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Who's paying attention? Measuring common ownership and its impact on managerial incentives ☆

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ABSTRACT

We derive a measure that captures the extent to which common ownership shifts managers' incentives to internalize externalities. A key feature of the measure is that it allows for the possibility that not all investors are attentive to whether a manager's actions benefit the investor's overall portfolio. Empirically, we show that potential drivers of common ownership, including mergers in the asset management industry and, under certain circumstances, even indexing, could diminish managerial motives to internalize externalities. Our findings illustrate the importance of accounting for investor inattention when analyzing whether the growth of common ownership affects managerial incentives.

1. Introduction

A growing sense among academics and practitioners is that common ownership (where two firms are at least partially owned by the same investor) is on the rise among US firms and that this could have important implications for acquisitions, executive pay, and governance, among numerous other outcomes (e.g., see Antón et al., 2018; Harford et al., 2011; He and Huang, 2017; He et al., 2019; Kempf et al., 2017; Liu et al., 2019). Such common ownership could affect firms' strategic choices because common owners have an incentive to internalize how each firm's actions will affect the value of other firms in the portfolio (Easterbrook and Fischel, 1982; Hansen and Lott, 1996; Rubin, 2006). This observation has led some to argue that common ownership by institutions can contribute to anticompetitive behaviors by firms (e.g., Azar et al., 2018, 2019) and that legal and regulatory actions are

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needed to limit institutions' ability to offer index funds and hold significant stakes in some industries (e.g., Posner et al., 2017).[1]

Despite the recent attention such common ownership has received, little discussion has taken place about when, if at all, managers will have an incentive to internalize the preferences of common investors and, more importantly, how one should quantify the extent to which common ownership affects managers' incentives. For example, while there is a sense that the rise of common ownership is driven, in part, by the merger of asset managers (e.g., see Azar et al., 2018) and the increasing popularity of index investing (e.g., see Harford et al., 2011), little consideration has been given to whether such mergers and index-induced overlapping ownership structures should be expected to increase managers' motives to internalize how their actions could affect the value of other firms. For example, if index fund investors or asset managers with larger, more diversified holdings are less informed or attentive to firm-specific actions, then managers would have little incentive to internalize the impact of their actions on the holdings of such investors.

In this paper, we fill this void by deriving a model-based measure that quantifies the impact of common owners on managerial motives. For a given pair of stocks, we quantify the impact ownership overlap will have on a manager's incentive to internalize how their actions could affect the value of the other firm. The resulting measure is simple and has a number of appealing properties. The measure is general in that it does not depend on the nature, sign, or magnitude of the externality and is best seen as a relative measure of how important common ownership is for manager incentives per unit of externality. Moreover, our model shows that the impact of each common investor on managerial incentives will intuitively be the product of three inputs: the extent to which the manager cares about that investor's preferences (which is proportional to the investor's ownership stake), the importance that investor places on the externality (which is proportional to his or her ownership stake in the other firm), and the likelihood that investor is informed about whether the manager's actions have improved the value of his or her overall portfolio (which, among other things, is related to the importance of the firm in the investor's portfolio).

A key feature of our measure is that it accounts for the possibility that not all institutional investors are fully attentive, which finds substantial empirical support (e.g., Ben-Rephael et al., 2017; Fang et al., 2014; Lu et al., 2016; Schmidt, 2019). This differs from other measures of common ownership, which assume that all investors are fully informed about the externalities that firms impose on each other [e.g., see the *MHHID* measure that was developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000) and implemented by Azar et al. (2018)]. Our model assumes that less attentive investors do not contribute as much to managers' incentive to internalize how their choices affect other firms. This assumption is consistent with evidence that investor inattention reduces firm monitoring and weakens the incentives of managers to take actions that benefit their shareholders (Kempf et al., 2017; Liu et al., 2019). Our measure also differs from existing measures in that it is invariant to the specific nature of externalities, allowing for its use in studying the effects of common ownership in a wider range of contexts.

We then take our measure of common ownership to the data to illustrate the importance of accounting for investor attention. In doing so, we must make specific modeling choices, including how managers ascribe importance weights to each investor, but we show that our subsequent findings are not sensitive to these choices. And, we begin by assuming that an investor's likelihood of being attentive is increasing in how important the stock is in the overall investor's portfolio, which is both theoretically micro-founded (e.g., Veldkamp and Van Nieuwerberg, 2010) and supported by empirical evidence (Fich et al., 2015; Gargano and Rossi, 2018; Iliev and Lowry, 2015; Iliev et al., 2019; Ward et al., 2018).

Accounting for investor attention is necessary to properly quantify the rise of common ownership and its importance for managerial motives. If one uses a version of our measure that assumes full investor attention, then managerial incentives to internalize ownership overlap for the average stock pair increased between 1980 and 2012 by 2,937%. But, if one instead allows for investor inattention, average incentives increased by 162%–1,301%, depending on how one models attention. The smaller increase in incentives, which is concentrated among small-cap stocks and holds regardless of how stock-pairs are weighted, occurs because the rise of common ownership coincides with investors becoming increasingly diverse in their holdings and, hence, less attentive as owners. This finding highlights that investor attention can affect how much common ownership affects incentives, which is still much debated by academics and policy makers.

Further highlighting the importance of investor attention, we find that managerial motives to internalize externalities can be lower following asset manager mergers. Calculating the predicted changes in managerial incentives resulting from the merger of Barclays Global Investors (BGI) and BlackRock in 2009, we find that 39%–56% of stock-pairs would experience a decline in incentives to internalize externalities following the merger. This decrease in incentives occurs because some stocks become less important in the larger, more diversified portfolio of the merged entity, which can reduce the likelihood that the larger common investor is as attentive as the two previously unmerged common investors. Only when we assume full attention does the merger necessarily increase managerial incentives to internalize externalities.

The possibility of inattention also raises the question of whether index investing, which contributes to ownership overlap, shifts the motives of managers to internalize the consequences of their actions on other companies. Index investors could be less attentive due to their highly

[1] E. A. Posner, F. S. Morton, and E. G. Weyl wrote a condensed version of their argument as an op-ed article in the December 7, 2016 edition of the *New York Times*, which is available at http://nyti.ms/2gRQKhH. Elhauge (2016) argues that existing antitrust law can and should be used to undo horizontal shareholdings that have led to anticompetitive outcomes.

diversified portfolio.[2] When measuring managerial incentives to internalize such externalities, we find that the relative contribution of the three institutions that account for 80% of indexed assets (BGI and BlackRock, State Street, and Vanguard) ranges between 1.5% and 46.1% in recent years, depending on how one models investor attention. We also find that managers' incentive to internalize externalities sometimes decreases when both firms are included in the same index (e.g., Russell 2000 index) despite sharp increases in ownership overlap.

Our findings highlight a key aspect of our model; that is, ownership overlap is a necessary but insufficient condition for shifting managerial incentives. For example, two stocks' inclusion in the same index, combined with the growing popularity of index funds, naturally increases ownership overlap, which enhances managerial motives to internalize externalities. However, if these new common investors are less attentive, then managers' incentives to internalize externalities can decline. By reducing the importance of each stock in investors' overall portfolios, indexing decreases investors' likelihood of evaluating whether managers take actions to improve the overall value of investors' increasingly diverse portfolios.

Given the important role of investor inattention, we estimate the association between investor attention and portfolio weights. While theory and empirical evidence show that this association is positive, the exact functional form is unclear. Following Iliev and Lowry (2015), we proxy for an institutional investor's attention by examining whether its votes follow the recommendations of the proxy advisory firm Institutional Shareholder Services (ISS). The underlying premise is that, all else equal, attentive investors are less likely to rubber-stamp ISS recommendations. We confirm earlier findings in the literature that institutional investors are more likely to disagree with ISS recommendations for stocks that represent a larger proportion of their portfolio, but we also find evidence that this relation is concave, suggesting that the increase in investor's attention is diminishing as the proportion gets larger.

The estimated concave association between investor attention and portfolio weights does not change our earlier findings. To illustrate this, we let the data speak for themselves by fitting the attention function nonparametrically and using the implied estimates to construct a fitted version of our proposed measure of common ownership. Our main results continue to hold with the fitted version of our measure.

Our findings illustrate the importance of accounting for investor attention and cast doubt on the idea that overlapping ownership structures, particularly those driven by asset manager mergers, significantly shift managers' incentives or induce anticompetitive behaviors among firms in the airline and banking industries (e.g., Azar et al., 2018, 2019). A bulk of the ownership overlap shown in those industries is driven by diversified asset managers such as BlackRock, State Street, and Vanguard. Because these firms own large stakes in virtually every US publicly listed company, a common ownership measure that accounts for investor attention suggests that such diversified investors are less likely to provide managers with strong incentives to soften competition. Moreover, these studies attempt to overcome endogeneity concerns using the growth of index funds and the merger between BlackRock and BGI as exogenous increases in managers' incentive to soften competition. Our analysis indicates that managers' incentive to internalize externalities (i.e., soften competition) can sometimes be weaker, not stronger, when two stocks are included in the same index and after the Blackrock and BGI merger.

To illustrate the applicability of our measure and the ease in which it can be used, we investigate its predictive power in the context of mergers and acquisitions (M&A), when externalities between firms are likely important. We find evidence that managerial incentives to internalize externalities positively predict target selections. This is particularly true when using the version of our common ownership measure in which we fit the attention function nonparametrically using voting data. While suggestive, these findings must be interpreted with caution because they do not isolate exogenous variation in common ownership, and we cannot exclude the possibility that omitted factors drive this correlation.

Overall, our findings contribute to the growing literature on common ownership by providing a framework for understanding when common ownership is and is not likely to shift managerial incentives. Quantifying the impact of overlapping ownership structures on incentives is important both for those seeking to make policy recommendations and for those attempting to study the impact of common ownership.[3] The use of common ownership measures that fail to account for investor attention could introduce measurement errors and induce biases that are hard to sign. To our knowledge, we are also the first to show time series and cross-sectional patterns of common ownership and its impact on managerial incentives across the entire universe of US publicly traded firms.

We provide a general way to measure common ownership that can be used in future studies and help researchers avoid using either ad hoc measures of common ownership or measures that make the implausible assumption of all investors being fully attentive. While we make specific modeling choices when taking our proposed

[2] While evidence exists that index funds and the institutions that offer them successfully influence firms' governance structures using low-cost monitoring techniques, such as developing proxy-voting guidelines that encapsulate their view on best governance practices and voting accordingly for all firms (e.g., see Appel et al., 2016, 2019), it is an open question whether index funds possess the resources or incentives necessary to monitor more firm-specific policy choices, such as investment and pricing choices, that could in turn affect the value of other stocks in their large portfolios.

[3] For example, recent work evaluates the impact common ownership could have on firm competitiveness (Azar et al., 2018, 2019; Dennis et al., 2018; Gramlich and Grundl, 2017; O'Brien and Waehrer, 2017), governance (Azar, 2011; He et al., 2019; Jung, 2013; Kang et al., 2018; Kempf et al., 2017; Liu et al., 2019), corporate outcomes (Matvos and Ostrovsky, 2008; Gompers and Xuan, 2008; Harford et al., 2011; Masulis and Nahata, 2011; Cici et al., 2015; He and Huang, 2017), executive pay (Antón et al., 2018; Kwon, 2016), stock price movements (Jotikasthira et al., 2012; Anton and Polk, 2014; Bartram et al., 2015; Hau and Lai, 2013), credit risks (Massa and Žaldokas, 2017), and weekly return predictability (Gao et al., 2017).

measure to the data, our model is flexible in that future researchers can easily change the importance weights that managers assign to different investors (e.g., by instead assuming that managers care only about their largest five investors) or how one models investor attention [e.g., by instead assuming economies of scale in monitoring and adding investors' assets under management (AUM) as another input for an investor's likelihood of being attentive]. In addition, versions of our measure can be constructed that capture a manager's incentive to internalize the impact of his or her actions on an entire set of firms (e.g., all product-market competitors), which can be useful in studying whether common ownership induces anticompetitive behaviors.[4]

Finally, our paper contributes to the theoretical literature on common ownership (e.g., see Azar, 2017; Edmans et al., 2019; Hansen and Lott, 1996; Kraus and Rubin, 2010; López and Vives, 2019; O'Brien and Salop, 2000; Rubin, 2006). Similar to this literature, we study how common ownership could affect corporate outcomes by shifting managerial incentives. The key distinction between our model and others is our assumption that investors perhaps do not pay full attention to actions taken by managers. As a consequence, managers in our model do not fully internalize the preferences of their inattentive investors, which can have significant implications for understanding of the importance of common ownership. This feature also differentiates our approach from Lewellen and Lewellen (2018), who argue that common owners themselves perhaps do not have incentives to internalize externalities.

2. Measuring common ownership

In this section, we construct a simple model that captures key features that are important for how investors affect managerial motives and use it to propose a novel measure of common ownership that captures the impact of ownership overlap on managers' incentives. A key feature of the model is an assumption that not all investors are fully attentive to managers' actions. We then compare our proposed measure against other measures of common ownership used in the existing literature.

2.1. The model and proposed measure, GGL

The main premise of the model is that firms impose externalities on one another, and managers have an incentive to internalize these externalities when shareholders benefit from this and are attentive to whether the manager has done so. In the model, managers care about these attentive common investors because a decline in their support (e.g., via voting, negative public statements, or the selling of shares) adversely affects managers' utility. Because the magnitude of externalities and how their internalization affects the likelihood of shareholder support is not observed, the measure we develop captures the relative effect of the ownership overlap on managerial incentives per unit of the unobserved externality.

2.1.1. Preliminaries

We consider an economy with $N \geq 2$ public firms, indexed by n, in which each firm has its own manager. The manager of firm n chooses a policy $x_n \in \{0, 1\}$, and the value of firm n is given by $V_n(\boldsymbol{X}) = \bar{v}_n + \Delta_n(\boldsymbol{X})$, where $\bar{v}_n > 0$ and $\boldsymbol{X} = (x_1, \ldots, x_N)$. Parameter $\bar{v}_n$ can be considered the market value of firm n absent the effect of policy choices, and $\Delta_n(\boldsymbol{X})$ captures the effect of policy choices (from both manager n and the managers of all other firms) on firm n's value.

The externalities from managerial actions are given by $\Delta_n(\boldsymbol{X}) = \sum_{m=1}^{N} \Delta_{n,m}(x_m)$. If $\Delta_{n,m}(x_m) > 0$ ($\Delta_{n,m}(x_m) < 0$), then firm m imposes a positive (negative) externality on firm n by adopting policy x_m. We do not make any restrictions on $\Delta_{n,m}(x_m)$, and the externalities can be asymmetric between two firms, such that $\Delta_{n,m}(\cdot) \neq \Delta_{m,n}(\cdot)$. To ensure that we measure only the direct effect of common ownership on managers' incentives, we assume no complementarities or substitution effects across firms with respect to the externality, which implies no strategic interactions between managers (i.e., the optimal decision of manager n is independent of actions taken by other managers).

2.1.2. Ownership structure

We assume there are $I \geq 1$ large investors in the economy, with the fraction of firm n's shares held by investor i given by $\alpha_{i,n} \in [0, 1]$. Short sales are not allowed (because $\alpha_{i,n}$ is non-negative), and we allow for the possibility that $\sum_{i=1}^{I} \alpha_{i,n} < 1$, because shares that are not owned by any of the large investors can be owned by retail or noise investors. The value of investor i's portfolio is given by $W_i(\boldsymbol{X}) = Y_i + \sum_{n=1}^{N} \alpha_{i,n} V_n(\boldsymbol{X})$, where the term $Y_i \geq 0$ captures non-traded assets, T-bills, or any other asset that has no externalities with any of the other N firms. The weight of firm n in the portfolio of investor i before policies are chosen can then be defined as $\beta_{i,n} = \alpha_{i,n}\bar{v}_n / (Y_i + \sum_{m=1}^{N} \alpha_{i,m}\bar{v}_m)$.

2.1.3. Voting and shareholder voice

We assume one share one vote, in which each investor casts her votes either for or against the manager of each of her portfolio companies. This can be interpreted as a vote during director elections or on a given proposal, or it can simply be an expression of discontent or support of the incumbent manager. In other words, while we model shareholders as expressing their views to managers and exerting influence via votes, one can view our model more generally as capturing any influence that shareholders could exert that is proportional to their ownership share. Such influence could occur through a variety of channels including public statements or the threat to exit one's position.

