Noncompete Agreements and the Welfare of Consumers*

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Abstract

Employee spinoffs harm incumbent firms by increasing competition (benefiting consumers) and by preventing firm owners from making beneficial investments in workers who may later spin off (harming consumers). We model noncompete agreements (NCAs) as solutions for the firm, and analyze the resulting tradeoff for consumers. We show that market structure and the nature of investment play large roles. Counterintuitively, increased investment benefits have the potential to harm consumers such that industries where firms value NCAs the most are those where harm is greater. Finally, we draw two analogies between NCAs and antitrust and show how those areas inform NCA policy.

Keywords: Noncompete agreements, entrepreneurship, employee spinoffs, antitrust, consumer welfare
JEL Classifications: J41, J53, K21, K31, L26, L41

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1 Introduction

Employee spinoffs make up a significant and important portion of new firm births (Muendler et al., 2012; Franco, 2005). Typically studied as engines of innovation, spinoffs may also foster competition in industries that are otherwise highly concentrated: as noted by Fulghieri and Sevilir (2011), "...in many industries, the majority of new firms are created by workers of established firms, and such firms end up competing in similar industries as their parent firm." By using the human capital they accrue at their parent firms, employee entrepreneurs are uniquely able to found spinoffs which may have success where entrepreneurs with less industry experience may fail (Franco and Filson, 2006; Campbell et al., 2012).

Fulghieri and Sevilir (2011) go on to ask "...why established firms do not prevent the creation of such new firms that lead to greater competition...". While they provide one answer to this question, another answer is that established firms do, in fact, prevent creation of employee spinoffs: they do so using employee noncompete agreements (NCAs). An NCA may stipulate that a worker is prohibited from founding a competing firm, typically for a set duration of time. NCAs are historically explained as a means by which to guarantee returns on investments: without the assurance that a worker will not leave to join or found a competing firm, an owner may not be willing to make a costly investment in a worker's human capital, or to impart trade secrets which aid in a firm's creation of value. In other words, NCAs solve an investment holdup problem on the part of the owner (Williamson, 1975; Klein et al., 1978; Rubin and Shedd, 1981; Hart and Moore, 1990).

The tradeoff between value creation and competition is the focus of this paper. Courts and policymakers who wish to determine optimal levels of NCA enforceability may be concerned with the overall impact of NCAs on the economy: for example, President Biden recently issued an executive order that in part seeks to "...curtail the unfair use of non-compete clauses".[1] While the impacts of NCA enforceability on workers (Balasubramanian et al., 2020; Starr, 2019; Johnson et al., 2021; Lipsitz and Starr, 2021) and firms (Samila and Sorenson, 2011; Starr et al., 2018; Jeffers, 2019; Marx and Fleming, 2012) have been examined extensively, the impact of NCAs on consumers has largely been ignored. We provide a unified framework to examine the welfare consequences of NCA enforceability on consumers, and provide analogies to assist policymakers in weighing the resulting tradeoff. While the prior literature has often leaned on behavioral reasons (Starr et al., 2020; Lipsitz and Starr, 2021) or liquidity constraints (Rauch and Watson, 2015; Wickelgren, 2018) as reasons that NCAs are used or have the potential to harm economic actors, we demonstrate that harms may arise even absent these explanations.

As motivation, we begin our analysis by documenting the extent to which NCAs and market

[1] See https://www.whitehouse.gov/briefing-room/presidential-actions/2021/07/09/executive-order-on-promoting-competition-in-the-american-economy.

outcomes are related. Using data from the US Census Bureau's County Business Patterns, we show that stricter NCA enforcement (making it easier for employers to legally enforce NCA contracts to prevent spin-offs) can result in increases in concentration.

To explain the mechanisms underlying this finding, we introduce a model of a firm operating in an industry in which the primary barrier to entry is industry-specific knowledge. The owner of this incumbent firm employs a worker who accumulates the knowledge necessary to compete in the industry, and who may ultimately decide to found their own competing firm (an employee spinoff). The owner and worker may agree to use an NCA, which legally prohibits the worker from spinning off, barring a negotiated buy-out payment (a payment from the worker to the firm which nullifies the NCA). NCAs have two effects on the market: on one hand, NCAs may increase the likelihood that the market remains a monopoly, preventing price competition. On the other hand, under an NCA, the owner does not face a holdup problem with respect to investment in their worker, and therefore is willing to make productivity-enhancing investments (for example, investments which reduce marginal costs) which may pass through to lower prices or higher quality for consumers.

We consider several comparative statics to analyze when a ban on NCAs may ultimately benefit consumers, and when such a ban may be harmful. We show that, in most cases, when price setting in duopoly markets closely mirrors perfectly competitive price setting, and when investments made by firms do not pass through to consumer prices, NCA bans are more attractive. Then, we show that while enhanced benefits from investment may pass through to lower consumer prices, they also increase the use of NCAs. Counterintuitively, increased investment benefits may therefore exacerbate consumer harms from NCAs, especially when investment pass-through to consumers is low. Industries with low investment pass-through and high investment benefits are likely to find NCAs attractive, which suggests that solving a significant hold-up problem is not sufficient to render NCAs nonproblematic from a consumer perspective.

The tradeoff between productivity enhancement and market competition mirrors tradeoffs present in antitrust policy. The Horizontal Merger Guidelines published by the U.S. Department of Justice and the Federal Trade Commission note that "the Agencies consider whether cognizable efficiencies likely would be sufficient to reverse the merger's potential to harm customers in the relevant market, e.g., by preventing price increases in that market."[2] Cognizable efficiencies refer to enhancements in productivity (for example, cost reductions or increased potential for new innovations) that a merged firm will achieve but non-merged firms will not. To clarify this analogy, we introduce a basic model of pass-through (drawing on Weyl and Fabinger (2013)). Based on this model, we show that the tradeoffs inherent in merger analysis are also present in NCA analysis. We note that firm wide NCA use may prevent several spinoffs from occurring (especially if the firm has a large number of workers), which increases the potential for harms associated with NCAs.

[2]The Horizontal Merger Guidelines are available online at https://www.justice.gov/atr/file/810276/download.

We also consider an analogy to pay for delay agreements, which are agreements between a patent holder and a generic producer under which the generic producer agrees not to enter a market in exchange for monetary compensation. We show that arguments supporting the procompetitive nature of pay for delay agreements do not apply to NCAs, but arguments supporting the anticompetitive nature of pay for delay agreements do. The literature and court decisions regarding pay for delay agreements are particularly important in assessing NCA policy when workers are sophisticated in their contract negotiations, with an ability to assess costs and benefits. In this case, high compensation for NCAs to sophisticated agents (such as the literature indicates CEOs may receive — see, e.g., Kini et al. (2020)) may indicate payment made to preserve anticompetitive market power.[3]

This paper is closest in spirit to Franco and Mitchell (2008), Kräkel and Sliwka (2009), Rauch and Watson (2015), and Rauch (2016), all of which examine how NCAs may limit worker entrepreneurship. We contribute to this literature an analysis of the *competitive* effects that arise due to NCAs, and how those effects may be evaluated against the gains from investment. Hausman and Lavetti (2021) also consider the competitive effects of NCAs, demonstrating that NCAs cause establishment-level HHIs to decrease, and firm-level HHIs to increase in the context of physicians. Finally, our model may be viewed as similar to that of Bernheim and Whinston (1998), which assesses the reasons for and effects of exclusive contracting: in particular, they show that exclusive contracting may act as a way for a manufacturer and retailer to collude against other retailers. In our model, an NCA may be viewed as a way for a firm owner and worker to collude against consumers in the market by committing to share monopoly rents.

2 Noncompetes and Market Concentration

To motivate our analysis, we investigate the connection between market concentration and NCA enforceability. In particular, we present the finding that strict NCA enforceability (i.e., a high likelihood that a given NCA will be upheld by the court) causes high industrial concentration.[4]

[3]Note that large payments may instead be compensation for forgoing the option of working for a competitor, rather than forgoing the option of spinning off. The mechanisms explained in this paper apply, to some extent, in this situation, as well: insofar as the CEO may allow the outside firm to compete more effectively, there is a tradeoff between the incumbent investing in its CEO and increasing effective levels of competition in the market.

[4]By "enforceability of NCAs", we mean the legal framework under which NCAs are assessed. At the lower extreme (lax enforceability), if an NCA is contended in front of a court, the court would rule that it will not be enforced: in other words, the worker is free to violate the NCA as it was written, and may therefore compete by joining or founding a competing firm. On the other end of the spectrum (strict enforceability), NCAs are much more likely to be upheld by the court (in which case the worker may not compete, or may face penalties for doing so). The enforceability of NCAs varies at the state level. Examples of states which do not enforce NCAs (with limited exceptions) are California (see California Business and Professions Code Section 16600) and North Dakota (See North Dakota Century Code Section 9-08-06.). At the other side of the spectrum, many NCAs are explicitly admissible under Florida law (See Florida Statute 542.335.).

We do not claim that our model is the *only* model that can explain this finding, nor do we suggest that the magnitudes presented here are predictive of changes that would occur if NCA policy were changed. Instead, we present this analysis to demonstrate that the issues with which we are concerned (namely, the effect of NCAs on market power) are of a magnitude important enough to merit discussion.

To demonstrate this, we combine data on NCA enforceability with county-level industrial data from the US Census Bureau's County Business Patterns (CBP) dataset. To measure the enforceability of NCAs, we use data collected by Johnson et al. (2021), which extends data initially collected by Hausman and Lavetti (2021). The dataset is a state by year panel of a measure, normalized to a zero to one scale, which reflects the relative enforceability of NCAs in each state (initially constructed in Bishara (2010)). The exogeneity to product market and labor market outcomes (a prerequisite for the forthcoming analysis) has been extensively vetted in Johnson et al. (2021) and Hausman and Lavetti (2021): indeed, part of the analysis in Hausman and Lavetti (2021) is comparable to the analysis presented here (see Figure 2 of that paper). Each of the aforementioned two papers contains a more detailed description of the database.

