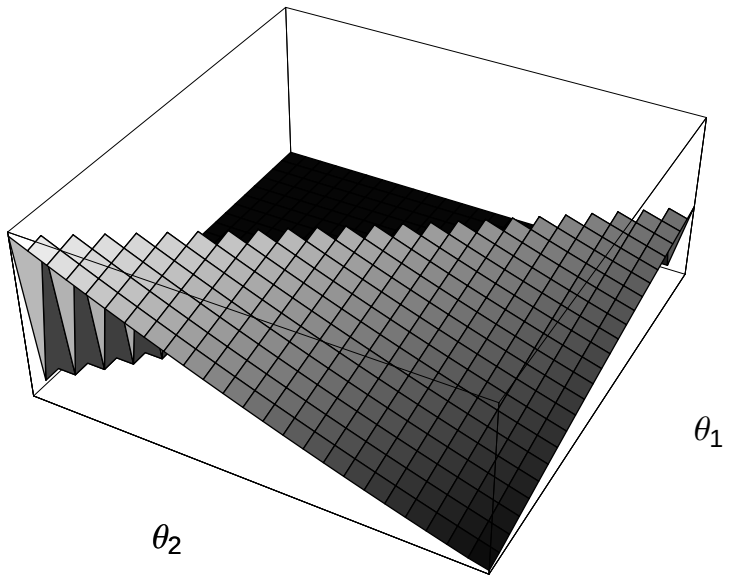
Proposition 9 *For $\lambda > 0$ and d big enough, T^* is always positive. The most efficient country has to compensate the less efficient one for renouncing to domestic production. The critical level of d is:*

$$d > \theta_2 + (\theta_2 - \theta_1)\Lambda(\lambda)$$

where $\Lambda(\lambda) = \frac{1+2\lambda(1+\lambda+\lambda^2)+(1+2\lambda)\sqrt{(1+2\lambda)(1+2\lambda(1+\lambda+\lambda^2))}}{2\lambda(1+\lambda)(2+3\lambda)} > 0 \ , \ \forall\lambda > 0.$

The country with the more efficient technology pays a transfer to the less efficient one in order to pay back some of the damage deriving from restructuring (shutting down the national firm) (see Figure 5). This seems to be the more relevant case. Since public funds are costly and national production is valuable for the regulator, market restructuring which reallocates production between countries on the basis of efficiency has to be accompanied with some transfer to the countries which suffer from restructuring. T^* is shown in Figure (5) for the case $d > \theta_2 + (\theta_2 - \theta_1)\Lambda(\lambda)$.

Figure 5: The optimal T



We have thus shown that, when the cost of public funds is taken into account, the transfer to the less efficient country is in general positive. Moreover, the transfer is increasing in λ. In fact, we have:

$$\frac{\partial T^*}{\partial \lambda} = \frac{d - \theta_1}{(1+2\lambda)^3} - \frac{(2\,d - \theta_1 - \theta_2)(\theta_2 - \theta_1)}{2(2+3\lambda)^2}$$

That this expression is always positive under Assumption 3 and for all $\theta_2 \geq \theta_1$. Even in the presence of the transfer T, the total fiscal revenue of the less efficient country (the international transfer plus the tax to the former national producer) *decreases* with respect to a closed economy. For this reason, the burden of transfers for the country with the less efficient technology increases with market integration. Relying on a more efficient foreign competitor may reduce prices and increase overall efficiency, but it has a negative impact on public finance.

5.2.1 Alternative specification: bargaining on the gains from integration

In the Nash bargaining solution computed in the section above, we have assumed bargaining on the *gains from coordination*, taking as given the fact that markets are perfectly integrated. This describes a situation in which countries have already committed to market integration.
An alternative specification could take the closed economy welfare as the non cooperative benchmark. In this case we have $W_i^N = W_i^C$ in the Nash bargaining problem described in Equation (16). Here we allow countries to bargaining over the *gains from integration*. This specification fits the case in which countries can stick to statutory monopoly if the have no gains from integration. One can verify that under this alternative specification all the results are preserved. In particular, the transfer from country 1 to country 2 becomes:

$$T' = \frac{4\,d^2\,\lambda(1+\lambda) - (2\,d\,-\theta_1-\theta_2)(\theta_2-\theta_1)(1-\lambda(1+2\lambda))}{4(1+2\lambda)^2} - \frac{(2\,d\,-\theta_2)\lambda\theta_2(1+\lambda)}{(1+2\lambda)^2}$$

This transfer T' is higher than T^* computed above. In fact we have:

$$T' - T^* = \frac{(2\,d\,-\theta_1-\theta_2)(\theta_2-\theta_1)(3+5\lambda)}{4(2+\lambda(7-6\lambda)} > 0$$

Then, if countries can oppose integration, the transfer to the least efficient one is bigger than in the case in which integration is taken as given. This also means that, if countries commit to share equally the full benefit from integration, the compensation to the country with the inefficient technology is bigger.

