Abstract

Using detailed, grant-level compensation data for large publicly listed firms between 1998-2013, I document that revenue-based compensation is more prevalent in CEO pay packages when the benefits of committing to aggressive product market behavior are greater. Furthermore, this relation does not emerge until after the introduction of the Compensation Discussion and Analysis section of the proxy statement (CD&A), which serves as a plausibly exogenous shock to contract observability. Lastly, post-CD&A product market outcomes are consistent with the shift towards revenue-based pay fostering more aggressive product market equilibria: higher revenues and expenses, but lower margins and profits. Collectively, these results are consistent with a large body of theoretical literature based on Schelling’s (1960) theory of “strategic delegation.” Notably, Fershtman and Judd (1987) show that oligopolistic competitors can boost profits by strategically incentivizing managers with revenue-based pay to commit to aggressive product market behavior, and Katz (1991) demonstrates that this approach to commitment is only effective if managers’ pay packages are observable to rivals.
1 Introduction

In many oligopolistic industries, firms stand to gain by credibly committing to aggressive product market behavior, thereby deterring entry or discouraging the competitive actions of incumbent rivals. Commitment can take many forms. For example, firms can build up large capacities, invest in marginal cost reducing technologies, or take out vast amounts of debt. Schelling (1960) introduces an alternative way to commit: “strategic delegation.” By delegating decision rights to a properly incentivized agent, a principal can make credible otherwise untenable product market policies. For instance, a principal can commit their firm to overproduction by delegating decision rights to an agent and designing an incentive contract to shield the agent from the direct costs of production (e.g., by using revenue-based pay instead of profit-based pay). As with other forms of commitment, strategic delegation must be observable to rivals in order to be effective.

I examine whether firms incorporate revenue-based compensation into CEO pay packages as a method of credibly committing to aggressive product market behavior. Consistent with strategic delegation, I document that revenue-based pay is more prevalent when the benefits of committing to aggressive product market behavior are greater—but only when executive pay packages are credibly disclosed. Furthermore, as predicted under strategic delegation, the post-disclosure shift towards revenue-based pay is associated with more aggressive product market equilibria. I interpret this as evidence that CEO pay packages are structured to confer strategic advantages to the firm in the product market.

Fershtman and Judd (1987) provide the analytical framework that is most closely tied to my study. They study a two-period Nash game in which rivalrous principal-agent pairs compete to sell a homogenous good. In the first period, profit-seeking principals simultaneously choose the weights on profits and revenues in their agents’ compensation contracts. In the second period, agents take all contracts as given, and compete on quantity to maximize their own contractually defined payoffs. Their model implies that principals will rationally place a positive weight on revenue based pay, but this weight diminishes as the number of product market competitors grows.

Intuitively, a greater weight on revenue incentivizes an agent to overproduce, ex post.\(^1\) Ex ante, however, this commitment to aggressive behavior disciplines rival agents, causing them to curtail their own production, and thereby exert less downward pressure on prices. In equilibrium, all firms rationally make this same commitment, so no one gets the edge. The end result is a more aggressive

\(^1\)The agent ‘overproduces’ in the sense that they produce more than the profit-maximizing amount.
product market equilibrium, faced by all competitors—a social dilemma.

Katz (1991) extends this framework by demonstrating the importance of contract observability; if pay packages are not observed by product market rivals, they cannot be used to manipulate rivals’ behavior. Jointly, these studies yield a number of testable hypotheses. Notably: (1) the prevalence of revenue-based compensation falls as the number of product market competitors rises; (2) the preceding hypothesis holds only when compensation contracts are credibly disclosed; and (3) the credible disclosure of pay package details fosters a more aggressive product market equilibrium characterized by greater revenues and expenses, but lower markups and profits.

These hypotheses will not hold generally. In particular, I predict and find that these hypotheses are specific to industries in which rivalrous firms’ strategic actions are predominantly substitutes, as opposed to complements.² Rivalrous firms’ strategic actions are substitutes (complements) if one firm’s aggressive product market behavior begets less (more) aggressive behavior from its product market rivals. For example, if firms compete by setting prices (à la Bertrand, 1883), when one firm lowers its price, rivals react by lowering their own prices—their actions are strategic complements. If, instead, firms compete by choosing production quantities (à la Cournot, 1838), then one firm’s choice to produce more pushes rivals to produce less—their actions are strategic substitutes. Hereafter, I refer to industries as “substitute industries” if strategic actions are predominantly substitutes, and “complement industries” if strategic actions are predominantly complements.³ Unilaterally committing to aggressive product market behavior is more beneficial in substitute industries, as the commitment begets reduced competition from incumbent product market rivals. In complement industries, such a commitment would have the opposite effect, and is therefore not strategically advantageous.

I begin my empirical investigation by classifying industries as substitute versus complement industries, using an approach similar to Kedia’s (2006). This method of classification is based on the relation between a representative rival firm’s aggressiveness, and the own firm’s marginal profits—if the relation is negative (positive), then strategic actions are said to be substitutes (complements).

²Importantly, substitute/complement refers to the strategic actions that rivalrous agents can take, not the products the rivalrous firms sell.
³The classic example of a “substitute industry” is the Cournot oligopoly. Cournot competition describes games in which product market rivals compete with one another by choosing quantities. While industries dominated by this type of competition would fall under my umbrella term of “substitute industry,” so do many other types of industries. For example, in a spatial competition game in which firms choose locations in a product market, but sell goods at an exogenous price, the strategic actions (location choices) are substitutes, even though firms don’t compete on quantity. Analogously, my usage of “complement industries” extends well beyond the canonical example of Bertrand competition, including various forms of non-price competition. For instance, if firms increase their advertising expenditures in response to a rival’s aggressive marketing campaign, this would not be considered Bertrand competition, but is a clear example of strategic complementarity.
The strategic benefits of revenue-based pay are determined not only by the type of competition (i.e., strategic substitutes vs. complements), but also by the intensity of competition. As a product market becomes more competitive, the benefits of commitment diminish. Accordingly, I examine the relation between industry concentration and the prevalence of revenue-based incentives in CEOs’ pay packages. Consistent with my theoretical predictions, I find that the prevalence of revenue-based pay is negatively associated with the number of competitors, but only in substitute industries.

This cross-sectional relation cannot be confidently interpreted as evidence of strategic delegation, because agency theoretic determinants of revenue-based pay are likely to vary across industries and over time. To mitigate this potential endogeneity concern, I include industry and year fixed effects. This design choice is not without its drawbacks. While industry fixed effects are desirable in that they preclude persistent industry-specific endogeneities from driving my results, they also absorb a lot of the variation that, in theory, drives heterogeneity in strategic delegation. With the inclusion of industry fixed effects, coefficient estimates are identified from intra-industry time series variation in competition: namely entry, exit, mergers, spinoffs and industry switches.

To better attribute my findings to strategic delegation, I exploit the introduction of the Compensation Discussion and Analysis section of the proxy statement (CD&A), in 2006, as a plausibly exogenous shock to contract observability. Prior to the introduction of the CD&A, firms were not required to disclose detailed information about the incentives provided to their top executives. While disclosing the pay packages voluntarily was not forbidden, few firms chose to. When CEO incentives are private information, observed only by contracting parties, there is no strategic value in deviating from the agency cost minimizing contract. As predicted, I find little evidence consistent with strategic delegation prior to 2006, and considerably more post-2005. As a falsification test, I replicate this analysis using the three most common profit-based performance metrics (“Operating Income,” “EPS,” and “Earnings”) and find that the association between metric reliance and industry concentration is not significantly different in pre- versus post-2006 periods.

I further use an event-study, triple-differences methodology to study the differential impact of disclosure on the relation between compensation and concentration in substitute versus complement industries. This design exploits cross-sectional variation in both the type (substitute vs. complement) and intensity of product market competition, as well as time series variation in disclosure requirements. As predicted under strategic delegation, I find that the post-disclosure strengthening of the relation between concentration and revenue-based pay is differentially present in substitute industries. For firms in substitute industries in the post-CD&A period, a one standard deviation
increase in competition is associated with a 7%-11% decrease in the likelihood that a CEO will have incentive pay tied to revenue.

One empirical challenge is ruling out alternative explanations for the patterns of revenue-based pay that I document. In particular, moral hazard/agency theoretic concerns also provide ample justification for the use of revenue-based pay. For example, if expenses are largely uncontrollable and fluctuate unpredictably, shielding an agent from this source of uncertainty by using revenue-based pay can reduce agency costs. As such, I rely on several research design choices intended to limit the possibility that agency theory explains my results: (1) I estimate within-industry and within-firm relations between competition and revenue-based pay to mitigate the effects of cross-sectional heterogeneity; (2) I exploit the CD&A’s introduction as a plausibly exogenous shock to contract observability, which theory suggests is of first order importance in strategic delegation, but not in solving moral hazard problems; (3) I include control variables for several agency theoretic determinants of revenue-based pay; (4) I exploit within-industry-year relations between competition and revenue-based pay to relax the parallel trends assumption my triple-differences analyses requires; and (5) I use a two-stage least squares approach, with proxies for fixed costs as instruments for competition, to estimate treatment effects from plausibly exogenous variation in competition.

Lastly, I examine whether product market outcomes change around 2006 in a manner consistent with strategic delegation. Theory suggests that, in substitute industries, the mandated disclosure of incentive contracts results in a more aggressive, strictly worse equilibrium. Consistent with these predictions, I find that in substitute industries with fewer product market rivals, the introduction of the CD&A is associated with increased revenues and expenses along with decreased profit margins and total profits. Relative to other industries, substitute industries of above-median concentration experience increases in per-firm revenues and costs of approximately 5% and 7% around the introduction of the CD&A. Accordingly, in these same industries, profit margins drop by approximately 3.5% while return on assets drops by almost 100 basis points. Collectively, these findings provide evidence of mandated disclosure facilitating strategic delegation.

This paper contributes to multiple streams of literature. First and foremost, this paper contributes to the empirical literature on strategic delegation, as one of the few papers to provide empirical evidence of strategic delegation, in practice. The lack of work in the area is likely due to the unavailability of reliable, detailed, broad sample compensation data—a problem that has only recently been remedied. Kedia (2006) and Aggarwal and Samwick (1999) provide some of the only closely-related empirical work, both providing suggestive evidence that oligopolistic interde-
ependencies shape executive pay. Kedia (2006) shows that pay for performance sensitivity is higher in complement industries, while Aggarwal and Samwick (1999) find that, in more competitive industries, managers’ bonuses are more highly correlated with rival firm performance. Both results are consistent with strategic delegation designed to facilitate collusive behavior. However, neither study was conducted with access to data on the underlying compensation contracts. Instead they rely on the empirical associations between bonus pay and financial performance metrics to infer the underlying contractual terms. Moreover, neither paper exploits any sort of plausibly exogenous variation in competition or disclosure. Thus, their descriptive results, while intriguing, cannot confidently be interpreted as evidence of strategic delegation. In contrast, I utilize detailed, grant-level compensation data and a quasi experimental triple-differences design to test for the prevalence of strategic delegation in executive compensation. I find that, consistent with the theory of strategic delegation, executives are more likely to have incentive pay tied to revenue when the benefits of committing to aggressive product market behavior are greater—but only if compensation contracts are disclosed. Furthermore, I find evidence suggesting that strategic delegation manifests in economically significant product market outcomes.

This paper also contributes to the literature on the real effects of disclosure by showing that the nature of a CEO’s compensation contract is affected in a fundamental way—the mix of performance metrics—when contract observability is exogenously shocked by a disclosure mandate. This is not the first paper to demonstrate that the disclosure of compensation details causes changes in the compensation contracts themselves. Complementary work by Gipper (2016) shows that the level of pay increases following mandated disclosure, but does not provide evidence that the mix of performance metrics was altered by disclosure, or that product market competition mediated the impact of these disclosures. Moreover, my paper is the first to show that the mandated disclosure of executive pay packages affects product market outcomes, such revenues, markups and profits.

The remainder of this paper is organized as follows: in Section (2), I develop my hypotheses; in Section (3), I outline my data sources and describe the sample selection and variable construction procedures; in Section (4), I describe my research design and present my empirical findings; and in Section (5), I conclude. Lastly, I provide a formal model illustrating the entangled roles of disclosure and product market competition in determining executive compensation in the Appendix, and tabulated results from my sensitivity analyses in the Internet Appendix.5

4Recent work by Guay, Kepler and Tsui (2016) demonstrates that regression based approaches do not accurately reflect executives’ true contractually specified incentives.

5The Internet Appendix can be found at http://home.uchicago.edu/~mjbloomfield/research.html
2 Hypotheses and Discussion

2.1 Hypothesis Development

2.1.1 Relation Between Competition and Revenue-Based Pay

Schelling (1960) first introduced the concept of strategic delegation, writing:

“The use of thugs and sadists for the collection of extortion or the guarding of prisoners, or the conspicuous delegation of authority to a military commander of known motivation, exemplifies a common means of making credible a response pattern that the original source of decision might have been thought to shrink from or to find profitless, once the threat had failed” (pp. 142–143).

This quote demonstrates the core idea which underlies strategic delegation—when multiple agents’ strategic actions are interdependent, credibly committing to an otherwise untenable policy can be strategically advantageous, and observably delegating decision rights to a properly incentivized agent is one viable method of committing.

A large body of theoretical literature has since applied this concept in the context of optimal incentive contracting in oligopolistic industries (e.g., Fershtman, 1985; Vickers, 1985; Sklivas, 1987; Fershtman and Judd, 1987; Katz, 1991; Koçkesen, 2004; Koçkesen, 2007; Bagnoli and Watts, 2014). Fershtman (1985) models duopolistic Cournot competitors, each with a profit-seeking principal who delegates to an agent the task of choosing a production quantity. Each principal decides on their agent’s objective function, by choosing the mix of profit- and revenue-based incentives in their agent’s publicly observable compensation contract. Despite the fact that both principals desire to maximize their firm’s profits, neither one will optimally give their agent profit-maximization incentives—doing so would fail to leverage the advantages of commitment that strategic delegation allows. Instead, they will give their agents [partially] revenue-based incentives, causing them to deviate from profit maximization toward more aggressive policies.

Ex post, this aggressive behavior is undesirable from the principal’s perspective. However, committing to this more aggressive policy, ex ante, is strategically beneficial because it causes the rival agent to rationally curtail production. If the compensation contract is set optimally, the ex ante benefits of committing to the more aggressive policy exceed the ex post costs. In equilibrium, both principals use revenue-based compensation to commit their agents to aggressive product market behavior, and both principals end up worse off for it. While it is individually optimal to provide aggressive revenue-based incentives, collectively this behavior is value-destroying for both principals—a prisoner’s dilemma.
Fershtman and Judd (1987) provide the model that is most directly applicable to my empirical analysis. They generalize Fershtman’s (1985) model from the Cournot duopoly to the N-firm Cournot oligopoly, and characterize equilibrium incentives as a function of the number of competitors. They find that the weight on revenue is maximized in the case of the duopoly, and falls as the number of competitors rises.\textsuperscript{6} Accordingly, my first hypothesis is:

**H1:** In substitute industries, the use of revenue-based pay is negatively associated with the number of product market competitors.