The CBP dataset measures the number of establishments with different employment levels in each county, in each year, for each NAICS code. We use data from 1998 to 2018 to construct an employment-based HHI[5] for 3-digit NAICS industries (indexed by i) in each county (indexed by c) in each year (indexed by y).[6] An establishment, e, consists of a building with a full address that is designated a 3-digit NAICS code; thus, we let the county containing establishment e be defined by $c(e)$ and the industry containing e be defined by $i(e)$. For each establishment-year, we impute employment (as discussed in Appendix A) in that establishment-year, $n(e, y)$, and calculate the percentage share of employment in that establishment-year, $s(e, y)$, according to $s(e, y) = 100 * \frac{n(e,y)}{\sum\limits_{j \in E(i(e),c(e))} n(j, y)}$, where $E(i(e), c(e))$ represents the set of all establishments in industry $i(e)$ and county $c(e)$. The HHI in industry i, county c, and year y is therefore calculated as:

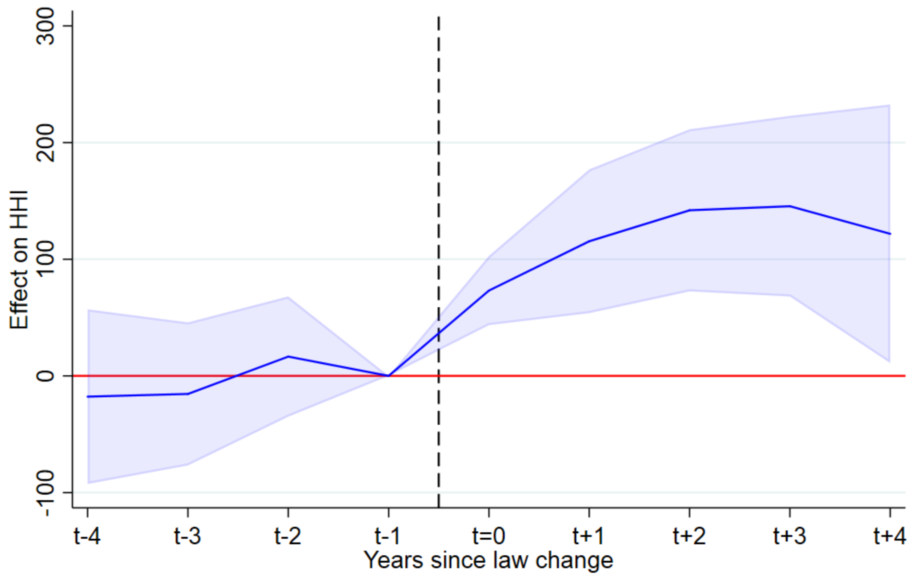
$$HHI_{icy} = \sum_{e \in E(i,c)} s(e, y)^2.$$

We estimate the impact of NCA law changes on HHI using a distributed lag model (Schmid-

[5]Employment-based HHIs, rather than revenue or unit sales based HHIs, are used for data availability reasons. Widespread data on revenue and sales are not available at the level of detail required for this analysis. Employment serves as an imperfect proxy.

[6]We note that the HHIs we calculate here are likely different from what an antitrust agency would calculate when investigating a merger. First, that HHI would likely not be based on employment, which is used here for data availability reasons. Second, an antitrust agency would define markets according to the *Horizontal Merger Guidelines*, as opposed to using a blanket method which is employed in this context for consistency across industries and markets.

Figure 1: Distributed Lag Estimates of the Effect of NCA Enforceability Changes on HHI



This figure plots distributed lag model estimates of the dynamic effects of an NCA law change on employment HHI at the county-by-3 Digit NAICS level. The coefficient representing one year prior to law changes is normalized to zero. The underlying regressions are weighted by employment in the county-industry-year cell, and also include Census division by year by 3-Digit NAICS fixed effects. Standard errors are clustered by state.

heiny and Siegloch, 2019), which examines the dynamic effects of NCA policy changes over time.[7] The resulting coefficients, shown with corresponding 95% confidence intervals in Figure 1, may be interpreted identically to an event study model. The coefficients in years $t-k$ represent the effect on HHI in year y of a law which will be changed k years in the future. We therefore expect, if NCA law changes are conditionally exogenous to past HHI, that the "pre-trend" in years $t-k$ will be essentially flat, and roughly equal to zero. Indeed, this is what we see in each of those years.

Following law changes (in years $t+k$), the coefficients may be interpreted as the effect of a law change which occurred k years in the past, beginning with the year of the law change, $t=0$. Here, we see that concentration rises substantially following NCA law changes, and appears to remain at a high level several years into the future.[8]

The effect is consistent and relatively large: at its peak, an NCA score increase of 1 (i.e., from the minimum observed enforceability level to the maximum) is associated with an HHI increase of just under 150 points relative to baseline. Compare this, for example, with the U.S. Department of Justice & FTC 2010 Horizontal Merger Guidelines, which state that, in moderately and highly concentrated markets, HHI increases of 150 points "potentially raise significant competitive concerns

[7]See Appendix A for details of the model, as well as details on sample selection and data imputation.

[8]Note that an identical analysis based on 4-digit NAICS level HHIs yields similar results. Using finer NAICS classifications may more accurately identify markets where concentration may affect outcomes; however, this comes at the cost of losing data due to privacy-related data omissions introduced by the Census Bureau.

and often warrant scrutiny."[9]

Several limitations of this analysis must be noted. First, the CBP data only contains employment information for establishments, rather than firms. It is therefore possible that firm-level HHIs (which are more likely to be reflective of competitive conditions in an industry) would react differently to changes in NCA enforceability (as, e.g., is found in Hausman and Lavetti (2021)). Running a comparable analysis to the one presented above using the US Census Bureau's Statistics of US Businesses (which presents data for firms, but only at the state level) returns directionally identical results. We present the analysis based on the CBP to isolate the local nature of markets which are likely to be affected by state-level law changes.

Second, the HHI measure we construct is based on employment, rather than unit sales or revenue. While it is likely that shares based on employment are correlated with shares based on some measure of sales, the analysis would benefit from direct data on sales, which are not easily available for broad swaths of the American economy.

Finally, our calculation of HHI uses imputed employment, which may be relatively imprecise. Employment is not reported directly in the CBP to protect privacy, and we therefore use the midpoint of the reported cells as a proxy for actual employment.

3 Model

Motivated by the impact of NCA law changes on HHI, we develop a model in which the owner of an incumbent monopoly firm hires a worker that has the potential to found a competing firm using industry-specific knowledge naturally acquired on the job. The owner may make a costly, productivity-enhancing investment in the worker's human capital (e.g., providing skills training for the worker or imparting a valuable trade secret), but faces a hold-up problem (Williamson, 1975; Klein et al., 1978; Hart and Moore, 1990): if the worker is the claimant on rents associated with the investment (because she can threaten to spin off a competing firm or go to work for a competitor), the owner will not have sufficient incentive to invest. This situation is often used as a justification for the use of an NCA, which the firm may decide to use. By ensuring that a worker cannot spin off a competing firm or work for a competitor, an NCA ensures that owners receive returns on their investments, encouraging the owner to make that investment in the first place (Rubin and Shedd, 1981).

To model this explicitly, suppose that the worker and incumbent firm may agree to use an NCA when they begin the employment relationship. We denote the employment contract by $\{w, NCA\}$, where w is the wage that the owner pays the worker and $NCA \in \{0, 1\}$ indicates the existence

[9] The 2010 Horizontal Merger Guidelines are available at https://www.justice.gov/atr/horizontal-merger-guidelines-08192010.

(1) or nonexistence (0) of an NCA. If a contract includes an NCA, then the worker may not form a spinoff without permission from the incumbent.[10] We allow contracts to be freely renegotiable, however: permission to found a spinoff may be granted if the worker makes a buy-out payment to the incumbent that is mutually agreed upon. We denote such a buy-out payment by BO. Similarly, without an NCA, the incumbent firm may make a *buy-in* payment to the worker to induce that worker *not* to found a spinoff: we denote such a side payment by BI.[11]

After the initial contract decision is made, both players observe the spinoff marginal cost draw, c_s, which is drawn from the distribution $F(\cdot)$, and then the worker makes the spinoff decision. One input into this decision may be the incumbent firm's marginal cost, c_i, which is exogenously given and observed by all players at the start of the game. If the worker pursues a spinoff, then the incumbent firm (which continues to face a marginal cost of c_i) competes with the spinoff, which operates at marginal cost c_s. Instead, if the worker remains employed by the incumbent, then the single firm operates at marginal cost c_i. We implicitly assume that the incumbent cannot use the cost draw of the spinoff: if it could, spinoffs would not occur in equilibrium, which is not true in reality. In practice, this restriction can be explained by nontransferable aspects of costs, such as differences in business philosophies or organizational or managerial differences, which would be costly to change in the incumbent firm.

Prior to the realization of c_s, but after the initial contract, $\{w, NCA\}$, has been agreed upon, the owner of the incumbent firm must decide whether or not to make a costly investment. The owner may choose to pay a one-time, exogenously determined cost, κ, to make a binary, relationship-specific investment which increases profit for the owner-worker pair if they operate as one firm. The specificity of the investment means that if the worker spins off, all value from the investment will be lost, but if the worker remains employed by the incumbent, profit will be greater than without the investment.

Altogether, the formal timing of the game is as follows. First, the incumbent owner makes a take-it-or-leave-it contract offer, $\{w, NCA\}$, to the worker, where $w \in \mathbb{R}$ and $NCA \in \{0, 1\}$. The worker may accept or reject the contract. If the worker rejects, each agent receives their outside option (normalized to zero for each agent) and the game ends. If the worker accepts the contract, then the owner pays the worker w and makes its investment decision, $I \in \{0, 1\}$. After the owner's investment decision, the worker's spinoff marginal cost, c_s, is observed by both parties. When

[10] We focus attention on employee spinoffs as a leading example, and to simplify the language used in the paper. However, the worker may comparably bring their knowledge to a new or existing firm they do not own (and which is therefore not a spinoff), and the mechanisms presented in this paper are largely unchanged.

[11] In reality, the renegotiability of an NCA or a payment made for a worker not to found a spinoff may be limited for a variety of reasons, such as liquidity constraints, reputational concerns, behavioral factors, or the law. We abstract away from these to focus attention on a model which explains the effects of NCAs without relying on, for example, behavioral explanations or liquidity constraints.

$NCA = 0$, the worker may spin off, or may make a take-it-or-leave-it offer[12] of a buy-in payment to the owner, BI, which, if accepted, will cause the worker to remain employed by the incumbent. With $NCA = 1$, the worker may decide to remain employed by the owner, or make a take-it-or-leave-it offer, BO, to the owner which, if accepted, allows the worker to buy out of the NCA and spin off. If the worker remains employed by the incumbent, then the owner receives gross profit $\Pi_{i,M}(I)$ from the final goods market,[13] where M represents that the market is a monopoly.[14] If the worker spins off, then the worker receives gross profit $\Pi_s(c_s)$ and the owner receives gross profit $\Pi_{i,D}(c_s)$ from the final goods market.

We assume that agents are risk-neutral, seek to maximize payoffs, and that information is perfect. To allow for a variety of market structures we make the following assumptions:

Assumption 1. *We assume that*

a. $\Pi_{i,M}(1) > \Pi_{i,M}(0) \geq \Pi_{i,D}(c_s)$ *for all* c_i, c_s

b. $\frac{d\Pi_s(c_s)}{dc_s} < 0$

c. $\frac{d\Pi_{i,D}(c_s)}{dc_s} > 0$ *but* $\frac{d(\Pi_{i,D}(c_s)+\Pi_s(c_s))}{dc_s} < 0$

d. For all I, there exists a $\bar{c}_s(I)$ such that $\Pi_s(c_s) + \Pi_{i,D}(c_s) > \Pi_{i,M}(I)$ *for all* $c_s < \bar{c}_s(I)$ *and* $\Pi_s(c_s) + \Pi_{i,D}(c_s) < \Pi_{i,M}(I)$ *for all* $c_s > \bar{c}_s(I)$.[15]

Qualitatively, Assumption 1a requires that investment by the incumbent owner improves gross profits when the incumbent firm is a monopoly, as well as requiring that monopoly profits exceed duopoly profits for the incumbent owner. Assumption 1b simply ensures that spinoff profits are decreasing in marginal cost. Assumption 1c states that the incumbent owner's profits are increasing in *spinoff* marginal costs in a duopoly, but the sum of gross profit in the market is decreasing in spinoff costs. Finally, Assumption 1d requires a threshold value of c_s, above which monopoly outperforms duopoly from the perspective of the pair, and below which duopoly outperforms monopoly.