6 Conclusion

The present paper analyzes the interaction between market integration and national regulatory policies. This constitutes a way to look to the issues arising in contexts such as the European market integration, in which national regulators have to deal with firms operating in a supranational market. Adopting a two firms and two regulators model, we show that market integration may decrease welfare in one or both countries. Market integration can be welfare reducing because of its impact on the budget constraint of the regulated firms (business stealing effect). The paper also show that the impact of supranational competition on the rent seeking

behavior of firms can go both ways, depending crucially on the level of cost correlation and the degree of ex ante technological risk. The effect of market integration on the agency problem of the regulator may thus be different in different industries. At the noncooperative equilibrium, the level of transfers increases for one or both countries with respect to closed economy. In particular the optimal regulatory scheme may involve financing the operating losses of a national inefficient producer. This kind of subsidies are optimal from the point of view of national regulators, although globally inefficient. In the last part of the paper, we show that the globally efficient allocation of production can be reached in a decentralized framework allowing for Nash bargaining between the regulators. In this case, side transfers are paid. When the cost of public funds is an issue, the less efficient country has to be compensated for the loss related to shutting down the national firm. The public finance aspects of regulation is shown to be important to determine the optimal regulatory policy. It may be necessary to accompany market integration with transfers to the losers of the integration process harmed by the process of restructuring triggered by market integration.

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Appendix 1: asymmetric demand

We have $\gamma_1 = x$, $\gamma_2 = 2 - x$. We now consider country 1 (the same result holds for country 2, taking into account that the size of country 2 is $2 - x$). Then:

$$W_1^O = d\,\frac{x}{2}\,(q_1+q_2) - \frac{x}{2}\left(\frac{q_1+q_2}{2}\right)^2 - \left(d - \frac{q_1+q_2}{2}\right) q_1 - \theta_1 q_1 - \lambda t$$

$$t = -\left(d - \frac{q_1+q_2}{2} - \theta_1\right) q_1$$

Moreover, at the optimal solution:

$$q_1 = \frac{2\,d\,(x+\lambda) + \theta_2(2+2\lambda-x) - \theta_1(2+4\lambda+x)}{2+3\lambda}$$

$$q_2 = \frac{2d(2+\lambda) + \theta_1(x+2\lambda) - \theta_2(4+4\lambda+x)}{2+3\lambda}$$

Welfare in the case of closed economy can be written:

$$W_1^C = \frac{x(d-\theta_1^v)^2(1+\lambda)}{2(1+2\lambda_1)}$$

Substituting these quantities in the welfare function and developing computation, one can verify that the difference in welfare $W_1^O - W_1^C$ is bigger than zero iff:

$$\theta_1 - \theta_2 \;\geq\; \lambda(d-\theta_2)Z(\lambda) \tag{17}$$

$$\theta_1 - \theta_2 \;\leq\; -\lambda(d-\theta_2)Z(\lambda) \tag{18}$$

Where $Z(\lambda) = \frac{(2+3\lambda)\sqrt{x(1+2\lambda)(4(1+\lambda)-x)}+x(1+\lambda(7+9\lambda))-4(1+2\lambda)^2}{4(1+\lambda)^3-x(1+\lambda(5+\lambda(11+9\lambda)))} > 0\,,\ \ \forall\lambda \geq 0,\ x \in [1,2]$

Moreover, further computations give:

$$\frac{\partial\,(W_1^O - W_1^C)}{\partial\,x} = -\frac{(1+\lambda)(\alpha_1\,d^2 + \alpha_2\,\theta_1^2 + \alpha_3\,\theta_2^2 - \alpha_4\,d\,\theta_1 + \alpha_5\,d\,\theta_2 - \alpha_6\,\theta_1\,\theta_2)}{2(1+\lambda)(2+3\lambda)^2} \equiv \Phi(d,\theta_1,\theta_2,\lambda)$$

Where:
$\alpha_1 = \lambda^2(5+9\lambda)$,
$\alpha_2 = 1+\lambda(5+\lambda(11+9\lambda))$,
$\alpha_3 = 1+\lambda(3+2\lambda)$,
$\alpha_4 = 2+\lambda(14+18\lambda)$,
$\alpha_5 = 2\lambda(1+2\lambda)$,
$\alpha_6 = 2+8\lambda(1+\lambda)$.

