

# Competitive effects of state aid in oligopoly\*

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## Abstract

Competitive effects of state aid are analysed in an oligopolistic setting. In period 1, firms invest in vertical product improvement. In period 2, firms compete in differentiated Bertrand fashion. State aid may then harm competitors even if it does not affect pricing directly. Since investments are strategic substitutes, aid that reduces the cost of capital will allow the recipient to increase investment at the cost of its rivals. It may then sell more at a higher price while the rivals sell less at a lower price. The recipient becomes dominant. Aid may be predatory if given in large amounts.

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# 1 Introduction

State aid is illegal in the European Union if it “distorts or threatens to distort competition by favouring certain undertakings” and if it affects trade between member states.<sup>1</sup> Members of the EU must inform the European Commission of intentions to grant state aid in order that the aid may be evaluated. Firms that receive state aid that has not been exempted from the general prohibition by the European Commission may be requested to pay back the aid. This has happened recently e.g. in the case of Olympic Airways.

On 11 December 2002, the European Commission decided that aid previously granted by Greece to Olympic Airways was illegal. The European Commission had authorised aid by Greece in 1994 and 1998 but Olympic Airways had misused the aid and had also received new illegal aid, giving it an unjustifiable competitive advantage. As a result, the European Commission asked the Greek authorities to recover the incompatible aid granted after 1998.<sup>2</sup>

Previous literature has focused more on competition between member states to grant state aid. Collie (2000) examines the effect of state aid in an integrated market using a symmetric Cournot duopoly model where one firm is located in each member state. He shows that the prohibition of state aid may very well increase overall welfare thus providing a rationale for a general ban of state aid.<sup>3</sup> In contrast with this model of symmetric oligopoly *I focus on how state aid distorts competition, giving firms that receive state aid a competitive advantage*. The resulting equilibrium is by nature asymmetric, unless state aid is entirely absent. In addition, while Collie (2000) assumes that the effect of state aid is to lower the receiving firm’s marginal costs, I show that there may be important non-price effects of state aid that seriously harm non-receivers. It could be argued that much of the state aid that is granted does not affect variable or marginal costs directly so that an immediate conclusion would be that competition is not affected. This is not correct if firms can or must undertake

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<sup>1</sup>Article 87(1) states that: “Save as otherwise provided in this Treaty, any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, insofar as it affects trade between Member States, be incompatible with the common market.” Exemptions from this general provision may be granted if the aid serves 1) to assuage abnormally low standards of living or serious unemployment, 2) “to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State;” 3) to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest; 4) to promote culture and heritage conservation where such aid does not affect trading conditions and competition in the Community to an extent that is contrary to the common interest.

<sup>2</sup>Other recent cases include the decision to order Electricité de France (EdF) to repay a record €1.2 billion unlawfully received in tax breaks granted by the French government and to scrap state guarantees that gives the company an unfair advantage in financial markets (December 17, 2003); and a decision to sue the French government for its failure to recover a large state loan from IT company Bull (October 2, 2003).

<sup>3</sup>See Besley and Seabright (1999) for a survey of possible reasons for and effects of state aid.

investments to increase demand.

The motivation for this study is the state aid received by firms that operate in industries where investments that enhance demand are important. This could be network industries such as airlines or television. For airlines, state aid in terms of financial advantages and slots allocations may increase the attractiveness of the recipients services, thus giving it a competitive advantage. For the TV industry, state aid in terms of financial packages and e.g. must-carry obligations can have competitive effects on the market for TV commercials that provide the major source of revenue for purely commercial channels.

To fix ideas, I consider the case of alleged state aid for Danish public broadcaster TV2.<sup>4</sup> On 5 April 2000 the European Commission received a complaint alleging that the financing scheme of in the period 1995-2002 should be regarded as illegal state aid. TV2 has a public service obligation (PSO) and the State of Denmark compensates it through a number of sources that commercial broadcasters could not obtain. These sources include licence-fee funds, transfers from public funds, exemption from corporate taxation, interest and installment-free establishment loans, state guarantees for operating loans, free transmission frequency and must-carry status. The European Commission has reached the tentative conclusion that

“without taking into account the public service obligation imposed upon TV2, the measures provide economic and financial advantages to TV2 that relieves TV2 from charges normally borne from its budget. The measures favour TV2 compared to its competitors not receiving the same funds, thereby distorting competition. All the measures, except the must-carry status, are granted through State resources. Furthermore, the measures affect trade between Member States, as they put TV2 in a more favourable condition compared to other undertakings, which are competing in intra Community trade.” (European Commission, 2003, 2)

The European Commission cannot rule out that the State of Denmark over-compensates TV2 even if its PSO is taken into account.<sup>5</sup> For this reason it has

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<sup>4</sup>For details on the case consult European Commission (2003), that gives a summary of the case in English.