[12]The assumption that buy-in and buy-out payment offers are take-it-or-leave-it, made by the worker, is unimportant: the alternative assumptions that the owner makes the offer, or that bargaining occurs, would not change the predictions of our model except for the ex-post allocation of cash between the worker and owner.

[13]This formulation of the incumbent firm's monopoly profit tacitly assumes that profit does not rely on c_s (the spinoff's marginal cost). Many of our results do not rely on this assumption; results are qualitatively equivalent if we instead assume that $\Pi_{i,M}(\cdot)$ depends on c_s. We use the current formulation for tractability and notational brevity. Similarly, since c_i is exogenously given at the outset of the model, and not a major focus of exploration in this paper, we omit it when writing the gross profit functions for brevity.

[14]To highlight the competitive issues involved in our model, we use the subscripts M and D to denote "monopoly" and "duopoly" markets. However, M may alternatively be understood to signify a market with $N \in \mathbb{N}$ firms, and D to signify a market with $N + 1$ firms. As long as Assumption 1 is satisfied, our model is robust across a variety of oligopoly settings where other competing firms may exist.

[15]The direction of the inequalities stem from Assumption 1c.

4 Equilibrium

Our solution concept is Subgame Perfect Nash Equilibrium. Solving the model backwards, the last stage of the game is the spinoff decision of the worker. Given frictionless renegotiation, this decision is straightforward: whenever the sum of profits in duopoly is greater than the sum of profits in monopoly, the worker founds a spinoff. Formally, the worker spins off whenever

$$\Pi_s(c_s) + \Pi_{i,D}(c_s) > \Pi_{i,M}(I).$$

Buy-in or buy-out payments are made if necessary to ensure that the owner receives as much as she would have had the "default" action (i.e., the market remaining a monopoly when $NCA = 1$ or the market becoming a duopoly when $NCA = 0$) occurred. So, when $NCA = 1$, the incumbent would receive $\Pi_{i,M}(I)$ if the worker does not spin off. If the worker opts to spin off, the payment BO is set so that $\Pi_{i,D}(c_s) + BO = \Pi_{i,M}(I)$. Note that, by Assumption 1a, $\Pi_{i,M}(I) \geq \Pi_{i,D}(c_s)$, so $BO \geq 0$. Similarly, when $NCA = 0$, the incumbent would receive $\Pi_{i,D}(c_s)$ if the worker spins off, and so BI is set such that $\Pi_{i,M}(I) + BI = \Pi_{i,D}(c_s)$. Again, since $\Pi_{i,M}(I) \geq \Pi_{i,D}(c_s)$, $BI \leq 0$ (i.e., BI is a payment made from the incumbent to the worker).

Beyond the spinoff decision, the next important feature of equilibrium is the hold-up problem (the relationship between NCA use and the incumbent owner's investment decision). Solving the investment decision subgame generates the following result:

Lemma 1. *If $NCA = 1$, then $I = 1$ if and only if $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$. Instead, if $NCA = 0$, then $I = 0$ for all $\kappa > 0$.*

All proofs may be found in Appendix B.

The investment decision is intuitive: with an NCA, regardless of whether the worker spins off, the owner controls the rents related to the investment and will be compensated accordingly. Therefore, the only thing that matters in the owner's investment decision is whether the investment contributes more to monopoly profits than it costs. Without an NCA, since the worker effectively controls the rents related to investment (due to her ability to credibly threaten to spin off), the owner is unable to recoup any of the rents associated with investment and is therefore unwilling to invest at any cost; in other words, the holdup problem prevents investment without an NCA.

Turning to the contracting stage, both the owner and the worker know that an NCA, with $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$, results in investment by the owner. Given that renegotiation is frictionless, an NCA is used whenever the expected value for the pair is greater with an NCA than without. Naturally, if $\kappa > \Pi_{i,M}(1) - \Pi_{i,M}(0)$ so that investment does not occur with or without an NCA (by Lemma 1), then use of an NCA makes no difference. However, if $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$, then the pair may or may not agree to an NCA in equilibrium:

Proposition 1. *If $\kappa > \Pi_{i,M}(1) - \Pi_{i,M}(0)$, then frictionless renegotiations cause contracts to be "inconsequential": the owner and worker receive identical expected utility with $NCA = 0$ or $NCA = 1$.*

Instead, if $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$, then there exists a $\tilde{\kappa} \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$ so that $NCA = 1$ in equilibrium if $\kappa \leq \tilde{\kappa}$ and $NCA = 0$ otherwise.

To understand why there exist values of κ close to but potentially less than $\Pi_{i,M}(1) - \Pi_{i,M}(0)$ where the owner and worker choose not to use an NCA, and then invest, consider a case where $\kappa = \Pi_{i,M}(1) - \Pi_{i,M}(0) - \epsilon$ for some small $\epsilon > 0$. In this case, an NCA followed by investment generates only a minor gain when the realization of c_s is such that a monopoly occurs; however, the cost κ generates no benefit when the realization of c_s is such that a duopoly occurs.[16] Thus, this loss in surplus from an investment that results in a duopoly restricts the pair's willingness to adopt an NCA in the initial contracting stage where the pair evaluates contracts based on the joint expected profit.

To complete the game and fully characterize the equilibrium outcomes across all realizations of c_s, we now discuss critical values that we use extensively: $\bar{c}_s(I)$ (for $I = 0$ and 1), as defined in Assumption 1d. The critical values $\bar{c}_s(I)$ represent the values of c_s such that $\Pi_{i,D}(c_s) + \Pi_s(c_s) = \Pi_{i,M}(I)$. Therefore, $\Pi_{i,D}(c_s) + \Pi_s(c_s) > \Pi_{i,M}(I)$ if and only if $c_s < \bar{c}_s(I)$. Furthermore, Assumption 1a implies that $\bar{c}_s(1) < \bar{c}_s(0)$. Intuitively, $\bar{c}_s(I)$ represents the cutoff at which duopoly joint profits equal monopoly profits (so the pair is indifferent between the worker founding a spinoff or not).

Given these thresholds, we describe the realized market outcomes (that depend on the realization of c_s) in Figure 2. In cells [1] and [2], we see that $\kappa > \bar{\kappa}$ so that NCAs are not used and investment does not occur; in addition, market structure depends on the total profit comparison so that a duopoly occurs whenever $c_s < \bar{c}_s(0)$ (i.e., whenever $\Pi_{i,D}(c_s) + \Pi_s(c_s) > \Pi_{i,M}(0)$). In cells [3]-[5], NCAs are used and the owner invests in the worker; however, the benefits of investment are only realized when a monopoly occurs, which happens whenever $\Pi_{i,D}(c_s) + \Pi_s(c_s) < \Pi_{i,M}(1)$ (i.e., whenever $c_s > \bar{c}_s(1)$).

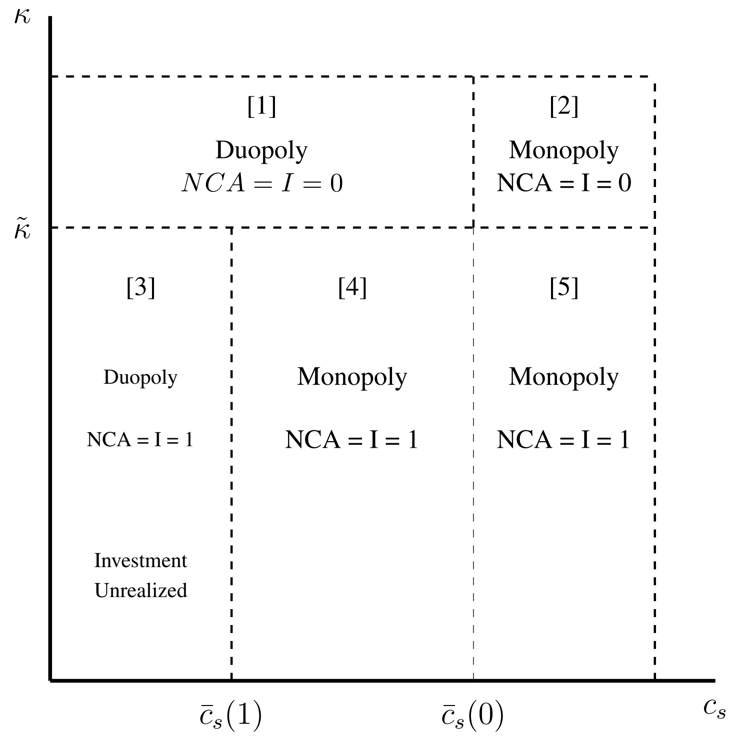
5 Policy and Heterogeneity

To illustrate the extent to which our model can inform policy, we consider an outright ban on NCAs.[17] Our model does not consider the full range of economic benefits and harms that would

[16]Of course, the difference in monopoly profit from investment, $\Pi_{i,M}(1) - \Pi_{i,M}(0)$, also impacts the c_s required for a duopoly to occur under $I = 1$ versus $I = 0$. To see a richer discussion, consider Equation (5) and the paragraphs that follow in Appendix B.

[17]This policy is comparable to the "Ban on Non-Compete Agreements Amendment Act of 2020", recently passed in Washington, DC. Note that most recently passed bans on NCAs (e.g., in Virginia, Maryland, Illinois, Massachusetts,

Figure 2: Equilibrium Realizations



result from such a ban; however, it does shed light on one particular tradeoff for consumers when NCAs are banned: consumers benefit from an increased likelihood that a duopoly will emerge, but they are harmed by decreased investment on the part of the owner, which may lower marginal costs and pass through to lower prices.

In this section, we first consider comparative statics with respect to characteristics of firms and markets which may drive a ban on NCAs to be more or less attractive when measured by consumer welfare. In Section 5.1, we look at the nature of competition in duopolies and how investments pass through to consumers. In Section 5.2, we look at the size of the benefit from investment. Then, we derive a generalized expression indicating when NCAs should optimally be banned, based solely on a consumer welfare criterion.

5.1 Competition and Pass-Through

The tradeoff related to NCA policy (as it pertains to *consumer* welfare) is governed directly by market structure and the benefits from firm investment. The extent to which the harm and benefit pass through to consumers is unclear without further details of the market.

