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Conference Paper

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Beiträge zur Jahrestagung des Vereins für Socialpolitik 2018: Digitale Wirtschaft - Session:
Organizations and Firms, No. F09-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Stadler, Manfred; Neus, Werner (2018) : Cross Holdings and Strategic Manager Compensation. The Case of an Asymmetric Triopoly, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2018: Digitale Wirtschaft - Session: Organizations and Firms, No. F09-V3, ZBW - Leibniz-Informationszentrum Wirtschaft, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/181534>

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Cross Holdings and Strategic Manager Compensation. The Case of an Asymmetric Triopoly

Werner Neus* and Manfred Stadler**

Abstract

We study an asymmetric triopoly in a heterogeneous product market where quantity decisions are delegated to managers. The two biggest firms are commonly owned by shareholders such as index funds while the smallest firm is owned by independent shareholders. Under such a cross-holding owner structure, the owners have an incentive to coordinate when designing their manager compensation schemes. This type of coordination leads to compensation contracts which make the managers less aggressive such that the firms involved in the coordination reduce their output while the outside firm increases its output. The reallocation of production induces a redistribution of profits: the outside firm and the most efficient firm owned by the index funds gain from the coordination while the less efficient firm owned by the index funds might suffer from a loss of profit if cost differences are large. The trade volume in the market is reduced so that shareholder coordination is detrimental to consumer surplus as well as welfare.

Keywords: Index funds, cross holdings, shareholder coordination, strategic manager compensation

JEL Classification: G32, L22, M52

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1 Introduction

The owners of big firms usually have to hire managers in order to run the business. Managers, however, have their own interests and choose decisions depending on the incentives given by the compensation contracts. This unavoidably implies that the compensation schemes offered by the owners strategically influence the operational decisions of their managers and hence the profits of the firms. In the theory of Industrial Organization, these strategic effects are derived with models of two-stage games where owners simultaneously offer performance-related compensation contracts in the first stage and managers simultaneously decide on prices or quantities in the second stage.

Vickers (1985), Sklivas (1987) and Fershtman and Judd (1987, 2006) have been the first to analyze the consequences of strategic manager compensation in homogeneous markets. They assumed that the compensation contracts consist of fixed salaries and performance-depending payments related to firm profits on the one hand and revenues (or equivalently sales) on the other hand. The managers maximize the performance-depending payments by choosing optimal quantities. The main result of these models is that, due to the strategic effects, the incentives of the managers are biased: they decide to produce more than the firm owners would do if no managers were involved.

This basic framework has been extended in several dimensions. First, other possible compensation contracts have been considered where revenues are replaced by market shares (see, e.g., Jansen, van Lier and van Witteloostuijn 2007, Kopel and Lambertini 2013, and Ritz 2008) or by relative profits (see, e.g., Salas Fumas 1992, Aggarwal and Samwick 1999, Chirco, Scrimatore and Colombo 2011, and Miller and Pazgal 2001 and 2002). For the duopoly case, a comparison of the different compensation contracts has been provided by Jansen, van Lier and van Witteloostuijn (2009, 2012). Second, mixed markets have been studied where some firms are governed by managers while others are run by the owners themselves (see, e.g., Basu 1995 and Tseng 2001). Spagnolo (2000) has considered a supergame with infinitely repeated competition where the dynamic compensation schemes are based on the shareholder values.

This paper aims to concentrate on the role of common large shareholders such as mutual or index funds which coordinate their strategic manager compensation decisions. Fund companies like Blackrock or CalPERS certainly hold shares of more firms which compete in a relevant product market.

Because of the growing popularity of index funds which duplicate the portfolio of firms constituting major national stock indices like S&P500, Nikkei, or DAX, even funds of different fund companies are invested in the same sample of firms. The obvious consequence of such a cross holding is that the shareholders coordinate on the design of the managers' compensation contracts of the firms they are invested in. Due to the increasing importance of mutual funds, most notably index funds, this topic is high on the research agenda.