### 2.1.2 Real Effects of Disclosure

Katz (1991) studies the importance of contract observability in strategic delegation. He shows that, under broad conditions, there is no strategic benefit to be gained by deviating from an agency cost minimizing contract if the contract will not be observable to other agents.\textsuperscript{7} Notably, even the possibility that agents engage in multiple rounds of actions (e.g., repeated play) does not justify deviations from the agency cost minimizing contract, sans disclosure.\textsuperscript{8} Thus, my next hypothesis is:

**H2:** H1 holds only after contracts are credibly disclosed via the 2006 introduction of the CD&A.

### 2.1.3 Product Market Outcomes—The Social Dilemma

As a final step, I examine whether executives’ altered incentives manifest in the predicted product market outcomes. If firms begin including revenue-based pay in CEO pay packages in order to commit to more aggressive product market behavior, it follows that firms will ultimately behave more aggressively. While it is individually advantageous for each firm in a substitute industry to commit to more aggressive behavior, collectively this behavior is value destroying for all firms—

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\textsuperscript{6}This intuition is formalized in the Appendix, Section A1. For a graphical depiction of the link between the number of competitors and the theoretically optimal use of revenue based pay, see Figure A1.

\textsuperscript{7}A formal analysis of equilibrium incentives with and without disclosure can be found in the Appendix.

\textsuperscript{8}Related work by Koçkesen and Ok (2004), and Koçkesen (2007) demonstrates that, in certain contexts, strategic delegation can arise even when contracts are unobservable to rivals. However, strategic delegation under unobservable contracts requires that the decision to delegate in the first place be costly, endogenous and observable. That is, a principal can manipulate rival behavior by sending a costly signal: observably choosing to delegate decision rights to an agent with an unobservable contract. In the context of my study, it seems unlikely that the owners of publicly traded firms decide to whether or not to delegate decision rights to executives based on strategic incentives. Accordingly, I assume that the decision to delegate is an exogenous precondition, and analyze the nature, rather than the existence, of compensation contracts. A violation of this assumption will bias against my empirical predictions.
a social dilemma. Accordingly, I predict that the introduction of the CD&A will foster a more aggressive product market equilibrium in concentrated substitute industries, characterized by higher revenues and expenses, and lower markups and profits.

**H3: In concentrated substitute industries, contract disclosure leads to more aggressive product market equilibria: higher revenues and expenses, and lower markups and profits.**

### 2.2 Discussion

#### 2.2.1 Credibility of the Null Hypothesis

These hypotheses might not attain for a variety of reasons. First, firms often have many options available for strategic commitment, and manipulating managerial incentives could be one of the less efficient. For example, firms might prefer to commit by investing in bigger capacities and/or building up large amounts of inventory (e.g., Kreps and Sheinkman, 1983; Moreno and Ubeda, 2006), investing in marginal cost reductions (e.g., Dixit, 1980; Brander and Spencer, 1983), leveraging up (e.g., Brander and Lewis, 1986; Brander and Lewis, 1988) vertically integrating (e.g., McGuire and Staelin, 1983; Hart and Moore, 1990), or pre-announcing their future competitive actions (e.g., Corona and Nan, 2013). One advantage of strategic delegation is that it does not require major, irreversible investments as many other forms of commitment do. Moreover, firms can use strategic delegation in conjunction with (rather than instead of) other forms of commitment.

Second, the assumption that principals seek to maximize firm value might not hold. For example, Anton, Ederer, Gine and Schmalz (2016) provide evidence that common ownership affects the nature of executive pay, with managers receiving incentives to behave more passively in the product market. Individually, this behavior is detrimental for firm value, but collectively this behavior is beneficial for aggregate industry value.

And third, firms might not be sophisticated enough to use such strategic devices, or might think their rivals aren’t sophisticated enough for them to be effective. Experimental evidence by Barreda-Tarrazon, Geogantzis, Manasakis, Mitrokostas and Petrakis Barreda-Tarrazon, Geogantzis, Manasakis, Mitrokostas and Petrakis (2016) speaks directly to the plausibility of this channel. They

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9This is a social dilemma from the viewpoint of producers. Taking consumer surplus into account, an equilibrium of heightened product market aggressiveness actually improves aggregate welfare by efficiently transferring surplus from producers to consumers. Consumers gain more than producers lose.

10An explicit derivation of these predictions, in the context of the Cournot oligopoly, can be found in the Appendix. For a summary, see Table A1.
find that Business and Human Resources students seem to intuitively grasp the value of strategic delegation when determining pay packages in an experimental quantity-setting duopoly.

One might also reasonably question why the CD&A is required for such a relation to emerge—given the strategic benefits of commitment, why wouldn’t firms disclose the details of their compensation contracts voluntarily? One possibility is that the proprietary costs of such disclosures outweigh the associated strategic benefits (à la Verrecchia, 1983). If the strategic benefits are quite large, this explanation seems unlikely. An alternative explanation is that the voluntary disclosure of contract details is not sufficiently credible to be a viable means of strategic commitment.

In line with this explanation, Morse, Nanda and Seru (2011) study compensation paid to CEOs over the period of 1993-2003 (entirely before the CD&A’s introduction), and find evidence that firms routinely deviate from previously specified performance metrics. They argue that such deviations are the result of rent-seeking behavior by powerful managers, and that more credible disclosure, *ex ante*, is needed to prevent these *ex post* deviations. On the other side of the coin, Gipper (2016) documents that executive pay levels rise following the CD&A and argues that this might be because “the CD&A disclosure can bind the compensation committee to a pay plan,” and that “binding to a set of performance metrics *ex ante* might become inefficient when the committed compensation determinants do not best measure the efforts of management *ex post*.”

While the two papers differ in their normative implications, they are aligned in suggesting that the mandatory disclosure of contract details binds firms to a pay plan. This view is shared by industry experts, with Exequity’s Robbi Fox commenting:

> “Historically, some compensation committees have deviated from their stated goals to provide executives with discretionary bonuses, but it’s become increasingly rare. That type of behavior was much more common before 2006, because these days you’d have to explain it in the CD&A. You had established goals, and now you’re varying from those goals—and with the CD&A those sorts of deviations receive a lot of scrutiny. Certainly the disclosures around those kinds of actions have caused companies to think twice. You’d need to have a really good reason” (R. Fox, personal communication, July 18, 2016).11

Binding is necessary for compensation packages to be a viable means of commitment. Without this binding, compensation disclosures would not be able to elicit favorable responses from rivals.

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11 Robbi Fox has been a Senior Advisor with Exequity since 2010. Before that, she was a Principal and Senior Compensation Consultant with Hewitt Associates for almost 25 years.
2.2.2 Relation to Agency Theory

Jensen and Meckling (1976) provide some of the seminal work on agency costs and the theory of the firm, but it was Hölmstrom (1979) who most famously formalized the problem of efficient compensation contracting under uncertainty. This framework, now best known as “agency theory,” has since been adopted by a wide variety of subdisciplines within the larger applied economics literature, notably quantitative marketing, finance and accounting. Under agency theory, compensation contracts are incentive alignment tools with a singular purpose: align the objectives of principals and agents. Much of the existing literature on executive pay exemplifies this view, with Core, Guay and Larcker (2003) defining ‘efficient’ compensation contracts as those that “minimize agency costs.”

The central tension in agency theory is the tradeoff between risk and incentives. Incentivizing agents to exert unobservable, costly effort requires tying their compensation to imperfectly controllable measured performance, thereby exposing them to outcome risk. A fundamental implication of traditional agency theory is that any metric which provides incremental information about an agent’s effort should be included in the optimal compensation contract. Moreover, the relative weight assigned to a metric should rise with the relative informativeness of the metric (e.g., Hölmstrom, 1979; Baiman and Demski, 1980; Hölmstrom and Milgrom, 1987; Lambert and Larcker, 1987; Hölmstrom and Milgrom 1991; Hölmstrom and Milgrom, 1994). Under this paradigm, the separation of ownership and control is a problem that must be solved, and an agency cost minimizing incentive contract is the optimal, but imperfect, solution.

Building upon Schelling’s (1960) theoretical framework of “strategic delegation,” I explore the complementary perspective that owners can also exploit the separation of ownership and control for strategic gain by using compensation contracts as commitment devices. When multiple agents’ actions are interdependent, the incentives of one agent affect not only that agent’s actions, but also those of rivalrous agents. Thus, if an agent’s incentives can be observably altered by a compensation contract, such alterations can be used to manipulate rivals (e.g., Fershtman and Judd, 1987).

Agency theory and strategic delegation are not mutually exclusive. Pay packages can be structured jointly, by trading off the desire to align incentives against the benefits of strategic commitment. The purpose of this study is not to pit agency theory and strategic delegation against each other. Rather, the goal is to hold fixed the agency theoretic drivers of compensation and examine whether strategic incentives are a first order driver of residual variation in CEO pay packages.
3 Data, Sample, Constructs and Proxies

3.1 Data Sources and Sample Selection

Data for this paper comes from the intersection of Compustat’s Annual and Quarterly Industrial Files, The Hoberg and Phillips Data Library and Incentive Labs. This yields a sample of 11,240 firm-year observations from 1,561 unique firms over the period of 1998-2013.

I use Incentive Labs, provided by ISS, to observe the underlying executive compensation contracts. Incentive Labs provides detailed, grant-level data on executive compensation contracts, including the choice of metrics, performance goals and associated payouts. Coverage is limited to the largest publicly traded firms over the period of 1998-2013.

I use the 10-K text-based Fixed Industry Classification (“FIC”) database from the Hoberg and Phillips Data Library to classify firms into industries and assess the degree of product market competition that firms face. In short, industries are constructed as follows: Step 1, construct a network of within-year pair-wise firm similarities using the cosine similarity of two firms’ 10-K product descriptions. Step 2, use a clustering algorithm to partition the network into approximately \( k \) industries, where \( k \) varies from 10 at the low end to 500 at the high end. Throughout the manuscript, I refer to the FIC with \( k \) industries as “FIC-\( k \).” This database is thoroughly described in Hoberg and Phillips (2010), Hoberg and Phillips (2014) and Hoberg and Phillips (2015).

3.2 Key Variables

Below, I outline the construction for the variables used in my study. Summary statistics can be found in Table (1).

3.2.1 Competition Intensity

Theoretical work on strategic delegation shows that the benefits of commitment decrease with the competitiveness of the industry (e.g., Fershtman and Judd, 1987). In my main analyses, I measure competition as the number of firms in a industry-year, where industries are defined based on Hoberg and Phillip’s FIC-50, and name this variable \( \text{Firms} \). Due to the skew of this measure, I use the natural logarithm in my statistical tests. I rely primarily on this measure as it ties in most closely to my model (see the Appendix), which also used the number of competitors as the driver of revenue-based pay.

In my supplemental and sensitivity analyses, I use nine alternative measures of competition
intensity. Five of these alternative measures are created simply by changing the industry definition. I use FIC-25 to capture a broader scope of competitive forces, and FIC-100, -200 and -500 to capture tighter competitive forces. Additionally, I use the Fama and French 48 Industry Classification to ensure that similar inferences attain with more traditional industry definitions. For the FIC-200 and FIC-500 industry definitions, I also construct indicator variables that take a value of one if there is exactly one firm in an industry-year. I refer to these variables as *Monopoly*.

The eighth alternative is the Herfindahl-Hirschman Index, calculated at the FIC-50 level. This measure is constructed as:

\[ HHI_{i,t} = \sum_{j \in M_t} \left( \frac{Sales_{j,t}}{\sum_{k \in M_t} Sales_{k,t}} \right)^2, \]

where \( k \) and \( j \) index firms in firm \( i \)'s industry, \( M \), in year \( t \). Due to the skewness of this measure, I use the natural logarithm in my statistical tests and name this variable \( \log(HHI) \).

I caveat that these measures, while intuitive, contain a variety of shortcomings. Most notably, these measures do not capture private firms. I address this concern by using Census data on industry concentration, as recommended by Ali, Klasa and Yeung (2009). Specifically, I use the proportion of sales generated by the largest 50 firms within a 3-digit NAICS industry as my measure of concentration and refer to this measure as *Prop50*. This approach captures information about the competitive nature of the industry based on both public and private competitors. This information is not available on an annual basis, so I use the concentrations as measured in 2007. Due to the skewness of this measure, I use the natural logarithm in my statistical analyses.

### 3.2.2 Competition Type

The theoretical relation between competition intensity and revenue-based compensation depends on whether strategic actions are substitutes or complements. Intuitively, strategic actions are substitutes (complements) if one firm’s more aggressive behavior begets less (more) aggressive behavior from its product market rivals. Formally, strategic actions are substitutes (complements) if

\[ \frac{\partial^2 \pi_i(x_i,x_j)}{\partial x_i \partial x_j} < 0 \quad (\frac{\partial^2 \pi_i(x_i,x_j)}{\partial x_i \partial x_j} > 0), \]

where \( \pi_i \) is firm \( i \)'s profit function, \( x_i \) is firm \( i \)'s aggressiveness, and \( x_j \) is a representative rival’s aggressiveness.

Kedia (2006) proposes a methodology to estimate the sign of \( \frac{\partial^2 \pi_i(x_i,x_j)}{\partial x_i \partial x_j} \) from Compustat data.

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12I thank Mary Billings for this suggestion.
First take the total differential of firm $i$’s marginal profits:

$$d\frac{\partial \pi^i}{\partial x_i} = \frac{\partial^2 \pi^i(x_i, x_j)}{\partial x_i \partial x_i} dx_i + \frac{\partial^2 \pi^i(x_i, x_j)}{\partial x_i \partial x_j} dx_j,$$

which can be approximated as the OLS specification:

$$d\frac{\partial \pi^i}{\partial x_i} = \beta_1 x_i dx_i + \beta_2 dx_i + \beta_3 x_i dx_j + \beta_4 dx_j,$$

where the sign of $\hat{\beta}_3 x_i + \hat{\beta}_4$ is the estimator of the sign of $\frac{\partial^2 \pi^i(x_i, x_j)}{\partial x_i \partial x_j}$.

Following Kedia (2006), I use quarterly revenues for firm $i$ as proxies for $x_i$’s and the average contemporaneous quarterly revenues for all of firm $i$’s industry rivals as proxies for $x_j$’s. Due to the discreteness of the data, I approximate $dx$ by the quarter-to-quarter $\Delta x$ and similarly, $d\frac{\partial \pi^i}{\partial x_i}$ by the quarter-to-quarter $\Delta \frac{\partial \pi^i}{\partial x_i}$.

This procedure yields a firm-year estimate of strategic direction, $\hat{\beta}_3 x_{i,t} + \hat{\beta}_4$. To produce an industry-level measure, I then take the median over all firms-years in an industry and define the industry as a “substitute industry” if the median sign is negative (indicating strategic substitutability) and a “complement industry” if the median sign is positive (indicating strategic complementarity). I code industries as substitute versus complement using the indicator variables $Subs$ and $Comps$, respectively. All industries are coded as either one or the other, so the two variables provide identical information content.\(^{13}\)

While revenues are undoubtedly an imperfect proxy for a firms’ strategic decisions, and OLS an imperfect approximation for the true strategic interdependencies of firm behavior, this method provides an unbiased estimator of the true strategic direction, if demand is linear and marginal costs are constant. Importantly, systematic or idiosyncratic shocks to supply or demand will not bias the sign of the estimated direction, although they can bias the magnitude. For this reason, I ignore the magnitude and use only the sign of the estimated direction in my analyses.

3.2.3 Incentives

In my main analyses, I measure executive incentives using an indicator variable equal to one if the CEO has any compensation tied to absolute performance “Sales” objectives, according to Incentive Labs. I refer to this variable as $RevenueBonus$.\(^{14}\) Kedia (2006) differs in that she codes industries as having no strategic interaction if the F-statistic of the estimated direction is insignificant.

