STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 2, pp. 049-057

DOI: 10.5937/StraMan2400020V

Received: October 17, 2024
Revised: November 28, 2024
January 15, 2025
Accepted: January 30, 2025
Published online: February 14, 2025

Managerial conflict of interests effects on duopoly market structure

Ilko Vrankic

University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
https://orcid.org/0000-0003-4539-5328

Tomislav Herceg

University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
https://orcid.org/0000-0001-8869-6775

Iva Vuksanovic Herceg

University of Belgrade, Faculty of Economics, Belgrade, Serbia
https://orcid.org/0000-0002-5892-7648

Abstract

Background: Principal-agent problem has been discussed intensively in the recent decade, but this specific case has not yet been analyzed in this manner; one of two companies in Cournot duopoly employs a manager who has a partial ownership of the second company, but without executive power in that company. This kind of conflict of interest changes the market game since the overlapping makes it difficult to determine how many actual players there are on the market, which is crucial to understanding what is about to happen with prices and quantities.

Purpose: This paper will determine which agent's share in the other company becomes a problem for the principal of the first company and how a change in the share affects market price, both companies' quantities and profits, and finally how a duopoly grows closer to a monopoly since the number of players is no longer integer.

Study design/methodology/approach: The manager of the first company is paid in that company's share in profit. As a partial owner of the other company, this manager also receives ownership revenue. Thus the manager (agent) tries to maximize his own revenue which consists of the share in both companies. The agent's actions in the first company are aimed to maximize his own profit instead of the principal's profit.

Findings/conclusions: The higher the agent's share in the competitive company, the greater the agent's reward has to be in terms of the share in the profit of the first company. Additionally, it also increases the prices, decreases the quantities, turning duopoly into a non-integer oligopoly, the closer to monopoly the higher the agent's share is in the competitive company.

Limitations/future research: The assumed Cournot game should also be transformed into a game where players do not act simultaneously. Therefore, a Stackelberg oligopoly analysis could bring a novel view of this specific interaction.

Keywords

Principal-agent problem, conflict of interest, Cournot duopoly, non-integer number of players, monopoly

Introduction

According to the agency theory, one party (the principal) delegates work to another party (the agent) (Daily et al., 2003; Shapiro, 2005; Bosse & Phillips, 2016). The application of the theory has been widespread, including economics (Cooper, 1949, 1951; Ross, 1973), management (Barnard, 1938; Eisenhardt, 1985, 1988; Kosnik & Bettenhausen, 1992, Zhang et al., 2022; Matinheikki, 2022), finance (Jensen & Meckling, 1976, Fama, 1980, Forster et al., 2025), politics (Mitnick, 1982, 1990; Hammond & Knott, 1996, Kiser & Tong, 1992, Al-Faryan, 2024), and sociology (Eccles, 1985; White, 1985; Shapiro, 1987, Davis et al., 2021). The principal–agent problem refers to the conflict in interests that arises when one party (the agent) takes actions on behalf of another party (the principal) (Eisenhardt, 1985). In practice, agency problem arises when the agent (e.g. manager) fails to act in the interest of the principal (e.g. owner) (Williamson, 1975; Arrow, 1984). Berle and Means (1932) conclude that the enforcement of the corporate law in the early 1930s in the U.S. allowed managers to be able to manage the resources of companies to their own advantage. Fama and Jensen, (1983) show that separation of ownership and control lead to the information asymmetry.

The purpose of this paper is to provide a mathematical model for conflicts of interest in a Cournot type duopoly, in which the principal-agent problem has quantitative effects both on the principal's agent and co-owners. After the introduction, the first part of the paper presents the theoretical background of the principal-agent conflict of interest. The second part presents a model which introduces the agency problem in canonical duopoly. It is followed with the Results and Discussion section which employs the comparative static analysis of the market quantity, price and companies' profit reaction to the change in the agent's share in competitive company, with algebraic analysis and numerical simulations. Conclusion summarizes the main findings and sheds a light on the possible future studies.

1. Theoretical background

The paper offers the extension of the model initially presented in Vrankić et al. (2022). The theoretical background of the principal-agent conflict of interest has been well-rounded and little break-through came up since the turn of the century (Vrankić et al., 2022).

Jensen and Meckling (1976) define an agency relationship as a contract between one or more parties (principals) and another party (agents), entrusting them with the responsibility of allocating resources on their behalf. If both parties are motivated by maximizing their own wealth, there is good reason to believe that agents will not always act in the best interests of the principal. As a result, the agency problem arises when the interests of the principal and agent conflict, and/or when the principal finds it difficult to verify the actions of the agent (Eisenhardt, 1989). In this situation, the agent is free to pursue his/her own interests in order to benefit from its position (Noreen, 1988; Cohen et. al, 2007). It is also possible for agents to exploit information asymmetry to take (hidden) actions in order to benefit themselves at the expense of the principal (Holmstrom, 1979; Panda & Leepsa, 2017). In order to prevent divergence of interests, the principal may establish an appropriate incentive program (Jensen, 1994; Laffont & Martimort, 2009) or incur oversight costs in order to prevent unwanted agent behavior (Donaldson and Davis, 1991; Bonazzi & Islam, 2007). Accordingly, it is impossible for the agent to make optimal decisions without incurring costs (both for the agent and the principal). According to Jensen and Meckling (1976), agency costs include monitoring costs, bonding costs, and residual losses.

It is argued that the agency theory fails to capture both sides of the relationship (i.e. the relationship between the principal and the agent), therefore failing to provide insight into the potential problem of the principal exploiting the agents (Shapiro, 2008). A key component of Perrow's stewardship theory is the rejection of the assumption that agents are work-averse, self-interested utility maximizers. In spite of this, he acknowledges that there are certain situations that are more likely to result in the emergence of agency problems.