On the market power side of the tradeoff, the primary characteristic of the market which im-

and others) apply only to workers making below a certain income threshold, or who satisfy other restrictions.

pacts the extent to which NCA policy impacts consumers is the nature of duopoly competition between the incumbent and the spinoff. Consider, for example, a spectrum where, at one end, the duopoly competes $\grave{a}$ la homogenous Bertrand, and at the other end, $\grave{a}$ la homogeneous Cournot. This distinction is important because differing levels of duopoly competition change the market power harms of NCAs. Broadly speaking, when the difference between a monopoly and duopoly is large (because the firms Bertrand compete), a given NCA will cause a larger gross harm than if that difference is small (Cournot competition), since price differences are amplified when moving from a monopoly incumbent to a more competitive market. However, note that the nature of competition also affects the cutoff values which determine when spinoffs will occur, as well as the investment decision and the decision of whether or not to use an NCA in the first place.

To consider these features in our context, we borrow the conduct parameter and pass-through approach from Weyl and Fabinger (2013). This allows us to abstract away from the exact nature of competitive interaction and investment benefits by assuming that there exists a market power parameter (known as the conduct parameter), θ, and an investment pass-through parameter, ρ, that captures the extent to which investment benefits pass onto consumers (e.g., if investment reduces marginal costs by ΔC, then $\rho \cdot \Delta C$ of those savings are passed onto consumers in the form of lower prices).[18] The conduct parameter $\theta \in [0, 1]$ captures the amount of market power so that $\theta = 0$ corresponds to homogenous Bertrand competition, $\theta = 1$ corresponds to a monopoly or perfect collusion, and $\theta = {}^1\!/_N$ corresponds to homogenous Cournot competition.[19]

Given this approach, we immediately see that (a) the duopoly price is increasing in market power $\left(\frac{dp_D}{d\theta} > 0\right)$ while the monopoly price is unaffected by duopoly conduct $\left(\frac{dp_M(I)}{d\theta} = 0\right)$ for $I \in \{0, 1\}$, and (b) prices are decreasing in consumer investment pass-through only when investment occurs $\left(\frac{dp_M(I=1)}{d\rho} < 0 \text{ and } \frac{dp_M(0)}{d\rho} = \frac{dp_D}{d\rho} = 0\right)$. In addition, we now rewrite the profit functions so that the incumbent receives $\Pi_{i,D}(c_s, \theta)$ under a duopoly, the spinoff receives $\Pi_s(c_s, \theta)$ under a duopoly, and the incumbent receives $\Pi_M(I, \rho)$ under a monopoly with $\Pi_M(0, \rho) = \Pi_M(I, 1)$ capturing the cases where investment generates no profit either because investment does not occur $(\Pi_M(0, \rho))$ or because all benefits from investment pass-through to consumers $(\Pi_M(I, 1))$. Under this characterization, we have that (a) $\frac{d\Pi_{i,D}(c_s,\theta)}{d\theta}, \frac{d\Pi_s(c_s,\theta)}{d\theta} > 0$ and $\frac{d\Pi_M(I,\rho)}{d\theta} = 0$ and (b) $\frac{d\Pi_M(I,\rho)}{d\rho} \leq 0$ and $\frac{d\Pi_{i,D}(c_s,\theta)}{d\rho}, \frac{d\Pi_s(c_s,\theta)}{d\rho} = 0$. Altogether we see that, conditional on market structure and c_s, θ only impacts duopoly markets and ρ only impacts the monopoly market; however, these parameters will play important roles in determining consumer surplus, NCA tradeoffs, and market outcome thresholds.

Since the model introduced in Section 3 was agnostic about the nature of competition and

[18] On the cost savings side of the tradeoff, several market characteristics may impact pass-through to consumers (see, e.g., Gron and Swenson (2000); Bonnet et al. (2013); Miller et al. (2017)).

[19] Weyl and Fabinger (2013) provide a rich set of micro-foundations that support such a parameterization.

investment pass-through, we examine the effect of θ and ρ on outcomes. We first focus on *within-box* differences, where boxes [1]-[5] are those depicted in Figure 2. In other words, we first take as given the NCA use and investment decisions, and focus on how consumer welfare changes when competition and pass-through change, considering those changes across NCA policies.

Regardless of NCA policy, [1] will always contain a duopoly without investment, [2] will always contain a monopoly without investment, and [3] will always contain a duopoly with (unrealized) investment, and all three are therefore uninteresting for the purposes of this section. In [4], both θ and ρ play a role: when NCAs are allowed, the market is a monopoly with (realized) investment, whereas when NCAs are banned, the market is a duopoly without investment. In other words, the differential impact on price of banning NCAs is the sum of the differential impacts from θ and ρ. Finally, in [5], the market will always be a monopoly (whether or not NCAs are allowed), and therefore only ρ plays a role: when ρ is positive (i.e., when investment pass-through to consumers exists), an NCA ban will harm consumers by reducing investment without increasing market competition.[20]

Moving now to changes in the boundaries between the boxes, consider first the thresholds $\bar{c}_s(0)$ and $\bar{c}_s(1)$. Recall that these thresholds are the critical values of the spinoff marginal cost which govern the spinoff decision of the worker, depending on the investment decision of the firm. These thresholds are determined by the joint profitability of the incumbent and spinoff firms, versus the incumbent firm remaining a monopolist: $\bar{c}_s(I)$ is given by $\Pi_s(\bar{c}_s(I), \theta) + \Pi_{i,D}(\bar{c}_s(I), \theta) = \Pi_M(I, \rho)$. Therefore, as the duopoly structure gains market power, $\Pi_s(\bar{c}_s(I), \theta) + \Pi_{i,D}(\bar{c}_s(I), \theta)$ increases, meaning that the value of c_s which makes the two sides equal is now larger. Put simply, greater market power in the duopoly allows for more spinoffs so that $\frac{d\bar{c}_s(I)}{d\theta} > 0$ for $I = 0, 1$.

The value of ρ does not play a role in determination of $\bar{c}_s(0)$, since investment does not play a role. However, ρ does play a role when considering $\bar{c}_s(1)$, which is defined by $\Pi_s(\bar{c}_s(1), \theta) + \Pi_{i,D}(\bar{c}_s(1), \theta) = \Pi_M(1, \rho)$. In this case, as the investment pass-through to consumers increases, $\Pi_M(1, \rho)$ decreases, meaning that the value of c_s which makes the two sides equal is now smaller. In other words, for large ρ, investment benefits pass-through in large part to consumers meaning that producers benefit less from investment. Therefore, the difference between $\Pi_M(1, \rho)$ and $\Pi_M(0, \rho)$ is smaller so that a large ρ results in a lower $\bar{c}_s(1)$ that approaches $\bar{c}_s(0)$.

To summarize, increased competition within the duopoly (through a reduction in market power captured by θ) lowers both $\bar{c}_s(0)$ and $\bar{c}_s(1)$. More competitive duopoly structures therefore decrease the attractiveness of an NCA ban from a consumer welfare perspective by increasing the mass that

[20]Given that a ban on NCAs harms consumers for equilibria in [5], it is worth noting that we implicitly assume that $c_i \geq \bar{c}_s(1)$. In this case, if the spinoff also has no chance of being more efficient than the incumbent (so that every c_s draw is greater than c_i and $\bar{c}_s(1)$), then only the outcomes in [2] and [5] occur so that a ban on NCAs is always detrimental to consumers. Altogether, this implies that NCAs that foreclose inefficient spinoffs are always beneficial to consumers as they prevent the investment holdup and allow investment benefits to pass-through to consumers.

will be on [5], which is where the unambiguous benefits of NCAs accrue. Factors that drive larger investment pass-through to consumers will decrease $\bar{c}_s(1)$, but do not change $\bar{c}_s(0)$: therefore, when investment pass-through to consumers is larger, an NCA ban is less attractive as the mass on [5] increases.

Finally, we consider $\tilde{\kappa}$. The value $\tilde{\kappa}$ represents the critical value of κ, the cost of investment, at which the owner/worker pair is indifferent between using an NCA and not. This determination is made by considering all the effects of investing: a monopoly with reduced costs and a diminished probability of a spinoff (see Equation (5)). Both investment pass-through to consumers and market power play a role in this determination. First, they impact the thresholds $\bar{c}_s(0)$ and $\bar{c}_s(1)$, as described above, which factor into $\tilde{\kappa}$. They also impact the magnitudes of profit, which determine whether the firm wishes to use an NCA or not. Ultimately, the impact of increased duopoly competition and increased investment pass-through is ambiguous. However, from a policy perspective, it is less important to pin down the exact nature of the impact on $\tilde{\kappa}$: while $\tilde{\kappa}$ influences whether or not a firm uses an NCA, it does not impact whether it is harmful or beneficial. In other words, consider two states of the world with identical values of $\tilde{\kappa}$: one in which $\kappa < \tilde{\kappa}$ (and therefore the firm uses an NCA) and one in which $\kappa > \tilde{\kappa}$ (and therefore the firm does not). If the firm in the latter state of the world accidentally used an NCA, it would be equally beneficial or harmful to consumers as the firm's NCA in the state of the world where the profit-maximizing decision was not to use an NCA.

Corollary 1. *In summary, we formally have the following results:*

1. *Greater duopoly competition (conditional on the spinoff occurring) implies that monopoly outcomes — with and without investment — are more likely to occur in equilibrium:* $\frac{d\bar{c}_s(I)}{d\theta} > 0$ *for* $I = 0, 1$.

2. *Greater investment pass-through to consumers does not impact the spinoff decision without investment (i.e.,* $\frac{d\bar{c}_s(0)}{d\rho} = 0$*). However, greater investment pass-through to consumers causes spinoff decisions with investment to approach spinoff decisions without investment (i.e.,* $\frac{d\bar{c}_s(1)}{d\rho} > 0$ *and* $\bar{c}_s(1) = \bar{c}_s(0)$ *when* $\rho = 1$*). Graphically, as* ρ *increases, [3] expands while [4] contracts in Figure 2, and when* $\rho = 1$*, [4] disappears so that [3] and [5] mirror [1] and [2] in Figure 2.*

3. *Greater competition between the incumbent and the spinoff or greater investment pass-through to consumers have ambiguous effects on NCA usage:* ρ *and* θ *have ambiguous effects on* $\tilde{\kappa}$.

Taken all together, under what circumstances should policymakers expect that a ban on NCAs would be most likely to benefit consumers? When duopoly markets generate relatively low prices (competition is fierce), consumers are helped more by a ban on NCAs because the duopoly is so beneficial; however, firms are more likely to retain their monopoly structure since the resulting duopoly would be less profitable for them. On the other hand, when investment pass-through is high, consumers are hurt more by a ban on NCAs because highly beneficial investments will never occur; nevertheless, consumers are helped more by a ban on NCAs because spinoffs are relatively more likely to occur.

While the circumstances of any given industry, occupation, or slice of the labor market are important to consider, it is likely that the first-order impacts (i.e., that Bertrand-style duopolies cause an NCA ban to benefit consumers more than in a Cournot-style duopoly, and that high investment pass-through causes an NCA ban to hurt consumers more than low investment pass-through) dominate the second-order impacts. If this is indeed the case, when considering an NCA ban, policymakers should weight more highly slices of the economy where increased competition is likely to have a large impact on prices and where investment pass-through to consumers is relatively low.