Investors can be either attentive to the manager's policy choices or inattentive to such choices. An investor is attentive with probability $g \in [0, 1]$ and inattentive with

[4] For example, we illustrate how *GGL* can be used in the product market–level studies often found in the literature on common ownership by revisiting the findings of Azar et al. (2018) and showing that they are not robust to using *GGL*, regardless of what assumption is made about the allocation of investor attention (see Appendix D). To facilitate future research on common ownership, both pair- and industry-level versions of our proposed measure are made available on Wharton Research Data Services (WRDS) via their "Contributed Data" depository.

probability $1-g$. This assumption captures the limited attention of investors and that some investors are more likely pay attention to a firm (and its manager's actions). An inattentive investor votes for management with probability $\gamma_i \in [0, 1]$, which is an investor-specific parameter and unaffected by manager policy choices. An attentive investor votes for management with probability $\rho w_{i,n}(\boldsymbol{X})$, where $w_{i,n}(\boldsymbol{X})$ is defined as the improvement in the value of investor i's portfolio from manager n's policy choice relative to the worst possible policy that manager could have chosen, and parameter $\rho > 0$ ensures $\rho w_{i,n}(\boldsymbol{X}) \in [0, 1]$. Specifically, $w_{i,n}(\boldsymbol{X}) = W_i(x_n, \boldsymbol{X}_{-n}) - min_x\, W_i(x_n, \boldsymbol{X}_{-n})$, where $\boldsymbol{X}_{-n}$ is the policy choices of all managers, except manager n. Intuitively, an attentive investor is more likely to support the manager if the action taken by the manager increases her portfolio value and is less likely to support a manager otherwise.

The function used to capture an investor's likelihood of being attentive, g, is flexible and could conceivably depend on a number of factors. For illustrative purposes, we begin by assuming that g depends only on how important a stock is the overall portfolio of the investor. We assume g is an increasing function in $\beta_{i,n}$, such that investors are more likely to be attentive for stocks that comprise a larger proportion of their overall portfolio, which is both theoretically micro-founded (e.g., Veldkamp and Van Nieuwerberg, 2010) and supported by empirical evidence (e.g., Fich et al., 2015; Iliev et al., 2019). Future researchers can easily modify our proposed common ownership measure by putting more structure on the functional form of g or by adding inputs into the g function to capture other potentially important factors (e.g., see Iliev et al., 2019).

Given this setup, the probability $p_{i,n}(\boldsymbol{X})$ that investor i votes in support of manager n is given by

$$p_{i,n}(\boldsymbol{X}) = (1 - g(\beta_{i,n}))\gamma_i + g(\beta_{i,n})\rho w_{i,n}(\boldsymbol{X}). \tag{1}$$

And, assuming retail investors vote for manager n with probability $\gamma_{retail,\,n} \in [0, 1]$ and all votes are conditionally independent across investors, the total expected fraction of votes in support of manager n is

$$P_n(\boldsymbol{X}) = \gamma_{retail,n}\left(1 - \sum_{i=1}^{I}\alpha_{i,n}\right) + \sum_{i=1}^{I}\alpha_{i,n}p_{i,n}(\boldsymbol{X}). \tag{2}$$

2.1.4. Managerial objective and decisions

Manager n maximizes

$$U_n(\boldsymbol{X}) = B_n(x_n) + \lambda_n P_n(x_n, \boldsymbol{X}_{-n}). \tag{3}$$

Intuitively, when the manager chooses a policy for her firm, she trades off the expected support from the shareholders of her firm, $P_n(x_n, \boldsymbol{X}_{-n})$, with the private benefits [if $B_n(x_n) > 0$] or costs [if $B_n(x_n) < 0$] from choosing policy x_n. Parameter $\lambda_n \geq 0$ is the weight the manager puts on getting shareholder support, which reflects the strength of the corporate governance in firm n.

2.1.5. Model solution

Manager n chooses $x_n = 1$ if and only if $U_n(1, \boldsymbol{X}_{-n}) \geq U_n(0, \boldsymbol{X}_{-n})$. Letting $\boldsymbol{\alpha_n} = \{\alpha_{i,n}\}_{i=1}^{I}$ and $\boldsymbol{\beta_n} = \{\beta_{i,n}\}_{i=1}^{I}$, we show in Appendix A that this inequality holds whenever $\Pi_n(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_N}) \geq 0$, where

$$\Pi_n\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_N}\right) \equiv \sum_{i=1}^{I}\alpha_{i,n}g(\beta_{i,n}) \times \left[\sum_{m=1}^{N}\alpha_{i,m}\rho[\Delta_{m,n}(1) - \Delta_{m,n}(0)]\right] + \frac{B_n(1) - B_n(0)}{\lambda_n}. \tag{4}$$

Intuitively, the incentive of manager n to choose policy $x_n = 1$ depends on the expected increase in the shareholder support, as given by $\sum_{i=1}^{I}\alpha_{i,n}g(\beta_{i,n})[\sum_{m=1}^{N}\alpha_{i,m}\rho[\Delta_{m,n}(1) - \Delta_{m,n}(0)]]$, and on the normalized change in the manager's private benefits, as given by $[B_n(1) - B_n(0)]/\lambda_n$.

Importantly, the expected increase in shareholder support depends on the likelihood of each investor being attentive, but the effect of inattention on investors' likelihood of support is endogenously determined. Expected investor attention affects managers' action choices and, in turn, these endogenous choices affect the likelihood of each attentive investor supporting the manager. Attentive investors are more (less) likely to support managers who take actions that increase (decrease) the value of their portfolios, but no unconditional prediction is made about whether an attentive investor is less likely to support management.

2.1.6. Definition of common ownership's effect on incentives

We define the effect of common ownership between firms A and B on manager A's incentives as

$$CO(A, B) = \Pi_A\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_N}\right) - \Pi_A\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_B} = 0, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_B} = 0, \ldots, \boldsymbol{\beta_N}\right). \tag{5}$$

That is, $CO(A, B)$ is the change in manager A's utility when choosing $x_n = 1$ over $x_n = 0$ under the existing ownership structure relative to a counterfactual in which no investor of firm A owns shares in firm B ($\boldsymbol{\alpha_B} = \boldsymbol{0}$) and investors' portfolio weights for all firms other than firm B do not change. In other words, $CO(A, B)$ captures how manager A's incentives to adopt policy $x_n = 1$ would change if each common investor in firms A and B sold his or her shares in B and reinvested them in Y_i. It can be shown that

$$CO(A, B) = \rho[\Delta_{B,A}(1) - \Delta_{B,A}(0)]\sum_{i=1}^{I}\alpha_{i,A}g(\beta_{i,A})\alpha_{i,B}. \tag{6}$$

Several remarks are in order. First, $CO(A, B)$ does not assume $x_n = 1$ is optimal. It measures only the effect of shareholder overlap between firms A and B on the incentives of the manager A to adopt this policy. Second, $CO(A, B)$ need not equal $CO(B, A)$ because externalities between firms can be asymmetric and because the weight of firm A in investors' portfolios, $\beta_{i,A}$, which contributes to investor attention, can be different from the weight of firm B, $\beta_{i,B}$. Third, the change in managers' utility depends only on the change in shareholder support because the change in private benefits from choosing $x_n = 1$ does not depend on common ownership. And, finally, the sign of $CO(A, B)$ is determined by the sign of $\Delta_{B,A}(1) - \Delta_{B,A}(0)$.

The expected shift in manager A's incentives, $CO(A, B)$, has some intuitive properties. If both policies of firm A exert the same externality on firm B, then $CO(A, B) = 0$ and, as expected, manager A has no reason to factor in the effect of her policy choice on firm B. In addition, investor i contributes more to $CO(A, B)$ in absolute terms when she holds more shares in firm A (because the manager cares more about the investor's opinion if the investor holds more shares), holds more shares in firm B (because the investor cares more about the externalities imposed on firm B when she holds more shares of firm B), and when firm A receives a larger weight in her portfolio (because the manager understands that the investor is more likely to be informed about and attentive to firm A's actions).

2.1.7. Proposed measure and intuition

Because researchers cannot typically observe the sign or magnitude of the externalities in the data, let alone how they could change the probability that an informed common investor supports the manager (as captured by parameter ρ), the measure we propose is invariant to these factors and accounts only for the absolute change in shareholder support that stems from changes in the ownership structure. Specifically, we drop the term $\rho[\Delta_{B,A}(1) - \Delta_{B,A}(0)]$ from $CO(A, B)$ and use

$$GGL(A, B) = \sum_{i=1}^{I} \alpha_{i,A} g(\beta_{i,A}) \alpha_{i,B} \tag{7}$$

as our measure of common ownership and its impact on managerial incentives to internalize externalities.

Defined as such, GGL is a relative measure of how common ownership affects managerial incentives per unit of the externality. In other words, a doubling of $GGL(A, B)$ reflects a 100% increase in manager A's incentive to internalize externalities on firm B. This interpretation holds because $\rho GGL(A, B)$ reflects the marginal change in shareholder support (expressed as a proportion) due to common ownership per unit of the externality that manager A's action has on firm B. For example, if $\rho GGL(A, B) = 0.0002$ and the absolute change in value of firm B because of manager A's action choice, $|\Delta_{B,A}(1) - \Delta_{B,A}(0)|$, is \$100, then manager A's action choice will swing shareholder support by $100 \times 0.0002 = 2$ percentage points because of common ownership. Because we do not observe the intensity by which externalities map into the likelihood of an investor's support, ρ, we use $GGL(A, B)$, which is proportional to this per unit effect of the externality on shareholder support and allows one to analyze the relative importance of common ownership across stock-pairs and time. To facilitate the interpretation of $GGL(A, B)$ as a relative measure, our subsequent analyses rescale $GGL(A, B)$ by its sample average so that a value of one indicates the average level of incentives, a value of two represents twice the average level of incentives, and so on.

The proposed measure, GGL, has a number of intuitive properties. Common investors who are completely inattentive, such that $g = 0$, do not shift managers' incentives to internalize externalities, whereas a doubling in each investor's likelihood of being attentive, holding all else equal, doubles a manager's incentive to internalize externalities. Moreover, the partial derivative of $GGL(A, B)$ with respect to $\alpha_{i,B}$ is given by $\alpha_{i,A} g(\beta_{i,A})$, indicating that an increase in investor i's holding of stock B increases manager A's incentive to internalize the externalities of her actions on firm B more when investor i is attentive (i.e., g is higher) and holds a larger proportion of shares in firm A (i.e., $\alpha_{i,A}$ is higher). Likewise, an increase in an investor's firm A holding, $\alpha_{i,A}$, has a bigger impact on manager A's incentive to internalize externalities on firm B when that investor is more attentive or holds a larger ownership stake in firm B.

2.1.8. Flexibility and other possible modeling choices

Our model and the resulting measure of common ownership is flexible. For example, our model can be easily augmented to allow managers to ascribe importance weights to the votes of different investors. In the baseline measure, managers assign importance weights to investors based on the proportion they own. If one wishes to instead assume that managers care only about the support of investors that hold at least 5% of the firm, then our model indicates that one should aggregate only over investors that own at least 5% of firm A when constructing $GGL(A, B)$. Alternatively, if one wishes to assume that managers care only about the preferences of their largest five investors, then one would construct $GGL(A, B)$ using the five investors with the largest $\alpha_{i,A}$. A solution for the more general model that accounts for these possibilities is provided in Appendix A.

Our measure can also be adjusted to reflect differing views regarding the importance of various governance mechanisms. Our model captures any influence that shareholders could exert that is proportional to their ownership share. Therefore, if one believes that shareholder threat to exit is the relevant governance mechanism, then no adjustment is needed. The investor's economic ownership is the only factor that matters. If one views shareholder voice as the only relevant governance mechanism, then managers would care only about the opinion of investors who own voting rights. In this case, $\alpha_{i,A}$ should include only the voting shares of the investor i in firm A. In our baseline measure, we choose to measure influence by ownership shares because they will capture both the influence of exit and of voice and because of known difficulties in accurately measuring voting rights (Dennis et al., 2018).

Because of how an investor's likelihood of being attentive enters the measure, one can easily change how one models investor attention. For example, if one believes that there are economies of scale in monitoring, one could add investors' assets under management as another input to g.[5] Likewise, if one believes investors' monitoring intensity varies with firm-specific characteristics, such as size or past profitability, one could use these as additional inputs. The model and measure can also be easily augmented to capture differences in monitoring across types of investors. For example, if one believes that index funds and the institutions that offer them are completely uninformed, one could set $g = 0$ for such investors.

[5] Notice that AUM already plays an important role in our GGL measure. Common investors with a larger AUM own larger stakes and, as a result, managers internalize their preferences to a larger extent.

One can also vary the functional form of g to create different assumptions on how attention is allocated across portfolio companies. For example, if $g(\beta_{i,A})$ is convex (concave), then a firm representing a larger share of an investor's portfolio gets proportionally more (less) attention from the investor relative to that firm's portfolio weight. To create a measure that assumes all investors are perfectly informed, one would set $g = 1$ for all investors. Because theory offers no clear guidance regarding the proper functional form for g, we begin by assuming that $g(\beta_{i,A})$ is linear such that $g(\beta_{i,A}) = \beta_{i,A}$, but, for robustness, we show that our subsequent empirical findings are not sensitive to using different functional form assumptions, including an estimation of the attention function using voting data (see Section 6).

Finally, the *GGL* measure can easily be aggregated to capture how common ownership affects the incentives of managers to internalize the externalities that their firms impose on an entire group of firms (e.g., industry) or the average incentives to internalize externalities within a group. Such aggregated measures could be useful when studying whether common ownership is likely to shift the incentives of managers to consider the valuations of product market competitors (e.g., Azar et al., 2018, 2019; Dennis et al., 2018; Gramlich and Grundl, 2017; O'Brien and Waehrer, 2017) in a firm- or industry-level analysis. If $\Delta_{m,A}(1) - \Delta_{m,A}(0)$ is the same across all firms in a reference set Γ, then manager A's incentive to internalize the impact of his or her actions on the firms in Γ is given by $GGL(A,\Gamma) = \sum_{m\in\Gamma, m\neq A} GGL(A,m)$, and the average level of such incentives in that group is given by $GGL(\Gamma) = (1/|\Gamma|)\sum_{A\in\Gamma}\sum_{m\in\Gamma, m\neq A} GGL(A,m)$, where $|\Gamma|$ is the number of firms in set Γ. This assumption does not require the externality that firm A imposes on any other firm in set Γ to be the same. It requires only that the differential impact is the same, which is a weaker assumption. A derivation of this group-level incentive measure is provided in Appendix A, and as an illustration of how to apply this market-level *GGL* measure, we revisit the frequently cited findings of Azar et al. (2018) and show that they are not robust to using *GGL*, regardless of what assumption is made about the allocation of investor attention (see Appendix D).

2.2. Comparing GGL with existing measures in the literature

To better understand the advantages and disadvantages of our proposed measure of common ownership, *GGL*, it is useful to compare it with measures in previous studies of common ownership.

Harford et al. (2011) propose a measure to account for the incentives of common investors during the merger of two firms. Harford et al. (2011) note that shareholders of a bidding firm are more likely to internalize the effect of paying a lower takeover premium on the target firm if they also own shares of the target. To capture this externality of common ownership, they estimate each investor's relative ownership stake in the target (B) to that of the acquirer (A) and aggregate these relative weights, $\alpha_{i,B}/(\alpha_{i,A} + \alpha_{i,B})$, across investors in the bidding firm. One such aggregation would be

$$HJL(A,B) = \sum_{i\in I^{A,B}} \frac{\alpha_{i,B}}{\alpha_{i,A} + \alpha_{i,B}}. \tag{8}$$

While the *HJL* measure is similar to *GGL* in that it is a bi-directional, pair-level measure of common ownership and its potential impact on managerial incentives, there are several key differences. First, the *HJL* measure accounts only for an investor's relative holdings in the bidding and the target firms. Therefore, it ignores the possibility that other firms in investors' portfolios could be affected by the merger and that investors' could be inattentive when both the bidding firm and the target firms constitute a small part of their portfolio. While these assumptions could be appropriate in the context of M&A, they likely do not apply more generally. Second, the $GGL_i^{A,B}$ measure increases when the relative ownership of firm A increases, but this does not occur for $HJL_i^{A,B}$. *GGL* assumes that managers care about shareholder support and, hence, pay more attention to action consequences for investors that constitute a larger part of the firm's ownership. Third, Harford et al. (2011) aggregate the relative weights across investors in many different ways. By contrast, the *GGL* measure uses a model as the guideline for how to aggregate.