Two lines of research have been conducted on the agency problem: positivist theory (Jensen & Smith, 2000) and principal-agent theory (Eisenhardt, 1989). In positivist theory, conflicting goals are identified and governance mechanisms are described to limit the agent's selfish behavior; it is less mathematical and focuses almost exclusively on the special case of large, public corporations (Jensen & Meckling, 1976; Fama, 1980; Fama & Jensen, 1983). Principal-agent research provides a rather general understanding of agency relationships (i.e. it impacts a variety of agency relationships such as client-lawyer, writer-publisher, owner-manager, etc.). A logical deduction and mathematical proof are followed by the specification of assumptions (e.g. Demski & Feltham, 1978). By developing a mathematical model for the special case of an agency relationship between the owner of a company and its manager who owns shares in another company in the same industry, this paper attempts to bridge the two streams. It is assumed that the market is Cournot duopoly (non-cooperative companies producing a homogeneous product and bringing their decisions simultaneously). Because it analyzes a special case with a high risk of agency problem occurrence (i.e. the stewardship theory's premise will not hold), it does not contradict the alternative view of principal-agent problem (Donaldson & Davis, 1991). Furthermore, the present research provides empirical evidence regarding the impact of agency problems on principal wealth (Crutchley & Hansen, 1989, Tosi Jr., & Gomez-Mejia, 1989, Lafontaine, 1992, Davidson III et al., 2004). A limited number of studies have investigated the broader social and institutional effects of agency problems. In the opinion of Hill and Jones (1992), an area that remains relatively unexplored is the capacity of agency theory to explain the nature of the contractual relationships between a firm's stakeholders (e.g. employees, customers, suppliers, creditors, communities, and the general public). In the meantime, this topic "grew cold" and few studies have recently focused on the application of principal-agent problem, but almost none have addressed oligopoly (Chen et al., 2022). It is the intention of this paper to fill this gap in the literature by developing a theoretical model to illustrate how agency theory directly negatively impacts company performance and the wealth of its owners, as well as indirectly negatively affecting consumers and the general public's interests since principal-agent problem in oligopoly is a gamechanger and this paper aims to prove it.

2. Models

One side of the story refers to the agency problem. The other is the plain Cournot duopoly. The overlapping of these two aspects shall provide the grounds for the analyses required to achieve the paper's goals.

2.1. Basic Cournot oligopoly model

In the Cournot duopoly model, each company announces its own profit-maximizing production level based on the production level of its competitor. There is no incentive for two companies to change their production level at the same time in Cournot equilibrium, which is one of the basic characteristics of Nash equilibrium too. Their production plans are announced simultaneously with the production of homogeneous products. Using standardized prices to simplify calculations, and maintain the explanatory power of the model, their joint quantity produced affects the price with the following relationship:

$$\boldsymbol{p = 1 - Y = 1 - y_1 - y_2} \tag{1}$$

where y_1 and y_2 are nonnegative quantities produced by these two companies. The second simplification, which allowed for price standardization, is that there is no cost assumption, which does not reduce the model's explanatory power.

$$\max_{y_1} \boldsymbol{\pi_1 = p y_1} \quad \& \quad \max_{y_2} \pi_2 = p y_2 \tag{2}$$

When maximizing profit ($\frac{\partial \pi_1}{\partial y_1} = 0$ & $\frac{\partial \pi_2}{\partial y_2} = 0$) the following reaction curves are obtained:

$$y_1 = \frac{1}{2} - \frac{1}{2} y_2 \quad \& \quad y_2 = \frac{1}{2} - \frac{1}{2} y_1 \tag{3}$$

Their intercept provides Cournot-Nash equilibrium where quantities account for 1/3 of the perfectly competitive market coverage, 2/3 in total:

$$y_1^C = y_2^C = \frac{1}{3}, Y^C = \frac{2}{3} \tag{4}$$

Price in the basic Cournot model is $p^C = 1 - \frac{2}{3} = \frac{1}{3}$ and profits, which are equal to revenues under the zero cost assumption, are equal to the quantities multiplied with price:

$$\pi_1^C = \pi_2^C = \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{9}, \pi = \frac{2}{9} \tag{5}$$

2.2. Modified Cournot duopoly model

The main idea of this paper is based on a specific situation where the Principal (owner of the Company 1) employs the Agent (minor shareholder of the competitive Company 2, but without executive power in that company) as the manager of Company 1 with full executive power. It is also assumed that he pays the Agent with the share in total profit of the Company 1, ϑ_1. The Agent owns ϑ_2 part of the Company 2 ($\vartheta_2 < 50\%$, since he has a non-controlling share).