5.2 The Benefit of Investment

The benefits or harms of banning NCAs are also affected by the relative payoff of investment. In our baseline model, we operationalize investment by assuming that the monopoly firm's profit (not necessarily net of the cost of investment itself) increases after it invests in the worker. In Section 5.1, we further assume that some percentage of the investment benefit, ρ, passes through to the consumer. We now introduce a parameter, $\iota > 0$, which represents the magnitude of the surplus benefit from investment so that $\Pi_M(I, \rho)$ from 5.1 becomes $\Pi_M(I, \rho, \iota)$, where ι captures the surplus generated in the market from investment (either through a cost reduction or an increase in demand). We accordingly assume that $\frac{d\Pi_M(I,\rho,\iota)}{d\iota} > 0$, and we now have that $\Pi_M(0, \rho, \iota)$, $\Pi_M(I, 1, \iota)$, and $\Pi_M(I, \rho, 0)$ all capture the case where the incumbent earns no benefit from investment.

Ignoring for the time being the impacts of ι on $\tilde{\kappa}$ and $\bar{c}_s(I)$, the first order impact of an increase in ι on consumers occurs either through a price reduction (from investment reducing costs) or through an increase in price and consumer surplus due to an increase in demand. Thus, while the price effect is ambiguous (depending on the type of investment), consumers clearly benefit from investments that generate greater surplus. At the same time, the prices $p_M(0)$ and p_D are unaffected.

The size of ι is also going to impact the size of each of the boxes in Figure 2. First consider the values of $\bar{c}_s(0)$ and $\bar{c}_s(1)$ which generate the vertical lines that divide [3] from [4], and [1] and [4] from [2] and [5]. Extending the expression to include ι, $\bar{c}_s(I)$ is defined by $\Pi_{i,D}(\bar{c}_s(I)) + \Pi_s(\bar{c}_s(I)) = \Pi_M(I, \rho, \iota)$. Given that no investment occurs when $I = 0$, we clearly have that $\bar{c}_s(0)$

is unaffected by ι. However, the value of $\bar{c}_s(1)$ is affected by changes in ι. Since joint profits of the duopoly are decreasing in c_s, it must be the case that $\frac{d\bar{c}_s(1)}{d\iota} < 0$. Again, this is intuitive: as the value of investment increases, spinoffs are less likely to occur, as the monopoly is more profitable and it is more difficult for the pair to find an acceptable buyout payment which makes both parties better off. Hence, under an NCA (and only under an NCA), greater ι implies that a monopoly occurs under a larger mass of c_s draws (increasing the size of [4] and decreasing the size of [3]).

Corollary 2. *In summary, we formally have the following results:*

1. *A larger surplus from investment increases consumers surplus (either through a price reduction or through an increase in demand):* $\frac{d\,CS}{d\iota} > 0$.
2. *Greater surplus from investment does not impact the spinoff decision without investment (i.e.,* $\frac{d\bar{c}_s(0)}{d\iota} = 0$*). However, greater surplus from investment causes spinoff decisions with investment to shrink (i.e.,* $\frac{d\bar{c}_s(1)}{d\iota} < 0$*). Graphically, as* ι *increases, [4] expands while [3] contracts in Figure 2.*

Lastly, consider $\tilde{\kappa}$ which generates the horizontal line that divides [1] and [2] from [3]-[5]. In this case we obtain the following result:

Proposition 2. *Greater benefits from investment result in greater NCA use:* $\left(\text{i.e., } \frac{d\tilde{\kappa}}{d\iota} \geq 0\right)$.

How do these relationships inform NCA policy? Based solely on the first order effect of ι on consumer welfare when NCAs are allowed, a ban becomes more harmful as ι increases (since the ban prevents investment which generates added consumer benefit with higher ι). While there are impacts on the thresholds to consider, when ι is low, a ban is (weakly) beneficial to consumers (with certainty when $\iota = 0$). As ι increases, a ban becomes less beneficial as $p_M(1)$ decreases or quality increases.

The effects on thresholds are more nuanced. Counterintuitively, and in contrast with historical arguments about NCAs and the hold-up problem, it is possible that larger benefits from investment may actually harm consumers. For example, when investment pass-through to consumers is low, the increase in monopoly prevalence due to greater investment benefit may hurt consumers more (by encouraging monopoly markets) than they help (due to low pass-through of investment). More formally, consider $\rho = 0$ with marginal cost reducing investment. In this case, $p_M(0) = p_M(1)$, since none of the benefit from investment passes through to consumers, and therefore $\frac{dp_M(0) - p_M(1)}{d\iota} = 0$. However, consumers are still harmed by the increase in the probability that a monopoly will occur so that the expected price increases in the size of the investment.[21]

[21]Formally, using notation from the proofs of Propositions 1 and 2, we have that $\frac{d(1-\mathcal{P}^{NCA})p_M(1)+\mathcal{P}^{NCA}p_D}{d\iota} > 0$ since $\frac{\mathcal{P}^{NCA}}{d\iota} < 0$.

For small values of ρ, this relationship still holds, since $\frac{dp_M(0)-p_M(1)}{d\iota}$ will be small, while harm due to monopoly may still be quite large, though at some point the relationship may flip such that increased investment benefits consumers for sufficiently high levels of investment pass-through to consumers.

Formally, Corollary 3 summarizes this result. For simplicity in this Corollary, we assume that investment benefits pass through to prices (as opposed to product quality), such that monopoly price may be written as a function of ρ and ι, i.e., $p_M(\rho, \iota)$.

Corollary 3. *There exists $\tilde{\rho} > 0$ such that $\frac{d(1-\mathcal{P}^{NCA})p_M(\rho,\iota)+\mathcal{P}^{NCA}p_D}{d\iota} > 0$ if and only if $\rho < \tilde{\rho}$: increases in the benefits from investment cause consumers to pay higher expected prices when investment pass-through to consumers is sufficiently low.*

A similar result is that changes in ι affect $\tilde{\kappa}$ (see Proposition 2). Therefore, there is an analogous "extensive margin" result with the benefit from investment: when ι increases, use of NCAs increases due to an increase in $\tilde{\kappa}$. Whenever the additional harms caused by increased use of NCAs outweigh the benefits obtained by consumers (due to low pass-through, for example), the increase in ι will further harm consumers.

These counterintuitive results are especially important because industries with low investment pass-through to consumers and high benefit of investment are exactly those where protection of investments with NCAs is most important, since firms reap substantial benefit from being able to invest. In other words, while a high rate of NCA use is not proof positive, it is evidence that is consistent with consumer harm due to NCAs: if investment pass-through were high (which would be most beneficial to consumers), then firms would have less incentive to use NCAs, as they would reap less of their benefit.

5.3 Analysis of an NCA Ban

Graphically, an NCA ban means that the investment decisions in cells [3]-[5] in Figure 2 change to the respective investment decisions in cells [1] and [2]: in all of cells [3]-[5], $NCA = I = 0$ when NCAs are banned (Lemma 1). Additionally, the market in cell [4] will be a duopoly: since investment does not occur even for $\kappa < \tilde{\kappa}$ when NCAs are banned, the benefits of investment do not drive the market structure to remain a monopoly.

Consider an extension of the model: at time $t = 0$, the policymaker chooses policy (whether or not to ban NCAs). Then, after observing the policymakers decision, a representative firm and worker decide whether or not to use an NCA. Time $t = 1$ is the first period of the firm's existence and production, during which a cost-saving investment may be made. At time $t = 2$, the worker decides whether or not to spin off. Finally, let time $t = 3$ be a second period of production where the worker may have spun off to form a new firm.

While there may be further concerns for a policymaker, we consider a policymaker focused solely on price: what is the expected change in price due to allowing NCAs versus not? Simplifying, let $\mathcal{P}^{NCA}$ be the probability of a spinoff with an NCA (i.e., $Pr(c_s < \bar{c}_s(1))$, and let $\mathcal{P}^{Free}$ be the probability of a spinoff when the worker does not have an NCA (i.e., $Pr(c_s < \bar{c}_s(0))$).[22] Let $\Delta\theta \cdot \frac{P}{-\epsilon}$be the change in price due to market power[23] and $\rho\Delta C$ be the change in price due to increased investment (incentivized by NCAs)[24]. Here, $\Delta\theta \cdot \frac{P}{-\epsilon}$ is interpreted as the difference in price between a monopoly and duopoly market structure, holding fixed any reductions in cost due to investment. Similarly, $\rho\Delta C$ is interpreted as the difference in price for a monopolist, with and without the investment having been made. Finally, let γ be the probability that the representative firm signs an NCA (supposing, for example, that exogenous parameters may be randomly drawn prior to $t = 1$, driving differences in κ).

The expected price in the market when NCAs are allowed is therefore given by

$$P + \gamma \left[\mathcal{P}^{NCA} \left(-\Delta\theta \cdot \frac{P}{-\epsilon} \right) + (1 - \mathcal{P}^{NCA})(-\rho\Delta C) \right] + (1-\gamma) \left[\mathcal{P}^{Free} \left(-\Delta\theta \cdot \frac{P}{-\epsilon} \right) \right],$$

where P represents the price that would prevail in the monopoly market with no cost savings. The expected price in the market when NCAs are not allowed is given by

$$P + \mathcal{P}^{Free} \left(-\Delta\theta \cdot \frac{P}{-\epsilon} \right).$$

The expected price difference is therefore

$$E(\Delta P) = \gamma \left[(\mathcal{P}^{NCA} - \mathcal{P}^{Free}) \left(-\Delta\theta \cdot \frac{P}{-\epsilon} \right) + (1 - \mathcal{P}^{NCA})(-\rho\Delta C) \right],$$

and the policymaker optimally bans NCAs (based solely on the price criterion) whenever

$$(\mathcal{P}^{Free} - \mathcal{P}^{NCA})\Delta\theta \cdot \frac{P}{-\epsilon} > (1 - \mathcal{P}^{NCA})\rho\Delta C. \tag{1}$$

[22]At the extreme, if spinoffs never occur (because $\bar{c}_s(1) > c_i$, for example), NCAs are clearly beneficial and a ban would harm consumers. This is because there is no market power benefit to banning NCAs, but a ban would eliminate beneficial investment. As the probability of a spinoff increases (e.g., because the distribution of c_s shifts downwards), the benefits of an NCA ban decrease, since the negative effects of NCAs with respect to market power increase.

[23]Under the conduct parameter approach, equilibrium prices are given by $P = C + \theta\frac{P}{-\epsilon}$ so that a change in market power by $\Delta\theta$ (holding costs fixed) results in a price change of $\Delta\theta \cdot \frac{P}{-\epsilon}$.