<sup>5</sup>In its recent *Altmarkt* decision (Case C-280/00, Judgement of 24 July 2003), the European Court of Justice has attempted to clarify what amount of state aid a company that is subject to a PSO may be entitled to. The Court held that stated aid in compensation of a PSO is legitimate provided that four conditions are satisfied, *viz.* that

1. the PSO is a real, clearly defined obligation;
2. the compensation scheme has been defined clearly in advance;
3. the compensation scheme covers the cost of the PSO but taking into account both the revenues generated by the PSO and making allowance for a reasonable profit; and
4. the company is selected through a public procurement procedure or, failing this, the compensation is calculated on the basis of what would be required to make a well run firm take on this obligation.

opened an investigation that may lead to the recovery of unlawful state aid from TV2.

The paper is organized as follows: In the next section I set up a model that captures the main features of the market for TV advertising. I show that state aid has a negative impact on rivals even if it does not affect pricing directly through a lowering of the marginal costs. State aid leads the recipient to invest more and the rival to invest less in the quality of programming. Since the resulting equilibrium of the asymmetric oligopoly is rather complicated, I turn to numerical examples that illustrate the size of the loss under various assumptions. The last section concludes.<sup>6</sup>

## 2 A Model of the Market for TV Commercials

Consider a model of the market for TV advertising. We assume that the main source of income for the competing TV channels arise from advertising, thus ignoring the effect of direct subscription. The product sold in this market is the number of viewers of commercials, see Bowman (1977). The underlying assumption is that better programming attracts more viewers and that a better coverage of all potential viewers also increases the number of actual viewers. To advertisers, the value of advertising is increasing in the number of viewers, so TV channels may invest in better programming or improved coverage to attract more advertising.<sup>7</sup> Once the channels have invested, they compete in prices. Since viewers of different channels may not be identical, we assume that there is horizontal product differentiation in the pricing game between TV channels.

Assume that firms engage in a two-stage game. First, at stage 1 the firms invest in product innovation, programme quality, penetration (the fraction of potential viewers that are able to view the channel), or a combination of the three, possibly spending state aid on this innovation. Second, at stage 2 the firms compete in prices à la Bertrand.

Competition for commercials is modelled by a simple extension of a standard model of oligopoly.<sup>8</sup> In period 2, two firms, 1 and 2, engage in price competition with differentiated products. We assume that they face the following inverse, derived demand curve:

$$p_i = \alpha_i(I_i) - \beta_i q_i - \gamma_i q_j \quad , \alpha_i > 0, \frac{\partial \alpha_i}{\partial I_i} > 0, \beta_i > |\gamma_i| > 0, i, j = 1, 2; i \neq j \quad (1)$$

where  $p_i$  is the price set by firm  $i$ ,  $q_i$  is the corresponding number of units (air time for commercials) sold,  $\alpha_i$  is the demand intercept and, if different from  $\alpha_j$ , a measure of *vertical* product differentiation. If  $\alpha_j > \alpha_i$ , then firm  $j$  is perceived as

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<sup>6</sup>The numerical calculations are found in an appendix that is available from the author upon request.

<sup>7</sup>See Nilssen and Sørsgard (2001) for a richer model of the TV industry that takes into account the fact that viewers dislike advertising. My model is a closed-form version that assumes that improved programming attracts more viewers than the resulting advertising discourages.

<sup>8</sup>The basic model is the same as the one used by Møllgaard & Lorentzen (2004).

providing a better quality than firm  $i$ , e.g. through a better reach to TV viewers. The relation between the parameters  $\gamma$  and  $\beta$ , on the other hand, measures the degree of *horizontal* product differentiation, i.e. customer preferences for a given brand independently of quality levels. If  $\gamma/\beta$  is close to unity, products are perceived as almost perfect substitutes and price competition is fierce; if  $\gamma = 0$ , products are independent in demand and the firms are essentially monopolists; if  $\gamma < 0$ , products are complements and the two firms are in fact not competitors but ‘complementors’.