This kind of the overlapping causes a conflict of interests since the Agent's income consists of both labor income (from Company 1, L) and the capital income (from Company 2, R):

$$\boldsymbol{V = L + R = \vartheta_1 \Pi_1 + \vartheta_2 \Pi_2} \tag{6}$$

Thus, the manager's goal is inconsistent with the owner's goal, which creates an agent-principal problem, where the agent acquires yield from both parties. Depending on the shares of companies' profits, $\boldsymbol{\vartheta_1}$ and $\boldsymbol{\vartheta_2}$, the Agent's goal would be more or less coherent with the principal's goal, maximizing their own income. Since the Agent has executive power only in the Company 1, as long as $\boldsymbol{\vartheta_2 < 0.5}$, the decision variable remains $\boldsymbol{y_1}$ only (otherwise, he would achieve executive power in both companies which would instantly lead to creation of a specific kind of a split monopoly, but not cartel). Therefore, the Agent tries to maximize his own revenues, V:

$$\max_{y_1} V = \vartheta_1 \Pi_1 + \vartheta_2 \Pi_2 \quad (7)$$

$$\max_{y_1} V = \vartheta_1 p y_1 + \vartheta_2 p y_2 \quad (8)$$

$$\max_{y_1} V = p(\vartheta_1 y_1 + \vartheta_2 y_2) \quad (9)$$

$$\frac{\partial V}{\partial y_1} = 0 \quad (10)$$

$$\frac{\partial p}{\partial y_1}(\vartheta_1 y_1 + \vartheta_2 y_2) + p\vartheta_1 = 0$$

$$\vartheta_1 - 2\vartheta_1 y_1 - (\vartheta_1 + \vartheta_2) y_2 = 0$$

$$\Rightarrow y_1 = \frac{1}{2} - \frac{\vartheta_1 + \vartheta_2}{2\vartheta_1} y_2 \quad (11)$$

where (11) is the Company 1's reaction curve. Note that, since the Agent has all the executive power in Company 1, company 1's reaction curve is deducted from the Agent's profit function, not its own. In contrast, Company 2 makes its own decisions and has its own profit maximizing reaction:

$$\max_{y_2} \Pi_2 = p y_2 = (1 - y_1 - y_2) y_2 \quad (12)$$

$$\frac{\partial \Pi_2}{\partial y_2} = 1 - y_1 - 2y_2 = 0 \quad (13)$$

$$\Rightarrow y_2 = \frac{1}{2} - \frac{1}{2} y_1 \quad (14)$$

where (14) is the Company 2's reaction curve. The intercept of the two reaction curves (11 & 14) provides the market equilibrium in Cournot model with conflict of interest (point C):

$$y_1^{CC} = \frac{\vartheta_1 - \vartheta_2}{3\vartheta_1 - \vartheta_2}; \; y_2^{CC} = \frac{\vartheta_1}{3\vartheta_1 - \vartheta_2}; \quad Y^{CC} = \frac{2\vartheta_1 - \vartheta_2}{3\vartheta_1 - \vartheta_2} \quad (15)$$

Stubbing (15) into demand provides the market price:

$$p = \frac{\vartheta_1}{3\vartheta_1 - \vartheta_2} \quad (16)$$

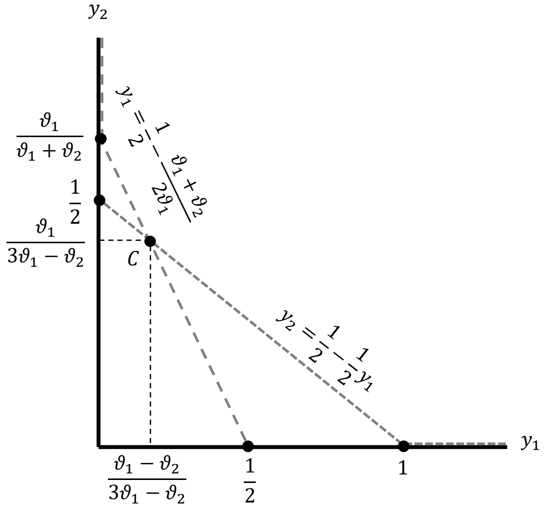

Figure 1 Cournot model in case of Agent's conflict of interests
Source: the authors

Profits of these two companies are:

$$\pi_1 = \frac{1}{9} - \frac{\vartheta_2(3\vartheta_1 + \vartheta_2)}{9(3\vartheta_1 - \vartheta_2)^2} \quad (17)$$

$$\pi_2 = \left[\frac{1}{3} + \frac{\vartheta_2}{3(3\vartheta_1 - \vartheta_2)}\right]^2 \quad (18)$$

$$\pi = \frac{2}{9} + \frac{\vartheta_2(3\vartheta_1 - 2\vartheta_2)}{9(3\vartheta_1 - \vartheta_2)^2} \quad (19)$$

2.3. Relation between Basic and Modified Cournot duopoly model

Market quantities, price and profits in the modified model can be rearranged as follows:

$$y_1^{CC} = \frac{\vartheta_1 - \vartheta_2}{3\vartheta_1 - \vartheta_2} = \frac{1}{3} - \frac{2\vartheta_2}{3(3\vartheta_1 - \vartheta_2)} < \frac{1}{3} = y_1^C \quad (20)$$

$$y_2^{CC} = \frac{\vartheta_1}{3\vartheta_1 - \vartheta_2} = \frac{1}{3} + \frac{\vartheta_2}{3(3\vartheta_1 - \vartheta_2)} > \frac{1}{3} = y_2^C \quad (21)$$

$$Y^{CC} = \frac{2\vartheta_1 - \vartheta_2}{3\vartheta_1 - \vartheta_2} = \frac{2}{3} - \frac{\vartheta_2}{3(3\vartheta_1 - \vartheta_2)} < \frac{2}{3} = Y^C \quad (22)$$

$$p^{CC} = \frac{\vartheta_1}{3\vartheta_1 - \vartheta_2} = \frac{1}{3} + \frac{\vartheta_2}{3(3\vartheta_1 - \vartheta_2)} > \frac{1}{3} = p^C \quad (23)$$

$$\pi_1^{CC} = \frac{1}{9} - \frac{\vartheta_2(3\vartheta_1 + \vartheta_2)}{9(3\vartheta_1 - \vartheta_2)^2} < \frac{1}{9} = \pi_1^C \quad (24)$$

$$\pi_2^{CC} = \left[\frac{1}{3} + \frac{\vartheta_2}{3(3\vartheta_1 - \vartheta_2)}\right]^2 > \frac{1}{9} = \pi_2^C \quad (25)$$

$$\pi^{CC} = \frac{2}{9} + \frac{\vartheta_2(3\vartheta_1 - 2\vartheta_2)}{9(3\vartheta_1 - \vartheta_2)^2} > \frac{2}{9} = \pi^C \quad (26)$$

It is proven that in this model Principal's company 1 produces less and earns less when the Agent has the conflict of interests; competitive company, where the Agent has the share, produces more and earns more; prices soar above the basic Cournot level of prices and the overall profit on the market is also above the overall Cournot profit without conflict of interest, showing a negative effect of the conflict on consumers and competition.