Another measure is the modified Herfindahl–Hirschman Index (MHHI), which was developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000). The MHHI is a measure of product market concentration, like the Herfindahl–Hirschman Index (HHI), but also accounts for the effect of cross-ownership and overlap in the shareholder base on market concentration. The difference between MHHI and HHI is called the MHHI delta (*MHHID*) and is commonly used as a measure of the additional incentives to internalize externalities coming from overlapping ownership structures (e.g., see Azar et al., 2018).

Three important differences exist between the *MHHID* and *GGL*. First, the *MHHID* is tailored to capture a specific type of externality: those that arise in oligopolistic product market. As such, it makes stronger assumptions on the nature of externalities (e.g., the type of competition) and requires more information than *GGL* (e.g., market shares), which can introduce additional endogeneity concerns (Dennis et al., 2018). Because the *GGL* measure is invariant to the specific nature of externalities, it also has a wider scope and can account for externalities that stem from vertical relations, innovation, M&A transactions, etc. Second, the *MHHID* is measured at the industry level, and the baseline *GGL* measure is a bi-directional, pair-level measure. As such, the baseline *GGL* measure is not sensitive to the scope of an industry or product market, which is not always well defined. However, as shown in Appendix A, a simple aggregation of *GGL* can be used to capture the industry-level incentive to internalize externalities among firms within the industry, if so desired. Third, and most important, *MHHID* assumes that investors are fully informed about the externalities firms impose on each other and, therefore, that managers fully internalize those externalities. By contrast, *GGL* accounts for the possibility that some investors are not as attentive, which finds

substantial empirical support (e.g., Kempf et al., 2017; Liu et al., 2019).[6]

In addition to the above model-based measures, a number of ad hoc common ownership measures also are used in the existing empirical literature (e.g., see Anton and Polk, 2014; Azar, 2011; Freeman, 2019; Hansen and Lott, 1996; He and Huang, 2017; He et al., 2019; Lewellen and Lowry, 2019;[7] Newham et al., 2018). It is not clear that any of these measures represent an economically meaningful measure of common ownership's impact on managerial incentives, and many of them have unappealing properties. We discuss these additional measures and their weaknesses in Appendix B.

To conclude, the innovation behind the *GGL* measure is as follows. It is a model-driven measure of the effect of common ownership on the incentives of managers to internalize externalities between two given companies. The measure is invariant to the specific nature of externalities between the firms, and the measure explicitly accounts for the limited attention that investors can pay to their portfolio companies. This last feature is key, because managers have incentives to internalize externalities only if their shareholders require them to do so. In other words, overlap in the shareholder base is a necessary but insufficient condition for common ownership to affect managers' incentives.

2.3. Limitations of GGL

While our proposed measure of common ownership is flexible and can be easily adjusted to capture different assumptions about managers' preferences and factors that affect investor attention, it has three limitations. First, our measure does not allow for strategic interactions where a shift in manager m's incentive to take an action affects manager n's incentive to take an action. We intentionally shut down this possibility because otherwise the common ownership of one stock-pair indirectly affects the incentives of managers in other companies, and this indirect effect in turn depends on the strategic environment (e.g., whether actions by different managers are taken simultaneously or sequentially, whether they are strategic complements or substitutes, etc.) and on the solution concept that is adopted (the notion of equilibrium). The indirect effect also requires shareholders to be aware of the strategic environment, which is perhaps not a plausible assumption. Given these complications, we focus only on the direct effect of common ownership.

Second, similar to existing measures of common ownership, our measure abstracts away from any form of coordination or communication between investors. In practice, investors can coordinate their attempts to exert influence by publicly communicating their views regarding the optimal policy before casting votes or talking to management. With such coordination, managers would no longer weight the importance of each investor independently and, in principle, if two investors perfectly coordinate their attempts to exert influence over managers, they should be treated as one investor from the perspective of our measure. While our model (and measure) can be extended along this dimension, we do not do so because it is unclear how one could measure the extent of coordination between different investors, which likely depends on the similarity of their investment objectives, their competition for fund flows, their familiarity with one another (e.g., through joint investment in the past or being alumni of the same university), etc.

Third, our measure ignores the possibility of a feedback from managers to investors. For example, our measure does not account for the possibility that managers could seek to attract or avoid the attention of certain investors. Investor inattention could be mitigated if managers choose to engage with investors, explain their strategies, and disclose additional information. More generally, investors' level of attention for individual firms can depend on other firm-specific factors that are not currently being modeled. However, to the extent these other firm-specific factors have an empirical counterpart, they could be accounted for in the g function by using them as additional inputs.

3. Data construction

To analyze the relevance of accounting for investor attention when quantifying the importance of common ownership, we create a sample of firm-pair–year observations that includes the universe of US-listed firm pairings between 1980 and 2012.[8] For each year, we include all publicly traded firms from the Compustat–Center for Research in Security Prices (CRSP) universe. We then construct a sample of firm-pairs each year based on these public firms as of December 31 of that year. For n firms in a given year, our pair construction yields $n \times [(n-1)/2]$ distinct pairs, and each stock is paired with each other stock only once. We end up with a total of 671,012,403 pairs and twice as many observations when calculating our bi-directional, pair-level measure, *GGL*.

We construct our measures of common ownership using the institutional Form 13F holdings that have been tabulated and aggregated by Thomson Reuters, which we access via Wharton Research Data Services. We calculate investors' ownership stakes using total reported shares.[9]

[6] The possibility of investor inattention also differentiates our measure from Backus et al. (2019), who drop the market shares from the modified Herfindahl–Hirschman Index and instead use the resulting firm-level weights (which lack a clear theoretical basis) to quantify the effect of common ownership.

[7] Although not motivated as such in their paper, the pair-level common ownership measure of Lewellen and Lowry (2019) is exactly the full-attention version of *GGL* (i.e., where $g = 1$). The firm- and industry-level versions of their measure are ad hoc and do not coincide with the firm- and industry-level versions of *GGL*.

[8] We do not use any post-2012 data in our current analysis because of known data problems with Thomson Reuters' 13F ownership data after 2012. While inaccuracies also exist in Thomson's data prior to 2013, we make the standard corrections for these, including adding the missing year-end filings of Barclays in 2003 and JP Morgan in 2003.

[9] We use total shares for two reasons. (1) Total shares likely better capture the potential influence of each investor, and (2), it is unclear whether the reported 13F data on voting rights is meaningful. When filing a 13F, institutions delineate their shares based on voting rights as "sole," "shared," and "none." But as discussed in Dennis et al. (2018), it is unclear what "shared" means, and some institutions, such as Vanguard, report all

Following Ben-David et al. (2018), we combine the holdings of BlackRock's various subsidiaries to the parent level.[10] Some firms can have multiple classes of publicly traded stock. In these instances, we aggregate ownership by the value of the share classes (e.g., an institution needs to be an owner of only one of the class of shares in a stock to have an ownership stake, and this overall ownership stake is reduced based on the proportion of ownership the share class has across all publicly traded classes of the firm). The result of the merge with 13F data is that for each pair we have a list of all institutions that own both stocks and their ownership stakes in each stock. With these data, we then compute the *GGL* measure as outlined in Section 2.

To examine the importance of investor inattention, we construct numerous permutations of the *GGL* measure. We start by constructing $GGL_{FullAttention}$, which measures the impact of common ownership on managerial incentives when investors are fully attentive (i.e., $g = 1$). We then construct a variety of measures that allow for investor inattention. GGL_{Linear} assumes investors' likelihood of being informed as being given by $g(\beta_{i,A}) = \beta_{i,A}$, and GGL_{Convex} and $GGL_{Concave}$ change the investor attention function to $g(\beta_{i,A}) = \beta_{i,A}^2$ and $g(\beta_{i,A}) = \beta_{i,A}^{0.5}$, respectively. We also construct versions of *GGL* that ascribe different managerial weightings to the importance of investors. With $GGL_{5\%}$, we modify GGL_{Linear} by assuming that managers care only about investors that own at least 5% of their outstanding shares, and with GGL_{Top5}, we assume that managers care only about their five largest shareholders (in terms of proportion of outstanding stock held). While this is by no means an exhaustive list of potential permutations, it does provide a reasonable foundation from which to study how managerial incentives to internalize externalities have changed over time, what factors are correlated with the level of these incentives, and whether these particular modeling choices are important for answering these questions.[11]

4. Empirical importance of accounting for investor attention

In this section, we provide summary statistics on managerial incentives to internalize externalities, as measured using the different versions of *GGL*, and the extent to which managers' motives have shifted over the last 30+ years. These summary statistics highlight the importance of accounting for investor attention when measuring common ownership. To further highlight the importance of investor attention, we illustrate how the merger of two asset managers need not result in an increase in managers' incentives to internalize externalities. Finally, we provide evidence on the relative importance of index versus activist investors in contributing to managerial motives.

4.1. Summary statistics, 1998–2012

Table 1 reports summary statistics for our overlap and *GGL* measures. For brevity, we restrict these summary statistics to the more recent sample period of 1998–2012, which, because of data limitations on index constituents, is the same sample period we use in our regressions that analyze cross-sectional variation in common ownership. Beyond providing a better sense of how prevalent common ownership is in recent years, these summary statistics are more useful in interpreting the economic magnitudes of our later estimates. We discuss earlier trends in common ownership in Section 4.2.

The summary statistics in Table 1 show substantial heterogeneity across stock-pairs in the importance of common ownership for managerial incentives. As discussed in Section 2, *GGL* reflects a relative measure of managers' incentives to internalize externalities per unit of any externality, and, because we rescale each *GGL* measure by its sample average, a value of one reflects the average level of incentives to internalize externalities during the sample period. This rescaling reveals considerable skewness in the distribution of *GGL*. For example, the median stock-pair has just 0%–7.8% of the average level of incentives to internalize externalities when one does not assume full attention by investors and 24.1% of the average incentives when one instead assumes full attention. Also, for the more than 10% of stock-pairs with no common investors, each *GGL* measure equals zero, reflecting no incentive for managers to internalize externalities. At the other end of the spectrum, managers of the 99th percentile stock-pair have 2.86–15.6 times the average incentive to internalize externalities, depending on the functional form assumptions one makes when calculating *GGL*.

4.2. Trends in common ownership since 1980

We next analyze how managers' incentives to internalize ownership overlap, *GGL*, has varied over time for the average pair of stocks. For this analysis, we extend our sample back to 1980.

Under the assumption that investors are fully attentive, managerial incentives to internalize externalities have increased substantially over the last few decades. This is shown in Fig. 1, where we plot the average percent increase in $GGL_{FullAttention}$ since 1980. Between 1980 and 2012, the average $GGL_{FullAttention}$ for a pair of US stocks increased by 2,938%. If we were to instead use the average market capitalization of stock-pairs to construct a value-weighted average, the increase since 1980 would be

their holdings under "none" even though they clearly maintain and exercise voting rights.

[10] BlackRock reports its holdings under seven different entities, and the Thomson data aggregates these to six different manager numbers. We follow Ben-David et al. (2018) and aggregate these holdings because BlackRock exercises its influence and votes these shares at the parent level. Our model implicitly assumes that each investor exerts influence independently, which is clearly not the case for BlackRock's various entities. A spot check of MGRNAMEs did not reveal any further obvious examples of other large institutions reporting their holdings in a disaggregated way similar to BlackRock. While one could argue that the influence of other institutions (e.g., smaller institutions that follow the vote recommendations of proxy advisory firms such as ISS) are also not independent, we do not aggregate these holdings because it is unclear how to identify these more nuanced violations of non-independence.

[11] In Section 6, we also estimate a $g(\beta_{i,A})$ using voting data and find evidence to support a concave function. We then use this estimated $g(\beta_{i,A})$ to construct a GGL_{Fitted}, which exhibits findings similar to that of $GGL_{Concave}$.

Table 1
Summary statistics.

This table reports summary statistics from 1998 to 2012 for common ownership variables and variables that are later used as explanatory variables. The ownership variables are defined in Section 2. As discussed in Section 2, all *GGL* variables are scaled by their sample average. The explanatory variables are composed of index indicator variables (coded one if both firms are in an index and zero otherwise), average institutional ownership across the pair, and average size (average log assets of the two firms). *Average Industry HHI* is the average Herfindahl–Hirschman Index of the industries, based on a three-digit Standard Industrial Classification (SIC) code, of each of the firms in a pair. The industry dummy is one if both firms in a pair belong to the same three-digit SIC industry and is zero otherwise.

Common ownership variables	*N*	Mean	Standard deviation	1st percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	99th percentile
$GGL_{FullAttention}$	447,358,398	1	1.83	0	0	0.009	0.241	1.199	3.059	7.984
GGL_{Linear}	447,358,398	1	52.61	0	0	0.00004	0.011	0.196	1.247	15.593
$GGL_{Concave}$	447,358,398	1	5.85	0	0	0.001	0.078	0.683	2.547	13.008
GGL_{Convex}	447,358,398	1	518.06	0	0	3.3×10^{-9}	0.00002	0.002	0.040	2.859
$GGL_{5\%}$	447,358,398	1	84.55	0	0	0	0	0.022	0.647	14.515
$GGL_{Top\ 5}$	447,358,398	1	65.21	0	0	0	0.002	0.117	0.956	15.557
$Beta^{Sum}$	447,358,398	1	9.10	0	0	0.0005	0.018	0.229	1.343	16.506
Explanatory variables										
Both S&P 500 Dummy	447,358,398	0.008	0.089	0	0	0	0	0	0	0
Both Russell 2000 Dummy	447,358,398	0.101	0.302	0	0	0	0	0	1	1
Both Russell 1000 Dummy	447,358,398	0.029	0.167	0	0	0	0	0	0	1
Both S&P 400 Dummy	447,358,398	0.005	0.067	0	0	0	0	0	0	0
Both S&P 600 Dummy	447,358,398	0.010	0.098	0	0	0	0	0	0	0
Both Nasdaq Index Dummy	447,358,398	0.0003	0.017	0	0	0	0	0	0	0
Average Institutional Ownership	447,358,398	0.420	0.218	0.014	0.125	0.255	0.415	0.572	0.725	0.898
Average Size	447,358,398	6.003	1.649	2.522	3.917	4.842	5.942	7.092	8.160	10.092
Both in Same Industry Dummy	447,358,398	0.026	0.158	0	0	0	0	0	0	1
Average Industry HHI	447,358,398	0.027	0.046	0.001	0.003	0.006	0.013	0.029	0.061	0.225

1,656%. The smaller value-weighted increase suggests that the shift in incentives is less prominent among stock-pairs containing larger firms. This is confirmed in Fig. 2, where we plot the average percent increase in managerial incentives for stock-pairs in which both stocks are either below or above the median market capitalization in that year. For stock-pairs with above median–size firms, managers' average incentive to internalize externalities increased by 2,295%, and for stock-pairs with below median–size firms, the average increase was 14,291%.

The assumption that all investors are perfectly informed plays a key role in the measured growth of managerial incentives. This is seen in Fig. 3, where we plot the average percent increase for each of the different versions of our incentives measure that allow for investor inattention. The increase in managers' incentive to internalize externalities, as measured GGL_{Linear}, is considerably smaller at 285% for the average stock-pair. The increase in our other measures of *GGL* is also smaller and ranges from 162% to 835%, with the largest increase being observed for $GGL_{Concave}$, which makes the assumption that firms representing a smaller share of an investor's portfolio get proportionally more investor attention relative to their portfolio weight, and the smallest increase being observed for GGL_{Convex}, which makes the assumption that firms representing a larger share of an investor's portfolio get proportionally more investor attention. Value-weighting has less impact for *GGL* measures that allow for inattention. In unreported estimates, the increase in the value-weighted average of these *GGL* measures is similar and ranges between 1% and 751%.

The smaller increase for measures that allow for the possibility of investor inattention highlights that the rise of ownership overlap over the last 30 years has coincided with the average institutional investor becoming increasingly diverse in his or her holdings. This diversification and the resulting average reduction in portfolio weights is consistent with investors paying less attention to their portfolio companies (Veldkamp and Van Nieuwerberg, 2010; Fich et al., 2015; Iliev et al., 2019) and, hence, managers having weaker incentives to internalize the preferences of investors. Measures that assume full attention among investors (e.g., *MHHID*) overlook this potentially important countervailing trend in ownership structures.