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\(^{13}\)Kedia (2006) differs in that she codes industries as having no strategic interaction if the F-statistic of the estimated direction is insignificant.

\(^{14}\)
In supplemental analyses, I also construct a measure designed to reflect the intensive margin of revenue-based pay. This approach captures the relative weight on profits versus revenues continuously. I approximate the marginal compensation associated with another dollar of profits and revenues as:

\[ w_{\pi} = \text{VestPercentage}_{\pi} \times \frac{\Delta \text{Payout}}{\Delta \text{Goal}_{\pi}} \]

\[ w_{\text{R}} = \text{VestPercentage}_{\text{R}} \times \frac{\Delta \text{Payout}}{\Delta \text{Goal}_{\text{R}}} \]

For a firm with multiple profit-based metric (e.g., EPS, and Operating Profit), I calculate \( w_{\pi} \) for each metric, and use their sum as my approximation of \( w_{\pi} \). Using these first order approximations, I then define:

\[ \lambda = \frac{w_{\pi}}{w_{\pi} + w_{\text{R}}} \]  \hspace{1cm} (4)

Thus, \( \lambda \) ranges continuously from 0 to 1, with 0 representing an entirely revenue-based contract, and 1 representing a pure profit contract.

This measure can only be constructed for post-CD&A firm-years and only if the terms in the contract are linearly separable. Many firms use more complicated contract structures, such as conditional performance sensitivity or matrix payout functions. For these contracts, a simple summary proxy capturing the relative weight on profits and revenues cannot be constructed. Thus, these firms are excluded from my intensive margin analyses. Furthermore, equity incentives comprise the bulk of executive pay (e.g., Core and Guay, 1999; Core et al., 2003; Core, Guay and Verrecchia, 2003; Conyon, Core and Guay, 2010), and act effectively as greater weight on value creation—a feature my proxy will overlook. I also note that the financial metrics used in the contract do not necessarily map neatly into GAAP measures of revenues and profits. For these reasons, I offer this measure only for supplemental analyses, and caution that results be interpreted carefully.

### 3.2.4 Contract Observability

According to theory, the role for strategic delegation in executive compensation hinges on the observability (and credibility) of the executive’s pay package. In my empirical analyses, I use \( \text{Post} \), which takes a value of one during and after 2006, the year in which the CD&A was introduced.\(^{14}\)

\(^{14}\)While a more precise \( \text{Post} \) measure, based on heterogeneity in firms’ fiscal year ends is simple to construct, it would be of questionable utility in this context as it is unclear exactly when the real effects of disclosure would begin. Would there be anticipatory real effects? Or would the effect be delayed until treatment? Given these concerns, I
3.2.5 Agency Theoretic Controls

Strategic delegation is not the only reason to include revenue-based pay in a CEO’s pay package. Revenue-based pay can also be useful in mitigating agency conflicts that might arise due to managerial myopia, stochastic expenses, and personally costly, but effective demand-improving activities (e.g., product improvements and/or marketing). Accordingly, I construct several proxies intended to reflect agency theoretic determinants of revenue-based pay.

I include \( Age \), defined as the number of years since a firm’s IPO, to control for growth-related reasons to include revenue-based pay. I also include \( R&D \) and \( Ads \), as measures of the marginal effectiveness of managerial effort at increasing sales. These are indicator variables, equal to one if a firm recognized R&D or Advertising expenses. I further include \( \log\left(\frac{\sigma_R}{\sigma_R}\right) \) as a proxy for the relative outcome risk associated with revenue-based versus profit-based performance incentives. For firm \( i \) in year \( t \), I measure \( \sigma_\pi \) (\( \sigma_R \)) as the standard deviation of a firm \( i \)’s quarterly income before extraordinary items (quarterly revenues), in fiscal year \( t \). Lastly, I include \( Inc.\text{Info} \), defined as the \( R^2 \) between quarterly revenues and profits, to reflect the incremental information contained in revenues. Due to the skewness of \( \log\left(\frac{\sigma_\pi}{\sigma_R}\right) \) and \( Inc.\text{Info} \), I use the natural logarithms of these variables in my statistical analyses.

3.2.6 Product Market Outcomes

The majority of this paper is aimed at demonstrating an effect of contract disclosures on the use of revenue-based compensation. This shift in manager incentives also yields predictions for product market outcomes. I study five additional outcome variables: revenue, costs, product markups, profits and competition-related disclosures.

I measure \( Revenues \) and \( Costs \) as annual revenues and costs of good sold, deflated by average total assets. Markups I measure as \( \frac{Revenues - Costs}{Revenues} \), and refer to this variable as \( Margins \). Due to the skewness of each measure, I use the natural log in my empirical analyses. I measure \( Profitability \) as annual income before extraordinary items, deflated by average total assets. Due to the kurtosis of this measure, I Winsorize at 1% and 99%.

Lastly, I use the text-based competition measure developed by Li, Lundholm and Minnis (2013). This measure is equal to the number of competition-related words\(^\text{15}\) contained within a firm’s 10-K, choose to use a simpler \( Post \) variable. Nonetheless, in untabulated analyses, I find that my inferences are unaffected if I code \( Post \) to capture CD&A compliance more precisely.

\( ^{15} \)“competition, competitor, competitive, compete, competing,” including those words with an ‘s’ appended, and
scaled by the total number of words in the firm’s 10-K. I refer to this measure as \( PCTCOMP \). Due to the skewness of this measure, I use the natural logarithm in my statistical analyses. To construct these alternative outcome measures, I do not require any contract data. Thus, I am able to expand the sample beyond those firms included in Incentive Labs.

### 4 Empirical Analysis

#### 4.1 Descriptive Analyses

The first step in my empirical analyses is to document the empirical association between industry competition and revenue-based executive compensation. These tests are all based on the following regression specification:

\[
RevenueBonus_{i,t} = \alpha + \beta \log(Firms_{j,t}) + \tau_t + u_j + \epsilon_{i,j,t},
\]

where \( \tau_t \) and \( u_j \) are year and industry fixed effects. The dependent variable, \( RevenueBonus_{i,t} \), is an indicator variable equal to one if the CEO of firm \( i \) in year \( t \) is given absolute performance incentives tied to revenue.

These tests vary across two dimensions: fixed effect structure and sample. The first three specifications are pure cross-sectional regressions with no fixed effects at all. Specifications four through six add year fixed effects and the final three specifications add industry fixed effects. For each fixed effect specification, I run the analysis on three samples: the full sample, the \( Subs \) subsample and the \( Comps \) subsample. Results are presented in Table 2.

The choice to include industry fixed effects is not without costs. Based on Fershtman and Judd (1987), the most intuitive empirical implementation is a cross-sectional one, in which the differences in competition across industries explain differences in revenue-based CEO pay across industries.\(^{16}\) However, industries differ from one another across a number of dimensions, and the incentive to engage in strategic delegation constitutes only one out of a variety of reasons to include revenue-based pay. For this reason, cross-sectional results cannot be confidently interpreted as evidence of strategic delegation. To mitigate the potential for persistent industry-specific endogeneities, I use industry fixed effects to strip out persistent cross-industry differences in the use of revenue-based incentives.

---

\(^{16}\) This implementation is presented in Table 2, specifications (1) through (6).
pay. Unfortunately, this approach also discards persistent differences in the competitive nature of the industry—variation that, ideally, I would like to retain. Instead, parameter estimates are identified from intra-industry time series variation in competition: namely entry, exit, mergers, spinoffs and industry switches.

My findings are aligned with my theoretical predictions. Greater competition is negatively associated with the propensity to include revenue-based compensation—but only in substitute industries. This is consistent with the notion that firms determine their executive compensation packages strategically, and use revenue-based compensation as a way to credibly commit to aggressive product market behavior, when it is advantageous to do so. The magnitude and statistical significance of the relation remains relatively stable across all three fixed effect structures, indicating that it cannot easily be explained by any macroeconomic time trends or persistent, industry-level endogeneities.

The benefits of aggressive commitment are not the only factors to vary with industry competition, thus I caution that the results be interpreted carefully. The number of competitors in a product market both affects and is affected by potentially compensation-relevant supply and demand forces. Jointly, year and industry fixed effects will strip out much of this confounding variation, but will not be able to address time-varying, industry-specific factors. For example, a rise in production cost volatility could push firms out of an industry while simultaneously increasing the agency theoretic benefits of revenue-based pay.

4.2 Event Study

To better attribute my finding to strategic delegation, I exploit the introduction of the CD&A, in 2006, as a plausibly exogenous shock to contract observability. While agency theoretic considerations potentially confound the relation between competition and compensation, these confounds should not vary with contract observability. Thus, an interactive effect of disclosure and competition in explaining revenue-based pay would provide further evidence that strategic delegation shapes executive pay.

Graphical analysis provides suggestive, visual evidence of such an interaction, and the role of the CD&A in facilitating strategic commitment via revenue-based executive pay. Figure 1 shows that the use of revenue-based pay stays fairly constant for firms in competitive, substitute industries. However, for firms in more concentrated, substitute industries—those with the greatest incentive to strategically commit to aggressive product market behavior—the use of revenue-based incentives
rises dramatically in 2006 through 2007, and remains relatively stable, after.

I test for the hypothesized interaction using the following regression specification:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times Post_t + \beta_2 \log(Firms_{j,t}) + \tau_t + u_j + \varepsilon_{i,j,t},
\]

where \(\tau_t\) and \(u_j\) are year and industry fixed effects.\(^{17}\) The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue.

The primary coefficient of interest is \(\beta_1\), which indicates whether the relation between competition and revenue-based pay is different under the disclosure regime. As before, the specification is presented with three different fixed effect structures: none, year, and industry and year. Within each fixed effect structure, I present results for the \(Subs\) and \(Comps\) industries, side by side. These results can be found in Table 3.

Results are aligned with Hypotheses H1 and H2. Prior to disclosure, when compensation contracts are least effective as commitment devices, the relation between competition and revenue-based pay is absent. However, in the post period, when the efficacy of executive compensation as a commitment device is likely substantially enhanced, a significant negative relation between competition and revenue-based pay emerges—but only in substitute industries.

As a falsification test, I use a few placebo specifications in which the left-hand side variable is replaced with a profit-based performance metric. In my sample, the three most common profit-based metrics are “Earnings,” “EPS” and “Operating Income.” For easy comparison, I include results for revenue-based pay, as well. All specifications are restricted to substitute industries and include year and industry fixed effects. Results can be found in Table 4.

The interaction between competition and disclosure only appears when the left-hand side variable reflects revenue-based pay. For the three profit-based metrics, there is no apparent post-disclosure change in the relation between competition and metric reliance.

4.2.1 Triple-Differences Analysis

For my main analysis, I augment the event study by using the full sample (instead of splitting it into \(Subs\) and \(Comps\)) and using complement industries as an additional level of control. The prior analyses can be thought of as a difference-in-differences design with a \(Post - Pre\) difference as well

\(^{17}\)The main effect of \(Post\) is implicitly included by way of year fixed effects.
as continuous variation in the intensity of industry competition. Thus, “treated” and “control” firms are quite different from one another with respect to the intensity of competition they face.

The augmented analysis is a triple-differences design, with a Post – Pre difference, a Subs – Comps difference, and continuous variation in industry competition. In essence, firms in concentrated, substitute industries form the “treatment group,” and their Post – Pre difference in revenue-based pay is benchmarked jointly against two different “control groups”: (1) firms in less concentrated, substitute industries, as in the prior analysis; and (2) firms in similarly concentrated, complement industries. While undoubtedly neither control group is perfect, this design provides fairly tight identification of the causal effect of disclosure on revenue-based pay.

The baseline regression specification is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 \log(Firms_{j,t}) \times Post_t \\
+ \beta_4 \log(Firms_{j,t}) \times Subs_j + \beta_5 \log(Firms_{j,t}) + \tau_t + u_j + \epsilon_{i,j,t},
\]

where \(\tau_t\) and \(u_j\) are year and product market fixed effects.\(^{18}\) The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. I present three specifications which differ only with respect to sample period. The first specification utilizes the entire period, while specifications two and three winnow the sample to symmetric 4-year and 3-year windows around the introduction of the CD&A. Across all three specifications, the results align with my theoretical predictions, as can be seen in Table 5.

In this baseline specification, the estimated coefficient on the two-way interaction (\(\beta_1\)) can be interpreted causally, with the following identifying assumption: absent the introduction of the CD&A, the relation between revenue-based pay and competition intensity would exhibit parallel trends across substitute and complement industries.

This identifying assumption is substantially more forgiving than that of a conventional difference in differences design. Notably, it allows for non-parallel trends in the relation between competition type and revenue-based pay, as well as in the relation between competition intensity and revenue-based pay. I must assume only that these non-parallel trends do not interact with one another. Any threat to the internal validity of my results must explain why within-industry variation in competition and revenue-based pay comove differentially in the pre- and post-2006 periods, and why the shift in this comovement relation is systematically different across substitute versus complement industries.

\(\text{---}^{18}\) The main effects of Post and Subs are implicitly included by way of year and industry fixed effects.
In what follows, I discuss three additional approaches I use to further mitigate the potential for correlated omitted variables or other endogeneity concerns to violate the identifying assumption and drive spurious inferences.

Agency Theoretic Considerations

As discussed previously, strategic delegation is far from the only reason to include revenue-based pay in a CEO’s compensation package. In many cases, revenue-based pay can also be used to soften agency conflicts between owners and managers. For example, in the presence of uncertain and [partially] uncontrollable production costs, revenue-based compensation can improve contracting efficiency by shielding a risk averse agent from excessive outcome risk. Alternatively, when a firm is growing its customer base, revenue-based pay can be used to mitigate the deleterious effects of managerial myopia; by compensating the manager for current revenues, even a myopic manager is prone to behave as if he wishes to maximize the long run value of the enterprise by expanding the customer base, even if such actions are profit-reducing in the near term.

In the baseline triple-differences analyses, I use industry and year fixed effects to control for such forces. This approach works well if the prevalence of these agency theoretic considerations is relatively stable over time, and fluctuations are fairly broad (i.e., not industry or firm specific). As discussed previously, even if there are industry-specific fluctuations, causal inferences from the triple-differences design remain unbiased so long as industry-specific variation in these agency theoretic considerations is not differentially associated with competition shortly before versus shortly after the introduction of the CD&A, and this change in association is not systematically different across substitute and complement industries.

However, to further rule out the possibility that agency theoretic determinants of revenue-based pay explain my results, I incorporate a number of additional proxies, designed to explicitly control this channel. I include Age to control for growth-related incentives to include revenue-based pay, and predict that it is negatively related to revenue-based pay. I also include R&D and Ads, as measures of the marginal effectiveness of managerial effort, and predict that they are positively associated with revenue-based pay. Lastly I include log(\(\frac{\sigma_\epsilon}{\sigma_R}\)) as a proxy for the uncertainty in costs, and log(Inc. Info) as a proxy for the incremental informativeness of revenues, and predict that both are positively related to revenue-based pay. I find evidence consistent with each of these predictions, but the strength of these relations attenuates dramatically with the inclusion of industry fixed effects, as shown in Table 6 Panel A. This attenuation suggests that industry fixed
effects are fairly effective at controlling for the agency theoretic determinants of revenue-based pay.