Market saturation in the Cournot oligopoly model can also be analyzed by the number of companies in the oligopolistic market. Fundamental microeconomic theory provides the information that the overall produced quantity on the Cournot oligopoly market (Y^C) with n companies is equal to $Y^C = \frac{n}{n+1} Y^{PC}$, where Y^{PC} is the perfectly competitive quantity. In the example presented in (1), Y^{PC} turns out to be equal to 1. Therefore, each total quantity of production in Table 1 could provide an equivalent of the market participants:

$$Y = \frac{n}{n+1} \Rightarrow n = \frac{Y}{1-Y} \quad (27)$$

It enables numeric comparison between the basic and the conflicted Cournot duopoly for any chosen Company 2 share ϑ_2 (Table 1).

Table 1 Conflict of interests and the equivalent number of market players

ϑ_2	0	.05	.25	.50	.75
Y^{CC}	0.667	0.630	0.590	0.500	0.500
n	2.000	1.703	1.441	1.000	1.000

Source: the authors

Notice that for the values of $\vartheta_2 \geq 0.5$ Company 1 is eliminated and Company 2 becomes a monopolist. Also notice that the quantity produced, which can be expressed through the number of participants on the market, gradually falls as ϑ_2 increases, showing that the larger the Agent's share in Company 2, the lower the equivalent number of participants is, corroborating the previous statements that the rise in the conflict of interests discourages competition. It in turn proves that the real monopolistic power lies in the overlapping ownership which is the cause of the agency problem in this case.

3. Results and Discussion

The owner of Company 1 (Principal) is left with the rest of the profit, Z, after he paid the Agent (manager):

$$\max_{\vartheta_1} Z = (1-\vartheta_1)\Pi_1 = \frac{(1-\vartheta_1)\vartheta_1(\vartheta_1-\vartheta_2)}{(3\vartheta_1-\vartheta_2)^2} \quad (28)$$

Principal then wants to find out the profit share ϑ_1 which maximizes his own profit for a given level of ϑ_2 he cannot control:

$$\max_{\vartheta_1} Z = \frac{(1-\vartheta_1)\vartheta_1(\vartheta_1-\vartheta_2)}{(3\vartheta_1-\vartheta_2)^2} \quad (29)$$

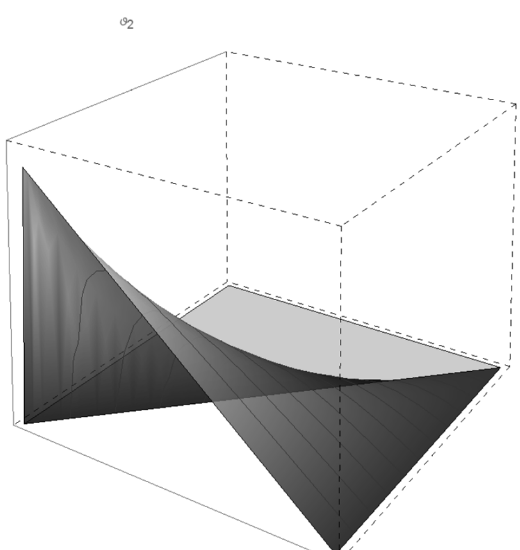

Figure 2 Principal's profit function Z
Source: the authors

Remember that $\boldsymbol{\vartheta_1 \epsilon [0,1]}$ by definition refers to the Figure 1; one notices that if $\frac{\vartheta_1}{\vartheta_1+\vartheta_2} \leq \frac{1}{2}$ then the Agent decides not to produce and competitive company 2 becomes a monopolist $(\boldsymbol{y_2^M} = \frac{1}{2})$.

As a result, the Principal must provide the following in order to maintain its position on the market:

$$\frac{\vartheta_1}{\vartheta_1+\vartheta_2} > \frac{1}{2} \Longrightarrow \boldsymbol{\vartheta_1 > \vartheta_2} \quad (30)$$

Secondly, one has to discuss the closed set $\boldsymbol{\vartheta_2 \epsilon [0,1]}$ since when $\boldsymbol{\vartheta_2 = 1}$ then it is impossible that share $\boldsymbol{\vartheta_1}$ exceeds the value of $\boldsymbol{\vartheta_2}$ making Z = 0. Therefore the optimum share of profit rewarded to the Agent has to be found at $\boldsymbol{\vartheta_1 \epsilon \langle \vartheta_2, 1 \rangle}$, where by definition $\boldsymbol{\vartheta_2 < \frac{1}{2}}$.

$$\frac{dZ}{d\vartheta_1} = \frac{-3\vartheta_1{}^3+3\vartheta_2\vartheta_1{}^2+\vartheta_2(1-2\vartheta_2)\vartheta_1+\vartheta_2{}^2}{(3\vartheta_1-\vartheta_2)^3} = 0 \quad (31)$$