[24]We use ρ as pass-through akin to our explanation of investment benefits in Section 5.1

6 Analogies with Antitrust

In this section, we provide two analogies to antitrust theory and practice in order to guide policymakers. The link between NCAs and consumers has not been deeply explored in policy spaces. Therefore, we intend for this section to allow policymakers to leverage their familiarity with two more deeply explored practices to better understand the mechanisms by which NCAs affect consumers. The analogies are not meant to be perfect facsimilies of the NCA mechanisms described above: rather, they are meant to be demonstrative of important pieces of the puzzle, especially with respect to how those pieces have been treated by policy in the past. We reiterate that NCAs may have many effects, including effects on workers, firms, and entrepreneurs, and the analogies presented here are only intended to consider the impacts on *consumers*, in line with the rest of the paper. We therefore do not claim that the analogies presented here contain a full view of the many aspects of the economy which may be considered by policymakers, all of which may be part of their decisions.

6.1 Merger Analysis

The first analogy is to merger analysis. In the past several years, one of the primary goals of merger analysis has been to quantify the tradeoff between harms and benefits to consumers, often in the form of price effects. In a horizontal merger (the merger of two firms selling substitutable goods or services), harms to consumers are typically due to increased market power in the market in which they participate. Benefits to consumers which have historically been used to justify otherwise anticompetitive mergers are often due to variable cost efficiencies, which are synergies from the merger that decrease variable costs and therefore may theoretically decrease equilibrium prices.

Merger analysis typically occurs on a case-by-case basis, whereas the conversation surrounding NCAs has been focused more on whether NCAs should be allowed for broader swathes of the workforce (e.g., if NCAs should be banned for all workers, for low-wage workers, allowed for all workers, etc.). To put the two analyses on equal footing, we consider a hypothetical choice facing a policymaker: should all mergers passing a given bright line test be banned? For example, one could imagine a ban on all mergers for retailers selling at least one overlapping product.

Consider a simple model of mergers, comparable to the simplified model of NCAs introduced in Section 5.3. Let $t = 0$ be a baseline period in which policy is made (i.e., whether mergers are banned). Let $t = 1$ be the first period of two representative companies' existence and production, let $t = 2$ be the point in time at which the companies decide whether or not to merge, and let $t = 3$ be another period of production during which the companies may have merged. Abstracting away from case-by-case antitrust decisions, policymakers at $t = 0$ ask: is the expected value of harm to consumers that is generated by allowing the representative firms to merge greater than the expected value of the benefit?

More specifically, at $t = 3$, if the companies merged, consumers will be harmed by market power pass-through (we label the *increase* in price due to the increase in market power by $\Delta\theta \cdot \frac{P}{-\epsilon}$, where $\frac{P}{-\epsilon}$ denotes the price markup term, as in Section 5.3), and will benefit due to cost efficiency pass-through (we label the *decrease* in price due to cost efficiency pass-through as $\rho \cdot \Delta C$, as in Section 5.3), where these effects are measured relative to a counterfactual world in which the two companies did not merge. The companies may or may not merge, even when allowed, so we allow the merger to happen with probability $\mathcal{P}$ (which may represent, for example, the probability that the merged firm will be more profitable than the unmerged firms).

Though there are other possible objectives, at $t = 0$, the policymaker may therefore be interested in $E(\Delta P)$, where ΔP is the difference in price between a world at $t = 3$ in which mergers are allowed versus a world where they are not. Since the merger itself generates both the benefit and the harm, the expected price difference is therefore given by:

$$E(\Delta P) = \mathcal{P} \cdot \left[\Delta\theta \cdot \frac{P}{-\epsilon} - \rho\Delta C\right],$$

The policymaker may therefore opt to ban mergers whenever $E(\Delta P) > 0$, i.e., when

$$\Delta\theta \cdot \frac{P}{-\epsilon} > \rho\Delta C. \tag{2}$$

While the values of the parameters may vary based on the context (mergers or NCAs), and while Inequalities 2 and 1 are not identical, there are four main components common across the two inequalities that would simultaneously cause a ban on mergers or on NCAs to help consumers by a greater amount: (i) a high $\Delta\theta$ (e.g., if the industry is highly concentrated, then a spinoff or merger will result in a large $\Delta\theta$), (ii) a large markup term (associated with highly profitable industries and ones with inelastic demand), (iii) a small ρ (which may occur when demand is inelastic or when industry concentration is low), and (iv) a low ΔC (which is likely the case in mature industries with low concentration and limited opportunities for innovation).[25] Altogether, the main takeaway is that industries with already high concentration levels, inelastic demand, and few opportunities for investments to pass-through to consumers are the industries in which a ban on NCAs would have the greatest positive impact.

We raise two additional nuances related to this analysis, which help distinguish between merger analysis and NCA analysis. First, while a merger from duopoly to monopoly requires two specific companies to agree to terms on a merger (which we represent with probability $\mathcal{P}$ above), the market

[25] From Weyl and Fabinger (2013) we have that $p = c + \theta\frac{p}{-\epsilon}$ so that $\rho = \frac{dp}{dc} = \frac{1}{1-\frac{\theta}{-\epsilon}}$ which implies that $\frac{d\rho}{d\theta} > 0$ and $\frac{d\rho}{d(-\epsilon)} < 0$.

power price effects due to a spinoff may potentially come from one of many workers at a given firm. In other words, $\mathcal{P}^{Free}$ and $\mathcal{P}^{NCA}$ qualitatively represent not the probabilities that a *given* worker will form a spinoff (without or with an NCA, respectively), but the probabilities that *any* worker at the firm will form a spinoff. For a monopolist whose market power is generated by industry-specific knowledge, many workers may be privy to the information necessary to build a startup, making the value of $\mathcal{P}^{Free}$ possibly quite large.[26] Additionally, while Inequalities 2 and 1 indicate *whether* it is likely that mergers and NCA cause harm, the size of the expected harm (given that it exists) is outside the purview of those inequalities. By the argument above (that many workers in any given industry are prohibited from increasing competition due to an NCA, whereas, for example, a ban on mergers to monopoly would impact two specific firms in any given industry), it is possible that the harms associated with NCAs, in the case that they are indeed harmful, could be substantially larger, especially since an NCA may act as a merger between several entities (if multiple workers are capable of forming spinoffs), while a merger proposal typical involves only two firms. In this regard, the $\Delta\theta$ for NCAs (in Inequality 1) might be substantially larger than $\Delta\theta$ for mergers (in Inequality 2), especially for firms with large labor forces.

Second, for both merger analysis and NCA analysis, there are harms and benefits that may not be captured in this simple example. While much of merger analysis has focused on consumer prices, there is a literature showing harms to workers from increased levels of employer power in the labor market (Azar et al., 2020; Rinz, 2020; Prager and Schmitt, 2021). Similarly, the literature has found that NCAs may cause harms to workers (Lipsitz and Starr, 2021; Balasubramanian et al., 2020; Johnson et al., 2021) by impeding their mobility and therefore their bargaining power. If a policymaker considers the welfare of workers in their objective function, Inequalities 2 and 1 must include terms on the left hand side that account for harms to workers, as well.

6.2 Reverse Payment Patent Settlements (Pay for Delay)

Merger analysis considers a market whose firm count moves from some n to $n-1$. Temporally, a more apt antitrust analogy for NCAs is the practice of reverse payment patent settlements, colloquially known as "pay-for-delay" (hereafter abbreviated as P4D). In a P4D case, an alleged or potential patent infringer receives a payment from the patent holder in return for staying out of the market (often a pharmaceutical market) for a specified period of time. Consider the landmark Supreme Court case, FTC v. Actavis, Inc., as an example. In that case, Solvay Pharmaceuticals held a patent on a low-testosterone treatment called Androgel. Actavis, a generic drug manufacturer, created a generic version of Androgel and sought to bring it to market. Solvay ultimately

[26] Here, we are concerned with the probability that greater than or equal to one employee spins off (i.e., the probability that the market is no longer a monopoly). A further consideration is whether additional firms may be added to the market beyond the second.

entered into a P4D agreement with Actavis, under the terms of which Actavis would delay bringing their drug to market, in return for receiving compensation from Solvay.

The intellectual history of P4D is worth reviewing, insofar as it relates to the analogy to NCAs. Generally speaking, settlements of disputes which might otherwise require a court hearing may be economically efficient: settlements can reduce litigation costs and alleviate court clogging (see, e.g., Bebchuk (1984)). However, in the case of P4D, the literature went on to point out several anticompetitive effects which may exceed the efficiency typically associated with settlement. For example, Shapiro (2003) points out that P4D agreements often act to preserve monopoly profits by allowing a monopolist and a potential entrant to collude by splitting monopoly profits, rather than sharing (lesser) duopoly profits. This theory informed the Actavis decision: the court ruled that outsize P4D payments are indicators that the agreement is based on avoiding competition (Edlin et al., 2015).

Some recent economic research calls into question the view that P4D agreements are necessarily anticompetitive on net. Consider Dickey and Rubinfeld (2012) who note that the possibility of a future P4D agreement may incentivize generic manufacturers to innovate more, possibly causing an increase in innovation. When P4D is not allowed, generic manufacturers may choose to take a gamble: they can innovate potentially infringing generic drugs, understanding that they may be able to bring the drug to market, or they may leave empty handed (if the courts determine that the generic clearly infringes the patent). P4D agreements improve the upside of this gamble. A patent holder may wish to avoid costly litigation or an uncertain outcome and offer a P4D agreement, which increases the payoff to a generic producer.

NCAs have similarities to and differences from P4D agreements. An NCA is also an agreement which is intended to keep a potential competitor from entering the market. In contrast to mergers, the timing of an NCA bears a resemblance to P4D agreements: an incumbent monopolist is attempting to prevent a future duopoly. However, NCAs differ from P4D agreements in two important ways. First, NCAs are not intended to avoid costly litigations (in fact, NCAs likely cause more litigation than they prevent, since NCAs are sometimes disputed[27]). Second, NCAs are not subject to the argument leveled by Dickey and Rubinfeld (2012). In P4D agreements, the risky and costly investment is made *prior* to receiving payment for the P4D agreement. With NCAs, especially those signed at the conception of an employment relationship or promotion, the payment (a pay increase in exchange for signing an NCA, assuming it is made) is made prior to the worker having an ability to engage in investment in themselves and a potential future spinoff, which is the parallel to generic drug development. Therefore, due to the timing of payment, there is no parallel argument to be made that NCAs can encourage competition by incentivizing workers to invest in

[27] See https://faircompetitionlaw.com/2021/01/02/new-trade-secret-and-noncompete-case-growth-graph-updated-january-2-2021

potential future spinoffs.

In relation to NCAs, the piece of the P4D literature which remains is that P4D agreements represent an anticompetitive means for a patent holder to collude with a potential entrant, decreasing competition in the market and harming consumers. This argument, as modeled in the rest of this paper, also applies to NCAs. However, NCAs also differ from P4D agreements in one way which suggests that consumers may benefit: in particular, P4D agreements do not encourage patent holders to invest resources in potential entrants, whereas NCAs may.