One can easily verify that for all values of the parameters d, θ_2, and λ, $\Phi(d,\theta_1,\theta_2,\lambda)$ is a concave function of θ_1, which maximum is attained along the line $\theta_1 = \frac{d\,\lambda(1+7\lambda+9\lambda^2)+\theta_2(1+2\lambda)^2}{1+5\lambda+11\lambda^2+9\lambda^3}$. This maximum value is given by:

$$\Phi_{max} = -\frac{(d-\theta_2)\lambda^2(1+\lambda)}{1+5\lambda+11\lambda^2+9\lambda^3} < 0\,,\ \ \forall\, d \geq \theta_2, \lambda > 0$$

Appendix 2: asymmetric λ

We consider the case $\lambda_i \neq \lambda_j$. In this case, what is relevant is not the difference in the marginal costs, but the difference in the closed economy Ramsey benchmark, which takes into account the cost of public funds in the country.
The reaction function of regulator i depend only λ_i

$$4d(1+\lambda_i) - (3+4\lambda_i)q_i - (1+2\lambda_i)q_j - 4\theta_i = 0 \quad i \neq j$$

The equilibrium quantities are computed from the system if the two first order condition:

$$q_i = \frac{d\,(2+\lambda_i+3\lambda_j+2\lambda_i\lambda_j+2\lambda_i\lambda_j) - (1+\lambda_i)(3+4\lambda_j)\theta_i + (1+2\lambda_i)(1+\lambda_j)\theta_j}{4+5(\lambda_i+\lambda_j)+6\lambda_i\lambda_j}$$

Substituting the quantities in the welfare function and developing computations we obtain:

$$\begin{aligned} \left.\frac{\partial\,(W_i^O - W_i^C)}{\partial\,\lambda_i}\right|_{\lambda_j=\lambda_i=\lambda} &= -\frac{(1+\lambda)(\alpha_1'\,d^2 + \alpha_2'\,\theta_i^2 + \alpha_3'\,\theta_j^2 - \alpha_4'\,d\,\theta_i + \alpha_5'\,d\,\theta_j - \alpha_6'\,\theta_1\,\theta_2)}{2(1+\lambda)^2(2+3\lambda)^2} \\ &\equiv \Phi'(d,\theta_i,\theta_j,\lambda) \end{aligned}$$

Where:
$\alpha_1' = 2\lambda(5+\lambda(24+\lambda(40+\lambda(25+3\lambda))))$,
$\alpha_2' = (11+2\lambda(41+\lambda(130+\lambda(218+\lambda(191+69\lambda)))))$,
$\alpha_3' = (1+\lambda)(1+2\lambda)^3(5+6\lambda)$,
$\alpha_4' = -(16+\lambda(31+4\lambda(20+\lambda(37+\lambda(43+21\lambda)))))$,
$\alpha_5' = (1+2\lambda)^2(6+\lambda(27+4\lambda(11+6\lambda)))$,
$\alpha_6' = (1+2\lambda)^2(16+\lambda(69+4\lambda(25+12\lambda)))$.

One can verify that $\Phi'(d,\theta_i,\theta_j,\lambda)$ is negative for:

$$\tilde{\theta} < \theta_i < \tilde{\tilde{\theta}}$$

Where:

$$\tilde{\theta} \equiv \frac{(\beta_1-\beta_2)d - \theta_j(\beta_3-\beta_2)}{2(11+2\lambda(41+\lambda(130+\lambda(218+\lambda(191+69\lambda)))))}$$

$$\tilde{\tilde{\theta}} \equiv \frac{(\beta_1+\beta_2)d - \theta_j(\beta_3-\beta_2)}{2(11+2\lambda(41+\lambda(130+\lambda(218+\lambda(191+69\lambda)))))}$$

and:

$\beta_1 = 6+\lambda(31+4\lambda(20+\lambda(37+\lambda(43+21\lambda))))$,
$\beta_2 = (2+3\lambda)(1+2\lambda)^{\frac{3}{2}}(9+2\lambda(61+4\lambda(55+\lambda(86+9\lambda(7+2\lambda)))))^{\frac{1}{2}}$,
$\beta_3 = (1+2\lambda)^2(16+\lambda(69+4\lambda(25+12\lambda)))$.

Since for all $d > \theta_2$, $\tilde{\tilde{\theta}} > d \geq \overline{\theta}$, the relevant constraint is:

$$\theta_i > \tilde{\theta}$$

Moreover, $\tilde{\theta}$ is smaller than θ_2 for any $d \geq \theta_2$.