The expression (31) can be solved as the cubic equation:

$$\boldsymbol{-3\vartheta_1{}^{*3} + 3\vartheta_2\vartheta_1{}^{*2} + \vartheta_2(1-2\vartheta_2)\vartheta_1^* + \vartheta_2{}^2 = 0} \quad (32)$$

Therefore a solution will be $\boldsymbol{\vartheta_1^* = \vartheta_1(\vartheta_2)}$ and can be obtained by solving a cubic equation for each given value of $\boldsymbol{\vartheta_2}$. That solution will provide relation between the Agent's ownership of the company 2 and the profit share as a reward from the Principal for managing Company 1. That result will, in turn, provide relation between $\boldsymbol{\vartheta_2}$ and the share in the Company 1's profit, individual production levels, total profits of the companies and the market price. The following sensitivity analyses will provide answers to these questions.

3.1. Effects of ϑ_2 change on Agent's reward

This section will provide the exact algebraic relation between the Agent's share in Company 2 and their profit share in Company 1. The answer to that question lies in solution of (32):

Its differentiation with respect to $\boldsymbol{\vartheta_2}$ gives:

$$\boldsymbol{\left[9\vartheta_1{}^{*2} - 6\vartheta_2\vartheta_1{}^* - \vartheta_2(1-2\vartheta_2)\right]\frac{d\vartheta_1{}^*}{d\vartheta_2} - 3\vartheta_1{}^{*2} - 2\vartheta_2 - \vartheta_1^*(1-4\vartheta_2) = 0} \quad (33)$$

Now $\boldsymbol{\frac{d\vartheta_1{}^*}{d\vartheta_2}}$ can be obtained, and the resulting fraction simplified as A/B:

$$\boldsymbol{\frac{d\vartheta_1{}^*}{d\vartheta_2} = \frac{3\vartheta_1{}^{*2}+2\vartheta_2+\vartheta_1^*(1-4\vartheta_2)}{9\vartheta_1{}^{*2}-6\vartheta_2\vartheta_1{}^*-\vartheta_2(1-2\vartheta_2)} = \frac{A}{B}} \quad (34)$$

The next step is to determine the sign of A. Multiplying A with $\boldsymbol{\vartheta_1^*}$ provides:

$$\boldsymbol{A\vartheta_1^* = 3\vartheta_1{}^{*3} + 2\vartheta_2\vartheta_1^* + \vartheta_1^{*2}(1-4\vartheta_2)} \quad (35)$$

Now express $\boldsymbol{3\vartheta_1{}^{*3}}$ from (24) and replace the bolded part of (27) to obtain:

$$A\vartheta_1^* = (1-\vartheta_2)\vartheta_1^{*2} + \vartheta_2(3-2\vartheta_2)\vartheta_1^* + \vartheta_2{}^2 > 0 \quad (36)$$

(36) is obviously positive, due to the assumptions about $\boldsymbol{\vartheta_2}$ and the sign of the square. Next step is determination of the B sign:

$$B = 9{\vartheta_1^*}^2 - 6\vartheta_2\vartheta_1^* - \vartheta_2(1-2\vartheta_2) \quad (37)$$

After multiplication of (29) with ϑ_1^* one obtains:

$$B\vartheta_1^* = 9{\vartheta_1}^3(\vartheta_2) - 6\vartheta_2{\vartheta_1^*}^2 - \boldsymbol{\vartheta_2(1-2\vartheta_2)\vartheta_1^*} \quad (38)$$

Now expressing $\vartheta_2(1-2\vartheta_2)\vartheta_1^*$ from (32) and replacing the bolded part of (38):

$$B\vartheta_1^* = 3{\vartheta_1^*}^2(2\vartheta_1^* - \vartheta_2) + {\vartheta_2}^2 > 0 \quad (39)$$

Knowing (30), (39) cannot be anything but positive. By dividing $A\vartheta_1^*$ and $B\vartheta_1^*$ one obtains (40) which is identical to (34):

$$\frac{d\vartheta_1^*}{d\vartheta_2} = \frac{A\vartheta_1^*}{B\vartheta_1^*} = \frac{A}{B} > 0 \quad (40)$$

This finding proves that the Principal's optimal reward for the Agent increases as the Agent's profit share in the competitive company rises, keeping in mind that the rewarded share should be greater than the Agent's share in the competitive company (expression 30).

3.2. Effects of $\boldsymbol{\vartheta_2}$ change on output, profits and price

In Chapter 1.3 the relation between basic and conflicted duopoly for different $\boldsymbol{\vartheta_2}$ is shown, but no sensitivity analysis has been conducted so far. Observing the equations (20) through (26), for the optimal value $\boldsymbol{\vartheta_1^*}$, one notices that variation of the common factor:

$$\boldsymbol{f(\vartheta_2) = \frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2} = D} \quad (41)$$

is the only factor that affects the change in all but $\boldsymbol{\pi_2^{CC}}$ and $\boldsymbol{\pi^{CC}}$. Therefore first step is to determine dynamics of (41):

$$\boldsymbol{f'(\vartheta_2) = \frac{3\vartheta_1^* - \vartheta_2 - \vartheta_2\left(3\frac{d\vartheta_1^*}{d\vartheta_2} - 1\right)}{3\vartheta_1^* - \vartheta_2} = \frac{3\left(\vartheta_1^* - \vartheta_2\frac{d\vartheta_1^*}{d\vartheta_2}\right)}{(3\vartheta_1^* - \vartheta_2)^2}} \quad (42)$$