4.3. Impact of asset manager mergers on managerial motives

The importance of accounting for investor attention can also be seen by calculating how the merger of two large asset management firms affects our measure of managerial incentives, *GGL*. Some existing papers that study the impact of common ownership on corporate policies use the merger of large asset managers as a positive shock to common ownership. For example, the merger of BGI and BlackRock in 2009 is argued to have increased common ownership and managers' incentives to internalize externalities (e.g., see Antón et al., 2018; Azar et al., 2018; He and Huang, 2017). Whether such mergers should be expected to shift managers' incentives is unclear. While the mergers likely increase ownership overlap, they could also reduce investor attention and, hence, managers' incentive to internalize the preferences of their investors, if

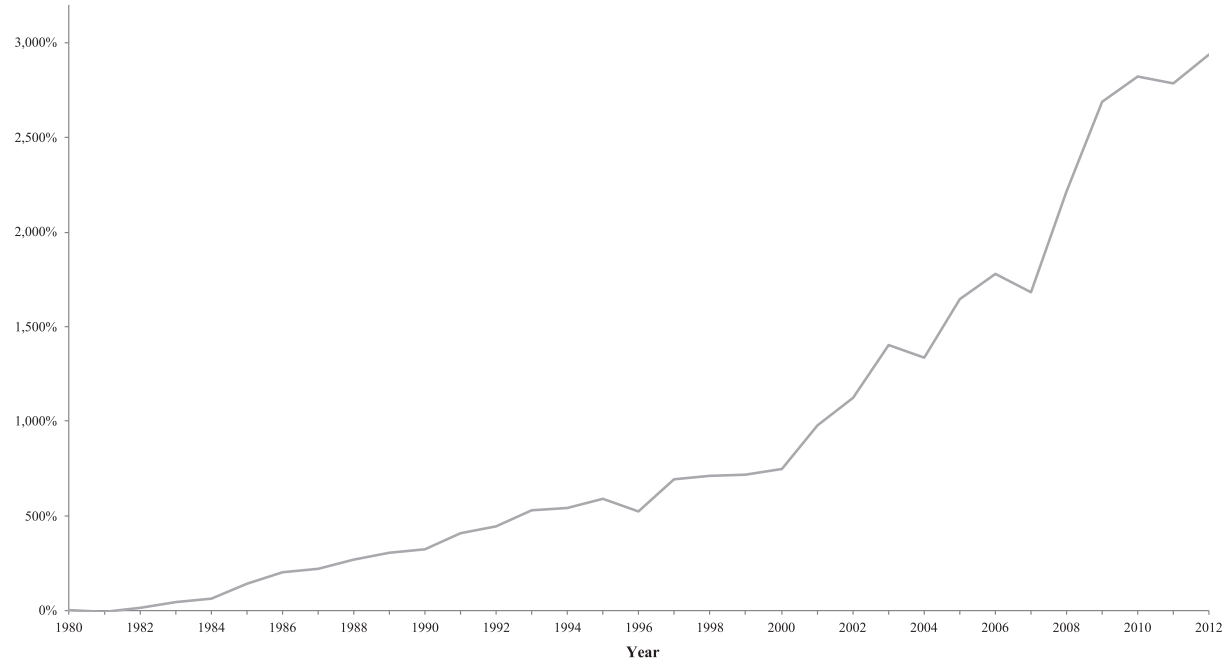

Fig. 1. Percent change in managers' incentive to internalize externalities since 1980 when assuming full attention. This figure plots the percent change in the average $GGL_{FullAttention}$ since 1980. Details of how this measure is constructed are in Section 2.

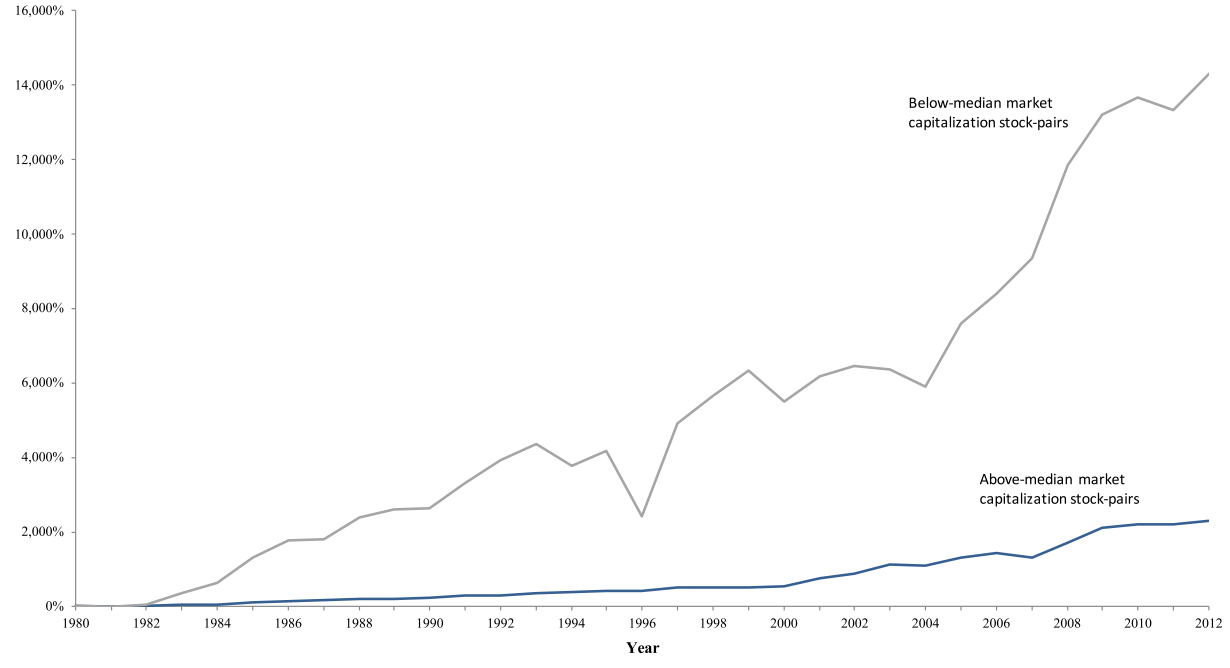

Fig. 2. Percent change in $GGL_{FullAttention}$ since 1980 by market capitalization. This figure plots the percent change in the average $GGL_{FullAttention}$ since 1980 for stock-pairs when both stocks are below the median market capitalization that year and for stock-pairs when both stocks are above the median market capitalization that year. Details of how $GGL_{FullAttention}$ is constructed are in Section 2.

the larger, more diversified portfolio of the merged entity makes it less likely the new common owner is as attentive.

To illustrate the potential for asset manager mergers to reduce managers' incentives to internalize externalities, we calculate the changes in GGL_{Linear} and $GGL_{FullAttention}$ that would be predicted by the merger of BGI and BlackRock in 2009 across stock-pairs if all institutions had maintained their same stock holdings after the merger. We first recalculate the two *GGL* measures in 2008 under the assumption that the portfolios of BGI and BlackRock are now owned by the same investor, the merged entity. This calculation changes both the size of the stake that

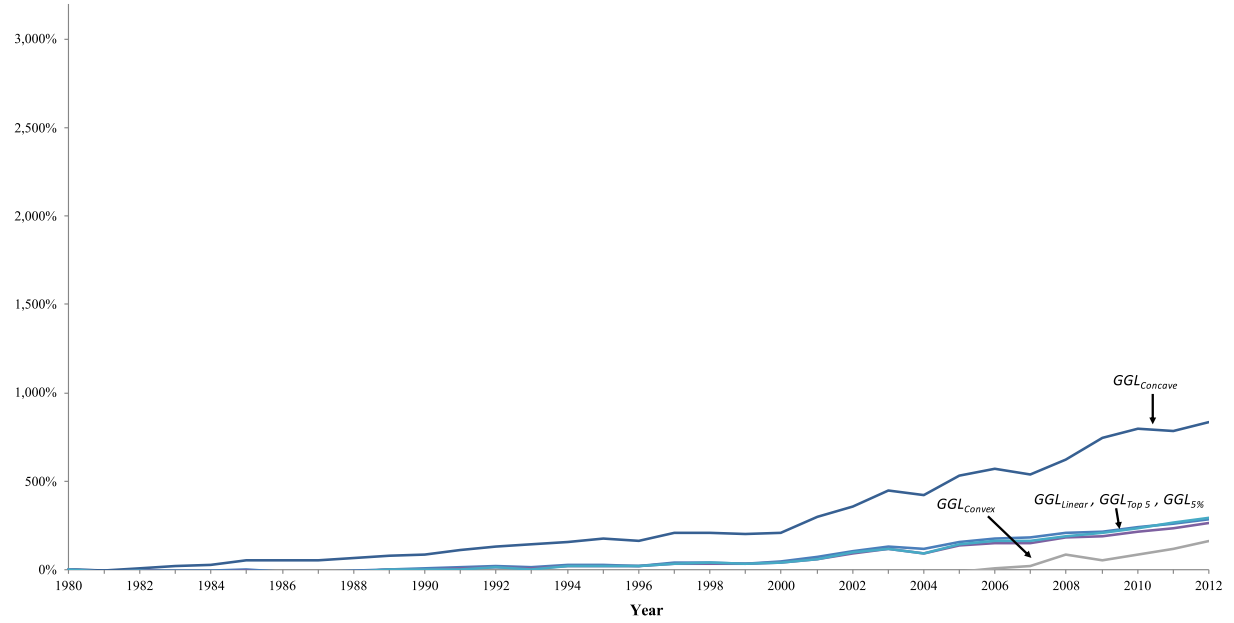

Fig. 3. Percent change in managers' incentive to internalize externalities since 1980 when allowing for investor inattention. This figure plots the percent change in the average stock pair *GGL* since 1980 for different versions of *GGL* that do not make the assumption that investors are fully attentive. Details on how each measure is constructed are in Section 2.

the merged entity owns in each company and the weight that each company receives in the merged entity portfolio. We then compare this recalculated *GGL* to the actual *GGL* and plot the histogram of the predicted changes for both GGL_{Linear} and $GGL_{FullAttention}$ in Fig. 4.

We find that an asset manager merger does not necessarily increase managerial incentives to internalize externalities. As shown in Fig. 4, all stock-pairs unsurprisingly experience an increase in $GGL_{FullAttention}$ because, by construction, the merger increases ownership overlap and, when all investors are attentive, this necessarily increases managers' incentive to internalize externalities. Moreover, even when overlap already exists, the higher AUM of the merged entity increases *GGL* by increasing the importance of the externality in the combined portfolio (via a higher $\alpha_{i,B}$) and the manager's incentive to internalize the merged entity's preferences (via a higher $\alpha_{i,A}$). When we allow for inattention, as done with GGL_{Linear}, 56.2% of stock pairs experience a decline in managerial incentives. This decline for GGL_{Linear} occurs because the relative importance of some stocks in the portfolio of the merged firm is lower than their importance in the individual portfolios of BGI and BlackRock before the merger. This drop in portfolio weights can result in a bigger, but less attentive common owner following the merger.[12]

4.4. Relative importance of indexing versus activist investors

In addition to asset manager mergers, the rise of common ownership is often attributed to the increasing popularity of index investing. We next analyze how much the growth of managerial incentives to internalize externalities since 1980 is being driven by the growth of index funds versus activist investors.

To quantify this, we construct two additional versions of our GGL_{Linear} measure, $GGL_{Indexer}$ and $GGL_{Activist}$. For $GGL_{Indexer}$, we use the holdings of BGI, BlackRock, State Street, and Vanguard. We focus on the last three institutions because in 2016 they alone accounted for 80% of all indexed mutual fund and exchange-traded fund (ETF) assets in the US, and indexed assets accounted for about 80% of each institution's overall assets under management.[13] And, we include BGI because it was one of the largest purveyors of index funds and ETFs prior to its acquisition by BlackRock in 2009. For $GGL_{Activist}$, we instead use the holdings of hedge funds that have engaged in some form of activism, as identified in the hedge fund activism data set constructed by Brav et al. (2008) and Brav et al. (2010).

At first blush, both activists and indexers seem to have contributed to the growth in managerial incentives to

[12] Allowing for economies of scale in monitoring, by including AUM as an input for *g*, could mitigate this effect, but our analysis illustrates that this mitigating factor would need to be significant to offset this effect and increase managerial incentives to internalize externalities for all stock pairs.

[13] This statistic was calculated by classifying mutual funds and ETFs as passive versus active using Thomson's S12 mutual fund database, the CRSP mutual fund database, and the classification methodology of Appel et al. (2016, 2019). We do not use Bushee (2001) classification of "quasi-indexer" to designate passive institutions because this is not a meaningful classification of passive versus active. Nearly two-thirds of institutions are classified as "quasi-indexers," while some obvious indexers, such as BlackRock, are not classified as such.

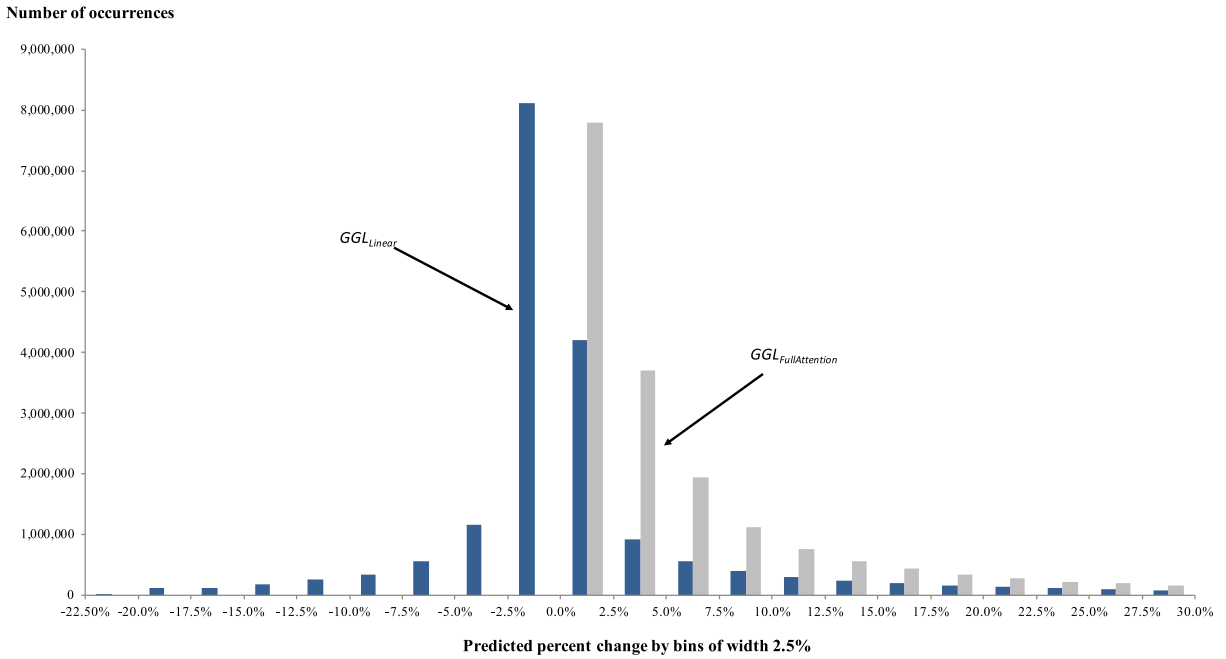

Fig. 4. Histogram of predicted changes in managers' incentives to internalize externalities following the Barclays Global Investors (BGI) and BlackRock merger in 2009. This figure plots a histogram of the predicted percentage change in GGL_{Linear} versus the predicted percentage change in $GGL_{FullAttention}$ due to the 2009 merger between BlackRock and BGI. The predicted change is calculated by holding the ownership stakes of all institutional investors constant and recalculating the two *GGL* measures in 2008 under the assumption that the portfolios of BGI and BlackRock are now owned by the same investor, the merged entity.

internalize externalities. This is seen in the Panel A of Fig. 5. If one plots the average yearly proportion of our GGL_{Linear} that is attributable to index and activist hedge fund holdings, as done in Panel A, both index and activist institutions appear important for the upward trend shown in Fig. 3. In 1980, index holdings accounted for just 0.05% of a manager's incentives to internalize externalities but accounted for 25% by 2012. Activist hedge funds increased their proportion from 2.2% in 1980 to about 11.7% in 2008 and fell to about 8.5% after that. (The remaining proportion of GGL_{Linear} each year is driven by the non-index and non-activist institutions that are not plotted.)

However, the relative importance of index and activist investors for the growth of *GGL* depends on how one models investor attention. This is shown in Panels B and C of Fig. 5, where we break out the relative contribution of indexers and activists to both GGL_{Convex} and $GGL_{Concave}$. When using a convex function to model an investor's likelihood of being informed about a particular stock, indexers contribute almost nothing to the growth in *GGL* (see Panel B) and, when using a concave function for modeling attention, they account for considerably more (Panel C). The reason that index investors contribute less when g is convex is that they are more diversified, such that the average weight of a firm in the portfolio is low, and a convex function gives relatively less weight to firms that contribute less to an investor's portfolio. The opposite is true for the concave function, which, as discussed in Section 6, seems to find more empirical support when using voting data to proxy for investor attention.