I incorporate these control variables, jointly, into the baseline specification by fully interacting each proxy with Subs, Post and a Post × Subs interaction. The estimation equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 \log(Firms_{j,t}) \times Post_t \\
+ \beta_4 \log(Firms_{j,t}) \times Subs_j + \beta_5 \log(Firms_{j,t}) + \psi X_{i,t} + \tau_i + u_j + \mu_i + \varepsilon_{i,j,t},
\]

where \(X_{i,t}\) are agency theoretic control variables, fully interacted with Post, Subs and the Post × Subs interaction. Table 6 Panel B demonstrates that the inclusion of these additional control variables does not adversely affect my results. In fact, with the inclusion of these additional control variables, my results grow stronger both economically and statistically. In Specifications (4) through (6), I further include firm fixed effects to flexibly control for any persistent firm-level endogeneities. Results attenuate modestly with the inclusion of firm fixed effects, but remain statistically and economically significant.

The control variables are, of course, imperfect. Thus, the fact that my results continue to attain despite the inclusion of these control variables does not entirely rule out the possibility that agency theory explains my results. However, if agency theory explains my results, then additional proxies designed to control this channel, however imperfect, would likely cause attenuation in the estimated treatment effect, by absorbing some of the confounding variation. I find exactly the opposite—the evidence of strategic delegation becomes even stronger, both in economic magnitude and statistical significance.

Within Industry-Year Design

To relax the required identifying assumption, I augment the triple-differences design with industry-year fixed effects, defined at a broad industry level (FIC-50), and exploit variation in competitive forces, measured at a narrower industry level (FIC-100), to explain intra industry-year variation in revenue-based pay. The industry-year fixed effects ensure parallel trends at the broad industry level, and therefore allow each broad industry to follow an arbitrary time series of competition and revenue-based pay without biasing my results. Variation in competitive forces within each broader industry determines the benefits (and therefore likelihood) of strategic revenue-based pay. Thus, this approach still relies on a parallel trends assumption, but a much more lenient one: only firms that reside within the same broad industry need to exhibit parallel trends.\(^{19}\)

\(^{19}\)To illustrate how this design works, consider the following hypothetical example. Suppose that canned beverage
While this is the tightest design I use, this tightness comes at a cost. My use of industry-year fixed effects enhances internal validity by synthetically ensuring parallel trends, but simultaneously absorbs much of the variation which, in theory, drives strategic delegation. The estimating equation is:

\[
Revenue_{Bonus_{i,t}} = \alpha + \beta_1 \log(Firms_{k,t}) \times Post_t \times Subs_j + \beta_2 \log(Firms_{k,t}) \times Post_t \\
+ \beta_3 \log(Firms_{k,t}) \times Subs_j + \beta_4 \log(Firms_{k,t}) + \theta_{j,t} + \mu_i + \varepsilon_{i,j,t},
\]  

(9)

where \(Firms_{k,t}\) is the number of competitors in FIC-100 industry \(k\) in year \(t\), \(Post_t\) is an indicator variable that takes a value of one during and after 2006, \(Subs_j\) is an indicator variable which takes a value of one if strategic actions in firm \(i\)'s FIC-50 industry, \(j\), are estimated to be substitutes, \(\theta_{j,t}\) are industry-year fixed effects\(^{20}\) and \(\mu_i\) are firm fixed effects (if included). The dependent variable, \(Revenue_{Bonus_{i,t}}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue.

Economically, my results using this approach are not dramatically different from the baseline analyses. This fact suggests that major violations of the parallel trends assumption do not induce my results. Statistically these analyses are somewhat weaker, as much of the variation is absorbed by the fixed effects, but results remain highly significant in three of the six specifications, and marginally statistically significant at conventional levels in the other three. These results can be found in Table 7.

**Two-Stage Least Squares**

In the preceding analyses, I treat competition as an exogenous regressor. In actuality, through endogenous entry and exit, the number of product market competitors reflects fixed costs of operation as well as potentially compensation-relevant characteristics of supply and demand. My triple-differences design is capable of addressing this endogeneity concern as long as the causal relation linking these compensation-relevant characteristics to product market competition does not change differentially for substitute versus complement industries, after 2006. Nevertheless, I

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\(^{20}\)The main effects of \(Post\) and \(Subs\), as well as their interaction, are implicitly included by way of industry-year fixed effects.
attempt to purge my competition measure of this endogenous variation by using a 2-stage least
squares methodology using fixed costs as an instrument for product market competition.

Fixed costs, if known *ex ante*, should not have much direct impact on the agency theoretic
determinants of pay. If the costs are fixed, they are outside of the agent’s control, so there is
no incentive-alignment rationale for changing the contract. If the costs are known *ex ante*, they
do not contribute to outcome risk, so there is no risk-sharing rationale for changing the contract.
Thus, fixed costs should impact the contract only indirectly, through their affect on product market
competition.

Fixed costs are not directly observable, and thus I must find suitable proxies. I choose Sales,
General and Administrative expenses (SG&A) as these tend not to scale much with produc-
tion, and depreciation expense as it captures the capital intensiveness of production. I construct
*AvgFixedCosts* instruments by taking the industry-year average of both SG&A and depreciation
expense. This approach is quite similar to Karuna’s (2007), who uses “entry costs,” proxied for
by the industry-average of property plant and equipment, to study the impact of competition on
pay-for-performance sensitivity.

The first stage regression is:

$$\log(Firms)_{i,j,t} = \delta + \gamma \log(AvgFixedCosts_{j,t}) + u_j + \tau_t + \eta_{j,t}, \quad (10)$$

where $\log(Firms)_{j,t}$ is the natural logarithm of the number of firms in industry, $j$, in year $t$ and
$AvgFixedCosts_{j,t}$ is the equal-weighted average of the fixed cost proxy (either SG&A or depre-
ciation expense) in industry, $j$, in year $t$. Lastly, $u_j$ and $\tau_t$ represent industry and year fixed
effects.

Even after the inclusion of industry and year fixed effects, which jointly explain approximately
96% of the variation in competition, I find that both instruments are sufficiently strong. Average
SG&A and depreciation expense yield F-statistics of 60.1 and 12.3, respectively. Results for the
first stage can be found in Table 8 Panel A.

The second stage estimating equation is:

$$RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms)_{j,t} \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 \log(Firms)_{j,t} \times Post_t$$
$$+ \beta_4 \log(Firms)_{j,t} \times Subs_j + \beta_5 \log(Firms)_{j,t} + \tau_t + u_j + \varepsilon_{i,j,t}, \quad (11)$$

where *Post* is an indicator variable that takes a value of one during and after 2006, *Subs* is
an indicator variable which takes a value of one if strategic actions in firm $i$’s industry, $j$, are estimated to be substitutes, $\tau_t$ and $u_j$ are year and industry fixed effects. The dependent variable $RevenueBonus_{i,t}$, is an indicator variable equal to one if the CEO of firm $i$ in year $t$ is given absolute performance incentives tied to revenue. Finally, $log(Firms)_{j,t}$ is the fitted value for industry $j$ in year $t$ from the first stage regression, described by equation (10).

Second stage results, reported in Table 8 Panel B, are slightly stronger than the baseline results reported in Table 5. This finding helps to mitigate concerns that the endogenous nature of industry concentration explains my results.

### 4.2.2 Effect on Product Market Outcomes

The preceding analyses shed light on the role of strategic delegation in shaping CEO compensation contracts, but do managers’ incentives manifest, ultimately, in realized product market outcomes?

In substitute industries, theory suggests that the disclosure of contracts results in greater revenue-based pay, which commits firms to more aggressive product market behavior. This more aggressive product market behavior is predicted to manifest in greater revenues and expenses, but lower profit margins and total profits. The predicted magnitude of these effects attenuates with the competitiveness of the industry.\(^{21}\)

Accordingly, I replicate the triple differences analysis using product market outcomes, rather than CEO incentives, as the lefthand side variable. The specification is:

$$<Outcome>_{i,t} = \alpha + \beta_1 log(Firms)_{j,t} \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 log(Firms)_{j,t} \times Post_t$$

$$+ \beta_4 log(Firms)_{j,t} \times Subs_j + \beta_5 log(Firms)_{j,t} + \tau_t + u_j + \epsilon_{i,j,t}. \tag{12}$$

where $\tau_t$ and $u_j$ are year and industry fixed effects.\(^{22}\) I use multiple dependent variables. The first four specifications use financial outcomes: (1) the natural logarithm of revenues, scaled by average total assets, $log(Revenues)$; (2) the natural logarithm of costs of goods sold, scaled by average total assets $log(Costs)$; (3) the natural logarithm of revenues net of costs of goods sold, scaled by revenues, $log(Margins)$; and (4) income before extraordinary items, scaled by average total assets, Winsorized at 1% and 99%, $Profitability$. In specification (5) I use the natural logarithm of the text-based competition measure developed by Li et al. (2013), $log(PCTCOMP)$. Results can be found in Table 9.

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\(^{21}\)See Table A1 in the Appendix for a summary of these objects with and without disclosure.

\(^{22}\)The main effects of $Post$ and $Subs$ are implicitly included by way of year and industry fixed effects.
I find that, consistent with theory, revenues and costs rise post-disclosure, in industries where the benefits of aggressive commitment are greatest. The estimated economic magnitude of these consequences is fairly substantial. Relative to other industries, substitute industries of above-median concentration experience increases in per-firm revenues and expenses of approximately 5% and 7% around the introduction of the CD&A. Accordingly, in these same industries, profit margins plummet by approximately 3.5% while profits drop by almost 1% of average total assets. These outcomes suggest that equilibrium behavior became more aggressive in these industries, around the introduction of the CD&A.

Lastly, I also find marginal evidence that, relative to other industries, firms in highly concentrated, substitute industries begin to mention competition more heavily in their public disclosure, post-CD&A. While this does not follow directly from the theory of strategic delegation, it is natural to expect that firms would mention “competition” more when they suddenly find themselves in a more aggressive equilibrium.

4.3 Supplemental Analyses

4.3.1 Asymmetric Product Markets

In real-world product markets, competitors can differ substantially with respect to their price-setting power. Relaxing Fershtman and Judd’s (1987) model to allow for asymmetric price-setting power, while holding the number of firms fixed, yields an intuitive result: the incentive to deviate towards revenue maximization increases with a firm’s price-setting power.\(^\text{23}\)

Measuring price-setting power is notoriously difficult, so I use two rough proxies: size (measured by average total assets) and market power (measured by profit margin). Because there is substantial variation in size and profit margins within each industry-year, this analysis can be done with interacted industry-year fixed effects. As discussed earlier, this fixed effect structure allows each industry to have an arbitrary time series of concentration and average revenue-based pay without biasing the estimated coefficients, thereby alleviating concerns that concentrated versus competitive industries, or substitute versus Bertrand industries exhibit non-parallel trends. This fixed effect structure imposes perfectly parallel trends. Unfortunately, this approach also relies on rough proxies (size and profit margin) which are likely correlated with other omitted factors, so results must be

\(^{23}\)Intuitively, If a firm has very little power to influence market prices, commitment to aggressive behavior is not an effective means of curtailing rivals’ competitive actions. Thus, greater revenue-based compensation carries all of the deleterious incentive effects, \textit{ex post}, without conferring any of the strategic benefits, \textit{ex ante}.\)
interpreted cautiously. The estimating equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Power_{i,t}) \times \log(Firms_{j,t}) \times Post_t \times Subs_j + \beta_2 \log(Power_{i,t}) \times Post_t \times Subs_j \\
+ \beta_3 \log(Power_{i,t}) \times \log(Firms_{j,t}) \times Post_t + \beta_4 \log(Power_{i,t}) \times \log(Firms_{j,t}) \times Subs_j \\
+ \beta_5 \log(Power_{i,t}) \times \log(Firms_{j,t}) + \beta_6 \log(Power_{i,t}) \times Subs_j + \beta_7 \log(Power_{i,t}) \times Post_t \\
+ \beta_8 \log(Power_{i,t}) + \theta_{j,t} + \varepsilon_{i,j,t},
\]

where \(Power_{i,t}\) is a proxy for firm \(i\)'s price-setting power in year \(t\) (average total assets, or profit margin), and \(\theta_{j,t}\) are industry-year fixed effects.\(^{24}\) The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue.

Results, presented in Table 10, are consistent with theoretical predictions. Disclosure is associated with a stronger deviation towards revenue-based pay for firms with greater price-setting power—but only within highly concentrated, substitute industries.

\subsection*{4.3.2 Intensive Margin of Revenue-Based Pay}

The preceding analyses studied compensation as a binary choice—whether or not to include revenue-based pay. This method of study is powerful because it is easy to compute for a large number of firms, and thus maximizes the sample size, and minimizes concerns about the selected nature of the sample. However, this approach also discards potentially valuable information about the degree to which revenue-based pay is relied upon. In the next two analyses, I examine the intensive margin of revenue-based pay, and explore its relation to product market competition.

The first analysis is based on the following regression specification:

\[
\lambda_{i,t} = \alpha + \beta \log(Firms_{j,t}) + u_j + \varepsilon_{i,j,t},
\]

where \(u_j\) are product market fixed effects. The dependent variable, \(\lambda_{i,t}\), is a continuous variable, ranging between 0 and 1, which represents the relative weight on profit versus revenue for the CEO of firm \(i\) in year \(t\). Results can be found in Table 11.

Despite the substantially more selective sample, results are closely aligned with theory. In substitute industries, a greater number of firms is associated with a greater weight on profit, relative

\(^{24}\)The main effects of \(Post, Subs, \log(Firms)\), as well as all of their interactions, are implicitly included by way of industry-year fixed effects.
to revenue. On average, doubling the number rivals is associated with about a 7.65% increase in the relative weight on profit. In contrast, for complement industries, there is no apparent association between competition and compensation at all.

My next tests address the theoretical non-monotonicity of the relation between competition and revenue-based compensation. Fershtman and Judd (1987) show that the use of revenue-based pay increases as the number of competitors drops, except for the extreme case of a monopolist.\(^{25}\)

Intuitively, this non-monotonic relation arises due to the non-monotonic prevalence of strategic interactions among product market rivals. When the number of product market rivals grows large, each one loses market power, ultimately becoming atomistic, at which point the industry is perfectly competitive and there are no strategic interactions. At the opposite extreme, a monopolist has no product market rivals, and thus there cannot possibly be strategic interactions with rival firms. In either case, there is no strategic incentive to try to manipulate a product market rival’s actions, and thus no reason to increase the weight on revenue as a commitment device.

I examine this non-monotonicity using two regression specifications:

\[
\lambda_{i,t} = \alpha + \beta_1 \text{Monopoly}_{j,t} + u_j + \tau_t + \epsilon_{i,j,t}, \tag{15}
\]

and

\[
\lambda_{i,t} = \alpha + \beta_1 \text{Monopoly}_{j,t} + \beta_2 \log(Firms_{j,t}) + u_j + \tau_t + \epsilon_{i,j,t}, \tag{16}
\]

where \text{Monopoly}_{j,t} is a dummy variable indicating if there is only one firm in industry \(j\) in year \(t\), and \(u_j\) and \(\tau_t\) represent industry and year fixed effects. The dependent variable, \(\lambda_{i,t}\), is a continuous variable, ranging between 0 and 1, which represents the relative weight on profit versus revenue for the CEO of firm \(i\) in year \(t\).