In order to determine the sign of the bolded expression in (42) one has to make the following transformations:

$$\boldsymbol{C = \vartheta_1^* - \vartheta_2\frac{d\vartheta_1^*}{d\vartheta_2}} \quad (43)$$

Now replace $\boldsymbol{\frac{d\vartheta_1^*}{d\vartheta_2}}$ with (34). Using algebraic transformations the following expression is obtained:

$$\boldsymbol{C = \frac{\vartheta_2(\vartheta_1^* + \vartheta_2)}{9{\vartheta_1^*}^2 - 6\vartheta_2\vartheta_1^* - \vartheta_2(1-2\vartheta_2)}} \quad (44)$$

Note that denominator is B (37) which is positive, while numerator is clearly positive:

$$\boldsymbol{C = \frac{\vartheta_2(\vartheta_1^* + \vartheta_2)}{B} > 0} \quad (45)$$

Going back to the expressions (20) to (23) & (25) it is obvious that as $\boldsymbol{\vartheta_2}$ increases, C is positive causing $\boldsymbol{y_1^{CC}}$ to fall, $\boldsymbol{y_2^{CC}}$ to rise, $\boldsymbol{y^{CC}}$ to fall, $\mathbf{p^{CC}}$ to rise and $\boldsymbol{\pi_2^{CC}}$ to rise.

By multiplying the 2nd part of the expression (24) with $\boldsymbol{\frac{3\vartheta_1^* - \vartheta_2}{3\vartheta_1^* - \vartheta_2}}$ (24) can be rewritten as (46) and apply the known fact from (45):

$$\pi_1^{CC} = \frac{1}{9} - \frac{1}{9}\cdot\frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2}\cdot\frac{3\vartheta_1^* - \vartheta_2}{3\vartheta_1^* - \vartheta_2}$$

$$\pi_1^{CC} = \frac{1}{9} - \frac{1}{9}\cdot\frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2}\left(1 + 2\frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2}\right) > 0 \quad (46)$$

The same transformation can be applied to (26); By multiplying the 2nd part of the expression with $\frac{3\vartheta_1^* - \vartheta_2}{3\vartheta_1^* - \vartheta_2}$ (26) can be rewritten as (47):

$$\pi^{CC} = \frac{2}{9} + \frac{1}{9}\cdot\frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2}\cdot\frac{3\vartheta_1^* - \vartheta_2}{3\vartheta_1^* - \vartheta_2}$$

$$\pi^{CC} = \frac{2}{9} + \frac{1}{9}\cdot\frac{\vartheta_2}{3\vartheta_1^* - \vartheta_2}\left(1 - \frac{\vartheta_2}{3\vartheta_1 - \vartheta_2}\right) \quad (47)$$

It is necessary to determine dynamics of the second part of the expression, which can be rewritten as $D(1-D)$ when (41) is applied. Graph of this equation is a parabola which increases for $D < 0.5$. However, due to the fact that $\boldsymbol{\vartheta_1 > \vartheta_2}$ (30), D always fulfills that requirement, concluding that (47) increases as ϑ_2 increases.

These findings bring to conclusion that as the conflict of interest increases, measured with the Agent's share in Company 2, the market shows tendencies towards monopoly: the overall quantity produced diminishes, prices soar as well as the Company 2 and the total market profit, while Company 1 gradually declines and disappears when $\boldsymbol{\vartheta_2}$ reaches 0.5.

3.3. Numeric analysis

The following table contains numeric simulation of the effects of different Agent's shares in Company 2 on the overall market quantities, profits and price.

Table 2 Simulation of the effects of different Agent's shares in Company 2

$\boldsymbol{\vartheta_2}$	0.05	0.25	0.50	0.75	Basic Cournot model
$\boldsymbol{\vartheta_1^*}$	0,168	0,447	0,68	0,859	
y_1^{CC}	0,26	0,181	0,117	0,06	0,333
y_2^{CC}	0,37	0,41	0,442	0,47	0,333
Y^{CC}	0,63	0,59	0,558	0,53	0,667
p^{CC}	0,37	0,41	0,442	0,47	0,333
π_1^{CC}	0,096	0,074	0,052	0,028	0,111
π_2^{CC}	0,137	0,168	0,195	0,221	0,111
π^{CC}	0,233	0,242	0,247	0,249	0,222

Source: the authors

$\boldsymbol{\vartheta_2}$ values are randomly picked, $\boldsymbol{\vartheta_1^*}$ is solved by solving (32) for the given $\boldsymbol{\vartheta_2}$ and the rest of the values are obtained by stubbing the $\boldsymbol{\vartheta}_1^*$ and $\boldsymbol{\vartheta}_2$ into (20) – (26). Z function for the scenarios given in the Table 2, as well as the $\boldsymbol{\vartheta}_2 = \mathbf{0}$ scenario (linear Z function), is given in the Figure 3.

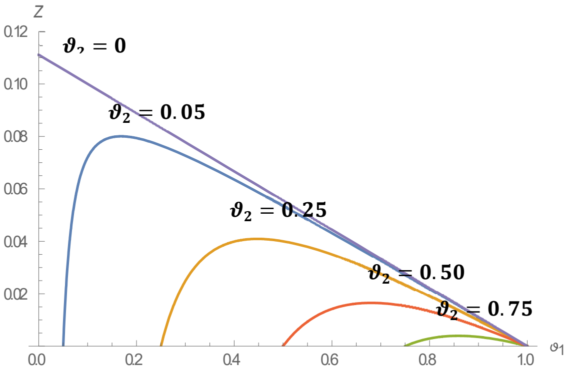

Figure 3 Principal's layer curves of the profit function Z for different values of ϑ_2
Source: the authors

Figure 3 shows that the larger the Agent's share in the competitive company, the greater the $\boldsymbol{\vartheta}_1$ share that the Principal has to give to the Agent, and the maximum payoff of the owner (Z) depletes gradually as $\boldsymbol{\vartheta}_2$ increases. Note that Figure 3 maps vertical cuts of the Z function shown on Figure 2.