To investigate the effects of cross holdings and shareholder coordination in a satisfying but still tractable way, we extend the basic scenario in several directions: First, to allow for a more complex market structure, we consider the case of a triopoly instead of the much simpler case of a duopoly. This enables us to study an ownership structure where two firms are commonly owned by coordinating shareholders while the shareholders of the third firm are not involved in that coordination. Second, in order to take into account the empirical evidence that major stock indices consist on the biggest firms, we introduce asymmetric unit costs of the firms as the source of asymmetric firm sizes. Such an extension to asymmetric market structures is interesting in its own right. Furthermore, it enables us to analyze a scenario where the index funds coordinate the behavior of the two bigger firms while the smallest one is the outside firm. Third, in case of a homogeneous market, coordinating shareholders would take a less efficient firm out of the market. To exclude this possibility, we consider a heterogeneous market. To sum up, we deal with a heterogeneous triopoly market, where the output decisions are delegated to managers who are compensated by optimized contracts and who have to run firms of different sizes.

Independent of the role of institutional investors and without referring to managerial incentives, the relevance of coordinated behavior in case of cross holdings has been intensively discussed in another strand of the literature. Reynolds and Snapp (1986) and Breshnahan and Salop (1986) have identified the incentives to mitigate competition in case of cross holdings. Therefore, antitrust authorities should care about cross holdings. Recently, the German Monopoly Commission (2016) has expressed concerns about competition-reducing effects of increasing cross holdings induced by institutional investors. Some models deal with the effects of common ownership in infinitely repeated games. Cross ownerships interact with the general incentives to collude. According to Gilo et al. (2006), the stability of collusion generally subtly depends on the different amounts of cross holdings within an industry. An increase in cross holdings, however, always increases the sta-

bility of collusion. Additionally, they investigate the role of a controller who internalizes the interest of minority shareholders (not participating in the cross holdings). Given this controller, the stability of collusion may diminish in case of an increased cross holding. The latter point has been strengthened by DeHaas and Paha (2016) who showed that the result holds under a wider range of conditions.

Our paper complements the literature on shareholder activism in the theory of corporate governance. While earlier models in this field have focused on the trade-off between liquidity and monitoring incentives (see, e.g., Admati, Pfleiderer and Zechner 1994 and Maug 1998), the more recent literature also provides empirical evidence. McCahery, Sautner and Starks (2016) have presented a survey on the role of institutional investors in corporate governance. One of their main findings is that the decisive triggers for interventions from institutional investors are governance and strategy. This is the issue we deeply emphasize with our model. Cvijanovic, Dasgupta and Zachariadis (2016) have found that mutual funds regularly support management proposals except for compensation proposals. Even though these papers highlight the level of compensation rather than its structure, the idea that mutual funds intervene in management compensation and strategic aspects strongly supports the relevance of our research question.¹

The rest of the paper is organized as follows: Section 2 presents the basic assumptions and the structure of the model. As a benchmark case, Section 3 studies the model with cross holdings but without coordination of shareholders. Section 4 extends the analysis to the case of a coordination of index funds shareholders and compares the results to the basic scenario. Section 5 presents a discussion of the main results and concludes the paper.

2 Assumptions and the Structure of the Model

We consider a heterogeneous product market with three firms $i = 1, 2, 3$, each producing a substitute good. The preferences of consumers with mass 1 are given by the quadratic utility function

$$U = q_0 + \alpha(q_1 + q_2 + q_3) - (q_1^2 + q_2^2 + q_3^2 + q_1q_2 + q_1q_3 + q_2q_3), \quad (1)$$

¹Two recent papers by Azar (2017) and Azar et al. (2017) investigate adjacent questions theoretically and empirically.

where $q_i, i = 1, 2, 3$, are the quantities supplied by the three firms and $q_0 > 0$ is the quantity of the numéraire good. Substituting q_0 from the budget constraint $I = q_0 + p_1q_1 + p_2q_2 + p_3q_3$ and maximizing the utility function with respect to the quantities gives the inverse demand system

$$p_i = \alpha - Q - q_i; \quad i = 1, 2, 3, \quad (2)$$

where $Q \equiv q_1 + q_2 + q_3$ is the quantity produced by the firms altogether.