In order to identify a coefficient on \text{Monopoly}_{j,t}, there must be industries which contain only one firm in some years, and multiple firms in other years. For this condition to hold, I require a narrower product market definition. The FIC-200 is the broadest definition that allows for such identification and is thus the most natural definition to use. I also include specifications using the FIC-500 classification, the narrowest that the Hoberg and Phillips Data Library provides. Results are similar across both classifications, and can be found in Table 12.

As predicted, both \(\beta_1\) and \(\beta_2\) are positive and significant. That is, being a monopolist is associated with a relatively lower reliance on revenue-based pay, but so is being in a more competitive market.

\(^{25}\)For a graphical depiction of this non-monotonicity, see Figure A1 in the Appendix.
industry. This finding reinforces the earlier evidence of strategic delegation. In particular, the non-monotonic nature of this theoretical prediction means that any alternative explanation for my results must be similarly non-monotonic.

### 4.3.3 Importance of Performance Metrics

The theoretical foundations of this study require that executives’ incentives can be materially affected by changing the mix of metrics used in performance evaluation. If equity incentives are so strong that they swamp any other incentives, then this assumption is violated. Several institutional features help to quell this concern: (1) performance goals are not used only to determine cash bonuses, but also a substantial amount of the equity grants CEOs receive; and (2) cash bonuses, while typically smaller than equity incentives, are not nearly as small as once thought (Guay, Kepler and Tsui, 2016). Both of these features suggest that the mix of performance metrics used to evaluate executive performance can plausibly affect managerial incentives.

To further shed light on the importance of the performance metrics used in executive compensation, I examine the direct monetary value associated with achieving a performance objective. While these incentives are small relative to equity incentives, they are fairly large in magnitude. For a typical CEO in my sample, hitting a performance target generates an extra $610,000 ($270,000) of short-term cash compensation and 38,000 (6,500) RSU or option grants on average (at the median). Moreover, I find that CEOs routinely just achieve their sales goals, suggesting that hitting these performance objectives is important to decision makers within the firm. The distribution of the scaled difference between firm-year revenues and the CEO’s revenue threshold (target) can be seen in Figure 2A (Figure 2B).

For both the threshold and target, there is a significant discontinuity at zero ($p < 0.01$), but the discontinuity is larger for the threshold than for the target. This finding is unsurprising, as executive pay typically jumps discretely at the threshold, creating a large incentive to “meet or beat”, while it often interpolates across the target, muting the incentive to “meet or beat” (Murphy, 1999).

### 4.3.4 Mechanism

In large firms, such as those in my sample, it is unlikely that CEOs play a direct role in their firms’ product market actions. Thus, at first blush, it may seem improbable that changing a

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26I caveat that the performance goals reported in Incentive Labs do not always map perfectly into the GAAP measures found in Compustat. Thus, these histograms includes measurement error attributable the use of non-GAAP revenue metrics in performance evaluation. This measurement error biases away from finding a sharp discontinuity.
CEO’s incentives would be a viable way to affect a firm’s product market behavior. One possible mechanism is that CEOs pass their incentives down to lower-level decision makers (e.g., lower level executives, divisional managers, sales forces, etc...) who play a more direct role in shaping a firm’s product market behavior. In untabulated analyses, I find evidence consistent with this explanation. Revenue-based pay in the CEO’s contract explains almost 83% of the variation revenue-based pay usage for lower level employees.\(^{27}\) Even after including year and firm (or individual) fixed effects, revenue-based pay in the CEO’s contract is a highly significant predictor of revenue-based pay for lower level employees.

This finding is consistent with complementary work by Guay et al. (2016) who document that for the vast majority of firms, CEOs and the lowest paid executive have perfectly ‘congruent’ pay packages in the sense that the performance metrics and associated targets are identical (although the payouts may differ substantially across executives).

\subsection*{4.4 Sensitivity Analyses}

In this subsection, I assess the robustness of the triple-differences analysis results to various research design choices. Tabulated results can be found in the Internet Appendix.

\subsubsection*{Logit Specification}

Despite a binary left-hand side variable, I use a linear probability model as my main specification. This approach confers advantages in the form of easier interpretability and greater stability with dense fixed effect structures and lots of interactions (Neyman and Scott, 1948; Lancaster, 2000; Ai and Norton, 2003). However, there are well-documented issues associated with linear probability models (e.g., Maddala, 1986; Horrace and Oaxaca, 2006), and accordingly I employ a logit analysis to verify that my results are not sensitive to my econometric specification. I find that my inferences are unaffected by this alteration, as shown in Table 1 of the Internet Appendix.

\subsubsection*{Standard Errors}

In the preceding analyses, I cluster standard errors by industry-year. This is a natural choice given that the primary measure of competition is industry-year. However, if errors are strongly correlated across industries within a year, or over time within an industry or firm, this approach can

\footnote{\(^{27}\)In addition to C-Suite executive pay packages, Incentive Labs provides data on performance goals for lower level executives, directors, general partners, general managers, presidents, vice presidents and many other roles.}
yield spurious inferences. To verify that my inferences are not sensitive to my choice of standard error calculation, I replicate the main analysis using several alternative approaches: clustering by firm, clustering by industry, clustering by fiscal year, and bootstrapping.

The bootstrap procedure is as follows: (1) randomly code each FIC-50 industry as a substitute or complement industry, based on the empirical frequency of each; (2) use the triple-differences design to estimate a placebo treatment effect based on this random coding; and (3) repeat 999 more times to obtain the distribution of treatment effects that attain using this random coding. I then compare the true estimated treatment effect against this distribution to determine the likelihood such a result would occur due to random chance.

Across all specifications, results remain significant at the 5%-level, and in the majority of cases the 1%-level. Thus, it seems unlikely that unaddressed error correlations drive my inferences. These results are shown in Table 2 of the Internet Appendix.

**Propensity Score Matched Sample**

The theoretical relation between competition intensity and revenue based pay depends on whether strategic actions are substitutes or complements—an endogenous industry characteristic. This endogeneity does not pose a concern for my results as long as it does not lead to a violation of my identifying assumption. However, to assess the possibility that substantive, agency-theoretic differences across substitute and complement industries drive my results, I replicate my main analysis on a propensity score matched sample.

I perform a 1-to-1 match of firms in substitute industries to firms in complement industries, with a 0.0001 caliper. The match variables are \( \log(Firms) \) and all of the agency theoretic control variables \((Age, Ads, R&D, \log(\frac{R}{\sigma_R}) \) and \( \log(Inc.Info.) \)). This procedure reduces the sample size substantially, but the results remain statistically significant and increase in magnitude, as shown in Table 3 of the Internet Appendix.

**Alternative Industry Sizes**

I use Hoberg and Phillips’ FIC-50 to define industries, in my main analyses. I chose this definition because it is sufficiently broad to avoid the theoretical non-monotonicities associated with monopolists (as seen in Figure A1), and because it is comparable in breadth to the oft-used Fama and French 48 industry classification. To ensure that my findings are not specific to the FIC-50 industry definition, I replicate the triple differences analysis using multiple different FIC-levels
to define industries: FIC-25, FIC-100 and FIC-200. I find that my inferences are stable across the various definitions, as shown in the Table 4 of the Internet Appendix.

**Fama-French Industry Classification**

The previous tests show that my inferences are robust to various industry breadths, *within the Hoberg and Phillips fixed industry classification*. To verify that my inferences also hold with more conventional industry definitions, I replicate my triple differences analysis using the Fama and French 48 industry classification to define each industry, and find similar results. These results are presented in Table 5 of the Internet Appendix.

**Herfindahl-Hirschman Index**

I use the number of competitors as my primary measure of product market competition. I choose this measure as it ties most closely to my motivating theory, which used the number of competitors, $N$, as the driver of equilibrium incentives. However, to ensure that my results are not overly sensitive to my choice of competition metric, I use the Herfindahl-Hirschman Index as an alternative measure of industry competition and find that my results are robust to the use of this alternative competition measure. These results are shown in Table 6 of the Internet Appendix.

**Competition From Private Firms**

In my main analyses, I use Compustat-based measures to quantify the competition each firm faces in the market place. One shortcoming of this approach is that it ignores the effects of private firms on product market competition. Following Ali et al. (2009) I use industry concentration ratios provided by the Census Bureau to get a more holistic measure of product market competition. Specifically, I proxy for competition intensity using the natural logarithm of the proportion sales attributable to the 50 largest firms with a 3-digit NAICS industry, as measured in the 2007 Census. I replicate my triple-differences analysis using this alternative measure and find that results are consistent, as shown in Table 7 of the Internet Appendix. For this sensitivity analysis, I do not include the interacted agency theoretic controls; without time series variation in industry competition, there is insufficient variation to include them.

**Single Segment Firms**

My triple-differences analyses depend on the ability of my competition proxies to successfully
capture product market competition. For many firms, these measures will naturally convey a lot of information about the product market competition a firm faces. However, for more complex firms with many segments spanning multiple industries, these measures can fail. To mitigate this concern, I replicate the triple differences analysis on the subset of single-segment firm-years. The documented effect is much larger for this subsample, as shown in Table 8 of the Internet Appendix. This finding is consistent with the notion that competition proxies provide a much cleaner measure of true competition intensity for firms which operate in only one industry.

5 Conclusion

This study provides evidence that firms use strategic delegation to improve their competitive positions. Specifically, I find that CEOs are more likely to have revenue-based pay when the benefits of aggressive commitment are greater. Consistent with theory, this relation only attains when compensation details are disclosed, suggesting that detailed pay package disclosures (i.e., a firm’s CD&A) facilitate the use of compensation contracts as strategic commitment devices.

Moreover, I find that these strategic deviations from agency cost minimizing compensation policies manifest in economically significant product market outcomes. In particular, I document that in substitute industries with fewer product market rivals, the introduction of the CD&A is associated with increases in revenues and costs, and decreases in profit margins and total profits. This evidence is consistent with revenue-based incentive pay being used a commitment device, ultimately leading to more aggressive product market equilibria.

More broadly, my results show that firms make accounting decisions strategically to confer competitive advantages to themselves in their product markets. While this study focuses on performance evaluation, there are many other [as yet untested] channels through which firms can make strategic accounting choices to gain product market advantages. In particular, my study opens up a number of possibilities for future research to explore the role of accounting decisions in facilitating strategic commitment.

One important caveat that bears mentioning regards the separation of ownership and control. Throughout my study, I treat this separation as both exogenous and total. In fact, neither is the case, in practice—executives typically retain a large ownership stake, and moreover, the extent of their ownership is determined endogenously. While ignoring the extent of separation does not confound inferences in my main analyses, it does preclude an investigation into related, potentially
interesting areas. For example, is the extent of executive ownership determined, in part, by the prevalence and nature of oligopolistic interdependencies? Based on my findings, it seems likely that firms would create a larger degree of ownership-control separation when the benefits of strategic commitment are larger. Further research is required to assess this possibility.

Appendix: Analytical Framework of Strategic Delegation

Here, I present the analytical framework from which I derive my hypotheses. In Section A1, I present a stylized model of the Cournot oligopoly to demonstrate the entangled roles of disclosure and product market competition in determining the optimal executive compensation contract. In Section A1.1, I solve the model exactly as originally formulated by Fershtman and Judd (1987), with all contracts being common knowledge. I then alter the model, in Section A1.2, by assuming that contracts are private information but that principals agents form rational conjectures regarding their rivals contracts. Lastly, in Section A2, I generalize the model presented in A1 and discuss when the main predictions would and would not be expected to hold, in real world settings.

A1: Stylized Nash Game: The Cournot Oligopoly

Consider a Cournot oligopoly, comprised of $N$ principal-agent pairs. Each principal owns one firm, but delegates to a risk-neutral and effort-neutral agent the responsibility of running the firm. The game has two periods; in the first period, principals simultaneously choose their contracts, and in the second period, agents make simultaneous quantity decisions.28

Each agent’s task is to choose a production quantity, $q_i$ at a constant marginal cost, $c$. The per-unit price at which any firm, $i$, can sell its goods is given by:

$$p_i = a - b(q_i + \sigma \sum_{j \neq i} q_j), \quad (17)$$

where $q_i$ is agent $i$’s quantity decision, $\sum_{j \neq i} q_j$, hereafter denoted as $Q_i$, is the collective quantity decision of all product market rivals, and $\sigma$ is the parameter of substitutability in the product market. When $\sigma = 1$, the goods are perfect substitutes, and when $\sigma = 0$, each firm is effectively a monopolist. For ease of analysis, I will assume $\sigma = 1$, however the model is equally tractable for any $\sigma \in [0, 1]$.29

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28For ease of discussion, I refer to principals as “she”/“her.”, and agents as “he”/“his.”
29Equilibrium results are qualitatively similar for any $0 < \sigma \leq 1$. 
Each principal’s problem is to maximize her firm’s value by providing the optimal incentives to her agent, in the form of a linear contract:

\[ w_i = \lambda_i \pi_i + (1 - \lambda_i)R_i, \]  

(18)

where \( \pi_i \) and \( R_i \) represent firm \( i \)'s profits and revenues, and the principal’s choice variable, \( \lambda_i \), parameterizes agent \( i \)'s incentive to maximize profit versus revenue. Equations (17) and (18) combine to define each agent’s objective function:

\[
\begin{align*}
& \lambda_i q_i(p - c) + (1 - \lambda_i)(q_i)p \\
& = \lambda_i q_i(a - b(q_i + Q_i) - c) + (1 - \lambda_i)q_i(a - b(q_i + Q_i) - c) \\
& = q_i(a - b(q_i + Q_i) - \lambda_i c).
\end{align*}
\]

(19)

In what follows, I characterize the entangled roles of product market competition and disclosure in shaping the incentive equilibrium of a Cournot oligopoly.

A1.1: Disclosed Contracts

In this subsection, I present the model, as originally formulated by Fershtman and Judd (1987). Contracts are disclosed, and therefore common knowledge to all agents.

Begin by differentiating each agent’s objective function with respect to his own quantity decision to define the system of best response functions:30

\[
q_i^*(Q_i) = \frac{a - bQ_i - \lambda_i c}{2b}.
\]

(20)

In order to determine the equilibrium quantity decisions, aggregate over all best response functions by summing them up:

\[
\sum_i q_i^*(Q_i) \equiv Q = \sum_i \frac{a - bQ_i - \lambda_i c}{2b} \\
= \frac{aN - b(NQ - \sum_i q_i^*) - \sum \lambda_i c}{2b} \\
= \frac{aN - b(N - 1)Q - \Lambda c}{2b},
\]

(21)

30An agent’s “best response function” describes the agent’s optimal action as a function of the actions taken by all other agents—or in this case, a representative rival agent.
where $N$ is the number of product market competitors, $Q$ is the total quantity produced, and $\Lambda$ is the sum over all $\lambda_i$.