We assume that the marginal cost of firm  $i$  is  $c_i$ . How these costs may be related to state aid will become apparent below. It may now be shown that, conditional on both firms being active, gross equilibrium profits are:

$$(p_i - c_i) q_i = \frac{\beta}{\beta^2 - \gamma^2} \left[ \frac{(2\beta^2 - \gamma^2)(\alpha_i - c_i) - \beta\gamma(\alpha_j - c_j)}{4\beta^2 - \gamma^2} \right]^2 \quad (2)$$

Observe that

$$\frac{d(p_i - c_i)q_i}{d(\alpha_j - c_j)} = -\frac{2\beta^2\gamma}{\beta^2 - \gamma^2} \frac{(2\beta^2 - \gamma^2)(\alpha_i - c_i) - \beta\gamma(\alpha_j - c_j)}{4\beta^2 - \gamma^2} < 0 \quad (3)$$

I.e. something that increases the rival’s product quality,  $\alpha_j$ , or decreases the rival’s marginal cost,  $c_j$ , will hurt the profits of the firm. State aid that reduces a rival’s marginal costs will thus directly hurt the firm. This is how the competitive effect of state aid is modelled in Collie (2000). However, it is rare that state aid takes a form that directly affects marginal costs. In the following, state aid is modelled as reducing the cost of capital (the interest rate) affecting competition through investments.

In period 1 firms must invest in vertical product quality (say, TV programmes that increase the value of a minute of advertising). The investment increases  $\alpha_i$  but this investment exhibits diminishing returns:  $\alpha'_i = d\alpha_i(I_i)/dI_i > 0$ ,  $\alpha''_i = d^2\alpha_i(I_i)/dI_i^2 < 0$ .

The firms solve the following problem:

$$\begin{aligned} & \max_{I_i} (p_i - c_i)q_i - r_i I_i \\ = & \max_{I_i} \frac{\beta}{\beta^2 - \gamma^2} \left[ \frac{(2\beta^2 - \gamma^2)(\alpha_i(I_i) - c_i) - \beta\gamma(\alpha_j(I_j) - c_j)}{4\beta^2 - \gamma^2} \right]^2 - r_i I_i \end{aligned} \quad (4)$$

since it has to borrow the amount of the investment in the first period to pay it back in the second at the interest rate  $r_i$ . Alternatively,  $r_i$  represents the opportunity cost of the investment. The first order conditions are:

$$2\beta(2\beta^2 - \gamma^2)\{(2\beta^2 - \gamma^2)(\alpha_i - c_i) - \beta\gamma(\alpha_j - c_j)\}\alpha'_i = (\beta^2 - \gamma^2)(4\beta^2 - \gamma^2)^2 r_i \quad (5)$$

Since  $\alpha_i(I_i)$  is a concave, increasing function of  $I_i$ , this shows that the investment will be decreasing with increasing interest rate,  $r_i$ . To find a closed

solution we assume that the demand intercepts measuring the vertical product differentiation (qualities as perceived by the customers) depend on the respective investments as follows<sup>9</sup>

$$\alpha_i(I_i) = \alpha_0 + \sqrt[2]{I_i} \quad (6)$$

so that  $\alpha'_i = 1/(2\sqrt[2]{I_i})$  and  $\alpha''_i = -\frac{1}{4}I^{-3/2}$ . We assume that  $\alpha_0 > c_i$ ,  $i = 1, 2$ . In this case (5) takes the form

$$\frac{\beta(2\beta^2 - \gamma^2)^2}{(\beta^2 - \gamma^2)(4\beta^2 - \gamma^2)^2} \{(\alpha_0 + \sqrt[2]{I_i} - c_i) - \frac{\beta\gamma}{2\beta^2 - \gamma^2}(\alpha_0 + \sqrt[2]{I_j} - c_j)\} = r_i \sqrt[2]{I_i} \quad (7)$$

We find that the investments become a relatively complicated function of all the parameters of the model ( $\alpha_0, \beta, \gamma, c_1, c_2, r_1$  and  $r_2$ ).<sup>10</sup>

Observe that for the second order condition to hold, we need that the interest rate attains a minimum of  $\hat{r}$ :

$$r_i > \hat{r} \equiv \frac{\beta}{\beta^2 - \gamma^2} \left( \frac{2\beta^2 - \gamma^2}{4\beta^2 - \gamma^2} \right), \quad i = 1, 2 \quad (8)$$

If the second order condition does not hold, then the firm(s) for which it is violated will either invest infinitely much or not at all.

### 3 Numerical examples

As an illustrative numerical example, consider the situation in which we fix the parameters at  $\alpha_0 = 2$ ,  $\beta = 10$ ,  $\gamma = 7.5$ ,  $c_1 = c_2 = 1$  and  $r_1 = 0.10$ , corresponding with a 10 per cent interest rate. In this case, the intercept of firm 1 in equilibrium depends on the rate of interest paid by its rival as indicated in Figure 1:

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<sup>9</sup>A mathematically equivalent formulation is that the investment is in process innovation lowering the marginal costs:  $c_i(I_i) = c_i - \sqrt[2]{I_i}$ . The relevant term that enters profits will again be  $(\alpha_0 + \sqrt[2]{I_i} - c_i)$ . The ensuing analysis thus holds for investments in both product innovations (quality improvements) and process innovations (reductions of marginal costs).