Overall, these findings illustrate that the link between indexing and managerial incentives to internalize externalities is not obvious. Our subsequent findings of how managerial incentives shift with index inclusion further emphasize this point.

5. Factors correlated with *GGL*

In this section, we regress our *GGL* measures onto possible determinants using pair-level panel regressions. Because we lack an exogenous source of variation for our explanatory variables, we do not seek to identify the causal effect of any given explanatory variable on managerial incentives. Instead, we simply seek to establish and quantify basic correlations between potential determinants of common ownership, such as index inclusion and industry structure, and managerial incentives. For example, we seek to answer questions such as: "If a pair of stocks goes from both being included in the S&P 500 index to both not being in that index, what is the average change in managerial incentives arising from this ownership overlap (as measured by *GGL*) and how economically large are the observed changes?"

5.1. Empirical specification

To analyze what stock-pair characteristics are correlated with managerial incentives arising from ownership overlap, as measured by *GGL*, we estimate a bi-directional pair-level panel regression,

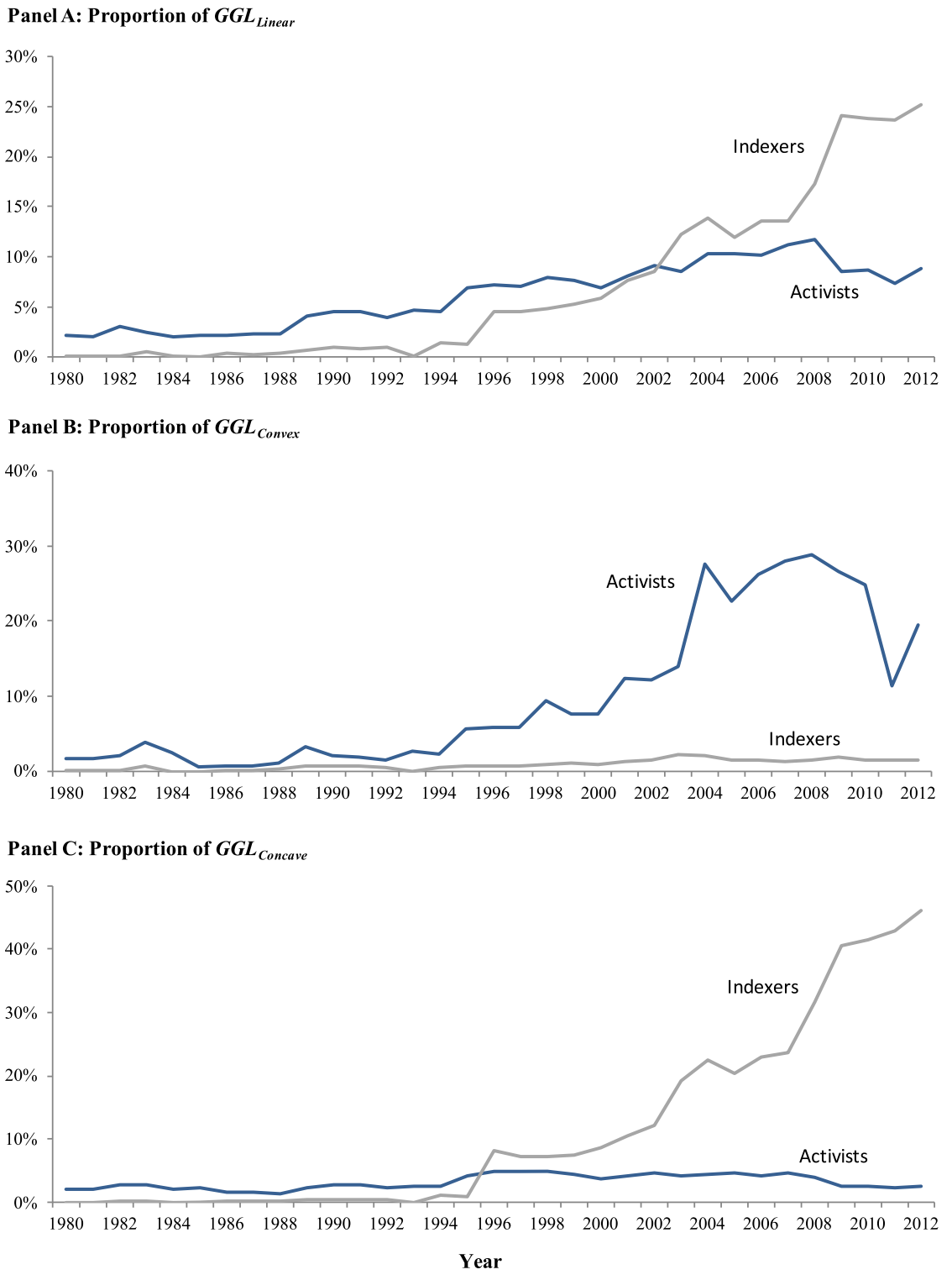

Fig. 5. Proportion of *GGL* attributable to index and activist investors by year. This figure plots the proportion of GGL_{Linear} (Panel A), GGL_{Convex} (Panel B), and $GGL_{Concave}$ (Panel C) that can be attributed to investors classified as either an activist investor or an index investor. The remaining proportion, which is not plotted, is all other institutions. For indexers, we use the holdings of Barclays Global Investors (BGI), BlackRock, State Street, and Vanguard. For activists, we use the holdings of hedge funds that have engaged in some form of activism, as identified in Brav et al. (2008) and Brav et al. (2010).

$$GGL_{ijt} = \beta X_{ijt} + \alpha_{ij} + \delta_t + \varepsilon_{ijt}, \quad (9)$$

where GGL_{ijt} is our measure of manager i's incentive to internalize the impact of her choices on firm j in year t and X_{ijt} is our time-varying explanatory variables of interest. For example, X_{ijt} could be an indicator equal to one if both firms in pair ij are listed in the S&P 500 index in year t and zero otherwise. We include bi-directional, pair-level fixed effects, α_{ij}, to control for time-invariant differences in manager i's incentives with respect to firm j and to ensure that we make use of only within bi-directional pair variation for this analysis. In other words, we are interested in how a change X_{ijt} for a given pair ij is associated with the observed change in managerial incentives for that pair, GGL_{ijt}. We also include year fixed effects, δ_t, to absorb the secular trend in common ownership. Finally, to account for potential covariance across pairs and over time, we cluster the standard errors at the stock level, i. We cluster at the stock level, instead of at the stock-pair level, because clustering at the stock level provides more conservative standard errors.

5.2. Index inclusion

We begin our regression analysis by focusing on the potential importance of index inclusion. We focus on indexing because it is often associated with the rise of common ownership (e.g., Harford et al., 2011) and the target of policy recommendations related to common ownership (e.g., Posner et al., 2017).

To analyze indexing, we construct a number of pair-level dummy variables that indicate whether the two firms in a particular pairing are both included in a certain market index or not. We construct six such indicators, one for each of the following indexes: S&P 500, S&P 400, S&P 600, Russell 1000, Russell 2000, and Nasdaq. Because of a lack of data on Russell index inclusions prior to 1998 and the absence of some S&P indexes prior to the mid-1990s, we restrict our sample to post-1997 data. In addition to bi-directional pair fixed effects, we control for the average share of equity held by institutions across the two stocks, which is positively associated with our measures because the 13F filings data covers only institutional investors. We also include a few other explanatory variables, including whether the two stocks are in the same industry. We discuss these other explanatory variables and their coefficients in Section 5.3, but their inclusion has little impact on the estimates. Likewise, controlling for additional stock characteristics, such as market-to-book ratio or momentum of the pair, has little impact on our estimates.

Index inclusion is positively associated with our *GGL* measure of incentives that assumes full attention. This is shown in Table 2. Inclusion of both stocks in the same index (S&P 400, S&P 500, S&P 600, Russell 1000, Russell 2000, or Nasdaq) is always associated with an increase in $GGL_{FullAttention}$. The estimates are all statistically significant at a level of at least 1% (with some t-statistics exceeding 25) and economically large. For example, moving from both stocks not being in the S&P 500 to both stocks being in the S&P 500 is associated with an 89% increase in managerial incentives relative to the sample average. The magnitudes are similarly large for inclusion of both stocks in other indexes, including the Russell 2000.

Table 2
GGL with full attention.

This table reports regression estimates of the relation between $GGL_{FullAttention}$ and index inclusion, average institutional ownership, industry, and industry concentration. The unit of observation is at the stock-pair-year direction level. The dependent variable, $GGL_{FullAttention}$, reflects the relative incentive of the manager of stock i to internalize the impact of externalities on the value of stock j in year t when $g = 1$. Index dummy variables are coded one if both stocks are in that particular index and zero otherwise, and average institutional ownership is the average share of equity held by institutional investors across the two stocks. *Average Size* is the average of the log assets of the two stocks in year *t*. *Average Industry HHI* is the average Herfindahl-Hirschman Index of the industries, based on a three-digit Standard Industrial Classification code, for the two stocks in the pair. The industry dummy is one if stocks in a pair belong to the same industry and is zero otherwise. These regressions are based on data from 1998 through 2012. All specifications include pair direction fixed effects. Standard errors are clustered by stock i, and t-statistics are reported in brackets below the coefficient estimates. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level. N = 447,358,398.

Variable	Dependent variable = $GGL_{FullAttention}$
Both S&P 500 Dummy$_{ijt}$	0.89***
	[26.39]
Both Russell 2000 Dummy$_{ijt}$	0.39***
	[40.73]
Both Russell 1000 Dummy$_{ijt}$	0.36***
	[18.51]
Both S&P 400 Dummy$_{ijt}$	0.58***
	[16.80]
Both S&P 600 Dummy$_{ijt}$	1.08***
	[30.64]
Both Nasdaq Index Dummy$_{ijt}$	0.39***
	[7.41]
Average Institutional Ownership$_{ijt}$	4.18***
	[99.43]
Average Size$_{ijt}$	0.09***
	[10.84]
Average Industry HHI$_{ijt}$	0.08*
	[1.80]
Both in Same Industry Dummy$_{ijt}$	0.02
	[1.20]
Average Industry HHI$_{ijt}$ * *Both in Same Industry Dummy*$_{ijt}$	0.13
	[1.55]
Pair direction fixed effects	Yes
Time fixed effects	Yes
R^2	0.692

Once we allow for investor inattention, we find no clear association between index inclusion and managerial incentives to internalize externalities. This is shown in Table 3. Using GGL_{Linear}, inclusion in some indexes (e.g., S&P 500, Russell 1000, and Nasdaq) is associated with, on average, an increase in managerial incentives to internalize externalities, and inclusion in other indexes (e.g., Russell 2000 and S&P 600) is associated with a decrease (Table 3, Column 1). For example, relative to the sample average, inclusion of both stocks in the Russell 2000 is associated with an average decline in GGL_{Linear} of 26%. The divergent association between index inclusion and incentives is robust to alternative versions of *GGL*, including when we change the functional form used for attention, g (Columns 2–3), or restrict our analysis to the largest five shareholders (Column 4) or shareholders holding at least 5% of shares (Column 5).

Table 3
GGL measures that do not assume full attention.

This table reports regression estimates of the relation between our model-derived measure of common ownership that accounts for the impact of investor inattention on managerial incentives and index inclusion, average institutional ownership, industry, and industry concentration. The unit of observation is at the stock-pair-year direction level. The dependent variable, *GGL*, reflects the relative incentive of the manager of stock *i* to internalize the impact of externalities on the value of stock *j* in year *t*. Definitions of the different versions of *GGL* are provided in the text, and each *GGL* measure is scaled by its sample average. Index dummy variables are coded one if both stocks *i* and *j* are in that particular index in year *t* and zero otherwise, and average institutional ownership is the average share of equity held by institutional investors across the two stocks in year *t*. *Average Size* is the average of the log assets of the two stocks in year *t*. *Average Industry HHI* is the average Herfindahl-Hirschman Index of the industries, based on a three-digit Standard Industrial Classification code, for the two stocks in the pair. The industry dummy is one if stocks in a pair belong to the same industry and is zero otherwise. These regressions are based on data from 1998 through 2012. All specifications include pair direction fixed effects. Standard errors are clustered by stock *i* and *t*-statistics are reported in brackets below the coefficient estimates. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level. $N = 447{,}358{,}398$.

Variable	GGL_{Linear}	GGL_{Convex}	$GGL_{Concave}$	$GGL_{Top\ 5}$	$GGL_{5\%}$
	(1)	(2)	(3)	(4)	(5)
Both S&P 500 Dummy$_{ijt}$	2.71***	0.82	2.58***	2.50***	2.03***
	[12.26]	[0.65]	[21.95]	[10.62]	[7.63]
Both Russell 2000 Dummy$_{ijt}$	−0.26***	−0.30*	−0.12***	−0.27***	−0.28***
	[−9.87]	[−1.75]	[−10.08]	[−8.47]	[−7.09]
Both Russell 1000 Dummy$_{ijt}$	0.94***	−0.19	1.06***	0.84***	0.79***
	[16.09]	[−0.80]	[31.53]	[13.35]	[10.49]
Both S&P 400 Dummy$_{ijt}$	0.03	−0.26	0.43***	−0.02	0.03
	[0.42]	[−0.75]	[8.28]	[−0.22]	[0.21]
Both S&P 600 Dummy$_{ijt}$	−0.12**	−0.87***	0.42***	−0.17***	−0.13*
	[−2.57]	[−3.08]	[13.52]	[−3.13]	[−1.87]
Both Nasdaq Index Dummy$_{ijt}$	2.61***	0.43	1.91***	2.35***	2.24***
	[8.61]	[1.46]	[11.88]	[7.98]	[6.66]
Average Institutional Ownership$_{ijt}$	5.50***	7.87***	4.76***	5.71***	6.67***
	[26.76]	[5.80]	[61.34]	[23.41]	[21.61]
Average Size$_{ijt}$	0.16***	−0.19	0.20***	0.11**	−0.03
	[3.61]	[−1.01]	[11.94]	[2.27]	[−0.51]
Average Industry HHI$_{ijt}$	0.21*	1.72	0.05	0.24*	0.35**
	[1.65]	[1.44]	[0.79]	[1.66]	[2.00]
Both in Same Industry Dummy$_{ijt}$	0.22	1.05	0.03	0.21	0.25
	[0.95]	[0.52]	[0.87]	[0.73]	[0.69]
Average Industry HHI$_{ijt}$ * *Both in Same Industry Dummy*$_{ijt}$	4.22	31.76	0.65*	5.68	7.24
	[1.06]	[0.89]	[1.75]	[1.15]	[1.13]
Pair direction fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.652	0.605	0.639	0.651	0.651

While the mixed association between index inclusion and incentives is less apparent when using $GGL_{Concave}$, the point estimates in Table 3 mask important heterogeneity across stock-pairs. The average change in $GGL_{Concave}$ following a stock-pair's inclusion in the same index is positive for five of the six indexes (Table 3, Column 3), but 33% to 40% of stock-pairs experience a decline in $GGL_{Concave}$ when the index indicator changes from zero to one for those five indexes. This is similar to the heterogeneity in predicted *GGL* changes one observes following the BGI and BlackRock merger (e.g., see Fig. 4).

The unclear association between being in the same index and *GGL* again highlights the importance of accounting for investor attention. The positive association between index inclusion and $GGL_{FullAttention}$ (Table 2), but negative association between some index inclusions and versions of *GGL* that do not assume full attention (Table 3), suggests that being in some indexes is associated with a shift in the composition of owners toward less attentive investors (as measured using a lower $\beta_{i,A}$). This is shown formally in Table 4, where we regress sum of $\beta_{i,A}$ across investors, β_A^{SUM}, onto the index indicators. Index inclusion often exhibits a negative correlation with the sum of $\beta_{i,A}$ for a stock-pair's common investors (Table 4).

5.3. Industry structure and competition

Given the potential for anticompetitive behavior by firms that have common owners, we assess how *GGL* could be linked with industry structure. To do this, we regress our *GGL* measures onto the average HHI of the industries of the two companies in the pair and on an interaction variable between the average HHI and whether or not the two companies are in the same three-digit Standard Industrial Classification (SIC) industry. Under this specification, a positive coefficient on the interaction variable would suggest that the *GGL* of two companies that are in the same industry is larger when the industry is more concentrated, as measured by the HHI.