Solving for $Q$ yields the unique equilibrium solution:

$$Q = \frac{aN - \Lambda c}{b(N + 1)}.$$  \hfill (22)

Further defining $\Lambda_i \equiv \Lambda - \lambda_i$, note that:

$$Q_i = Q - q_i = \frac{aN - \Lambda c}{b(N + 1)} - q_i = \frac{aN - (\Lambda_i + \lambda_i)c}{b(N + 1)} - q_i,$$  \hfill (23)

which can be substituted into the original first order condition, eq. (20), to produce an expression for agent $i$’s optimal quantity decision, purely as function of $\lambda_i$ and $\Lambda_i$:

$$q_i^{**} = \frac{a - bQ_i - \lambda_i c}{2b} = \frac{a - b\left(\frac{aN - (\Lambda_i + \lambda_i)c}{b(N + 1)} - q_i^{**}\right) - \lambda_i c}{2b} \quad \Rightarrow \quad q^{**} = \frac{a - c(N\lambda_i - \Lambda_i)}{b(N + 1)}.$$  \hfill (24)

(25)

Each principals’ problem is to maximize profit by choosing $\lambda_i$. That is, the each principal has an objective function:

$$\pi_i = q_i^{**} \times (p_i - c) = \frac{(a + c(\lambda_i + \Lambda_i - N - 1))(a + c(\Lambda_i - N\lambda_i))}{b(N + 1)^2}.$$  \hfill (26)

The first order condition with respect to $\lambda_i$ yields the system of best response functions:

$$\lambda_i^*(\Lambda_i) = \frac{a - aN + c(\Lambda_i + N(1 - \Lambda_i + N))}{2Nc}.$$  \hfill (27)

Finally, by leveraging the symmetric nature of the product market, we can assume that $\lambda_i^{**} = \lambda^{**}$, for all firms, which would imply that $\Lambda_i = (N - 1)\lambda^{**}$. Using this fact, we can characterize the
incentive equilibrium:

\[
\lambda^{**} = \frac{a - aN + c((N - 1)\lambda^{**} + N(1 - (N - 1)\lambda^{**} + N))}{2Nc}
\]

\[
\Rightarrow \lambda^{**} = \frac{a - aN + cN + cN^2}{c(1 + N^2)}.
\]

This expression, illustrated graphically in Figure A1, has a number of useful properties:

1. \(\lambda^{**}(1) = 1\)

2. \(\lim_{N \to \infty} \lambda^{**}(N) = 1\)

3. \(\lambda^{**}\) is strictly increasing in \(N\), for \(N > 1\).

This result demonstrates how oligopolistic interdependencies, coupled with public disclosure, can drive a wedge between the agency cost minimizing contract and the profit maximizing contract. In this setting, the agency cost minimizing contract is \(\lambda = 1\); agents are neither risk averse nor effort averse, so there is no friction preventing costless incentive alignment. But providing such a contract would be suboptimal, because it would fail to leverage one key element of a disclosed compensation contract: the effect of the contract on rivals’ actions. Shifting weight towards revenue (i.e., lowering \(\lambda\) below 1) commits the agent to over-production, relative to profit maximization. This commitment, in turn, forces product market rivals to curtail production, which keeps market prices higher, ultimately elevating the firm’s profits.

In essence, a firm can gain a quasi “first mover advantage” (à la Stackelberg, 1934) by committing, in an observable way, to a more aggressive response function. Of course, in equilibrium, all firms attempt to get this first mover advantage and no firm manages to gain a strategic edge. Rivals instead engage in an even more aggressive Nash game—a social dilemma.

**A1.2: Private Contracts**

In this subsection, I alter the preceding analysis with one crucial distinction: contracts are no longer disclosed publicly. Instead, choices of \(\lambda\) are private information, observed only within a principal-agent pair.

As before, each agent’s optimal quantity decision is a function of the quantity decisions made, simultaneously, by all other agents. However, in contrast to the case of disclosed contracts, agents cannot rely on observing their rivals’ contracts to ascertain their rivals’ actions. Instead, agents must form conjectures of their rivals’ contracts and corresponding quantity decisions.
Taking these conjectures as given, the first order condition describing agent \(i\)'s optimal quantity choice can be represented as:

\[
q_i^*(\hat{Q}_i) = \frac{a - b\hat{Q}_i - \lambda_i c}{2b},
\]

where ‘hats’ denote conjectures.

Due to the private nature of rivals’ contracts, determining the correct quantity conjectures requires solving a complicated higher order beliefs problem—an agent’s quantity choice is not only a function of his own contract, \(\lambda\), but also of his conjecture regarding all rivals’ contracts, \(\hat{\lambda}\), as well as his conjecture about his rivals’ conjectures, \(\hat{\hat{\lambda}}\), and so on ad infinitum. In order to make this higher order beliefs problem analytically tractable, I impose that all conjectures are “rational” in the sense that they will be sustained in equilibrium.

The assumption of rational conjectures does a great deal to collapse the parameter space and simplify the problem. First, it guarantees that, for any firm \(i\), all rivals share a common “first order conjecture,” \(\hat{\lambda}_i\), of firm \(i\)’s contract and \(\hat{q}_i\) of firm \(i\)’s quantity decision—if rivals had divergent conjectures, at least one conjecture would not be sustained in equilibrium. Moreover, it assures that every conjecture about a conjecture, or “higher order conjecture,” will be equivalent to the corresponding first order conjecture. That is,

\[
\hat{\lambda}_i = \hat{\hat{\lambda}}_i = \ldots = \hat{\lambda}_i = \ldots, \forall i,
\]

and similarly,

\[
\hat{q}_i = \hat{\hat{q}}_i = \ldots = \hat{q}_i = \ldots, \forall i.
\]

These facts simplify the analysis (and notation) immensely. The only distinctions which must be retained are those between choice variables, \(q\)’s and \(\lambda\)’s, and the corresponding first order conjectures which relate to these choice variables, \(\hat{q}\)’s and \(\hat{\lambda}\)’s.

Lastly, I leverage symmetry to further simplify the parameter space. The symmetry of the product market implies that all rivals’ decisions will be identical, in equilibrium. Thus, any agent \(i \neq j\) will form equivalent conjectures \(\hat{q}_j\) and \(\hat{\lambda}_j\) for all product market rivals.

Jointly, the first order conditions on \(q_i\), the rationality conditions on conjectures, and the symmetry of the product market imply that all agent’s quantity choices can be fully described by
the following system of simultaneous equations:

\[ q^*_i = \frac{a - b(N - 1)q_j - c\lambda_i}{2b}, \quad (33) \]
\[ \hat{q}_i = \frac{a - b(N - 1)\hat{q}_j - c\hat{\lambda}_i}{2b}, \quad (34) \]
\[ \hat{q}_j = \frac{a - b((N - 2)\hat{q}_j + \hat{q}_i) - c\hat{\lambda}_j}{2b}. \quad (35) \]

Solving this system of simultaneous equations yields:

\[ q^*_i = \frac{2a - c(\lambda_i(N + 1) + (N - 1)(\hat{\lambda}_i - 2\hat{\lambda}_j))}{2b(N + 1)}, \quad (36) \]
\[ \hat{q}_j = \frac{a + c(\hat{\lambda}_i - 2\hat{\lambda}_j)}{b(N + 1)}, \quad (37) \]
\[ \hat{q}_i = \frac{a - c(\hat{\lambda}_i N - \hat{\lambda}_j N + \hat{\lambda}_j)}{b(N + 1)}. \quad (38) \]

Using the expressions for \( q^*_i \) and \( \hat{q}_j \), we can calculate firm \( i \)'s profit, as a function of \( \lambda_i \):

\[ \pi_i = q_i \times (p_i - c) \]
\[ = \frac{2a - c(\lambda_i(N + 1) + (N - 1)(\hat{\lambda}_i - 2\hat{\lambda}_j))}{2b(N + 1)} \times (a - b(\frac{2a - c(\lambda_i(N + 1) + (N - 1)(\hat{\lambda}_i - 2\hat{\lambda}_j))}{2b(N + 1)}) + (N - 1)\frac{a + c(\hat{\lambda}_i - 2\hat{\lambda}_j)}{b(N + 1)} - c). \quad (39) \]

Differentiating the profit function with respect to \( \lambda_i \) yields:

\[ \frac{\partial \pi_i}{\partial \lambda_i} = -\frac{c^2(\lambda_i - 1)}{2b}, \quad (40) \]

indicating that profit is maximized by choosing \( \lambda_i = 1 \), the agency cost minimizing contract.

In this setting, the principal \( i \)'s choice variable, \( \lambda_i \), only affects profit through its affect on \( q_i \). In order to manipulate rivals' behavior, the principal would need to change \( \hat{\lambda}_i \), which is not a parameter the principal has power to influence, sans disclosure. Without the ability to use contracts strategically, there is no reason to deviate from the agency cost minimizing contract—in this case, pure profit maximization. A summary of the equilibrium outcomes, with and without disclosure can be found in Table A1.
A2: Generalizability/Discussion

The preceding analysis leveraged a highly stylized model of product market competition to provide tight predictions regarding the relations among product market competition, disclosure and revenue-based compensation. In order to gauge the plausibility of such relations manifesting in real-world data, it is critical to assess the generalizability of the underlying intuition.

While the exact nature of the incentive equilibrium is sensitive to the specifics of the model, the core intuition—that contract disclosure pushes Nash competitors to overweight revenue—holds fairly broadly. Formally, in a Nash oligopoly with linear incentives based on profit and revenue, the following three assumptions are sufficient to demonstrate that disclosure leads to a greater weight on revenue:

A1. $\frac{\partial \pi^i(x_i,x_j)}{\partial x_i} < \frac{\partial R^i(x_i,x_j)}{\partial x_i}$

A2. $\frac{\partial \pi^i(x_i,x_j)}{\partial x_j} < 0$

A3. $\frac{\partial^2 \pi^i(x_i,x_j)}{\partial x_i \partial x_j} < 0$

where $\pi^i$ and $R^i$ are firm $i$’s [convex] profit and revenue functions, with respect to its own product market aggressiveness, $x_i$, and a representative rival’s product market aggressiveness, $x_j$.

Proof. Let $w_i = \lambda_i \pi^i + (1 - \lambda_i)R^i$ be agent $i$’s objective function. Taking the total derivative of firm profits, $\pi^i$, with respect to the contract, $\lambda_i$, yields:

$$\frac{d\pi^i(x_i,x_j)}{d\lambda_i} = \frac{\partial \pi^i}{\partial x_i} \cdot \frac{\partial x_i}{\partial \lambda_i} + \frac{\partial \pi^i}{\partial x_j} \cdot \frac{\partial x_j}{\partial \lambda_i},$$

(41)

when contracts are disclosed. And,

$$\frac{d\pi^i(x_i,x_j)}{d\lambda_i} = \frac{\partial \pi^i}{\partial x_i} \cdot \frac{\partial x_i}{\partial \lambda_i},$$

(42)

when contracts are private information. The optimal contract, $\lambda_i^*$, is defined as the one satisfies:

$$\frac{d\pi^i(x_i,x_j)}{d\lambda_i} = 0.$$

(43)

By the convexity of the profit function, strictly increasing (decreasing) $\frac{d\pi^i(x_i,x_j)}{d\lambda_i}$ reduces (increases) the optimal weight on revenue. Thus, whether disclosure increases or decreases the weight on
revenue depends only on the sign of:
\[
\left( \frac{\partial \pi^i}{\partial x_j} \cdot \frac{\partial x_j}{\partial x_i} \cdot \frac{\partial x_i}{\partial \lambda_i} \right).
\] (44)

This expression can be easily signed. The terms \( \frac{\partial \pi^i}{\partial x_j} \), \( \frac{\partial x_j}{\partial x_i} \) and \( \frac{\partial x_i}{\partial \lambda_i} \) are each negative by A2, A3 and A1, respectively. Thus, when contracts are disclosed, there is a gain to be made by decreasing \( \lambda_i \) by a strictly positive amount (i.e., shifting weight towards revenue-based pay).

With an additional assumption that the magnitude of the strategic interaction, \( \text{abs}\left( \frac{\partial^2 \pi^i(x_i, x_j)}{\partial x_i \partial x_j} \right) \), grows with market concentration, the model further demonstrates the attenuating effects of competition.

Assumptions A1 and A2 are mild and will hold broadly. In plain English, A1 simply states that, holding rivals’ behavior fixed, a more aggressive action increases a firm’s expenses (e.g., selling more and/or higher quality goods results in a higher cost of goods sold). A2 states that, holding rivals’ behavior fixed, a more aggressive action decreases rivals’ profits (e.g., selling equivalent goods at a lower price will draw consumers—and therefore profits—away from rivals).

Less innocuous is assumption A3—that rivalrous firms’ strategic actions are substitutes. That is, as one firm engages in more aggressive product market behavior, rivals optimally respond by curtailing their own competitive actions. A game in which rivalrous agents make simultaneous quantity decisions, as in Fershtman and Judd (1987), is the canonical way to satisfy this condition. However, many other strategic environments admit similar properties, such as strategic horizontal positioning in a spatial competition game, or rivalrous quality choices in a vertical differentiation game. In such games, observably committing to a more aggressive behavior is strategically beneficial, as this commitment begets reduced competition from rivals.

When strategic actions are complements instead of substitutes (i.e., \( \frac{\partial^2 \pi^i(x_i, x_j)}{\partial x_i \partial x_j} > 0 \)), the logic reverses. There can still be a strategic incentive to deviate from the agency cost minimizing contract, but in the opposite direction; firms will want to observably commit to reducing their aggressiveness in the product market (i.e., setting \( \lambda > 1 \)). The canonical instance of strategic complementarity is “differentiated Bertrand,” in which rival firms compete to sell horizontally differentiated goods by strategically setting prices. In this game, a contract that offers a bonus based on profit margins or imposes a penalty for costs of goods sold will result in higher equilibrium prices (both from the firm, and from its product market rivals), and thus greater profits.\textsuperscript{31}

\textsuperscript{31}My data does not allow me to cleanly observe these types of contracts. Thus I am unable to assess whether or not this kind of collusive strategic delegation takes place, as well.
In most industries, the reality is likely to fall somewhere in between the two extremes. Strategic actions are not always substitutes, nor are they always complements. What matters is whether strategic actions are predominantly one or the other. For example, in a two-period spatial competition model, where firms first choose their locations, and then compete with one another by choosing prices, there are two opposing forms of competition. Location choices are strategic substitutes; as one firm moves towards a particular point in the product space, rivals will optimally spread themselves further away from that location, so as to mitigate the competitive forces they endure. However the prices they charge are strategic complements; when one firm raises (lowers) its price, rivals will optimally respond by raising (lowering) their own prices. Many other games will admit similar properties, for example a two stage game in which firms choose a production capacity, and then compete on price. Whether firms prefer to observably commit to more or less aggressive behavior depends on the relative importance of the two forms of competition.
References


Guay, W., J. D. Kepler, and D. Tsui (2016). Do CEO bonus plans serve a purpose? Available at SSRN 2849934.


Figure 1: Time series of Revenue-Based Pay In Substitute Industries

This figure plots the time series of revenue-based pay for CEO’s in substitute industries. I split the sample, at the median, into more and concentrated and more competitive industries. Each line represents the proportion of CEO’s who have at incentive pay tied to absolute revenue objectives.
Figure 2A: Distribution of Actual Sales Relative to The CEO’s Sales Threshold

This figure presents the distribution of actual sales relative to the CEO’s sales threshold. Performance relative to the threshold is calculated as GAAP revenues minus the threshold sales, as a percent of average total assets.
This figure presents the distribution of actual sales relative to the CEO’s sales target. Performance relative to the target is calculated as GAAP revenues minus the target sales, as a percent of average total assets.
Table 1: Summary Statistics

This table presents summary statistics for selected variables used in my analyses. Panel A provides summary statistics while Panel B provides Pearson correlations. The sample spans 1998 to 2013 and comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library, containing 11,240 firm-year observations for 1,561 unique firms. For the product market outcome analyses I do not require contract data, leading to a larger sample.