The test based on FTC v. Actavis is often called the Actavis Inference (in which P4D agreements are likely to be anticompetitive when an outsize payment is made). The Actavis Inference does allow for some insight into a possible test regarding NCAs, though such a test may be difficult to implement. Using an analogy to the Actavis Inference, policymakers could institute policy which regards NCAs as presumptively illegal when a large payment is made for the NCA. In this case, "large" would be assessed relative to the potential benefits to productivity stemming from the NCA: if the productivity benefits of an NCA (due to increased training provided by the firm) are equal to X, then payments substantially larger than X would likely reflect the value of lost competition. Note that the productivity benefits must be assessed net of lost investment on the part of the worker, which is disincentivized by an NCA, though it is not explicitly modeled in this paper.

This test may be difficult to implement for two reasons, though. First, the productivity benefits of an NCA may be difficult to measure, which means that determining whether a payment is large is also difficult. Second, workers who sign NCAs are often uncompensated for them (possibly due to informational asymmetries or possibly because they are asked to sign NCAs after their bargaining power has declined — i.e., after they have turned down alternative employment offers). This means that using a test of whether a payment to workers is large is likely to return a large number of false negatives, since NCAs which lead to consumer harm may not be accompanied by large payments to the worker.

These caveats suggest a tradeoff with respect to evaluation of NCAs. When payments for NCAs are small or nonexistent, workers may not be receiving compensation in line with NCA law (which in many jurisdictions requires that workers receive adequate "consideration", or compensation, for their NCA). When payments for NCAs are large, they may indicate that the NCA is anticompetitive. Of course, there may be large payments made for NCAs which are solely or primarily due to possible benefits associated with NCA use (in other words, if there is no anticompetitive effect from an NCA, a large payment could represent the owner and worker sharing the rents from solving the investment hold-up problem). Additionally, a rule presuming that large payments indicate anticompetitive activity would create the perverse incentive for firms to underpay their workers for signing an NCA.

One final implication of the analogy to P4D bears noting. The literature on NCAs has pointed out several harms to workers in the form of decreased earnings. There are notable exceptions, though, one of which is CEOs (Kini et al., 2020), who have been shown to receive increased pay when they sign NCAs, or when NCAs are more enforceable. However, CEOs are workers that are highly likely to have advanced knowledge of contracting and labor practices, and may even consult attorneys before signing NCAs. They are therefore highly likely to receive compensation which is appropriately negotiated, and likely reflects a mutually agreeable arrangement.

With the framework we have developed in this paper, and the analogy to P4D, we may shed light not on the question of whether CEOs and firms benefit from using NCAs, but whether consumers may be harmed by such NCAs. Since payments to CEOs are likely to be more reflective of the true benefits to the worker and the firm (versus, for example, a low-wage worker who is unable to hire counsel to consult on their labor contract), outsize payments are much more likely to be present and therefore to reveal an anticompetitive NCA. Of course, the size of the payment must still be weighed against the value of training (and whatever allocation of that value would likely be made to the CEO). But, evidence that CEOs are highly compensated for signing NCAs may in fact be evidence that those NCAs are most likely to be indicative of arrangements which, similar to P4D, are intended to collude over monopoly profits.

7 Conclusion

Employee spinoffs are a primary means by which concentrated industries become more competitive. NCAs may prevent employee spinoffs, simultaneously creating value for firms by encouraging investment (by solving holdup problems) and lessening future competition. While increased levels of investment may benefit consumers, decreased levels of competition do not. To assess this tradeoff, we posit a model that demonstrates the extent to which each of these two factors impact consumers.

Policymakers who are interested in the role that NCAs play in the economy may consider a variety of affected individuals, including low- and high-wage workers, entrepreneurs, and established firm owners. We add to this conversation by discussing the role that NCAs may have on *consumers*, specifically with respect to competition. In other words, the economic and policy debate over NCAs has largely focused on the apparent trade off between the solution of the hold-up problem (which favors NCA use) and harms to workers (which disfavors NCA use). As we show in this paper, while consumers may benefit from the solution to the hold up problem, the third element which should be considered in this conversation is the competitive harm which arises from NCA use. Holistically, NCAs may act as a way for firm owners and workers to collude by maintaining a monopoly market (using costly investment as a commitment device) to the detriment of consumers. Furthermore, as has been highlighted in the literature, workers may be unable to properly negotiate over compensation for an NCA. If this is the case, the sole beneficiaries of NCA use may be firm owners, while workers and consumers may suffer.

We show that consumers in industries with high levels of *potential* competition, and industries with low levels of investment pass-through are those that would likely benefit from an NCA ban. Increased benefits from investment increase NCA use, and may increase consumer welfare, but may counterintuitively decrease consumer welfare when investment pass-through is relatively low. We also compare NCA policy to merger policy and law governing pay-for-delay agreements. Both analogies reveal that NCAs may present puzzles akin to those studied in the antitrust literature: for example, the existence of outsize payments made to CEOs for signing NCAs may reveal that those NCAs are used for anticompetitive reasons.

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A Empirical Appendix

In this Appendix, we describe the steps taken to perform the analyses reported in Section 2.

We begin with the CBP county-level data. We flag industries, using US Census Bureau concordances,[28] which had nonconstant NAICS codes over the relevant period, and omit these industries to avoid data abnormalities associated with changing NAICS codes.[29] We omit data prior to 1998 for this same reason: NAICS was first used in 1998, and prior to that year, SIC codes were used, which grouped industries somewhat differently.

Next, we impute employment per establishment in each size bin as the midpoint of the range given by the bin: e.g., 2.5 employees per establishment when the bin indicates between 1 and 4 employees, 7 employees per establishment when the flag indicates between 5 and 9 employees, and so on. For the bin indicating more than 5000 employees, we impute 6000 employees. We additionally impute total employment in the industry by county cell, instead of relying on reported employment or the employment flags provided in the data: this is done to avoid instances in which HHI is calculated to be greater than 10,000 (the theoretical maximum), often greatly so. Such an issue would arise if, for example, there was just one firm with 5 employees. The data would report one firm in the 5-9 employee size range, and we would impute a size of 7 employees for it. Its share would then be calculated as 100*7/5=140, and HHI would be calculated as 19,600. If, instead, the total employment in the county-industry cell were calculated as the sum of imputed employment (here, 7 employees total), the HHI would (correctly) be calculated as 10,000.

We further omit industry-county cells which had a calculated HHI of zero at some point during the time period: an HHI of zero represents a nonexistent industry. We would not want to conflate, for example, the advent of a new industry in a given county with an increase in concentration, which would occur if we observed a positive change after an HHI of zero. Furthermore, several of the industry-county-year observations with HHIs of zero appear to be misreported data (perhaps due to changing industrial classification). Finally, we omit industry-county observations which experience HHI changes greater than 6000 in a one-year period. The imputation procedure outlined above, combined with issues similar to but not identical to the zero-HHI issue, cause infrequent but enormous HHI changes year over year, which likely do not reflect true competitive conditions. Note that if we remove both of these sample restrictions, we find qualitatively similar results, but with some strange patterns attributable to artifacts of the cleaning and imputation procedures.

We run the distributed lag model outlined in Schmidheiny and Siegloch (2019) by calculating annual changes in HHIs in county by industry cells, and changes in NCA enforceability in state cells. We identify five leads and five lags of the corresponding event study coefficients, and report

[28] Available at https://www.census.gov/naics/?68967.

[29] Note that harmonizing NAICS codes across time and performing the analysis using those harmonized NAICS codes yields noisier, but qualitatively similar, results.

the coefficients which do not correspond to binned endpoints. We use Census division by year by industry fixed effects to alleviate concerns that treatment effects simply represent varying industrial trends, varying regional trends, or even varying industrial trends within specific regions. We weight the regressions by imputed employment in the industry-county-year cell and cluster standard errors by state, the level of the treatment.

B Appendix of Proofs

Proof of Lemma 1: Using backward induction, we first consider the decision to spin off given the values of NCA, I, and c_s. Due to free renegotiation, the pair will select a renegotiation transfer payment and opt for a spin-off whenever it is pairwise efficient: $\Pi_s(c_s) + \Pi_{i,D}(c_s) > \Pi_{i,M}(I)$. From Assumption 1d, we have that $\bar{c}_s(I)$ defines the cutoff value for c_s such that $\Pi_s(c_s) + \Pi_{i,D}(c_s) = \Pi_{i,M}(I)$. This implies that for any $c_s < \bar{c}_s(I)$ we have that $\Pi_s(c_s) + \Pi_{i,D}(c_s) > \Pi_{i,M}(I)$. Moving backwards, the owner will opt for $I = 1$ whenever investment nets a greater payoff than no investment.

Thus, if $NCA = 1$ and c_s is unrealized, then the owner invests whenever

$$P(c_s < \bar{c}_s(1))E[\Pi_{i,D}(c_s) + BO|c_s < \bar{c}_s(1)] + (1 - P(c_s < \bar{c}_s(1)))E[\Pi_{i,M}(1)|c_s > \bar{c}_s(1)] - \kappa$$
$$> P(c_s < \bar{c}_s(0))E[\Pi_{i,D}(c_s) + BO|c_s < \bar{c}_s(0)] + (1 - P(c_s < \bar{c}_s(0)))E[\Pi_{i,M}(0)|c_s > \bar{c}_s(0)].$$

Instead, if $NCA = 0$ and c_s is unrealized, then the owner invests whenever

$$P(c_s < \bar{c}_s(1))E[\Pi_{i,D}(c_s)|c_s < \bar{c}_s(1)] + (1 - P(c_s < \bar{c}_s(1)))E[\Pi_{i,M}(1) + BI|c_s > \bar{c}_s(1)] - \kappa$$
$$> P(c_s < \bar{c}_s(0))E[\Pi_{i,D}(c_s)|c_s < \bar{c}_s(0)] + (1 - P(c_s < \bar{c}_s(0)))E[\Pi_{i,M}(0) + BI|c_s > \bar{c}_s(0)],$$

Since the worker makes a take-it-or-leave-it offer to the owner if she wishes to spin off (if she has an NCA), or if she wishes to remain employed by the owner (if she does not have an NCA), the worker will capture all profit above and beyond what the owner would achieve with the other action. So, if the worker has an NCA and wishes to spin off, she will offer the owner exactly the difference in profit that the owner would receive if the worker remained employed (i.e., $BO = \Pi_{i,M}(I) - \Pi_{i,D}(c_s)$). And, if the worker does not have an NCA and wishes to remain employed, she will appropriate all of the profits above and beyond what the owner could receive in a duopoly (i.e., $BI = -\Pi_{i,M}(I) + \Pi_{i,D}(c_s)$). Taking this into account, the inequalities above reduce to

$$E[\Pi_{i,M}(1)] - \kappa > E[\Pi_{i,M}(0)] \text{ for } NCA = 1,$$

$$E[\Pi_{i,D}(c_s)] - \kappa > E[\Pi_{i,D}(c_s)] \text{ for } NCA = 0.$$

This implies that if $NCA = 1$, then $I = 1$ if and only if $\Pi_{i,M}(1) - \Pi_{i,M}(0) > \kappa$ (since $\Pi_{i,M}(I)$ is independent of the r.v. c_s), and if $NCA = 0$, then $I = 0$ for all $\kappa > 0$. $\square$

