

NBER WORKING PAPER SERIES

WHO'S PAYING ATTENTION? MEASURING COMMON OWNERSHIP AND ITS IMPACT
ON MANAGERIAL INCENTIVES

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Working Paper 25644
<http://www.nber.org/papers/w25644>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2019

We thank Jason Donaldson, Eli Fich, Murray Frank, John Graham, Dirk Jenter, Inessa Liskovich, Song Ma, Greg Nini, Giorgia Piacentino, Nancy Rose, seminar and brown bag participants at Dartmouth College, Cornell University, Indiana University, Michigan State University, University of Colorado, University of Michigan, Virginia Tech, Washington University in St. Louis, and participants at the American Economics Association Annual Meeting, BI Corporate Governance Conference, Colorado Finance Summit, Eastern Finance Association Annual Meeting, ECGI Global Corporate Governance Conference (Harvard), London Business School Finance Symposium, NBER Corporate Finance Summer Institute, SFS Cavalcade, University of Minnesota Corporate Finance Conference, and University of Tennessee “Smokey” Mountain Conference. We also thank Alon Brav and Carola Schenone for sharing data on activists and airlines, respectively. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 25644
March 2019
JEL No. D82,D83,G23,G34

ABSTRACT

We derive a measure that captures the extent to which overlapping ownership structures shift 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 ownership overlap, including mergers in the asset management industry and the growth of indexing, could in fact diminish managerial motives. Our findings illustrate the importance of accounting for investor inattention and cast doubt on the possibility that the growth of common ownership has had a significant impact on managerial incentives.

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There is a growing sense among academics and practitioners that common ownership—where two firms are at least partially owned by the same investor—is on the rise among U.S. firms and that this could have important implications for acquisitions, executive pay, and governance, among numerous other outcomes (e.g., see Antón et al., 2016; Harford et al., 2011; He and Huang, 2017; He et al., 2018; Kempf et al., 2017; Liu et al., 2017). Such common ownership might affect firms’ strategic choices since 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 may contribute to anticompetitive behaviors by firms (e.g., Azar et al., 2016, 2018) and that legal and regulatory actions are needed to limit institutions’ ability to offer index funds and hold significant stakes in some industries (e.g., Posner et al., 2016).¹

Despite the recent attention such common ownership has received, there is little discussion of 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., 2016, 2018) and the increasing popularity of index investing (e.g., see Harford et al., 2011), there is little discussion of whether we should expect such mergers and index-induced overlapping ownership structures to increase managers’ motives to internalize how their actions might 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. Specifically, for a given pair of stocks, we quantify the impact ownership overlap will have on a manager’s incentive to internalize how their actions might affect the value of the other firm. The resulting measure is simple and has a number of appealing properties. In particular, 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

¹ Posner et al. published a condensed version of their argument as an op-ed article in *The New York Times* on December 7, 2016, which is available at <http://nyti.ms/2gRQKhH>. Similarly, Elhauge (2016) argues that existing antitrust law can and should be used to undo horizontal shareholdings that have led to anti-competitive outcomes.

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 their ownership stake in the other firm), and the likelihood that investor is informed about whether the manager's actions have improved the value of their 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, forthcoming). 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)]. In particular, our model assumes that less attentive investors will 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., 2017). 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., 2018; 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 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% to 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 the average investor becoming increasingly diverse in their holdings, and hence, less

attentive as an owner. This finding highlights that investor inattention 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 actually be lower following asset manager mergers. Calculating the predicted changes in managerial incentives resulting from the merger of BGI and Blackrock in 2009, we find that 39% to 56% of stock-pairs would experience a decline in incentives to internalize externalities following the merger. This decline also occurs for many stock pairs in the airlines industry, which is a setting where the merger is argued to have increased such incentives (Azar et al., 2018). 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 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.

The importance of index investing for a possible shift in managerial motives is also questionable. When measuring managerial incentives to internalize externalities, the relative contribution of institutions that primarily offer index funds is no more than 50% in recent years. Moreover, we find that managers' incentive to internalize externalities sometimes decreases when both firms are included in the same index (e.g., the S&P or Russell indexes). For example, we find that if both firms become members of the Russell 2000 index, managers' incentive to internalize externalities decreases, on average, by 12% to 30%.