We find little evidence that managerial incentives are higher among pairs of companies operating in the same industry or when their industry becomes more concentrated. While always positive, the interaction between average HHI and our indicator for being in the same industry is statistically different from zero only for $GGL_{Concave}$ (Table 3, Columns 1–5). These findings provide little evidence that managerial incentives to internalize externalities tend to be higher as industry concentration rises. We also find no difference in the incentive to internalize externalities among stock-pairs from the same industry.

Table 4
Common investor portfolio weights and index inclusion.

This table reports regression estimates of the relation between the sum of the betas, $Beta^{Sum}$, and index inclusion, average institutional ownership, industry, and industry concentration. The unit of observation is at the stock-pair-year direction level. The dependent variable is the sum of portfolio weights of stock *i* in common investors' portfolios in year *t* across all common investors in stocks *i* and *j* in year *t*. Index dummy variables are coded one if both stocks are in that particular index and zero otherwise, and average institutional ownership is the average share of equity held by institutional investors across the two stocks. *Average Size* is the average of the log assets of the two stocks in year *t*. *Average Industry HHI* is the average Herfindahl-Hirschman Index of the industries, based on a three-digit Standard Industrial Classification code, for the two stocks in the pair. The industry dummy is one if stocks in a pair belong to the same industry and is zero otherwise. These regressions are based on data from 1998 through 2012. All specifications include pair direction fixed effects. Standard errors are clustered by stock *i*, and *t*-statistics are reported in brackets below the coefficient estimates. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level. $N = 447{,}358{,}398$.

Variable	Dependent variable = $Beta^{Sum}$
Both S&P 500 Dummy$_{ijt}$	10.55***
	[14.55]
Both Russell 2000 Dummy$_{ijt}$	−0.23***
	[−16.48]
Both Russell 1000 Dummy$_{ijt}$	2.60***
	[17.75]
Both S&P 400 Dummy$_{ijt}$	−0.18***
	[−2.75]
Both S&P 600 Dummy$_{ijt}$	−0.15***
	[−6.53]
Both Nasdaq Index Dummy$_{ijt}$	7.87***
	[6.44]
Average Institutional Ownership$_{ijt}$	1.41***
	[9.93]
Average Size$_{ijt}$	0.76***
	[9.98]
Average Industry HHI$_{ijt}$	−0.14
	[−0.71]
Both in Same Industry Dummy$_{ijt}$	−0.01
	[−0.10]
Average Industry HHI$_{ijt}$ * *Both in Same Industry Dummy*$_{ijt}$	0.25
	[0.61]
Pair direction fixed effects	Yes
Time fixed effects	Yes
R^2	0.841

6. Measuring investor inattention using voting data

The key assumption that underlies our analysis is that investors pay more attention to companies that are relatively more important in their portfolios. That is, g is an increasing function of $\beta_{i,A}$. This assumption is both grounded in theory and backed by empirical evidence. Theory, however, is ambiguous on the form of this positive association (e.g., one can give arguments for both concave and convex shapes), and empirical evidence does not exist to provide clear guidance. Given this, our above analysis shows the robustness of our main findings to generic linear, convex, and concave attention functions.

In this section, we further highlight the robustness of our conclusions using an attention function, g, that we estimate. In an ideal test, we would estimate the functional form of $g(\beta)$ by regressing an indicator for whether the investor is attentive to a particular company's actions, g, onto a source of exogenous variation in the investor's portfolio weights, β. Investor attention, however, is unobserved and portfolio weights are inherently endogenous and could be correlated with other investor- or company-specific factors that drive differences in investor attention. One can also not easily use a vote for or against managers or an investor's exit after bad news (e.g., disappointing financial reports or an undesirable vote outcome) as a way to uncover an individual investor's level of attention, because, as illustrated by our model, whether an investor opposes management (either via a negative vote or exit) is determined by the endogenous combination of managerial actions and investor attention.[14]

Because investor attention is unobservable, we follow Iliev and Lowry (2015) and proxy for it using an indicator for whether an institution's votes fail to follow the recommendations of the proxy advisory firm ISS. If investors pay close attention to a given company in their portfolios, then they are more likely to form an independent opinion about the merits of various corporate proposals and less likely to follow the one-size-fits-all recommendations of proxy advisors such as ISS. Consistent with this, Iliev and Lowry (2015) confirm that a greater likelihood of disagreeing with ISS is observed among mutual funds in which the net benefits of being an attentive investor are greater, and Iliev et al. (2019) find that this voting behavior is positively related to whether an investor attempts to become informed before a key vote. To mitigate concerns about the endogeneity of portfolio weights, we partial out potential confounding factors that can drive differences in attention at the investor-by-year or company-by-year level.

To approximate $g(\beta)$, we estimate the likelihood that an investor's vote on a given proposal disagrees with the ISS recommendation as a function of the portfolio weight the underlying firm receives in the investor's portfolio. In particular, we regress a vote-investor–level measure for disagreement with ISS onto dummy variables for each portfolio weight decile, and we create a fitted attention function using a linear extrapolation between point estimates. Because the voting data are at mutual fund level but our ownership data are at the institution level, we map the fund-level votes to the appropriate institutions. We also include institution-by-year and company-by-year fixed effects in the estimation to account for heterogeneity in the level of attention across investors over time and in the overall level of shareholder support a company typically receives over time. Finally, we set the intercept of our fitted attention function to be zero for $\beta = 0$. The point estimates of this nonparametric estimation and our fitted

[14] For example, some attentive investors could vote to support the manager because that manager endogenously took actions to gain their support, whereas other attentive investors would not support the manager because the manager failed to take actions that benefit them (possibly because their holdings in that company are not particularly large). In unreported analysis, we verify no significant association between portfolio weights and an investors' tendency to vote against management. Similar issues apply to using an investor's exit after bad news. Actions taken by a manager to benefit some attentive investors can be opposed by other investors, thus generating a negative market reaction but no clear prediction about attentive investor exits following this market response.

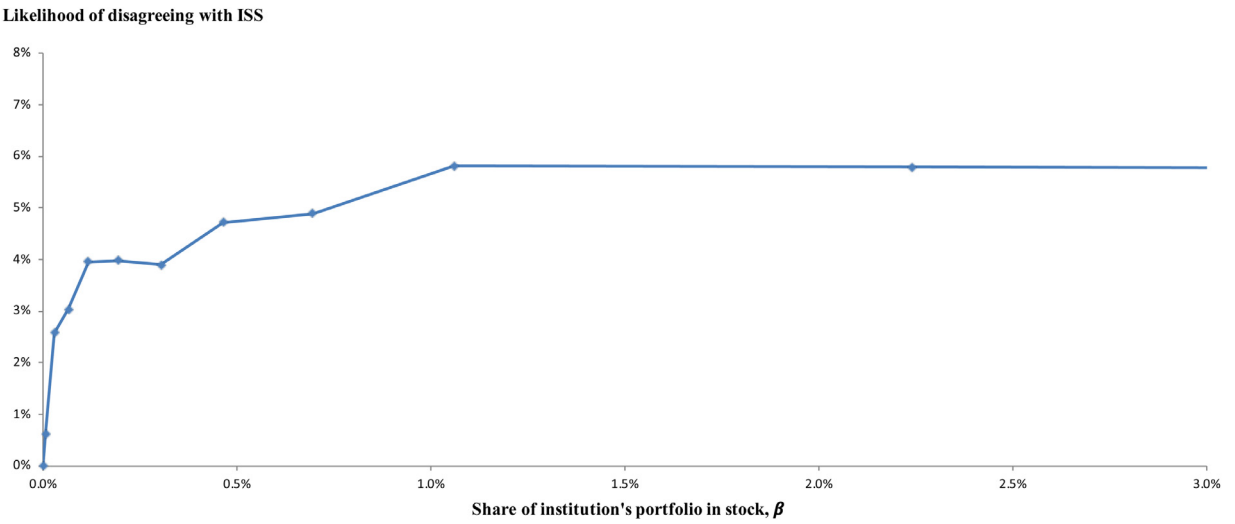

Fig. 6. Fitted $g(\beta)$ function, as estimated using the Iliev and Lowry (2015) proxy for investor attention. This figure plots the point estimates from the fund-investor–level regression of an indicator for disagreement with Institutional Shareholder Services (ISS) onto decile indictors for each portfolio weight, β, decile. The regression includes investor-by-year and stock-by-year fixed effects, and a linear extrapolation is applied between point estimates to construct the figure, where $g(\beta)$ is set equal to zero for $\beta = 0$. More details of the underlying estimation are provided in Section 6 and Appendix C.

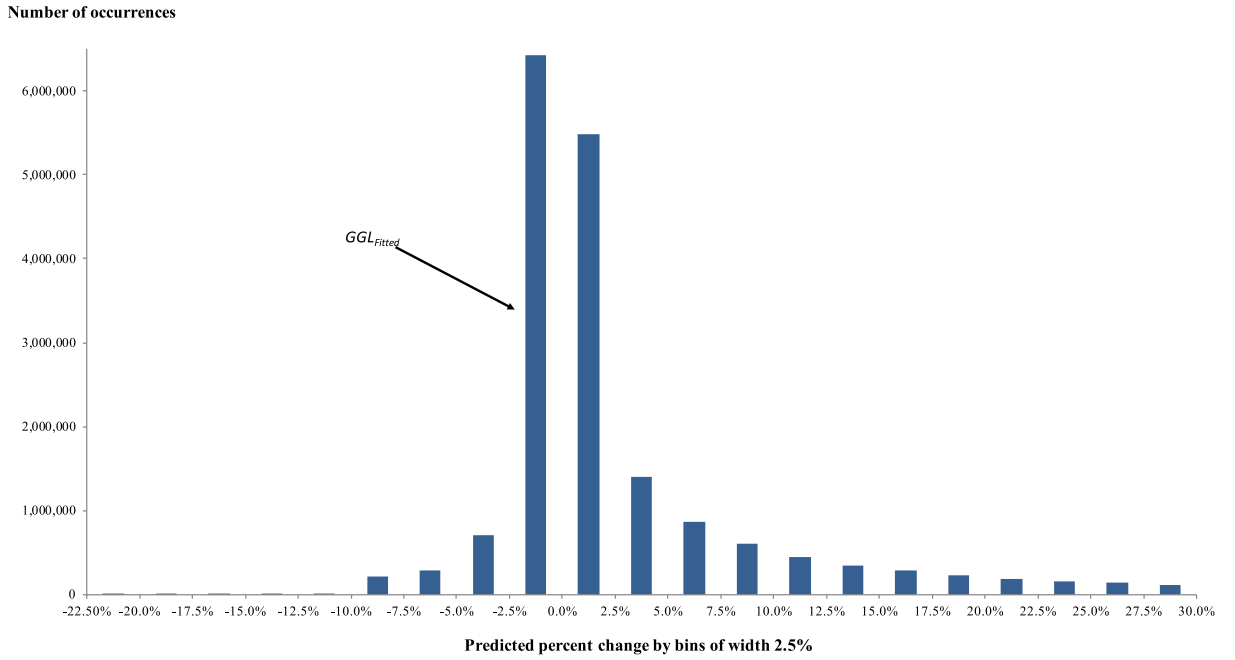

Fig. 7. Histogram of predicted changes in GGL_{Fitted} following the Barclays Global Investors (BGI) and BlackRock merger in 2009. This figure plots a histogram of the predicted percentage change in GGL_{Fitted} due to the 2009 merger between BlackRock and BGI. The predicted change is calculated by holding the ownership stakes of all institutional investors constant and recalculating the *GGL* measure in 2008 under the assumption that the portfolios of BGI and BlackRock are now owned by the same investor, the merged entity.

g function are presented in Fig. 6, and the precise details of the underlying estimation are given in Appendix C.

As can be seen from Fig. 6, the estimated attention function has a concave shape, suggesting that, for an average institutional investor, the increase in attention that occurs for more important holdings is diminishing as the portfolio weight increases. This fitted attention function most closely resembles the attention function used to construct $GGL_{Concave}$ (i.e., $g(\beta_{i,A}) = \beta_{i,A}^{0.5}$) but exhibits less curvature at higher portfolio weights, indicating that investors' attention is less sensitive to small changes in weights for the more important portfolio holdings than assumed by $GGL_{Concave}$.

Table 5
GGL with fitted attention function.

This table reports regression estimates of the relation between our model-derived measure of common ownership that accounts for the impact of investor inattention on managerial incentives and index inclusion, average institutional ownership, industry, and industry concentration. The unit of observation is at the stock-pair-year direction level. The dependent variable, GGL_{Fitted}, reflects the relative incentive of the manager of stock i to internalize the impact of externalities on the value of stock j in year t, based on the attention function estimated in Section 6. Index dummy variables are coded one if both stocks i and j are in that particular index in year t and zero otherwise, and average institutional ownership is the average share of equity held by institutional investors across the two stocks in year t. *Average Size* is the average of the log assets of the two stocks in year t. *Average Industry HHI* is the average Herfindahl–Hirschman Index of the industries, based on a three-digit Standard Industrial Classification code, for the two stocks in the pair. The industry dummy is one if stocks in a pair belong to the same industry and is zero otherwise. These regressions are based on data from 1998 through 2012. All specifications include pair direction fixed effects. Standard errors are clustered by stock i, and t-statistics are reported in brackets below the coefficient estimates. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level. $N = 447{,}358{,}398$.

Variable	Dependent variable = GGL_{Fitted}
Both S&P 500 Dummy$_{ijt}$	2.55***
	[27.52]
Both Russell 2000 Dummy$_{ijt}$	−0.20***
	[−14.00]
Both Russell 1000 Dummy$_{ijt}$	1.25***
	[32.95]
Both S&P 400 Dummy$_{ijt}$	0.72***
	[11.18]
Both S&P 600 Dummy$_{ijt}$	0.45***
	[11.06]
Both Nasdaq Index Dummy$_{ijt}$	1.48***
	[11.37]
Average Institutional Ownership$_{ijt}$	4.68***
	[64.69]
Average Size$_{ijt}$	0.21***
	[15.24]
Average of Industry HHI$_{ijt}$	0.03
	[0.44]
Both in Same Industry Dummy$_{ijt}$	−0.01
	[−0.32]
Avg. of Industry HHI$_{ijt}$ * *Both in Same Industry Dummy*$_{ijt}$	0.37***
	[2.66]
Pair direction fixed effects	Yes
Time fixed effects	Yes
R^2	0.633

None of our earlier findings is significantly affected by using this fitted attention function when constructing *GGL*. To illustrate this, we use the estimated attention function plotted in Fig. 6 to create a new version of our *GGL* measure, GGL_{Fitted}, and repeat our earlier analyses. Doing so, we confirm that our main findings remain robust to this alternative specification of the g function. For example, we find that 39.4% of stock-pairs are predicted to exhibit a decline in managerial incentives to internalize externalities after the BlackRock-BGI merger (see Fig. 7) and that index inclusion can still be associated with an average decline in GGL_{Fitted} (see Table 5). And even for the five indexes in which inclusion is associated with an average increase in GGL_{Fitted} (Table 5), about 31% to 39% of stock-pairs experience a decline in GGL_{Fitted} following inclusion in those same indexes. Moreover, while the average level of GGL_{Fitted} did increase by 1,301% since 1980, this is still 50% lower than the average increase observed for $GGL_{FullAttention}$, and 49.6% of GGL_{Fitted} in 2012 is driven by the three large indexers: BGI and BlackRock, State Street, and Vanguard.

GGL_{Fitted} is positively associated with industry HHI when both stocks are in the same industry, suggesting that managerial incentives to internalize externalities are higher, on average, in more concentrated industries. For stocks in the same industry, increasing HHI by one standard deviation is associated with a 1.7% increase in GGL_{Fitted} (t-statistic = 2.66; Table 5).

While it is tempting to use GGL_{Fitted} as the baseline measure for the effect of ownership overlap on managerial incentives, the nonparametric estimate of the g function has limitations. Investors can affect firms' decisions by means beyond the voting outcomes we use to proxy for investor attention (e.g., direct communications, exit decision, etc.). Also, GGL_{Fitted} does not account for potential heterogeneity among investors in their level of attention. For example, the voting data do not include voting by pension and hedge funds, which are both included in the 13F data used to construct our proposed *GGL* measure. Therefore, if pension and hedge funds have different associations between attention and portfolio weights, which we are not able to estimate in our data, then GGL_{Fitted} could measure their level of attention with error. Future research that addresses these concerns could greatly improve the precision of the *GGL* measure.