Conclusion

This paper analyzes a basic Cournot duopoly model with standardized prices and zero costs. It was proposed that the agent of company 1 (Agent) is rewarded with a share of profits by the company's owner (Principal). A share of the other company is owned by the Agent, but without executive power. The purpose of this study was to demonstrate how the conflict of interests increases as the Agent's share of the other company increases. Principal's profit function is positive only when he rewards the Agent with a greater share than the Agent's share in the other company, but depletes as that share increases. Using comparative statics, it is shown that these two shares are positively correlated. Also, it has been shown that as the Agent's share in the competitive company increases, the market gradually becomes monopolized, as the overall quantity produced decreases. As the market price increases, the profits of both the competitive company and the agent also increase, while the company they run is gradually choked by the Agent, depleting its profits and reducing its production as a result. Consequently, the greater the conflict of interest, the lower the consumer's welfare and the lower the level of competitiveness.

The paper presents a novel method of measuring competitiveness by relating the market coverage to the equivalent number of companies in an oligopoly, demonstrating that the conflict of interests is the same as if the number of companies were not integer. Future studies will focus on generalizing the analysis to more participants, not only two.

Declarations

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

Not applicable

Acknowledgements

Not applicable

References

Al-Faryan, M. A. S. (2024). Agency theory, corporate governance and corruption: an integrative literature review approach. *Cogent Social Sciences*, *10*(1), 2337893. https://doi.org/10.1080/23311886.2024.2337893

Arrow, K. J. (1984). *The economics of agency*. Stanford univ ca inst for mathematical studies in the social sciences. https://apps.dtic.mil/sti/pdfs/ADA151436.pdf)

Barnard, C. (1938). *The functions of the executive*. Harvard University Press.

Berle, A., & Means, G. (1932). *The modern corporate and private property*. McMillian.

Bonazzi, L., & Islam, S. M. (2007). Agency theory and corporate governance: A study of the effectiveness of board in their monitoring of the CEO. *Journal of modelling in management*, *2*(1), 7-23. https://doi.org/10.1108/17465660710733022

Bosse, D. A., & Phillips, R. A. (2016). Agency theory and bounded self-interest. *Academy of management review*, *41*(2), 276-297. https://doi.org/10.5465/amr.2013.0420

Chen, S. S., Ko, P. S., Tsai, C. S., & Lee, J. Y. (2022). Managerial Delegation and Conflicting Interest in Unionized Duopoly with Firm Heterogeneity. *Mathematics*, *10*(22), 4201. https://doi.org/10.3390/math10224201

Cohen, J. R., & Holder-Webb, L., Sharp, D. J., & Pant, L. W. (2007). The effects of perceived fairness on opportunistic behavior. *Contemporary Accounting Research*, *24*(4), 1119-1138. https://doi.org/10.1506/car.24.4.3

Cooper, W. W. (1949). Social accounting: An invitation to the accounting profession. *The Accounting Review*, *24*(3), 233-239.

Cooper, W. W. (1951). A Proposal for Extending the Theory of the Firm. *The Quarterly Journal of Economics*, 87-109. https://doi.org/10.2307/1879501

Crutchley, C. E., & Hansen, R. S. (1989). A test of the agency theory of managerial ownership, corporate leverage, and corporate dividends. *Financial Management*, 36-46. https://doi.org/10.2307/3665795

Daily, C. M., Dalton, D. R., & Rajagopalan, N. (2003). Governance through ownership: Centuries of practice, decades of research. *Academy of Management Journal*, *46*(2), 151–158. https://doi.org/10.2307/30040611

Davidson III, W. N., Jiraporn, P., Kim, Y. S., & Nemec, C. (2004). Earnings management following duality-creating successions: Ethnostatistics, impression management, and agency theory. *Academy of management journal*, *47*(2), 267-275. https://doi.org/10.2307/20159577

Davis, P. E., Bendickson, J. S., Muldoon, J., & McDowell, W. C. (2021). Agency theory utility and social entrepreneurship: issues of identity and role conflict. *Review of Managerial Science*, *15*, 2299-2318. https://doi.org/10.1007/s11846-020-00423-y

Demski, J., & Feltham, G. (1978) Economic incentives in bud- getary control systems. *Accounting Review*, *53*, 336-359

Donaldson, L., & Davis, J. H. (1991). Stewardship theory or agency theory: CEO governance and shareholder returns. *Australian Journal of management*, *16*(1), 49-64. https://doi.org/10.1177/031289629101600103

Eccles, R. (1985). *Transfer pricing as a problem of agency*. In J. Pratt & R. Zeckhauser (Eds.), Principals and agents: The structure of business (pp. 151-186). Harvard Business School Press.