To allow for different firm sizes, we assume constant but different unit costs c_i of the firms. In order to keep the model tractable, we follow Barros (1998) and assume equal differences δ in the unit costs such that

$$c_i = \begin{cases} c - \delta & \text{for } i = 1 \\ c & \text{for } i = 2 \\ c + \delta & \text{for } i = 3. \end{cases}$$

To guarantee that all firms realize nonnegative profits in the triopoly market, we assume that the unit cost differences are not too large and restrict them to the interval $0 < \delta/(\alpha - c) < 13/28 \approx 0.4643$. We define $\mu \equiv \alpha - c$ and obtain the firms' gross profits

$$\pi_i = \begin{cases} (\mu + \delta - Q - q_1)q_1 & \text{for } i = 1 \\ (\mu - Q - q_2)q_2 & \text{for } i = 2 \\ (\mu - \delta - Q - q_3)q_3 & \text{for } i = 3, \end{cases} \quad (3)$$

depending on the basic market conditions α , c , and δ . Managers are awarded according to the contracts offered by the owners. We follow Fershtman and Judd (1987) and assume simple contracts implying the linear payments

$$s_i = f_i + b_i\psi_i, \quad i = 1, 2, 3,$$

where f_i denotes the fixed salary, b_i serves as a weight parameter which guarantees that the total payments s_i to each manager are equal to a given market-specific payment \bar{s} , and $\psi_i = (1 - \hat{\kappa}_i)\pi_i + \hat{\kappa}_ip_iq_i$, $i = 1, 2, 3$, is the performance-depending payment as a weighted sum of the performance measures profit π_i and revenue p_iq_i . This specification leads to the managers' objective functions $\psi_i = \pi_i + \hat{\kappa}_ic_iq_i$. We define $\kappa_i \equiv \hat{\kappa}_ic_i$ and obtain the performance-depending manager payments

$$\psi_i = \begin{cases} (\mu + \delta + \kappa_1 - Q - q_1)q_1 & \text{for } i = 1 \\ (\mu + \kappa_2 - Q - q_2)q_2 & \text{for } i = 2 \\ (\mu - \delta + \kappa_3 - Q - q_3)q_3 & \text{for } i = 3. \end{cases} \quad (4)$$

While owners aim to maximize the firm profits (3), the managers aim to maximize the performance-depending payments (4) which differ from the firm profits for all biased compensation schemes with $\kappa_i \neq 0$. Owner decisions involving $\kappa_i > 0$ induce managers to raise production and therefore reflect aggressive top-dog strategies of the owners which lower the firm profits (for the taxonomy of business strategies see, e.g., Tirole 1988, Chapter 8).

3 Cross Holdings without Owner Coordination

As a benchmark, we start our analysis by considering the case of manager delegation without owner coordination. In the second stage of the model, the managers decide on quantities q_i ,² given the (transformed) contract parameters κ_i . The maximization of (4) with respect to the quantities leads to a system of three linear first-order conditions which can be solved in terms of the quantities

$$q_i = \begin{cases} (3\mu + 6\delta + 5\kappa_1 - \kappa_2 - \kappa_3)/18 & \text{for } i = 1 \\ (3\mu - \kappa_1 + 5\kappa_2 - \kappa_3)/18 & \text{for } i = 2 \\ (3\mu - 6\delta - \kappa_1 - \kappa_2 + 5\kappa_3)/18 & \text{for } i = 3 . \end{cases} \quad (5)$$

These quantities imply the gross reduced-form profit functions

$$\pi_i = \begin{cases} (6\mu + 12\delta - 8\kappa_1 - 2\kappa_2 - 2\kappa_3)(3\mu + 6\delta + 5\kappa_1 - \kappa_2 - \kappa_3)/324 & \text{for } i = 1 \\ (6\mu - 2\kappa_1 - 8\kappa_2 - 2\kappa_3)(3\mu - \kappa_1 + 5\kappa_2 - \kappa_3)/324 & \text{for } i = 2 \\ (6\mu - 12\delta - 2\kappa_1 - 2\kappa_2 - 8\kappa_3)(3\mu - 6\delta - \kappa_1 - \kappa_2 + 5\kappa_3)/324 & \text{for } i = 3 . \end{cases} \quad (6)$$

In the first stage, since managers' total payment $s_i = \bar{s}$ is fixed, the firm owners maximize the reduced-form profit functions (6) with respect to the contract parameters κ_i . The first-order conditions again constitute a system of three linear reaction functions

$$\begin{aligned} \kappa_1 &= (3\mu + 6\delta - \kappa_2 - \kappa_3)/40 , \\ \kappa_2 &= (3\mu - \kappa_1 - \kappa_3)/40 , \end{aligned} \quad (7)$$