The index inclusion findings highlight a key aspect of our model; ownership overlap is a necessary but insufficient condition for shifting managerial incentives. 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.²

Given the important role of investor inattention, we also provide estimates of the association between investor attention and portfolio weights. While theory and empirical evidence tell us this association is positive, the exact functional form is unclear. Following Iliev and Lowry (2015), we proxy for an

² While there is evidence that index funds and the institutions that offer them successfully influence firms' governance structures using low-cost monitoring techniques, like 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, 2018), it is an open question whether index funds possess the resources or incentives necessary to monitor more firm-specific policy choices, like investment and pricing choices, that might in turn affect the value of other stocks in their large portfolios.

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's recommendations for stocks that represent a larger proportion of their portfolio, but we also find robust evidence that this relationship 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 itself" by fitting the attention function nonparametrically and using the implied estimates to construct a fitted version of our proposed measure of common ownership. We find that our main results continue to hold with the fitted version of our measure.

Combined, 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 and the growth of indexing, significantly shift managers' incentives or induce anticompetitive behaviors among firms in the airline and banking industries (e.g., Azar et al., 2016, 2018). A bulk of the ownership overlap documented in those industries is driven by diversified asset managers such as BlackRock, State Street, and Vanguard. However, since these firms own large stakes in virtually every U.S. publicly-listed company, a common ownership measure that accounts for investor attention will suggest that such diversified investors are unlikely 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. But our analysis indicates that managers' incentive to internalize externalities (i.e., soften competition) can actually be weaker, not stronger when two stocks are included in the same index and after the Blackrock/BGI merger.

In further support of this argument, we also show that the main results of an important paper in this literature, Azar et al. (2018), are not robust to using our proposed measure of common ownership. In particular, we find no evidence that common ownership is positively associated with prices in the airline industry under a variety of different assumptions on how investor attention is allocated. These findings raise additional questions regarding the conclusions of this and other related studies that use *MHHID* as a measure of common ownership and lend support to the argument that the documented correlations are instead driven by the endogeneity of the *MHHID* measure being used (e.g., see Dennis et al., 2018).

Interestingly, we do find evidence that managerial incentives to internalize externalities positively predict target selections in acquisitions. This is particularly true when using the version of our common ownership measure where we fit the attention function nonparametrically using voting data. While suggestive, these findings must be interpreted with caution since they do not isolate exogenous variation in common ownership, and we cannot exclude the possibility that omitted factors drive this correlation. Nevertheless, our analysis of common ownership's association with both pricing in the airline industry and target selection in acquisitions underscores the applicability of our measure to a wide range of contexts.

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 document time series and cross-sectional patterns of common ownership and its impact on managerial incentives across the entire universe of U.S. publicly-traded firms.

We also provide a general way to measure common ownership that can be used in future studies. While we make specific modeling choices when taking our proposed 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 only care 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). Additionally, we show that it is possible to construct versions of our measure that capture a manager's incentive to internalize the impact of their actions on an entire set of firms (e.g. all product-market competitors), which may be useful in studying whether common ownership induces anti-competitive behaviors.⁴

³ E.g., recent work evaluates the impact common ownership might have on firm competitiveness (Azar et al., 2016, 2018; Dennis et al., 2018; Gramlich and Grundl, 2017; O'Brien and Waehrer, 2017), governance (Azar, 2012; He et al., forthcoming; Jung, 2013; Kang et al., 2013; Kempf et al., 2017; Liu et al., 2017), corporate outcomes (Matvos and Ostrovsky, 2008; Gompers and Xuan, 2009; Harford et al., 2011; Masulis and Nahata, 2011; Cici et al., 2015; He and Huang, 2016), executive pay (Antón et al., 2016; Kwon, 2016), stock price movements (Jotikasthira et al., 2012; Anton and Polk, 2014; Bartram et al., 2015; Hau and Lai, 2016), credit risks (Massa and Žaldokas, 2016) and weekly return predictability (Gao et al., 2016).

⁴ To facilitate future research in this area, we will be posting versions of our proposed measure on WRDS so that other researchers can more readily study the potential determinants and effects of common ownership.

Finally, our paper contributes to the theoretical literature on common ownership (e.g., see Azar, 2017; Edmans et al., 2018; Hansen and Lott, 1996; Kraus and Rubin, 2010; Lopez and Vives, forthcoming; O’Brien and Salop, 2000; Rubin, 2006). Similar to these papers, we study how common ownership might affect corporate outcomes by shifting managerial incentives. The key distinction between our model and these papers is our assumption that investors may 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 important 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 may not have incentives to internalize externalities.