Proof of Proposition 1: Starting with the case where $\kappa > \Pi_{i,M}(1) - \Pi_{i,M}(0)$, by Lemma 1 we have that investment does not occur ($I = 0$). Given frictionless renegotiations, if $NCA = 1$, the worker will propose a payment $BO = \Pi_{i,M}(0) - \Pi_{i,D}(c_s)$. If $NCA = 0$, the worker will propose a payment which guarantees the owner a profit of $\Pi_{i,D}(c_s)$. If the worker remains employed by the owner, profit of $\Pi_{i,M}(0)$ will accrue to the owner, meaning that $BI = \Pi_{i,D}(c_s) - \Pi_{i,M}(I)$. Moving back to the contracting stage prior to the draw of c_s, we have that the owner will decide between a contract with an NCA, $\{w^1, 1\}$, and one without, $\{w^0, 0\}$, by comparing:

$$\mathcal{P}^{NCA} \cdot E[\Pi_{i,D}(c_s) + BO | c_s < \bar{c}_s(1)] + (1 - \mathcal{P}^{NCA})\Pi_{i,M}(1) - w^1, \tag{3}$$

$$\mathcal{P}^{Free} \cdot E[\Pi_{i,D}(c_s) | c_s < \bar{c}_s(0)] + (1 - \mathcal{P}^{Free})E[\Pi_{i,M}(0) + BI | c_s > \bar{c}_s(0)] - w^0, \tag{4}$$

where $\mathcal{P}^{NCA} = Pr(c_s < \bar{c}_s(1)$ denotes the probability of a spinoff with an NCA and $\mathcal{P}^{Free} = Pr(c_s < \bar{c}_s(0))$ denotes the probability of a spinoff when the worker does not have an NCA. Note that $\mathcal{P}^{NCA} = P(c_s < \bar{c}_s(1)) < P(c_s < \bar{c}_s(0)) = \mathcal{P}^{Free}$ since $\bar{c}_s(1) < \bar{c}_s(0)$.[30]

To determine wages, note that the worker's IR constraints are given by:

$$w^1 + \mathcal{P}^{NCA}\mathcal{P}^{NCA} \cdot E[\Pi_s(c_s) - BO | c_s < \bar{c}_s(1)] \geq 0, \tag{$\hat{IR}_E^1$}$$

$$w^0 + \mathcal{P}^{Free} \cdot E[\Pi_s(c_s) | c_s < \bar{c}_s(0)] + (1 - \mathcal{P}^{Free})E[-BI | c_s > \bar{c}_s(0)] \geq 0, \tag{$\hat{IR}_E^0$}$$

Solving for the w^1 and w^0 that make Inequalities $\hat{IR}_E^1$ and $\hat{IR}_E^0$ hold with equality, and plugging into Expressions 3 and 4 generates identical expressions for the owner's expected utility, regardless of contract. In fact, in either case, the owner captures all of the expected utility associated with the pairwise efficient market structure:

$$P(c_s > \bar{c}_s(I))\Pi_{i,M}(I) + P(c_s < \bar{c}_s(I))(\Pi_{i,D}(c_s) + \Pi_s(c_s)).$$

Furthermore, given that w^1 and w^0 are such that Inequalities $\hat{IR}_E^1$ and $\hat{IR}_E^0$ hold with equality, the worker is also indifferent between the two contracts.

For the more interesting case where $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$, note that Lemma 1 implies that investment occurs if and only if $NCA = 1$. Moving back to the contracting stage prior to the draw of c_s, we have that the pair will agree to a contract that includes an NCA whenever the joint payoff

[30] Recall that $\bar{c}_s(I)$ solves $\Pi_{i,D}(c_s) + \Pi_s(c_s) = \Pi_{i,M}(I)$ so that $\bar{c}_s(1) < \bar{c}_s(0)$ since $\Pi_{i,M}(1) > \Pi_{i,M}(0)$.

with an NCA/investment is greater than the joint payoff without an NCA/investment:

$$\mathcal{P}^{NCA} \cdot E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(1)] + (1 - \mathcal{P}^{NCA})\Pi_{i,M}(1) - \kappa$$
$$> \mathcal{P}^{Free} \cdot E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(0)] + (1 - \mathcal{P}^{Free})\Pi_{i,M}(0).$$

Rewriting and simplifying, the pair will use an NCA whenever

$$\underbrace{\Pi_{i,M}(1) - \Pi_{i,M}(0)}_{\text{monopoly benefit from } I=1} - \kappa$$
$$> \underbrace{\mathcal{P}^{Free} E[\Pi_{i,D}(c_s) + \Pi_s(c_s) - \Pi_{i,M}(0)|c_s < \bar{c}_s(0)]}_{\text{duopoly benefits for } I=0} \tag{5}$$
$$- \underbrace{\mathcal{P}^{NCA} E[\Pi_{i,D}(c_s) + \Pi_s(c_s) - \Pi_{i,M}(1)|c_s < \bar{c}_s(1)]}_{\text{duopoly benefits for } I=1},$$

Given that we are considering the case where $\kappa \leq \Pi_{i,M}(1) - \Pi_{i,M}(0)$, the inequality given by Equation (5) holds whenever the right-hand side is less than or equal to zero. Given our general characterization, the right-hand side is ambiguous.[31] Note that the right-hand side of Equation (5) captures the difference in the expected duopoly benefits across investment. This generates a clear interpretation for when Equation (5) fails: if the cost from investment κ and the benefits from the duopoly without investment (relative to those with investment) are sufficiently large, then investment does not occur.

Let $\bar{\kappa}$ be the κ so that Equation (5) holds with equality. As a technicality, we also assume that the inequality in Equation (5) holds when $\kappa = 0$. Otherwise an NCA never occurs in equilibrium and the investment exercise is non-existent. In addition, let $\tilde{\kappa} = \min\{\bar{\kappa}, \Pi_{i,M}(1) - \Pi_{i,M}(0)\}$. These results imply that $NCA = 1$ for all $\kappa \in [0, \tilde{\kappa}]$ and $NCA = 0$ for all $\kappa \in (\tilde{\kappa}, \Pi_{i,M}(1) - \Pi_{i,M}(0)]$.[32]
$\square$

Proof of Proposition 2: For notational simplicity, we denote the joint duopoly profit by $\Pi_D(c_s)$ so that $\Pi_D(c_s) := \Pi_{i,D}(c_s) + \Pi_s(c_s)$. Rewriting the definition of $\tilde{\kappa}$ based on Equation (5) gives the following:

$$\tilde{\kappa} = \Pi_M(1) - \Pi_M(0)$$
$$+ \mathcal{P}^{NCA} E[\Pi_D(c_s) - \Pi_M(1)|c_s < \bar{c}_s(1)] - \mathcal{P}^{Free} E[\Pi_D(c_s) - \Pi_M(0)|c_s < \bar{c}_s(0)],$$

[31] Assumption 1c and $\bar{c}_s(1) < \bar{c}_s(0)$ imply that $E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(1)] > E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(0)]$ but we also know that $\Pi_{i,M}(1) > \Pi_{i,M}(0)$ so the difference in $E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(1)] - \Pi_{i,M}(1)$ and $E[\Pi_{i,D}(c_s) + \Pi_s(c_s)|c_s < \bar{c}_s(0)] - \Pi_{i,M}(0)$ is ambiguous.

[32] Note that $[\tilde{\kappa}, \Pi_{i,M}(1) - \Pi_{i,M}(0)]$ is the empty set if the right-hand side of Equation (5) is negative.

where, as defined in the proof of Proposition 1, $\mathcal{P}^{NCA} = Pr(c_s < \bar{c}_s(1)$ denotes the probability of a spinoff with an NCA and $\mathcal{P}^{Free} = Pr(c_s < \bar{c}_s(0))$ denotes the probability of a spinoff when the worker does not have an NCA. Simplifying implies that

$$\tilde{\kappa} = (1 - \mathcal{P}^{NCA})\Pi_M(1) - (1 - \mathcal{P}^{Free})\Pi_M(0) \\ + \mathcal{P}^{NCA} E[\Pi_D(c_s)|c_s < \bar{c}_s(1)] - \mathcal{P}^{Free} E[\Pi_D(c_s)|c_s < \bar{c}_s(0)],$$

implying

$$\tilde{\kappa} = (1 - \mathcal{P}^{NCA})\Pi_M(1) - (1 - \mathcal{P}^{Free})\Pi_M(0) \\ + \int_{-\infty}^{\bar{c}_s(1)} (\Pi_D(c_s))\, dF(c_s) - \int_{-\infty}^{\bar{c}_s(0)} (\Pi_D(c_s))\, dF(c_s),$$

which finally gives

$$\tilde{\kappa} = (1 - \mathcal{P}^{NCA})\Pi_M(1) - (1 - \mathcal{P}^{Free})\Pi_M(0) - \int_{barc_s(1)}^{\bar{c}_s(0)} (\Pi_D(c_s))\, dF(c_s).$$

Note that $\frac{d\mathcal{P}^{Free}}{d\iota} = \frac{dE[\Pi_D(c_s)|c_s<\bar{c}_s(0)]}{d\iota} = \frac{d\Pi_M(0)}{d\iota} = 0$. Therefore we have that

$$\frac{d\tilde{\kappa}}{d\iota} = \frac{d\left[(1 - \mathcal{P}^{NCA})\Pi_M(1) - \int_{barc_s(1)}^{\bar{c}_s(0)} (\Pi_D(c_s)) dF(c_s)\right]}{d\iota}$$

Differentiating using the Leibniz Rule, we arrive with

$$\frac{d\tilde{\kappa}}{d\iota} = (1 - \mathcal{P}^{NCA})\frac{d\Pi_M(1)}{d\iota} + \frac{d\mathcal{P}^{NCA}}{d\iota}(\Pi_M(1)) + (\Pi_D(\bar{c}_s(1)))\, \frac{d\bar{c}_s(1)}{d\iota}$$

With $\mathcal{P}^{NCA} = \int_{-\infty}^{\bar{c}_s(1)} dF(c_s)$, we have that $\frac{d\mathcal{P}^{NCA}}{d\iota} = \frac{d\bar{c}_s(1)}{d\iota}$. And, by definition of $\bar{c}_s(1)$, $\Pi_M(1) = \Pi_D(\bar{c}_s(1))$. Therefore, the latter two terms cancel, and we are left with:

$$\frac{d\tilde{\kappa}}{d\iota} = (1 - \mathcal{P}^{NCA})\frac{d\Pi_M(1)}{d\iota}$$

Finally, since $\mathcal{P}^{NCA} \in [0, 1]$ and $\frac{d\Pi_M(1)}{d\iota} > 0$ (by assumption), we have that $\frac{d\tilde{\kappa}}{d\iota} \geq 0$. $\square$