<sup>10</sup>For details, see the appendix that is available from the author upon request.

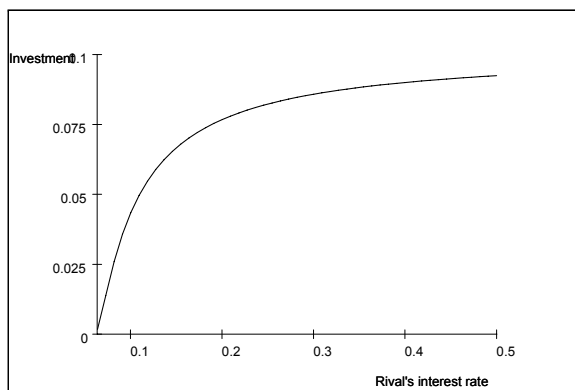


Figure 1: How  $I_1$  depends on  $r_2$  (when  $r_1 = 0.1$ )

If a level playing field obtains so that both firms pay a 10 per cent interest on their loan, they would both want to borrow  $I_1 = I_2 = 0.0432$ . If the rival receives state aid so that the interest rate is lower than the market rate (and possibly negative, if the "loan" does not have to be paid back in full), then that reduces the investment of the firm that does not receive state aid and increases the investment of the firm that receives state aid.

The numerical examples are summarized in Table 1. First consider the case of relatively little horizontal product differentiation ( $\gamma = 7.5$ , so that  $\gamma/\beta$  is at .75). If both firms face the same cost of capital ( $r_1 = r_2 = 0.10$ ) then a level playing field obtains; prices, quantities, investments and profits will be identical. However, if firm 2 – the recipient – receives state aid corresponding to a drop in its cost of capital of only 1 percentage point, then the recipient will increase its investment by more than 40 per cent, while the non-receiving firm will decrease its investment by more than 20 per cent since investments are strategic substitutes. The increased investment will allow the firm to increase both its quantity and its price compared with the level playing field. The non-receiving firm will have to decrease its price and quantity. The profits of the recipient increases by 14 percent while the non-receiving firm will suffer a loss of a similar size compared with the level playing field.

In fact, as the third column shows, if the state aid reduces the recipient's cost of capital corresponding to 3.5 percentage points ( $r_2 = 0.065$  down from .10), then the non-receiving firm's profit is reduced to virtually zero. An even bigger reduction will result in a loss and the non-receiving firm may be forced out of the market. In this sense, state aid may be predatory.

The last two columns show that these effects prevail even if the degree of substitutability is lower ( $\gamma = 5$  so that  $\gamma/\beta = 0.5$ ). The competitive effects are, as one would expect, smaller since the two firms' output compete less fiercely. However, as long as the two products are not independent in demand ( $\gamma = 0$ ), these competitive effects will prevail.

Table 1: Competitive effects of state aid.

$\alpha_0 = 2, \beta = 10, c_1 = c_2 = 1, r_1 = 0.10$						
Substitutability:		$\gamma = 7.5$			$\gamma = 5$	
Aid recipients $r$ :	$r_2$	0.10	0.09	0.065	0.10	0.09
Prices	$p_1$	1.2416	1.2233	1.1135	1.4194	1.4111
	$p_2$	1.2416	1.2638	1.3969	1.4194	1.4399
Quantities	$q_1$	0.0552	0.0510	0.0259	0.0559	0.0548
	$q_2$	0.0552	0.0603	0.0907	0.0559	0.0603
Investments	$I_1$	0.0432	0.0345	0.0028	0.0666	0.0638
	$I_2$	0.0432	0.0621	0.2485	0.0666	0.0903
Profits	$\pi_1$	0.0090	0.0079	0.0026	0.0168	0.0162
	$\pi_2$	0.0090	0.0103	0.0198	0.0168	0.0177

## 4 Conclusion

Economic models of state aid often assume that state aid reduces the recipient's marginal costs. The competitive effects then arise because of a direct advantage from the state aid.

Much state aid is, however, not given in a form that is in any way related to the marginal costs. Rather, it has the effect of lowering the recipient's cost of capital. This may indeed be very harmful if demand-enhancing investments are important. State aid then will allow the recipient to gain market share and become dominant while charging higher prices and selling larger quantities compared with the level playing field.

Non-receiving firms will be hurt. They are forced to reduce price, quantity and investment, effectively accepting the dominant firm's leadership or dominance. They suffer a loss of profits compared with the level playing field. If the aid is sufficiently large, if the demand-enhancing investments in product quality are sufficiently important and/or if investments in cost-reducing process innovation are significant, then the non-receiving firm may be forced to leave the market. In this case, state aid results in predation.

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