1. 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.

1.1 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 will care about these attentive common investors since a decline in shareholder support (e.g. via voting, negative public statements, or the selling of shares) adversely affects managers’ utility. Since 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.

Preliminaries: We consider an economy with $N \geq 2$ public firms, indexed by n , where 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 $V_n(\mathbf{X}) = \bar{v}_n + \Delta_n(\mathbf{X})$ where $\bar{v}_n > 0$ and $\mathbf{X} = (x_1, \dots, x_N)$. Parameter \bar{v}_n can be considered the market value of firm n absent the effect of policy choices, while $\Delta_n(\mathbf{X})$ 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 $\Delta_n(\mathbf{X}) = \sum_{m=1}^N \Delta_{n,m}(x_m)$. 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 only measure the direct effect of common ownership on managers' incentives, we assume that there are no complementarities or substitution effects across firms with respect to the externality, which implies that there are no strategic interactions between managers (i.e., the optimal decision of manager n is independent of actions taken by other managers).

Ownership structure: We assume there are $I \geq 1$ large investors in the economy, where the fraction of firm n 's shares held by investor i is 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 $\sum_{i=1}^I \alpha_{i,n} < 1$, since shares that are not owned by any of the large investors can be owned by retail/noise investors. The value of investor i 's portfolio is given by $W_i(\mathbf{X}) = Y_i + \sum_{n=1}^N \alpha_{i,n} V_n(\mathbf{X})$, where the term $Y_i \geq 0$ captures non-traded assets, T-bills, or any other asset which 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 $\beta_{i,n} = \alpha_{i,n} \bar{v}_n / (Y_i + \sum_{m=1}^N \alpha_{i,m} \bar{v}_m)$.

Voting and shareholder voice: We assume one share one vote, where each investor casts her votes either for or against the manager of each of her portfolio companies. This can be interpreted literally 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 might exert that is proportional to their ownership share. Such influence might occur through a variety of channels including public statements or the threat to exit one's position.

Investors can either be 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 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, however, votes for management with probability $\rho w_{i,n}(\mathbf{X})$, where $w_{i,n}(\mathbf{X})$ 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 $\rho w_{i,n}(\mathbf{X}) \in [0,1]$. Specifically,

$w_{i,n}(\mathbf{X}) = W_i(x_n, \mathbf{X}_{-n}) - \min_x W_i(x_n, \mathbf{X}_{-n})$, where \mathbf{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.

The function used to capture an investor's likelihood of being attentive, g , is quite flexible and could conceivably depend on a number of factors. For illustrative purposes, we begin by assuming that g only depends on how important a stock is to the overall portfolio of the investor. Specifically, 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., 2018). However, as discussed later, it will be easy for future researchers to 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., 2018).

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

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

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

$$P_n(\mathbf{X}) = \gamma_{retail,n}(1 - \sum_{i=1}^I \alpha_{i,n}) + \sum_{i=1}^I \alpha_{i,n} p_{i,n}(\mathbf{X}).$$

Managerial objective and decisions: Manager n maximizes

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

Intuitively, when the manager chooses a policy for his firm, she trades off the expected support from the shareholders of her firm, $P_n(x_n, \mathbf{X}_{-n})$, 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 .

Model solution: Manager n chooses $x_n = 1$ if and only if $U_n(1, \mathbf{X}_{-n}) \geq U_n(0, \mathbf{X}_{-n})$. Letting $\boldsymbol{\alpha}_n = \{\alpha_{i,n}\}_{i=1}^I$ and $\boldsymbol{\beta}_n = \{\beta_{i,n}\}_{i=1}^I$, we show in the Appendix that this inequality holds whenever $\Pi_n(\boldsymbol{\alpha}_1, \dots, \boldsymbol{\alpha}_N; \boldsymbol{\beta}_1, \dots, \boldsymbol{\beta}_N) \geq 0$, where

$$\Pi_n(\boldsymbol{\alpha}_1, \dots, \boldsymbol{\alpha}_N; \boldsymbol{\beta}_1, \dots, \boldsymbol{\beta}_N) \equiv \sum_{i=1}^I \alpha_{i,n} g(\beta_{i,n}) \left[\sum_{m=1}^N \alpha_{i,m} \rho [\Delta_{m,n}(1) - \Delta_{m,n}(0)] \right] + \frac{B_n(1) - B_n(0)}{\lambda_n}.$$

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 $[B_n(1) - B_n(0)]/\lambda_n$.