Eisenhardt, K. (1985). Control: Organizational and economic approaches. *Management Science*, *31*, 134-149. https://doi.org/10.1287/mnsc.31.2.134

Eisenhardt, K. (1988). Agency and institutional explanations of compensation in retail sales. *Academy of Management Journal*, *31*, 488-511. https://doi.org/10.2307/256457

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of management review*, *14*(1), 57-74. https://doi.org/10.2307/258191

Fama, E. (1980). Agency problems and the theory of the firm. *Journal of Political Economy*, *88*, 288-307. https://doi.org/10.1086/260866

Fama, E., & Jensen, M. (1983). Separation of ownership and control. *Journal of Law and Economics*, *26*, 301-325. https://doi.org/10.1086/467037

Forster, R., Lyons, A., Caldwell, N., Davies, J., & Sharifi, H. (2025). A lifecycle analysis of complex public procurement: an agency-institutional theory perspective. *International Journal of Operations & Production Management*, *45*(1), 62-87. https://doi.org/10.1108/IJOPM-07-2023-0608

Hammond, T., & Knott, J. (1996). Who controls the bureaucracy? Presidential power, congressional dominance, legal constraints, and bureaucratic autonomy in a model of multi-institutional policy-making. *Journal of Law, Economics, and Organization*, *12*(1), 119–166. https://doi.org/10.1093/oxfordjournals.jleo.a023355

Hill, C. W., & Jones, T. M. (1992). Stakeholder-agency theory. *Journal of management studies*, *29*(2), 131-154. https://doi.org/10.1111/j.1467-6486.1992.tb00657.x

Holmstrom, B. (1979). Moral hazard and observability. *Bell Journal of Economics*, *10*, 74-91. https://doi.org/10.2307/3003320

Jensen, M. C. (1994). Self-interest, altruism, incentives, and agency theory. *Journal of applied corporate finance*, *7*(2), 40-45. https://doi.org/10.1111/j.1745-6622.1994.tb00404.x

Jensen, M. C., & Smith, C. W. (2000). Stockholder, manager, and creditor interests: Applications of agency theory. *Theory of the Firm, 1*(1), 2000. https://doi.org/10.2139/ssrn.173461

Jensen, M.C, & Meckling, W.H. (1976). Theory of the Firm: Managerial Behavior, Agency Cost and Ownership Structure, *Journal of Financial Economics, 4*, 305-360. https://doi.org/10.1016/0304-405X(76)90026-X

Kiser, E., & Tong, X. (1992). Determinants of the amount and type of corruption in state fiscal bureaucracies: An analysis of late imperial China. *Comparative Political Studies*, *25*(3), 300–331. https://doi.org/10.1177/0010414092025003002

Kosnik, R. D., & Bettenhausen, K. L. (1992). Agency theory and the motivational effect of management compensation: An experimental contingency study. *Group & Organization Management*, *17*(3), 309-330. https://doi.org/10.1177/1059601192173009

Laffont, J. J., & Martimort, D. (2009). *The theory of incentives*. In The Theory of Incentives. Princeton university press. https://doi.org/10.2307/j.ctv7h0rwr.5

Lafontaine, F. (1992). Agency theory and franchising: some empirical results. *The rand journal of economics*, 263-283. https://doi.org/10.2307/2555988

Matinheikki, J., Kauppi, K., Brandon–Jones, A., & van Raaij, E. M. (2022). Making agency theory work for supply chain relationships: a systematic review across four disciplines. *International Journal of Operations & Production Management*, *42*(13), 299-334. https://doi.org/10.1108/IJOPM-12-2021-0757

Mitnick, B. M. (1982). Regulation and the theory of agency. *Review of Policy Research*, *1*(3), 442-453. https://doi.org/10.1111/j.1541-1338.1982.tb00448.x

Mitnick, B. M. (1990). *The Two-Part Problem of Regulatory Compliance: Compliance Reform and Strip Mining.* Government Regulation and Business Response: Research Issues and Empirical Studies, 85.

Noreen, E. (1988). The economics of ethics: A new perspective on agency theory. Accounting, *Organizations and society*, *13*(4), 359-369. https://doi.org/10.1016/0361-3682(88)90010-4

Panda, B., & Leepsa, N. M. (2017). Agency theory: Review of theory and evidence on problems and perspectives. *Indian Journal of Corporate Governance*, *10*(1), 74-95. https://doi.org/10.1177/0974686217701467

Perrow, C. (1986). *Complex organizations*. Random House.

Ross, S. A. (1973). The economic theory of agency: The principal's problem. *The American Economic Review*, *63*(2), 134-139.

Shapiro, S. P. (1987). The social control of impersonal trust. *American journal of Sociology*, *93*(3), 623-658. https://doi.org/10.1086/228791

Shapiro, S. P. (2005). Agency theory. *Annu. Rev. Sociol*., *31*, 263-284. https://doi.org/10.1146/annurev.soc.31.041304.122159

Tosi Jr, H. L., & Gomez-Mejia, L. R. (1989). The decoupling of CEO pay and performance: An agency theory perspective. *Administrative Science Quarterly*, 169-189. https://doi.org/10.2307/2989894

Vrankić, I., Vuksanović Herceg, I., & Herceg, T. (2022, June). Conflict of interests in duopoly. *Proceedings of FEB Zagreb International Odyssey Conference on Economics and Business (Vol. 4, No. 1)*, 427-437.

Correspondence

Iva Vuksanovic Herceg

University of Belgrade, Faculty of Economics
Kamenička 6, 11000 Belgrade,Serbia

E-mail: iva.vuksanovic@ekof.bg.ac.rs

White, H. (1985). Agency as control. In J. Pratt & R. Zeckhauser (Eds.), *Principals and agents: The structure of business.* (pp. 187-214). Harvard Business School Press.

Williamson, O. E. (1975). *Markets and hierarchies: analysis and antitrust implications: a study in the economics of internal organization*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Zhang, J., Chen, H., Zhang, P., & Jiang, M. (2022). Product market competition and the value of corporate cash: An agency theory explanation. *International Review of Financial Analysis*, *84*, 102422. https://doi.org/10.1016/j.irfa.2022.102422