²Quantity competition can be regarded as a reduced form of competition by capacity choice with subsequent price competition, as in Kreps and Scheinkman (1983) for the case of homogeneous markets and in Maggi (1996) for the generalized case of heterogeneous markets.

$$\kappa_3 = (3\mu - 6\delta - \kappa_1 - \kappa_3)/40 ,$$

which can be solved in terms of the subgame perfect strategic decisions

$$\kappa_i^* = \begin{cases} (13\mu + 28\delta)/182 & \text{for } i = 1 \\ 13\mu/182 & \text{for } i = 2 \\ (13\mu - 28\delta)/182 & \text{for } i = 3 , \end{cases} \quad (8)$$

implying the quantities

$$q_i^* = \begin{cases} (65\mu + 140\delta)/364 & \text{for } i = 1 \\ 65\mu/364 & \text{for } i = 2 \\ (65\mu - 140\delta)/364 & \text{for } i = 3 , \end{cases} \quad (9)$$

and the gross profits

$$\pi_i^* = \begin{cases} (104\mu + 224\delta)(65\mu + 140\delta)/364^2 & \text{for } i = 1 \\ 6760\mu^2/364^2 & \text{for } i = 2 \\ (104\mu - 224\delta)(65\mu - 140\delta)/364^2 & \text{for } i = 3 . \end{cases} \quad (10)$$

The welfare in the market is defined as the sum of the producer surplus

$$\Pi^* = \pi_1^* + \pi_2^* + \pi_3^* = (20,280\mu^2 + 62,720\delta^2)/18$$

and the consumer surplus $CS = U - q_0 - p_1q_1 - p_2q_2 - p_3q_3$. Given the utility function (1) and the inverse demand functions (2), we obtain the consumer surplus

$$\begin{aligned} CS^* &= q_1^2 + q_2^2 + q_3^2 + q_1q_2 + q_1q_3 + q_2q_3 \\ &= (25,350\mu^2 + 19,600\delta^2)/364^2 , \end{aligned}$$

so that the welfare adds up to

$$W^* = \Pi^* + CS^* = (45,630\mu^2 + 82,320\delta^2)/364^2 .$$

Due to the definition $\mu \equiv \alpha - c$, both measures are increasing in the market size α and the degree of cost asymmetries δ but decreasing in the average unit cost c .

4 Cross Holdings and Owner Coordination

In order to capture the influence of a coordinated owner behavior, we assume that the bigger firms 1 and 2 are owned by index funds shareholders. This implies that these owners have an incentive to cooperate in specifying their managers' contracts while the managers compete in quantities as before.

4.1 Manager Compensation with Owner Coordination

The index funds shareholders of the firms 1 and 2 maximize their common profit $\pi_1 + \pi_2$ in (6) with respect to the quantities q_1 and q_2 while the owners of firm 3 maximize the profit π_3 in (6) as before. The corresponding first-order conditions consist of the system of reaction functions³

$$\begin{aligned}\kappa_1 &= (-3\mu + 6\delta - 2\kappa_2 + \kappa_3)/38, \\ \kappa_2 &= (-3\mu - 12\delta - 2\kappa_1 + \kappa_3)/38, \\ \kappa_3 &= (3\mu - 6\delta - \kappa_1 - \kappa_2)/40,\end{aligned}$$

which are solved in terms of the subgame perfect contract variables

$$\kappa_i^{**} = \begin{cases} (-26\mu + 61\delta)/356 & \text{for } i = 1 \\ (-26\mu - 117\delta)/356 & \text{for } i = 2 \\ (28\mu - 52\delta)/356 & \text{for } i = 3, \end{cases} \quad (11)$$

implying the quantities

$$q_i^{**} = \begin{cases} (52\mu + 145\delta)/356 & \text{for } i = 1 \\ (52\mu - 33\delta)/356 & \text{for } i = 2 \\ (70\mu - 130\delta)/356 & \text{for } i = 3 \end{cases} \quad (12)$$

and the profits

$$\pi_i^{**} = \begin{cases} (130\mu + 229\delta)(52\mu + 145\delta)/356^2 & \text{for } i = 1 \\ (130\mu + 51\delta)(52\mu - 33\delta)/356^2 & \text{for } i = 2 \\ (112\mu - 208\delta)(70\mu - 130\delta)/356^2 & \text{for } i = 3. \end{cases} \quad (13)$$

³Remarkably, while the contract parameters generally are strategic substitutes (cf. (7)), in the relation between one inside firm and the outside firm, the parameters κ_i prove to be strategic complements.