7. Does *GGL* predict outcomes that could be associated with common ownership?

In this section, we provide an illustration of how one could use our proposed measure to study the implications of common ownership. We do this by assessing the ability of *GGL* to predict an outcome that could be influenced by common ownership: target selection in an acquisition. If significant externalities exist between two firms, a common investor can favor an acquisition so as to ensure that these externalities are internalized, particularly when that investor also stands to gain from the positive takeover premium that is typically offered by the acquirer. To conduct this analysis, we estimate

$$Acquisition_{ijkt+1} = \beta GGL_{ikt} + \Gamma X_{ijkt} + \alpha_{ik} + \delta_{jt} + \varepsilon_{ijkt}, \qquad (10)$$

where $Acquisition_{ijkt+1}$ is an indicator variable that equals one if firm i operating in industry j acquires firm k in year $t + +1$, and GGL_{ikt} is our bi-directional measure of how common ownership affects manager i's incentive to internalize the impact of her actions on firm k in period t. To improve interpretation of β, we scale *Acquisition* by its sample average. To remove the potential importance of industry-specific merger waves and ensure that we are isolating variation in incentives for a given pair of firms over time, we include both industry-year fixed effects, δ_{jt}, and pair-direction fixed effects, α_{ik}. Following Harford et al. (2011), we also control for a variety of factors thought to influence target selection, X_{ijkt}, including target market capitalization, target leverage, and the absolute difference in return on assets across firms, among other controls (see Table 6). Finally, we cluster the standard

Table 6
Managerial incentives arising from common ownership and mergers.
This table reports regression estimates of the relation between our model-derived measure of common ownership that accounts for the impact on managerial incentives, *GGL*, and firm decisions to merge. The unit of observation is at the stock-pair-year direction level. The dependent variable, is a zero or one depending on whether stock *i* acquires firm *k* at time *t + +1*. Definitions of the different versions of *GGL* are provided in the text, and each *GGL* measure is scaled by its sample average. Control variables included in the regressions are target institutional ownership percentage, target market capitalization, target market leverage, target market-to-book ratio, target earnings-to-price ratio, target asset liquidity, target return on assets, target prior year stock return, absolute difference in institutional ownership percentage across firms, absolute difference in market capitalization across firms, absolute difference in market-to-book across firms, absolute difference in return on assets across firms, absolute difference in prior year stock return across firms. All specifications include pair direction fixed effects and industry-by-year fixed effects, where industries are defined using three-digit Standard Industrial Classification codes. Standard errors are clustered by stock *i*, and *t*-statistics are reported in brackets below the coefficient estimates. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level. $N = 303{,}102{,}145$.

Dependent variable = indicator for acquisition of firm *k* by firm *i* operating in industry *j* in year *t + +1*							
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GGL_{FullAttention,ikt}$	0.175***						
	[3.22]						
$GGL_{Linear,ikt}$		0.003*					
		[1.78]					
$GGL_{Convex,ikt}$			0.00004				
			[0.95]				
$GGL_{Concave,ikt}$				0.084***			
				[2.99]			
$GGL_{Top5,ikt}$					0.002		
					[1.60]		
$GGL_{5\%,ikt}$						0.001	
						[1.36]	
$GGL_{Fitted,ikt}$							2.37***
							[4.42]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pair direction fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.238	0.238	0.238	0.238	0.238	0.238	0.238

errors by firm *i*. A fuller description of the data we used to estimate this equation is provided in Appendix F.

We find evidence that *GGL* does positively predict target selections. This is shown in Table 6. The coefficient on *GGL* is always positive and is statistically significant when using $GGL_{FullAttention}$, GGL_{Linear}, $GGL_{Concave}$, or GGL_{Fitted} (Table 6, Columns 1, 2, 4, and 7; *t*-statistics = 3.22, 1.78, 2.99, and 4.42, respectively). The *t*-statistic and economic magnitude are both the largest when using GGL_{Fitted}, which is the version of *GGL* that uses the attention function estimated from voting data (see Section 6). The point estimate on GGL_{Fitted} indicates that moving from no managerial incentives to internalize externalities because of common ownership ($GGL = 0$) to the average level of incentives in our sample ($GGL = 1$) is associated with a 23.7% increase in the likelihood of a merger (merger probability goes from 0.000206% to 0.000255%) relative to the sample average likelihood of a merger between any two firms in a given year. In unreported analysis, we find a similar positive association between *GGL* and *Acquisition* when excluding the pair-direction fixed effects, with GGL_{Fitted} retaining the highest economic magnitude and *t*-statistic.

While these findings are suggestive, they must be interpreted with caution. One possible interpretation is that *GGL*, particularly GGL_{Fitted}, accurately captures managerial incentives arising from common ownership and that these incentives influence target selection. In our sample, the target announcement returns are positive in 94.4% of the cases, suggesting that acquiring firm shareholders would be more willing to support a merger if they also own shares of the target. Another possibility is that some other unmodeled firm characteristics could be associated with both target selection and *GGL*, and these omitted variables drive the observed correlations. This possibility is difficult to exclude absent some exogenous source of common ownership.

In general, an empirical validation of *GGL*, and any other measure of common ownership, is difficult to achieve absent a setting in which the impact of common investors on a particular outcome is known with certainty (i.e., the proposed measure empirically uncovers a known benchmark). To the best of our knowledge, this setting does not exist, as theory gives no guidance on what levels of common ownership should matter empirically. That aside, *GGL* does have some appealing properties that suggest it would be more reflective of how common ownership impacts managerial incentives to internalize externalities. The measure is derived from a model of managerial incentives that accounts for common ownership and the potential for some investors to be less attentive than others, and it does not require assumptions regarding the nature, sign, or magnitude of externalities.

8. Concluding remarks

Common ownership across US stock-pairs has been on the rise over the last few decades, but its determinants

and implications for economic outcomes are still not well understood. For example, attempts to study whether common ownership results in anticompetitive behaviors is ongoing. Some empirical work suggests that it is linked to anticompetitive behavior by firms (e.g., Azar et al., 2018, 2019), and others argue otherwise (e.g., Dennis et al., 2018; Gramlich and Grundl, 2017; O'Brien and Waehrer, 2017). Despite these inconclusive findings, some have already begun discussing possible policy responses (e.g., Elhauge, 2016; Posner et al., 2017), many of which have the potential to significantly reshape corporate ownership structures and the asset management industry more broadly.

One challenge with studying common ownership is the difficulty in measuring its level and impact on managers' incentive to internalize how their actions could affect the value of other stocks held by their investors. Existing measures of common ownership used in the literature tend to be either measures of ownership overlap that lack any theoretical connection to managerial incentives or measures that make strong assumptions about the nature of externalities and take as a given that all common investors are fully attentive to managers' actions and the implications of these actions for their overall portfolio, which runs counter to existing empirical evidence regarding limited investor attention (e.g., Kempf et al., 2017; Liu et al., 2019).

Our paper addresses these measurement concerns by deriving a general measure of common ownership that quantifies how overlapping ownership structures influence managerial incentives in a setting in which not all investors are fully attentive and does so without making strong assumptions about the structure of externalities. We thus illustrate that the assumed drivers of common ownership can have little impact on managerial incentives. For example, we show that asset manager mergers, and even index ownership under certain circumstances, have no clear association with changes in managerial incentives because both can reduce the attentiveness of a firm's investors. Together, these findings cast doubt on the conclusions of previous research that assumes asset manager mergers and index investing necessarily increase managers' incentives to internalize externalities, including studies claiming to find evidence that common ownership is reducing competition in some industries (e.g., Azar et al., 2018, 2019).

Overall, our findings provide important context for recent empirical and theoretical work arguing that common ownership is important for competitiveness, corporate governance, etc. We show that accounting for investor attention can have important implications for the impact of overlapping ownership structures on managerial incentives and, hence, possible policy responses. The generality of flexibility of our proposed measure will also facilitate future empirical research regarding both the importance of common ownership for corporate outcomes and the aggregate economy and the potential determinants of common ownership across stock pairs and industries. While much attention has been given to the effects of common ownership, a promising direction for future research is to further explore its determinants.

Appendix A. Generalizations of *GGL* measure

In this Appendix, we offer two generalizations to the *GGL* measure. Under the first generalization, we allow the manager to weigh the votes of investors differently. Let

$$P_n(\boldsymbol{X}) = \gamma_{retail,n}\left(1 - \sum_{i=1}^{I}\alpha_{i,n}\right) + \sum_{i=1}^{I}\eta(\alpha_{i,n})p_{i,n}(\boldsymbol{X}). \quad \text{(A1)}$$

The key difference from the expression in the main text is in the second term: $\eta(\alpha_{i,n})$ replaces $\alpha_{i,n}$, where $\eta(\cdot) > 0$ and $\eta'(\cdot) > 0$. Intuitively, the function η measures the importance that managers ascribe to a block of votes. If managers care just about whether a proposal is passed or voted down, then η would be the identity function as in the main text. In this more general specification, managers can overweight the importance of large blocks and underweight the importance of small blocks.[15]

Using this formulation, $U_n(1, \boldsymbol{X}_{-n}) \geq U_n(0, \boldsymbol{X}_{-n})$ holds if and only if

$$P_n(1, \boldsymbol{X}_{-n}) - P_n(0, \boldsymbol{X}_{-n}) + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0 \Leftrightarrow \quad \text{(A2)}$$

$$\sum_{i=1}^{I}\eta(\alpha_{i,n})[p_{i,n}(1, \boldsymbol{X}_{-n}) - p_{i,n}(0, \boldsymbol{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0 \Leftrightarrow \quad \text{(A3)}$$

$$\sum_{i=1}^{I}\eta(\alpha_{i,n})g(\beta_{i,n})\rho[w_{i,n}(1, \boldsymbol{X}_{-n}) - w_{i,n}(0, \boldsymbol{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0 \Leftrightarrow \quad \text{(A4)}$$

$$\sum_{i=1}^{I}\eta(\alpha_{i,n})g(\beta_{i,n})\rho[W_i(1, \boldsymbol{X}_{-n}) - W_i(0, \boldsymbol{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0 \Leftrightarrow \quad \text{(A5)}$$

$$\sum_{i=1}^{I}\eta(\alpha_{i,n})g(\beta_{i,n})\left[\sum_{m=1}^{N}\alpha_{i,m}\rho[\Delta_m(1, \boldsymbol{X}_{-n}) - \Delta_m(0, \boldsymbol{X}_{-n})]\right] + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0 \Leftrightarrow \quad \text{(A6)}$$

$$\sum_{i=1}^{I}\eta(\alpha_{i,n})g(\beta_{i,n})\left[\sum_{m=1}^{N}\alpha_{i,m}\rho[\Delta_{m,n}(1) - \Delta_{m,n}(0)]\right] + \frac{B_n(1) - B_n(0)}{\lambda_n} \geq 0. \quad \text{(A7)}$$

Applying the same logic as in the main text results in the following generalized *GGL* measure :

$$GGL(A, B) = \sum_{i=1}^{I}\eta(\alpha_{i,A})g(\beta_{i,A})\alpha_{i,B}. \quad \text{(A8)}$$

[15] The function η can also be applied to the noise or retail votes, but it will not change any of the results.

For example, if

$$\eta(\alpha_{i,A}) = \begin{cases} \alpha_{i,A} & if\ \alpha_{i,A} > z \\ 0 & else, \end{cases} \tag{A9}$$

then the manager of firm A is affected by the votes of his investors only if the investor's ownership in firm A is larger than z. In this case, the generalized GGL measure will aggregate only across common owners of firm A and B who own at least z percentage of the equity of firm A.[16]

Under the second generalization, we consider the effect of common ownership on the incentives of managers to internalize externalities with respect to a group of firms (e.g., industry). We start by constructing the effect of common ownership on the incentives of each manager to internalize externalities on a group of firms, instead of a single firm, and we then take the average of this measure across all managers within this group to construct the group-level incentives to internalize externalities.

Let Γ denote the set of firms with respect to which we seek to measure the effect of common ownership. Following the same logic as in the main text, for each firm A in this group, we measure the effect by the difference in the manager A's incentives to take action $x_A = 1$ under the existing ownership structure relative to a counterfactual in which investors in firm A have no ownership in any of the other firms in the set Γ (assuming the weights of all other firms in their portfolios remain unchanged). Recall

$$\Pi_n\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \beta_1, \ldots, \boldsymbol{\beta_N}\right) = \sum_{i=1}^{I} \eta(\alpha_{i,n}) g(\beta_{i,n}) \left[\sum_{m=1}^{N} \alpha_{i,m} \rho[\Delta_{m,n}(1) - \Delta_{m,n}(0)] \right]. \tag{A10}$$

Given the linearity of $\Pi_n(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_N})$, the generalized group-level measure from the perspective of manager A is the sum of the pairwise measures from the perspective of manager A:

$$CO(A, \Gamma) = \sum_{m \in \Gamma, m \neq A} \left[\Pi_A\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_N}\right) - \Pi_A\left(\boldsymbol{\alpha_1}, \ldots, \boldsymbol{\alpha_m} = 0, \ldots, \boldsymbol{\alpha_N}; \boldsymbol{\beta_1}, \ldots, \boldsymbol{\beta_m} = 0, \ldots, \boldsymbol{\beta_N}\right) \right]. \tag{A11}$$

Therefore,

$$CO(A, \Gamma) = \sum_{i=1}^{I} \eta(\alpha_{i,A}) g(\beta_{i,A}) \times \left[\sum_{m \in \Gamma, m \neq A} \alpha_{i,m} \rho[\Delta_{m,A}(1) - \Delta_{m,A}(0)] \right], \tag{A12}$$

which can be rewritten as

$$CO(A, \Gamma) = \sum_{m \in \Gamma, m \neq A} \left[\rho[\Delta_{m,A}(1) - \Delta_{m,A}(0)] \sum_{i=1}^{I} \eta(\alpha_{i,n}) g(\beta_{i,A}) \alpha_{i,m} \right]. \tag{A13}$$

If $\rho[\Delta_{m,A}(1) - \Delta_{m,A}(0)]$ is the same across all firms in the set Γ, then we can normalize $CO(A, \Gamma)$ by the term $\rho[\Delta_{m,A}(1) - \Delta_{m,A}(0)]$ and get the following group-level unit-free measure:

$$GGL(A, \Gamma) = \sum_{m \in \Gamma, m \neq A} GGL(A, m). \tag{A14}$$

Assuming that $\rho\ [\Delta_{m,A}(1) - \Delta_{m,A}(0)]$ is the same across all firms in the set Γ does not require the externalities that firm A imposes on each of these firms to be the same. It requires only that the difference between the externalities when $x_A = 1$ and the externalities when $x_A = 0$ and its impact on the likelihood of shareholder support be the same. This is a much weaker assumption. For example, under this assumption, the product market strategy employed by firm A can have a different effect on each of its competitors, but a change in that strategy should have the same differential effect on each competitor. Without this assumption, group-level measure cannot be unit-free.

$GGL(A, \Gamma)$ captures the impact of common ownership on manager A's incentive to internalize the impact of her action choices on all other firms in group Γ. Such a firm-level measure could be useful in a firm-level regressions that seek to analyze the importance of common ownership.

If one instead is interested in conducting a group-level analysis, as is usual in the literature on common ownership that tries to analyze whether certain industries are becoming less competitive because of common ownership, then one can use the average of $GGL(A, \Gamma)$ across all firms in group Γ,

$$GGL(\Gamma) = \frac{1}{|\Gamma|} \sum_{A \in \Gamma} GGL(A, \Gamma), \tag{A15}$$

where $|\Gamma|$ is the number of firms in set Γ. $GGL(\Gamma)$ is the average effect that common ownership between firms in the set Γ has on the incentives of managers to internalize externalities between these firms.

Appendix B. Additional measures of common ownership used in the literature

Many additional ways exist to measure common ownership at the stock-pair level that are currently used in the literature. Four examples are

$$Overlap_{Count}(A, B) = \sum_{i \in I^{A,B}} 1, \tag{B1}$$

$$Overlap_{Min}(A, B) = \sum_{i \in I^{A,B}} min\{\alpha_{i,A}, \alpha_{i,B}\}, \tag{B2}$$

$$Overlap_{AP}(A, B) = \sum_{i \in I^{A,B}} \alpha_{i,A} \frac{\bar{v}_A}{\bar{v}_A + \bar{v}_B} + \alpha_{i,B} \frac{\bar{v}_B}{\bar{v}_A + \bar{v}_B}, \tag{B3}$$

and

$$Overlap_{HL}(A, B) = \sum_{i \in I^{A,B}} \alpha_{i,A} \times \sum_{i \in I^{A,B}} \alpha_{i,B}, \tag{B4}$$

where $\alpha_{i,\,n}$ is the fraction of company n owned by investor i, $I^{A,\,B}$ is the set of institutional investors who own a stake in firm A and in firm B, and $\bar{v}_A$ and $\bar{v}_B$ are the market values of firms A and B, respectively.