Panel A: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>sd</th>
<th>D1</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>D9</th>
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<td>4.875</td>
<td>5.215</td>
<td>5.894</td>
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<td>5.024</td>
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<td>Monopoly, FIC-500</td>
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<td>0.000</td>
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<td>Revenue-Based</td>
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<td>0.464</td>
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<td>1.000</td>
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Panel B: Pearson Correlations

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<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
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<tr>
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<td>0.182</td>
<td>−0.034</td>
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<td>−0.094</td>
<td>0.034</td>
<td>0.020</td>
<td>0.154</td>
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</table>
Table 2: Revenue Use and Industry Concentration

This table presents descriptive evidence on the association between industry concentration and the use of revenue-based incentives in CEO contracts. The sample spans 1998 to 2013 and comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Specifications 1, 4 and 7 use the full sample, while specifications 2, 5 and 8 (3, 6 and 9) include only substitute (complement) industries, as estimated using the method based on Kedia (2006). In each specification, the regression equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta \log(Firms_{j,t}) + \tau_t + u_j + \epsilon_{i,j,t},
\]

where \(Firms_{j,t}\) is the number of competitors in industry \(j\) in year \(t\), and \(\tau_t\) and \(u_j\) are year and industry fixed effects. The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. Industries are defined by the Hoberg and Phillips FIC-50. In specifications 4 through 9, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

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<tr>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
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<td>-0.043</td>
<td>-0.088***</td>
<td>-0.012</td>
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<td>0.546***</td>
<td>0.720***</td>
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<td>Yes</td>
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<td>Yes</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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<td>Subs</td>
<td>Comps</td>
<td>Full</td>
<td>Subs</td>
<td>Comps</td>
<td>Full</td>
<td>Subs</td>
<td>Comps</td>
</tr>
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<td>3,398</td>
<td>11,240</td>
<td>7,842</td>
<td>3,398</td>
<td>11,240</td>
<td>7,842</td>
<td>3,398</td>
</tr>
<tr>
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<td>0.014</td>
<td>0.001</td>
<td>0.037</td>
<td>0.031</td>
<td>0.065</td>
<td>0.193</td>
<td>0.186</td>
<td>0.182</td>
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</tbody>
</table>

\(t\)-statistics, clustered by industry-year, in parentheses

*** p<0.01, ** p<0.05, * p<0.1
This table presents descriptive evidence on the association between industry concentration and the use of revenue-based incentives in CEO contracts, before and after 2006. The sample spans 1998 to 2013 and comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Odd (even) numbered specifications include only substitute (complement) industries, as estimated using the method based on Kedia (2006). In each specification, the regression equation is:

\[ \text{RevenueBonus}_{i,t} = \alpha + \beta_1 \log(\text{Firms}_{j,t}) \times \text{Post}_t + \beta_2 \log(\text{Firms}_{j,t}) + \tau_t + u_j + \epsilon_{i,j,t}, \]

where \( \text{Firms}_{j,t} \) is the number of competitors in industry \( j \) in year \( t \), \( \text{Post} \) is an indicator variable that takes a value of one during and after 2006, and \( \tau_t \) and \( u_j \) are year and industry fixed effects. Note that the main effect of \( \text{Post} \) is implicitly included by way of year fixed effects. The dependent variable, \( \text{RevenueBonus}_{i,t} \), is an indicator variable equal to one if the CEO of firm \( i \) in year \( t \) is given absolute performance incentives tied to revenue. Industries are defined by the Hoberg and Phillips FIC-50. In specifications 3 through 6, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

<table>
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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<td>−0.054***</td>
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<td>(1.507)</td>
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<td>(1.366)</td>
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<td>No</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Industry FE’s</td>
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<tr>
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<td>Subs</td>
<td>Comps</td>
<td>Subs</td>
<td>Comps</td>
<td>Subs</td>
<td>Comps</td>
</tr>
<tr>
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<td>7,842</td>
<td>3,398</td>
<td>7,842</td>
<td>3,398</td>
</tr>
<tr>
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<td>0.063</td>
<td>0.038</td>
<td>0.068</td>
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t-statistics, clustered by industry-year, in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Table 4: Falsification Test—Revenue vs. Common Profit Metrics

This table presents evidence on the relations among industry concentration and the four most common performance evaluation metrics ("Revenue," "Earnings," "EPS" and "Operating Income"), before and after 2006. The sample spans 1998 to 2013 and comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. The sample include only substitute industries, as estimated using the method based on Kedia (2006). In each specification, The regression equation is:

\[
<\text{Metric}>_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times \text{Post}_t + \beta_2 \log(Firms_{j,t}) + \tau_t + u_j + \varepsilon_{i,j,t},
\]

where \(Firms_{j,t}\) is the number of competitors in industry \(j\) in year \(t\), \(\text{Post}\) is an indicator variable that takes a value of one during and after 2006, and \(\tau_t\) and \(u_j\) are year and industry fixed effects. Note that the main effect of \(\text{Post}\) is implicitly included by way of year fixed effects. The dependent variable, which varies across specifications, is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) was given incentive pay tied to absolute performance on a given metric—"Revenue," "Earnings," "EPS" or "Operating Income" for specifications 1-4, respectively. Industries are defined by the Hoberg and Phillips FIC-50. In all specifications, the constant term is not reported as it is subsumed by fixed effects. Standard errors are clustered by industry-year.

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<tr>
<th>VARIABLES</th>
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<th>(4)</th>
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<td>(\log(Firms) \times \text{Post})</td>
<td>(-0.054^{***})</td>
<td>(-0.004)</td>
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<td>(0.013)</td>
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<td>((-0.264))</td>
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<td>(0.080^{**})</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Industry FE's</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
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<td>Subs</td>
<td>Subs</td>
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<tr>
<td>R-squared</td>
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<td>0.034</td>
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* t-statistics, clustered by industry-year, in parentheses
  
  *** p<0.01, ** p<0.05, * p<0.1
Table 5: Event Study—Triple Differences

This table presents the baseline results from the “triple differences” event study analysis. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Specification 1 utilizes the full sample while specifications 2 and 3 winnow the sample to symmetric 4-year and 3-year windows around the CD&A’s introduction in 2006. The estimating equation is:

\[ \text{RevenueBonus}_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times Post_t \times Subs_j + \beta_2 \text{Post}_t \times Subs_j + \beta_3 \log(Firms_{j,t}) \times Post_t \]
\[ + \beta_4 \log(Firms_{j,t}) \times Subs_j + \beta_5 \log(Firms_{j,t}) + \tau_t + u_j + \epsilon_{i,j,t}, \]

where \( Firms_{j,t} \) is the number of competitors in industry \( j \) in year \( t \), \( Post \) is an indicator variable that takes a value of one during and after 2006, \( Subs_j \) is an indicator variable which takes a value of one (zero) if industry \( j \) is estimated to be a substitute (complement) industry, and \( \tau_t \) and \( u_j \) are year and industry fixed effects. Note that the main effects of \( Post \) and \( Subs \) are implicitly included by way of year and industry fixed effects. The dependent variable, \( RevenueBonus_{i,t} \), is an indicator variable equal to one if the CEO of firm \( i \) in year \( t \) is given absolute performance incentives tied to revenue. Industries are defined by the Hoberg and Phillips FIC-50. In all specifications, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

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<td>-0.083***</td>
<td>-0.089***</td>
<td>-0.089***</td>
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<td>( Post \times Subs )</td>
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<tr>
<td>( \log(Firms) \times Post )</td>
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<td>0.047**</td>
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* t-statistics, clustered by industry-year, in parentheses
  *** p<0.01, ** p<0.05, * p<0.1
Table 6: Event Study—Triple Differences (Agency Theoretic Controls)

This table presents results for the “triple differences” event study analysis, using time-varying controls for agency theoretic determinants of revenue-based pay. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Panel A shows the relation between the agency theoretic determinants of revenue-based pay and actual revenue-based pay. Panel B presents the triple differences analysis, with the additional control variables. Specification 1 utilizes the full sample while specifications 2 and 3 winnow the sample to symmetric 4-year and 3-year windows around the CD&A’s introduction in 2006. The estimating equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms_{j,t}) \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 \log(Firms_{j,t}) \times Post_t \\
+ \beta_4 \log(Firms_{j,t}) \times Subs_j + \beta_5 \log(Firms_{j,t}) + \psi X_{i,t} + \tau_t + u_j + \mu_i + \epsilon_{i,j,t},
\]

where \(Firms_{j,t}\) is the number of competitors in industry \(j\) in year \(t\), \(Post\) is an indicator variable that takes a value of one during and after 2006, \(Subs\) is an indicator variable which takes a value of one (zero) if industry \(j\) is estimated to be a substitute (complement) industry, and \(\tau_t\) and \(u_j\) are year and industry fixed effects, and \(\mu_i\) are firm fixed effects (included only in specifications 4 through 6). Note that the main effects of \(Post\) and \(Subs\) are implicitly included by way of year and industry fixed effects. \(X_{i,t}\) are agency theoretic control variables, fully interacted with \(Post\), \(Subs\) and the \(Post \times Subs\) interaction. The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. Industries are defined by the Hoberg and Phillips FIC-50. In all specifications, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

Panel A: Agency Theoretic Determinants of Revenue-Based Pay

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<th>(4)</th>
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<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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<td>Ads</td>
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<td>(6.123)</td>
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<td>log((\frac{\sigma_r}{\sigma}))</td>
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* t-statistics, clustered by industry-year, in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Panel B: Triple Difference Analysis with Agency Theoretic Controls

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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<td>−0.145***</td>
<td>−0.132***</td>
<td>−0.101***</td>
<td>−0.094***</td>
<td>−0.083**</td>
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<td>(−3.784)</td>
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<td>Post×Subs</td>
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<td>0.459**</td>
<td>0.423**</td>
<td>0.460***</td>
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<td>0.417*</td>
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<td>(1.749)</td>
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<td>0.096***</td>
<td>0.059***</td>
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<td>(3.771)</td>
<td>(3.406)</td>
<td>(2.894)</td>
<td>(2.482)</td>
<td>(1.950)</td>
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<td>−0.206*</td>
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<td>0.163*</td>
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<td>(−1.364)</td>
<td>(1.037)</td>
<td>(1.597)</td>
<td>(1.213)</td>
<td>(1.628)</td>
<td>(1.846)</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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Observations                                10,798     5,630      4,302      10,798     5,630      4,302
R-squared                                   0.209      0.194      0.204      0.677      0.741      0.780

t-statistics, clustered by industry-year, in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Table 7: Event Study—Triple Differences (Within Industry-Year Design)

This table presents results from the “triple differences” event study analysis, based on within industry-year variation in competition. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Specification 1 utilizes the full sample while specifications 2 and 3 winnow the sample to symmetric 4-year and 3-year windows around the CD&A’s introduction in 2006. The estimating equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms_{k,t}) \times Post_t \times Subs_j + \beta_2 \log(Firms_{k,t}) \times Post_t \\
+ \beta_3 \log(Firms_{k,t}) \times Subs_j + \beta_4 \log(Firms_{k,t}) + \theta_{j,t} + \mu_i + \epsilon_{i,j,t},
\]

where \(Firms_{k,t}\) is the number of competitors in FIC-100 industry \(k\) in year \(t\), \(Post_t\) is an indicator variable that takes a value of one during and after 2006, \(Subs_j\) is an indicator variable which takes a value of one if strategic actions in firm \(i\)’s FIC-50 industry, \(j\), are estimated to be substitutes, \(\theta_{j,t}\) are industry-year fixed effects, and \(\mu_i\) are firm fixed effects (included only in specifications 3 through 6). The dependent variable, \(RevenueBonus_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. The main effects of \(Post\) and \(Subs\), as well as their interaction, are implicitly included by way of industry-year fixed effects. In all specifications, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

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<th>(2) (\text{R. Bonus})</th>
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<th>(5) (\text{R. Bonus})</th>
<th>(6) (\text{R. Bonus})</th>
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<td>log(Firms)\times Post\times Subs</td>
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<td>-0.106***</td>
<td>-0.065</td>
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<td>(-3.733)</td>
<td>(1.573)</td>
<td>(-1.668)</td>
</tr>
<tr>
<td>log(Firms)\times Post</td>
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<td>0.066***</td>
<td>0.056*</td>
<td>0.063***</td>
<td>0.043</td>
<td>0.062</td>
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<td>(2.983)</td>
<td>(1.275)</td>
<td>(1.519)</td>
</tr>
<tr>
<td>log(Firms)\times Subs</td>
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<td>0.087***</td>
<td>0.063**</td>
<td>0.066*</td>
<td>0.087***</td>
<td>0.088*</td>
<td>0.119**</td>
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\(t\)-statistics, clustered by industry-year, in parentheses

*** \(p<0.01\), ** \(p<0.05\), * \(p<0.1\)
This table presents the results from the 2-stage least squares “triple differences” event study analysis. The sample comes from the intersection of Compustat and the Hoberg and Phillips Data Library. Panel A shows the first stage results. The first stage specification is:

\[
\log(Firms)_{j,t} = \delta + \gamma \log(AvgFixedCosts_{j,t}) + u_j + \tau_t + \eta_{j,t},
\]

Where \(AvgFixedCosts_{j,t}\) is the industry-year average level of SG&A and depreciation expense in specifications 1 and 2, respectively, and \(u_j\) and \(\tau_t\) represent industry and year fixed effects. The dependent variable, \(\log(Firms)_{j,t}\), is the natural logarithm of the number of firms in industry \(j\) during year \(t\). Panel B presents the second stage results from the 2-stage least squares “triple differences” event study analysis. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Specifications 1 and 4 utilize the full sample while specifications 2 and 5 (3 and 6) winnow the sample to a symmetric 4-year (3-year) window around the CD&A’s introduction in 2006. The second stage estimating equation is:

\[
RevenueBonus_{i,t} = \alpha + \beta_1 \log(Firms)_{j,t} \times Post_t \times Subs_j + \beta_2 Post_t \times Subs_j + \beta_3 \log(Firms)_{j,t} \times Post_t \\
+ \beta_4 \log(Firms)_{j,t} \times Subs_j + \beta_5 \log(Firms)_{j,t} + \tau_t + u_j + \varepsilon_{i,j,t},
\]

where \(Post\) is an indicator variable that takes a value of one during and after 2006, \(Subs_j\) is an indicator variable which takes a value of one (zero) if industry \(j\) is estimated to be a substitute (complement) industry, as estimated using the method based on Kedia (2006), \(\tau_t\) and \(u_j\) are year and industry fixed effects. The dependent variable \(RevenueBonus\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. Finally, \(\log(Firms)_{j,t}\) is the fitted value for firm \(i\) in year \(t\) from the first stage regression, equation (10). In specifications 1 through 3 (4 through 6), I use SG&A (depreciation expense) as the proxy for fixed costs. Industries are defined by the Hoberg and Phillips FIC-50. In all specifications, the constant term, \(Post\) main effect and \(Subs\) main effect are not reported as they are subsumed by the fixed effects. Standard errors are clustered by industry-year.