The consumer surplus is

$$CS^{**} = (20,292\mu^2 - 6,408\mu\delta + 23,059\delta^2)/356^2 ,$$

the welfare amounts to

$$W^{**} = (41,652\mu^2 - 6,408\mu\delta + 81,621\delta^2)/356^2 .$$

In addition to the number of firms and the degree of heterogeneity, which are treated as exogenously given in our model, there are two decisive channels influencing firm behavior and performance: the first is the ownership structure leading to a (partial) coordination in the design of the compensation contracts, the second is the firms' unit cost asymmetry. To separate these two forces, we will first discuss the results for equal unit costs, i.e. $\delta = 0$, in order to identify the pure strategic effects. Afterwards, we will analyze the overall results by taking into account the technological asymmetry. Whenever we refer to numerical values, we normalize the market size variable $\mu = \alpha - c$ to one.

4.2 Pure Effects of Shareholder Coordination

The coordination between index funds shareholders leads to a less intensive competition between the firms because the strategic effects of manager compensation are mitigated when they are internalized by the coordinated firms. Indeed, the coordinating shareholders now choose a puppy dog strategy in designing the compensation contracts ($\kappa_1^{**} = \kappa_2^{**} = -0.0730 < \kappa_1^* = \kappa_2^* = 0.0714$), whereas the shareholders of the outside firm choose an even more aggressive top-dog strategy ($\kappa_3^{**} = 0.0787 > \kappa_3^* = 0.0714$).

The modified incentive structure induces managers to reallocate production. The quantities of the coordinated firms decrease from $q_1^* = q_2^* = 0.1786$ to $q_1^{**} = q_2^{**} = 0.1461$, while the quantity of firm 3 increases to $q_3^{**} = 0.1966$. The overall quantity Q is decreasing ($\Delta Q = -0.0469$), implying that the coordination leads to a softer competition and higher overall profits ($\Delta \Pi = 0.0154$). The profit gains, however, are asymmetrically distributed: the profits of the two coordinated firms only slightly increase of from $\pi_1^* = \pi_2^* = 0.0510$ to $\pi_1^{**} = \pi_2^{**} = 0.0533$, while the profit of the outside firm 3 increases to $\pi_3^{**} = 0.0619$. Remarkably, the profit gain of firm 3 even exceeds the joint profit gains of the coordinated firms. This is a reminiscent of an important result which is well-known from the merger literature: the merging firms also

slightly increase their profits while the non-merging firms experience an even higher increase of their profits (see Salant, Switzer and Reynolds 1983).

Evidently, the decline of the trade volume reduces the consumer surplus (from $CS^* = 0.1913$ to $CS^{**} = 0.1601$) as well as the welfare (from $W^* = 0.3444$ to $W^{**} = 0.3287$) in the market.

4.3 General Effects of Shareholder Coordination

The coordination effects of index funds shareholder become more complex when we allow for cost differences between firms. Since index funds shareholders usually are invested in the bigger firms (here firms 1 and 2), we assume that the outside firm (here firm 3) is the smallest one. The technological asymmetry offers an additional option which allows for a reallocation of production between the coordinated firms. Of course, production quantities and firm profits can be moved from the less efficient firm 2 to the most efficient firm 1. Without loss of generality, we continue to normalize $\mu = \alpha - c$ to one. Table 1 summarizes the results in terms of the parameter $\delta < 13/28 \approx 0.4643$, reflecting the firms' size differences.