Appendix 3: uncorrelated costs

The information rent in the case of closed economy (U_i^O) and common market (U_i^C) are computed replacing respectively (10) and (3) in (8) and 2. Solving the inequality $U_i^O - U_i^C \geq 0$ with respect to θ_i gives the result in Proposition 6.
Substituting for the values of the quantities and the information rents in the welfare functions (4) and (1) we can compute the value of the difference in welfare along the line $\theta_i = \theta_j^v$. One can show that for $\lambda = 0$

$$W_i^O - W_i^C|_{\theta_i=\theta_j} = -\frac{1}{72}(1-2\theta_i^v)^2 \leq 0 \; \forall \, \theta_j$$

Moreover, when $\lambda > 0$, $W_i^O - W_i^C$ is stricly positive whenever $|\theta_i - \theta_j|$ is large enough. To show this, let $\theta_i = \theta_j + D$. We have $W^O - W^C > 0$ if and only if:

$$|D| > |\frac{1}{4}(1-2\theta_1)|$$

For $\lambda > 0$, more tedious computations show that the same kind of result holds for $\theta_i = \theta_j^v$ and $\theta_i = \theta_j^v + D'$.

Appendix 4: perfectly correlated costs

The information rent U_i^O is computed using 8 and 12. Solving the inequality $U_i^O - U_i^C \geq 0$ with respect to θ gives the result in Proposition 8.
Substituting for the values of the quantity $q(\theta)$ and the information rent in the welfare function we can compute the value of the difference in welfare $W^1 - W^M$. One can verify that, $\forall \lambda > 0$, $W^1 - W^M > 0$ iff:

$$\theta < \hat{\theta} = \frac{2d(1+\lambda) - \underline{\theta}(5+6\lambda) - \sqrt{\gamma_1 d^2 + \gamma_2 \overline{\theta}^2 - \gamma_3 \underline{\theta}^2 - \gamma_4 d\,\overline{\theta} + \gamma_5 d\,\underline{\theta} - \gamma_6 \overline{\theta}\,\underline{\theta}}}{(1+2\lambda)(2+3\lambda)}$$

$$\theta > \hat{\theta}' = \frac{2d(1+\lambda) - \underline{\theta}(5+6\lambda) + \sqrt{\gamma_1 d^2 + \gamma_2 \overline{\theta}^2 - \gamma_3 \underline{\theta}^2 - \gamma_4 d\,\overline{\theta} + \gamma_5 d\,\underline{\theta} - \gamma_6 \overline{\theta}\,\underline{\theta}}}{(1+2\lambda)(2+3\lambda)}$$

Where:
$\gamma_1 = 2(1+\lambda)^2(2+\lambda+2\lambda^2)$,
$\gamma_2 = (1+2\lambda)(2+3\lambda)$,
$\gamma_3 = \lambda(6-\lambda(3+2\lambda(9+8\lambda)))$,
$\gamma_4 = 4(1+\lambda)^2(1+2\lambda)(2+3\lambda)$,
$\gamma_5 = 6\lambda(1+\lambda)^2(3+2\lambda)$,
$\gamma_6 = 2\lambda(2+3\lambda)(1+2\lambda)(3+4\lambda)$.

We have:

$$\hat{\theta} < \overline{\theta} \quad \text{and} \quad \hat{\theta}' > \overline{\theta} \quad \text{iff} \quad d < \underline{\theta} \quad \text{or} \quad d > \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$$

By Assumption 3, $d \geq \overline{\theta}^v \geq \underline{\theta}$, then a sufficient condition for having $\underline{\theta} < \hat{\theta} < \overline{\theta}$ is $d > \overline{\theta} + (\overline{\theta} - \underline{\theta})\frac{3+5\lambda}{1+\lambda}$.

Appendix 5: the cooperative solution

The optimal T is given by:

$$T^* = \frac{2\,d^2\,\lambda(2+\lambda(5+3\lambda)) - (2\,d\,-\theta_1-\theta_2)(\theta_2-\theta_1)(1+2\lambda(1+\lambda(1+\lambda)))}{2(1+2\lambda)^3(2+3\lambda)} - \frac{(2\,d\,-\theta_2)\lambda\theta_2(1+\lambda)}{(1+2\lambda^2)}$$

From this expression, we derive:

$$T^*|_{\lambda=0} = \frac{(2\,d-\theta_1-\theta_2)\;(\theta_1-\theta_2)}{4} < 0, \quad \forall \theta_1 < \theta_2$$

$$T^*|_{\theta_1=\theta_2} = \frac{(d\,-\theta_2)^2\lambda(1+\lambda)}{(1+2\lambda)^2} > 0, \quad \forall \lambda > 0$$

$$\frac{\partial T^*}{\partial \theta_2} = -\frac{(d-\theta_2)(1+2\lambda)}{(2+3\lambda)^2} < 0, \quad \forall \lambda > 0$$

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