Each variable approaches the measurement of ownership overlap from a different angle. The first measure

[16] $\eta(\alpha_{i,\,A}) \neq \alpha_{i,\,A}$ is another reason that in general $GGL(A, B) \neq GGL(B, A)$.

simply counts the number of common investors in stocks *A* and *B*, which is similar to He and Huang (2017) and He et al. (2019), which count the number of common blockholders a firm has with other firms in the industry, with a common blockholder defined as an investor who owns at least 5% of the outstanding shares in both the firm and one of its industry peers.[17] To better capture the extent of common ownership across the two firms, the second measure, which is used by Newham et al. (2018), calculates the minimum ownership stake of each common investor and sums up these minimum stakes across common investors. The third measure was proposed in Antón and Polk (2014) in their study of stock price movements and, unlike the second measure, it uses market capitalization to weigh the relative importance of investors' ownership in each of the two firms before aggregating across investors. The fourth measure, proposed in Hansen and Lott (1996), sums the total fraction of shares held by common investors in firm *A* and firm *B* and then multiples the two together. Each of the last two measures has also been used in recent studies of common ownership (e.g., see Freeman, 2019).

While intuitive as measures of ownership overlap, all four measures have a number of downsides as measures of common ownership. Unclear is whether any of these measures represents an economically meaningful measure of common ownership's impact on managerial incentives. In addition, both $Overlap_{Count}$ and $Overlap_{AP}$ are invariant to the decomposition of ownership between the two firms, which leads to some unappealing properties. For example, if a common investor sells all but one share in firm *B* and uses the proceeds to buy shares in firm *A*, the values of $Overlap_{Count}$ and $Overlap_{AP}$ would not change, although common ownership for that investor, for all intents and purposes, has effectively dropped to zero.

Appendix C. Additional details on how the $g(\beta)$ for GGL_{Fitted} is estimated

Broadly, we follow the methodology of Iliev and Lowry (2015) with a few modifications for our setting. The primary data set we rely on is the same as Iliev and Lowry (2015), the ISS-compiled Voting Analytics database, which has fund-level voting data since 2003 based on Form NP-X. Our primary unit of analysis is at the 13-F filer or institution level. We therefore map mutual funds to institutions (i.e., fund families) using data based on holding structure, name, and address of institution. We include voting data only for which we could unequivocally confirm a match across the 13-F data and the Form NP-X data. We follow the approach of Iliev and Lowry (2015) and focus only on shareholder-sponsored proposals and code vote decisions of "Against," "Abstain," and "Withhold" as "Against" and "For" as "For." Our final sample of analysis is based on 1,331,433 votes across 11 years and 240 institutions. The unit of observation is at agenda item *a*, stock *s*, fund *f*, institution *i*, year *t* level, and $InstAgainstISS_{a,s,f,i,t}$ is an indicator for whether a fund's vote for a given agenda item is different from the ISS recommendation for that particular vote. We then construct dummy variables based on deciles of institutions' holding percentage, β. We use dummies to allow for maximum flexibility in terms of how the $g(\beta)$ can look, thereby imposing minimal functional form assumptions.

We estimate the following regression specification:

$$InstAgainstISS_{a,s,f,i,t} = \sum_{d=2}^{10} \beta_d HoldingDecileDummy_{i,s,t} + \alpha_{i,t} + \delta_{s,t} + \varepsilon_{a,s,f,i,t}. \quad \text{(C1)}$$

We then use the coefficients we recover on the dummy variables, relative to the omitted first ownership decile dummy, to estimate the $g(\beta)$ function. The function is concave. These estimates control for company × year specific factors, $\delta_{s,t}$. For example, if a company is doing poorly and that affects how institutions vote for or with ISS broadly, that is controlled for. This also controls for any firm-specific factor that can change over time and affect voting (management quality, leverage, etc.). Our identification of $g(\beta)$ is entirely coming from the size of the position a holding has relative to an institution's total portfolio. We also control for institution × year specific factors, $\alpha_{i,t}$, meaning that if an institution has a policy of always voting against ISS, regardless of ownership stake in firms, this is also controlled for.

Appendix D. Revisiting Azar et al. (2018) using *GGL* instead of *MHHID*

In this Appendix, we illustrate how *GGL* can be used in the product market–level studies often found in the literature on common ownership. We do this by revisiting the findings of Azar et al. (2018) to determine whether using *GGL* and accounting for the possibility of investor inattention affects existing findings regarding common ownership's effect on product market competition. We choose to focus on Azar et al. (2018) because it is the most well known paper in the recent literature. Azar et al. (2018) find evidence that the market-level measure of common ownership, *MHHID*, is positively associated with fares in the airline industry, and they interpret these findings as evidence that the rise of common ownership is leading to anticompetitive behaviors in the airline industry.

We begin by first replicating the main findings of Azar et al. (2018), as reported in Table 3 of their paper. To do this, we download the Azar et al. (2018) replication package, which is found at https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12698, as well as the required airlines and ownership data that are not included in the replication package. While we had to make a couple of minor modifications to their code (see Appendix E), we are able to obtain estimates that are very close to those reported in Azar et al. (2018). Our estimated coefficients for *MHHID*'s association with airline fares are all positive, statistically significant, and match the Azar et al. (2018) Table 3 estimates out to two decimal places. These point estimates are reported in the first row of Appendix Table D1, and our point estimates for the other controls reported in their Table 3 are provided in Appendix Table D2.

[17] He and Huang (2017) also construct and use an indicator for having a common blockholder with another firm in the industry, and Azar (2011, 2017) constructs an indicator for having any common investor at the pair level.

Table D1
Replication of Table 3 in Azar et al. (2018) using *GGL*.

This table reports our replication of the findings in Table 3 of Azar et al. (2018) after replacing their market-level measure of common ownership, *MHHID*, with the market-level version of *GGL*. Each reported value represents a point estimate from an individual regression using the same controls and specification from Azar et al. (2018). For brevity, the estimates for the controls in each regression are not reported. The estimates are creating using the replication package posted by Azar, Schmalz, and Tecu, which can be downloaded at https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12698. Details on the modifications made to their code to create these estimates are provided in Appendix E. Standard errors are reported in parentheses. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level.

Common ownership variable	Dependent variable: Log(*Average Fare*)					
	Market-carrier level			Market level		
	(1)	(2)	(3)	(4)	(5)	(6)
MHHID	0.195***	0.219***	0.147***	0.324***	0.313***	0.200***
	(0.0464)	(0.0393)	(0.0380)	(0.0452)	(0.0403)	(0.0360)
GGL_{Linear}	0.0025	0.0004	−0.0010	0.0039	0.0024	−0.0004
	(0.0036)	(0.0034)	(0.0034)	(0.0039)	(0.0039)	(0.0037)
GGL_{Convex}	−0.0003	−0.0003	−0.0014	0.0006	0.0005	−0.0013
	(0.0009)	(0.0012)	(0.0012)	(0.0009)	(0.0014)	(0.0014)
$GGL_{Concave}$	0.0121	0.0016	0.0051	0.0067	0.0017	0.0054
	(0.0121)	(0.0091)	(0.0088)	(0.0129)	(0.0105)	(0.0095)
GGL_{Top5}	0.0052	0.0025	0.0015	0.0064	0.0042	0.0020
	(0.0039)	(0.0033)	(0.0034)	(0.0041)	(0.0037)	(0.0037)
$GGL_{5\%}$	0.0062	0.0036	0.0025	0.0075*	0.0055	0.0031
	(0.0039)	(0.0031)	(0.0033)	(0.0041)	(0.0035)	(0.0036)
GGL_{Fitted}	0.0118	0.0009	0.0053	0.0046	0.0005	0.0059
	(0.0114)	(0.0091)	(0.0088)	(0.0122)	(0.0107)	(0.0097)
$GGL_{FullAttention}$	0.0050	−0.0046	0.0000	−0.0043	−0.0072	−0.0009
	(0.0105)	(0.0089)	(0.0087)	(0.0114)	(0.0107)	(0.0098)
Log(Distance) * Year-quarter fixed effects	No	Yes	Yes	No	Yes	Yes
Year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Market-carrier fixed effects	Yes	Yes	Yes	No	No	No
Market fixed effects	No	No	No	Yes	Yes	Yes

Table D2
Replication of Table 3 in Azar et al. (2018).

This table reports our replication of the findings in Table 3 of Azar et al. (2018) using the replication package posted by Azar, Schmalz, and Tecu at https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12698. The replication, while very close to the original findings reported in Azar et al. (2018), are not exact. This is likely because of small, post-publication changes in the underlying Form 13F and airlines data, which are not provided as part of the replication package. Details on the modifications to their code that were made to create these estimates are provided in Appendix E. Standard errors are reported in parentheses. * indicates significance at the 10% level; ** at the 5% level; and ***, at the 1% level.

Variable	Dependent variable: Log(*Average Fare*)					
	Market-carrier level			Market level		
	(1)	(2)	(3)	(4)	(5)	(6)
MHHID	0.195***	0.219***	0.147***	0.324***	0.313***	0.200***
	(0.0464)	(0.0393)	(0.0380)	(0.0452)	(0.0403)	(0.0360)
HHI	0.222***	0.231***	0.164***	0.365***	0.359***	0.256***
	(0.0248)	(0.0249)	(0.0211)	(0.0317)	(0.0314)	(0.0243)
Number of Nonstop Carriers			−0.0105***			−0.00822**
			(0.00264)			(0.00354)
Southwest Indicator			−0.119***			−0.150***
			(0.00930)			(0.0135)
Other LCC Indicator			−0.0595***			−0.0992***
			(0.00732)			(0.00992)
Share of Passengers Traveling Connect, Market Level			0.123***			0.169***
			(0.0169)			(0.0191)
Share of Passengers Traveling Connect			0.105***			
			(0.0139)			
Log(Population)			0.306***			0.344***
			(0.106)			(0.122)
Log(Income per Capita)			0.370***			0.312***
			(0.103)			(0.109)
Log(Distance) * Year-quarter fixed effects	No	Yes	Yes	No	Yes	Yes
Year-quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Market-carrier fixed effects	Yes	Yes	Yes	No	No	No
Market fixed effects	No	No	No	Yes	Yes	Yes
N	1,237,878	1,237,878	1209,791	262,534	262,534	255,173
R^2	0.821	0.826	0.836	0.852	0.861	0.876
Number of market-carrier pairs	46,510	46,510	45,244			
Number of markets				7,190	7,190	6,911

We then modify the Azar, Schmalz, and Tecu code to calculate the market-level *GGL* for each airline market. We accomplish this using the market-level version of *GGL*, as defined at the end of Section 2.1. The market-level measure of *GGL* captures how much common ownership shifts the average incentive of firms in that market to internalize how their actions affect all the other firms operating in the market.

Replacing the *MHHID* in the main specification of Azar, Schmalz, and Tecu with *GGL* results in significant changes in their findings. This is shown in Appendix Table D1, where we repeat the estimations of Azar et al. (2018) using the different market-level versions of our *GGL* measure and report the point estimate on *GGL* from each individual regression, for a total of 42 *GGL* regressions. In many instances, the coefficient on *GGL* is negative, and in only one estimation do we find a marginally significant positive coefficient. The economic magnitudes are also small. Moving from no common ownership ($GGL = 0$) to the average market-level common ownership ($GGL = 1$) is associated only with a −0.7% to 1.2% shift in average fares. These findings provide additional evidence that the measurement of common ownership can significantly affect inferences.

These estimates also suggest that the findings of Azar et al. (2018) are not driven by *MHHID*'s questionable assumption of full attention. As seen in Appendix Table D1, even the full attention version of *GGL* is uncorrelated with airline fares, suggesting that the Azar, Schmalz, and Tecu findings are instead driven by the other key difference between *GGL* and *MHHID*, that is *MHHID*'s inclusion of market shares as an input. As discussed in Dennis et al. (2018), *MHHID*'s use of market shares in a regression that uses prices as the dependent variable raises significant endogeneity concerns. Because *GGL* does not make assumptions about the nature of the externality (as *MHHID* does), constructing *GGL* does not require using the potentially problematic market shares as an input, which is another advantage of *GGL*.[18]

Appendix E. Modifications made to Azar et al. (2018) code

Below is a list of the changes made to the replication code of Azar et al. (2018), which is available at https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12698. These modifications were necessary to get the code to run on Wharton's High-Performance Computing Cluster (HPCC) using the newest versions of ownership and airlines data.

1. Because parts of the Azar, Schmalz, and Tecu code were designed to access files stored on a personal computer, changed all back slashes ("\") found in file paths to forward slashes ("/").
2. Added lines to "master.do" to install FTOOLS and OUTREG2 Stata programs that were used in the replication code but not already installed on Wharton's HPCC.
3. Opened a log file in the "master.do" file to help with debugging of the Azar, Schmalz, and Tecu code, and changed the main directory that the "master.do" file points to so as to match where the replication package and data files were saved on Wharton's HPPC.
4. Deleted the "assert _m!=1" command after merging in the "mgrno cleaned.dta" file in the "Prepare Data – Ownership RP.do" file. This line was causing the Azar, Schmalz, and Tedu replication to stop running because a small number of institution names in our 13F ownership data are different from what was used in Azar et al. (2018). Another line of code was added to keep these unmatched institutions. Dropping these institutions instead has little impact.
5. Deleted the "capture log close" command in "Prepare Data – Regressions RP.do" to prevent the program from crashing because of the earlier log file we already created and opened.

   Below are the additional modifications made to the code to incorporate *GGL* and reestimate Azar et al. (2018) Table 3 regressions using a market-level *GGL* instead of *MHHID*.
6. Inserted code into "Prepare Data – Ownership RP.do" file to construct a variable that captures the β needed to later calculate an institution's likelihood of being attentive, $g(\beta)$. This β is calculated for each institution-stock-quarter observation and saved alongside the other ownership variables being constructed in the Azar, Schmalz, and Tecu code.
7. Inserted code into "Prepare Data – Ownership RP.do" file to set the probability of attention, g, equal to zero for Azar et al. (2018) hand-collected data on non-institutions. This is necessary because we do not observe a non-institution's full portfolio, which is required to calculate its β. This effectively drops these non-institutions from our *GGL* estimations. If we instead assume full attention (i.e., $g = 1$) for these non-institutions, there is little impact on the *GGL* estimates.
8. Inserted code into "Prepare Data – Deltas RP.do" to calculate the likelihood of being attentive, $g(\beta)$, for each institution-stock-quarter observation. This code is modified depending on which version of *GGL* is being constructed. Then, inserted code to calculate the market-level *GGL* for each market, as defined by Azar et al. (2018), using this attention probability and the other ownership variables that are already constructed in Azar et al. (2018) code. These market-level measures of *GGL* are then saved to a separate DTA file.
9. Added code to the "Prepare Data – Regressions RP.do" file to merge in the market-level *GGL* measures constructed in the earlier DO files.
10. Added code to the "Regressions – Price Baseline RP.do" file to run the regressions of Azar, Schmalz, and Tecu using the market-level *GGL* measure instead of the *MHHID*.

[18] Despite this advantage, the non-findings in Appendix Table D1 should not be interpreted as evidence that common ownership has no impact on product market competition. While the *GGL* estimations do not suffer endogeneity concerns with respect to market shares, they do potentially suffer from biases related to the endogeneity of ownership. While Azar et al. (2018) attempt to overcome this concern using the 2009 merger of BlackRock and BGI as a source of exogenous variation in ownership, we do not do that here because the merger has no clear impact on managerial incentives to internalize externalities.

Appendix F. Additional details regarding acquisition data and regression

We follow the approach of Harford et al. (2011) in constructing our merger data and control variables with a few modifications. Our data set consists of all completed acquisitions during our 1998–2012 sample time period, resulting in 1,790 acquisitions. Similar to Harford et al. (2011), we rely on Thomson Reuters Securities Data Company for our underlying raw merger data on the bidder and target identity. Unlike Harford et al. (2011), we use all firm-pairs in our data set, as opposed to merger-pairs and a matched sample. We construct all control variables as in Harford et al. (2011), except we winsorize several ratio variables at the 1% level for the computation of controls: return on assets (ROA), earnings to price, and market to book.

Our comparisons in the main paper between *GGL* metrics and mergers relate to the GGL_{ikt} as of December 31 in a given year (manager i's incentive to internalize the impact of her actions on firm k in year t) and the likelihood of firm i acquiring firm k in year $t + 1$.

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