Table 1: Numerical Results for the compensation games with $a = 1$

	Without coordination	With coordination
κ_1	$0.0714 + 0.1538 \delta$	$-0.0730 + 0.1713 \delta$
κ_2	0.0714	$-0.0730 - 0.3287 \delta$
κ_3	$0.0714 - 0.1538 \delta$	$0.0787 - 0.1461 \delta$
q_1	$0.1786 + 0.3846 \delta$	$0.1461 + 0.4073 \delta$
q_2	0.1786	$0.1461 - 0.0927 \delta$
q_3	$0.1786 - 0.3846 \delta$	$0.1966 - 0.3652 \delta$
Q	0.5357	$0.4888 - 0.0506 \delta$
CS	$0.1913 + 0.1479 \delta^2$	$0.1601 - 0.0506 \delta + 0.1819 \delta^2$
π_1	$0.0510 + 0.2198 \delta + 0.2367 \delta^2$	$0.0533 + 0.2427 \delta + 0.2620 \delta^2$
π_2	0.0510	$0.0533 - 0.0129 \delta - 0.0133 \delta^2$
π_3	$0.0510 - 0.2198 \delta + 0.2367 \delta^2$	$0.0619 - 0.2298 \delta + 0.2133 \delta^2$
Π	$0.1531 + 0.4734 \delta^2$	$0.1685 + 0.4621 \delta^2$
W	$0.3444 + 0.6213 \delta^2$	$0.3287 - 0.0506 \delta + 0.6440 \delta^2$

A comparison of the strategic decisions on the contract designs shows that the inequalities

$$\kappa_1^{**} < \kappa_1^*, \quad \kappa_2^{**} < \kappa_2^*, \quad \kappa_3^{**} > \kappa_3^*$$

continue to hold. However, the technological differences induce the index funds shareholders to design different compensation contracts, providing the manager of the most efficient firm 1 with an incentive to act more aggressively and the manager of the less efficient firm 2 to act even more inoffensive. The consequence is that some production is moved from firm 2 to firm 1. A comparison of the managers' quantity decisions proves that the relation

$$q_1^{**} < q_1^*, \quad q_2^{**} < q_2^*, \quad q_3^{**} > q_3^*$$

generally holds. A comparison of the firm profits lead to

$$\pi_1^{**} > \pi_1^*, \quad \pi_2^{**} \geq \pi_2^* \text{ for } \delta \leq 0.1539, \quad \pi_3^{**} > \pi_3^* .$$

Of course, an implication of the reallocation of production is that the profitability of firm 1 further increases. The low profit of the less efficient firm 3 still increases as a consequence of shareholder coordination. The coordination effect on the profit of firm 2 can be positive or negative, depending on the size of cost differences. In case of small unit cost differences, $\delta < 0.1539$, its profit goes up due to the less aggressive behavior of both coordinated firms. However, in case of large unit cost differences, $\delta > 0.1539$, the coordination of the index funds shareholders drives its profit down.

This result reflects a basic conflict between institutional investors invested in the firms 1 and 2 and minority shareholders being solely invested in firm 2. Obviously, the latter have no interest in shifting quantities from firm 2 to firm 1. The relevance of this effect is even strengthened by the fact that institutional investors usually act well organized while small investors often even prefer not to participate in general meetings.

Finally, we find $CS^{**} < CS^*$ and $W^{**} < W^*$, i.e., shareholder cooperation reduces the consumer surplus as well as the welfare in the market. While firms benefit from a less aggressive compensation scheme, consumers suffer from a loss of surplus due to the shareholder coordination. The reduction in welfare is less severe when there are cost differences. Accordingly, the increase of overall profits declines with increasing cost differences. Since the latter effect is stronger than the former one, the reduction in welfare increases in the cost differences.

5 Summary and Conclusion

A broad characterization of many markets shows that bigger firms are often commonly owned by shareholders such as index funds while smaller firms are owned by independent shareholders. Given such a cross-holding ownership structure, the index funds have an incentive to coordinate in designing their manager compensation schemes. The paper studied the consequences of such a coordination by analyzing an asymmetric triopoly where the two biggest firms are owned by an index fund and the smallest firm by independent shareholders. We showed that this type of collusion leads to compensation contracts which make the managers less aggressive such that the firms involved in the coordination reduce the output while the outside firm increases its output. This reallocation of production induces a redistribution of the profits: the outside firm and the most efficient firm owned by the index funds gain from the coordination while the less efficient firm owned by the index funds might suffer from a loss of profits when the cost differences are large. The total output in the market is reduced such that shareholder coordination is detrimental to consumer surplus as well as welfare. Therefore, neglecting the existence of index funds leads to a serious shortcoming of models of strategic manager compensation. Our results confirm the concerns about competition-reducing effects of cross holdings of institutional investors.

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