### Panel A: First Stage

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\(t\)-statistics, clustered by industry-year, in parentheses

*** \(p<0.01\), ** \(p<0.05\), * \(p<0.1\)
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<th>(3)</th>
<th>(4)</th>
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<th>(6)</th>
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<td>-0.105***</td>
<td>-0.106***</td>
<td>-0.095***</td>
<td>-0.106***</td>
<td>-0.109***</td>
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<td></td>
<td>(2.705)</td>
<td>(2.601)</td>
<td>(2.292)</td>
<td>(2.763)</td>
<td>(2.531)</td>
<td>(2.263)</td>
</tr>
<tr>
<td>log(Firms)×Post</td>
<td></td>
<td>0.029</td>
<td>0.051**</td>
<td>0.055**</td>
<td>0.026</td>
<td>0.051**</td>
<td>0.057**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.443)</td>
<td>(2.332)</td>
<td>(2.191)</td>
<td>(1.344)</td>
<td>(2.318)</td>
<td>(2.210)</td>
</tr>
<tr>
<td>log(Firms)×Subs</td>
<td></td>
<td>0.047</td>
<td>-0.105</td>
<td>0.042</td>
<td>0.062</td>
<td>-0.219</td>
<td>-0.148</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.570)</td>
<td>(-0.662)</td>
<td>(0.191)</td>
<td>(0.726)</td>
<td>(-1.207)</td>
<td>(-0.460)</td>
</tr>
<tr>
<td>log(Firms)</td>
<td></td>
<td>-0.207*</td>
<td>-0.093</td>
<td>-0.266</td>
<td>-0.695***</td>
<td>-0.150</td>
<td>-0.493</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-1.913)</td>
<td>(-0.566)</td>
<td>(-1.282)</td>
<td>(-3.317)</td>
<td>(-0.490)</td>
<td>(-1.305)</td>
</tr>
<tr>
<td>Year FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Industry FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>11,240</td>
<td>5,847</td>
<td>4,476</td>
<td>11,240</td>
<td>5,847</td>
<td>4,476</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.197</td>
<td>0.183</td>
<td>0.190</td>
<td>0.198</td>
<td>0.183</td>
<td>0.190</td>
<td></td>
</tr>
</tbody>
</table>

T-statistics, clustered by industry-year, in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 9: Product Market Outcomes

This table presents evidence on the affect of the CD&A on product market outcomes. For specifications (1)-(4), the sample is the intersection of Compustat and The Hoberg and Phillips Data Library, over the period of 2004 to 2008. In specification (5), the sample is winnowed to include only firms for which Li, Lundholm and Minnis’ (2013) PCTCOMP measure is available. The specification is:

\[
< \text{Outcome} >_{i,t} = \alpha + \beta_1 \log(\text{Firms}_{j,t}) \times \text{Post}_t \times \text{Subs}_j + \beta_2 \text{Post}_t \times \text{Subs}_j + \beta_3 \log(\text{Firms}_{j,t}) \times \text{Post}_t \\
+ \beta_4 \log(\text{Firms}_{j,t}) \times \text{Subs}_j + \beta_5 \log(\text{Firms}_{j,t}) + \tau_t + u_j + \varepsilon_{i,j,t},
\]

where \(\text{Firms}_{j,t}\) is the number of competitors in firm \(i\)’s industry, \(j\), in year \(t\), \(\text{Post}_t\) is an indicator variable that takes a value of one during and after 2006, \(\text{Subs}_j\) is an indicator variable which takes a value of one (zero) if industry \(j\) is estimated to be a substitute (complement) industry, and \(\tau_t\) and \(u_j\) are year and industry fixed effects. Note that the main effects of \(\text{Post}\) and \(\text{Subs}\) are implicitly included by way of year and industry fixed effects. The first four specifications use (1) the natural logarithm of revenues, scaled by average total assets, \(\log(\text{Revenues})\); (2) the natural logarithm of costs of goods sold, scaled by average total assets \(\log(\text{Costs})\); (3) the natural logarithm of revenues net of costs of goods sold, scaled by revenues, \(\log(\text{Margins})\); and (4) income before extraordinary items, scaled by average total assets, Winsorized at 1% and 99%, \(\text{Profitability}\). In specification (5) I use the natural logarithm of the text-based competition measure developed by Li et al. (2013), \(\log(\text{PCTCOMP})\). Industries are defined by the FIC-50. Standard errors are clustered by industry-year.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>log(Revenue)</td>
<td>log(Costs)</td>
<td>log(Margins)</td>
<td>Profit</td>
<td>log(PCTCOMP)</td>
</tr>
<tr>
<td>log(Firms)×Post×Subs</td>
<td>-0.082***</td>
<td>-0.183***</td>
<td>0.113***</td>
<td>0.018***</td>
<td>-0.058*</td>
</tr>
<tr>
<td>Post×Subs</td>
<td>0.388***</td>
<td>0.833***</td>
<td>-0.518***</td>
<td>-0.073**</td>
<td>0.238</td>
</tr>
<tr>
<td>log(Firms)×Post</td>
<td>0.065***</td>
<td>0.155***</td>
<td>-0.073***</td>
<td>-0.006</td>
<td>0.010</td>
</tr>
<tr>
<td>log(Firms)×Subs</td>
<td>-0.224*</td>
<td>-0.251</td>
<td>-0.022</td>
<td>-0.079***</td>
<td>0.053</td>
</tr>
<tr>
<td>log(Firms)</td>
<td>0.021</td>
<td>0.070</td>
<td>0.111</td>
<td>0.021</td>
<td>0.080</td>
</tr>
<tr>
<td>Year FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>18,214</td>
<td>18,167</td>
<td>18,348</td>
<td>18,384</td>
<td>7,949</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.550</td>
<td>0.571</td>
<td>0.264</td>
<td>0.192</td>
<td>0.150</td>
</tr>
</tbody>
</table>

*\(t\)-statistics, clustered by industry-year, in parentheses
*** \(p<0.01\), ** \(p<0.05\), * \(p<0.1\)
This table presents the evidence on the mediating effect of product market influence on the triple-differences analyses. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library, restricted to a symmetric 3-year window around the CD&A’s introduction in 2006. The estimating equation is:

\[
\text{RevenueBonus}_{i,t} = \alpha + \beta_1 \log(\text{Power}_{i,t}) \times \log(\text{Firms}_{j,t}) \times \text{Post}_t \times \text{Subs}_j + \beta_2 \log(\text{Power}_{i,t}) \times \text{Post}_t \times \text{Subs}_j + \beta_3 \log(\text{Power}_{i,t}) \times \log(\text{Firms}_{j,t}) \times \text{Post}_t \times \text{Subs}_j + \beta_4 \log(\text{Power}_{i,t}) \times \log(\text{Firms}_{j,t}) \times \text{Post}_t + \beta_5 \log(\text{Power}_{i,t}) \times \theta_{j,t} + \varepsilon_{i,j,t},
\]  

(45)

where \(\text{Power}_{i,t}\) is a proxy for firm \(i\)’s price-setting power in year \(t\) (average total assets, or profit margin), \(\text{Firms}_{j,t}\) is the number of competitors in industry \(j\) in year \(t\), \(\text{Post}_t\) is an indicator variable that takes a value of one during and after 2006, \(\text{Subs}_j\) is an indicator variable which takes a value of one (zero) if industry \(j\) is estimated to be a substitute (complement) industry, as estimated using the method of Kedia (2006), and \(\theta_{j,t}\) are industry-year fixed effects. The main effects of \(\text{Post}_t\), \(\text{Subs}_j\), \(\log(\text{Firms})\), as well as all of their interactions, are implicitly included by way of industry-year fixed effects. The dependent variable, \(\text{RevenueBonus}_{i,t}\), is an indicator variable equal to one if the CEO of firm \(i\) in year \(t\) is given absolute performance incentives tied to revenue. Industries are defined by the Hoberg and Phillips FIC-50. In all specifications, the constant term is not reported as it is subsumed by the fixed effects. Standard errors are clustered by industry-year.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Prediction</th>
<th>(1) R. Bonus</th>
<th>(2) R. Bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\log(\text{Power}) \times \log(\text{Firms}) \times \text{Post} \times \text{Subs})</td>
<td>-0.065**</td>
<td>-0.186*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.217)</td>
<td>(-1.945)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \text{Post} \times \text{Subs})</td>
<td>0.357**</td>
<td>0.810*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.423)</td>
<td>(1.720)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \log(\text{Firms}) \times \text{Post})</td>
<td>0.022</td>
<td>0.052</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.461)</td>
<td>(0.613)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \log(\text{Firms}) \times \text{Subs})</td>
<td>0.015</td>
<td>0.066</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.699)</td>
<td>(0.810)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \log(\text{Firms}))</td>
<td>0.009</td>
<td>-0.022</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.787)</td>
<td>(-0.293)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \text{Subs})</td>
<td>-0.105</td>
<td>-0.366</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.966)</td>
<td>(-0.919)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}) \times \text{Post})</td>
<td>-0.150*</td>
<td>-0.144</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.796)</td>
<td>(-0.349)</td>
<td></td>
</tr>
<tr>
<td>(\log(\text{Power}))</td>
<td>-0.023</td>
<td>0.205</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.356)</td>
<td>(0.576)</td>
<td></td>
</tr>
<tr>
<td>Industry-Year FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Measure of Price-Setting Power</td>
<td>Avg. Assets</td>
<td>Profit Margin</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>4,444</td>
<td>4,388</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.224</td>
<td>0.241</td>
<td></td>
</tr>
</tbody>
</table>

_t-statistics, clustered by industry-year, in parentheses_

*** p<0.01, ** p<0.05, * p<0.1
Table 11: Intensive Margin

This table presents evidence of an intensive margin relation between industry concentration and revenue-based compensation. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. Specifications 1 uses the full sample, while specification 2 (3) includes only substitute (complement) industries, as estimated using the method based on Kedia (2006). The sample is further restricted to include only CEO’s cash compensation grants for which the relative weight on profits versus revenues (λ) can be computed. The specification is:

\[ \lambda_{i,t} = \alpha + \beta \log(\text{Firms}_{j,t}) + u_j + \varepsilon_{i,j,t}, \]

where \( \text{Firms}_{j,t} \) is the number of competitors in industry \( j \) in year \( t \), and \( u_j \) represent industry fixed effects. The dependent variable, \( \lambda \), is a continuous variable, ranging between 0 and 1, which represents the relative weight on profit versus revenue for the CEO of firm \( i \) in year \( t \). Industries are defined by the Hoberg and Phillips FIC-50. Standard errors are clustered by industry-year.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lambda )</td>
<td>0.071*</td>
<td>0.104**</td>
<td>-0.006</td>
</tr>
<tr>
<td>( \log(\text{Firms}) )</td>
<td>(1.958)</td>
<td>(2.361)</td>
<td>(-0.097)</td>
</tr>
<tr>
<td>Industry FE’s</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sample</td>
<td>Full</td>
<td>Subs</td>
<td>Comps</td>
</tr>
<tr>
<td>Observations</td>
<td>2,740</td>
<td>1,922</td>
<td>818</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.159</td>
<td>0.180</td>
<td>0.088</td>
</tr>
</tbody>
</table>

\[ t\text{-statistics, clustered by industry-year, in parentheses} \]

*** \( p<0.01 \), ** \( p<0.05 \), * \( p<0.1 \)
Table 12: Non-Monotonicity

This table presents evidence of the non-monotonic relation between industry concentration and revenue-based compensation. The sample comes from the intersection of Compustat, Incentive Labs and the Hoberg and Phillips Data Library. The sample is restricted to include only substitute industries, as estimated using the method based on Kedia (2006). The sample is further restricted to include only CEO’s cash compensation grants for which the relative weight on profits versus revenues ($\lambda$) can be computed.

\[
\lambda_{i,t} = \alpha + \beta_1 Mono_{j,t} + \tau_t + u_{j,t},
\]

and

\[
\lambda_{i,t} = \alpha + \beta_1 Mono_{j,t} + \beta_2 \log(Firms_{j,t}) + \tau_t + u_{j,t},
\]

where $Mono_{j,t}$ is a dummy variable indicating if firm $i$ is the only one in its industry, in year $t$, and $Firms_{j,t}$ is the number of competitors in firm $i$’s industry in year $t$, and $\tau_t$ and $u_{j}$ are year and industry fixed effects. The dependent variable, $\lambda$, is a continuous variable, ranging between 0 and 1, which represents the relative weight on profit versus revenue for the CEO of firm $i$ in year $t$. Specifications 1 and 2 (3 and 4) define industries according to the Hoberg and Phillips FIC-200 (FIC-500). Standard errors are clustered by industry-year.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Prediction</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\lambda$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monopoly</td>
<td>+</td>
<td>0.088***</td>
<td>0.179***</td>
<td>0.098*</td>
<td>0.137**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.558)</td>
<td>(5.722)</td>
<td>(1.839)</td>
<td>(2.513)</td>
</tr>
<tr>
<td>log(Firms)</td>
<td>+</td>
<td>0.032***</td>
<td></td>
<td>0.014**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.517)</td>
<td></td>
<td>(2.223)</td>
<td></td>
</tr>
<tr>
<td>Year FE’s</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry FE’s</td>
<td>Yes</td>
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<td></td>
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</tr>
<tr>
<td>Industry Level</td>
<td>FIC-200</td>
<td>FIC-200</td>
<td>FIC-500</td>
<td>FIC-500</td>
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<tr>
<td>Observations</td>
<td>1,922</td>
<td>1,922</td>
<td>1,922</td>
<td>1,922</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.183</td>
<td>0.190</td>
<td>0.184</td>
<td>0.186</td>
<td></td>
</tr>
</tbody>
</table>

$t$-statistics, clustered by industry-year, in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
This figure presents a graphical representation of the function linking product market competition to equilibrium incentives, when contracts are publicly disclosed, as derived in the Appendix, Section A1.1. The function is \( \lambda^{**} = \frac{a-aN+cN+cN^2}{c(1+N^2)} \) where \( N \) is the number of product market rivals, \( a \) is the level of demand, \( c \) is the marginal cost of production and \( \lambda \) is the relative weight of profit versus revenue in the compensation contract, with \( \lambda = 1 \) (\( \lambda = 0 \)) representing a pure profit (revenue) contract.
This table summarizes the theoretical predictions which attain from the stylized model in the Appendix, Section A1. I present the formulae which characterize each equilibrium outcome. I also provide the signs of the main effects of disclosure and competition (operationalized by the number of competitors, \( N \)), as well as the sign of their interactive effect. Other model primitives are the level of demand, \( a \); the sensitivity of price to output, \( b \); and the marginal cost of production, \( c \). The relative weight on profit is given by \( \lambda \).

<table>
<thead>
<tr>
<th>Outcome</th>
<th>w/o Disclosure</th>
<th>w/ Disclosure</th>
<th>Disc. Main</th>
<th>( N ) Main</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lambda )</td>
<td>1</td>
<td>(-aN+a+cN^2+cN)</td>
<td>(-)</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Quantity</td>
<td>( \frac{a-c}{bN+b} )</td>
<td>( \frac{aN-cN}{bN^2+b} )</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Price</td>
<td>( \frac{a+cN}{N+1} )</td>
<td>( \frac{a+cN^2}{N^2+1} )</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Revenue</td>
<td>( \frac{(a-c)(a+cN)}{b(N+1)^2} )</td>
<td>( \frac{N(a-c)(a+cN^2)}{b(N^2+1)^2} )</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>COGS</td>
<td>( \frac{c(a-c)}{bN+b} )</td>
<td>( \frac{cN(a-c)}{b(N^2+1)} )</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Markup</td>
<td>( \frac{a-c}{N+1} )</td>
<td>( \frac{a-c}{N^2+1} )</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Profit</td>
<td>( \frac{(a-c)^2}{b(N+1)^2} )</td>
<td>( \frac{N(a-c)^2}{b(N^2+1)^2} )</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>