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

$$CO(A, B) = \Pi_A(\alpha_1, \dots, \alpha_N; \beta_1, \dots, \beta_N) - \Pi_A(\alpha_1, \dots, \alpha_B = \mathbf{0}, \dots, \alpha_N; \beta_1, \dots, \beta_B = \mathbf{0}, \dots, \beta_N).$$

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 ($\alpha_B = \mathbf{0}$) 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 their shares in B and reinvested them in Y_i . It can be shown that

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

Several remarks are in order. First, $CO(A, B)$ does not assume $x_n = 1$ is optimal; it only measures 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 $CO(B, A)$ since 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 only depends on the change in shareholder support since 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 . Additionally, investor i contributes more to $CO(A, B)$ in absolute terms when she (1) holds more shares in firm A (because the manager cares more about the investor's opinion if the investor holds more shares), (2) 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 (3) when firm A receives a larger weight in her portfolio (because the manager understands that the investor is more likely to be an informed and attentive to firm A 's actions).

Proposed Measure and Intuition: Since researchers cannot typically observe the sign or magnitude of the externalities in the data, let alone how they might change the probability an informed common

investor supports the manager (as captured by parameter ρ), the measure we propose is invariant to these factors and only accounts 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

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

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. However, 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 that 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 .

Flexibility and other possible modeling choices: Our model and the resulting measure of common ownership is quite 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. But, if one wishes to instead assume that managers only care about the support of investors that hold at least 5% of the firm, then our model indicates that one should only aggregate over investors that own at least 5% of firm A when constructing $GGL(A, B)$. Alternatively, if one wishes to assume that managers only care 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 the Appendix.

Our measure can also be adjusted to reflect differing views regarding the importance of various governance mechanisms. As noted earlier, our model captures any influence that shareholders might 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. On the other hand, if one views shareholder voice as the only relevant governance mechanism, then managers would only care about the opinion of investors who own voting rights. In this case, $\alpha_{i,A}$ should only include the voting shares of the investor i in firm A . In our baseline measure, we choose to measure influence by ownership shares since 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 also 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 (AUM) as another input to g .⁵ Likewise, if one believes investors' monitoring intensity varies with firm-specific characteristics, like size or past profitability, one could add 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.

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 firms representing a larger share of an investor's portfolio get proportionally more (less) attention from the investor relative to their

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.

portfolio weight. To create a measure that assumes all investors are perfectly informed, one would set $g = 1$ for all investors. Because theory gives us 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 5).

Finally, the *GGL* measure can easily be aggregated to capture how common ownership affects the incentives of managers to internalize the externalities their firms impose on an entire group of firms (e.g., industry). As we show in Section 6, such an aggregated measure might 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., 2016, 2018; Dennis et al., 2018; Gramlich and Grundl, 2017; O’Brien and Waehrer, 2017). Specifically, if $\Delta_{m,A}(1) - \Delta_{m,A}(0)$ is the same across all firms in a reference set Γ , then the group-level measure 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 . Note that this assumption does not require the externality that firm A imposes on any other firm in set Γ to be the same; it only requires the differential impact to be the same, which is a weaker assumption. A derivation of this group-level incentive measure is provided in the Appendix.

1.2 Comparing *GGL* to 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 to measures used 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. Specifically, one such aggregation would be:

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

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 only accounts 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' might be inattentive when both the bidding firm and the target firms constitute a small part of their portfolio. While these assumptions might be appropriate in the context of M&A, they may not apply more generally. Second, the $GGL_i^{A,B}$ measure increases when the relative ownership of firm A increases, while this does not occur for $HJL_i^{A,B}$. This is because 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) aggregated 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) that was developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000). The MHHI is a measure of product market concentration, like the 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., 2016 and 2018).

There are three important differences 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). Since 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 relationships, innovation, M&A transactions, etc. Second, the $MHHID$ is measured at the industry level, while 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 are not always well defined. However, as noted in the previous section, 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 importantly, $MHHID$ assumes 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 may not be as attentive, which finds substantial empirical support (e.g., Kempf et al., 2017; Liu et al., 2017).⁶

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.

In addition to the above model-based measures, there are also a number of ad hoc common ownership measures used in the existing empirical literature (e.g., see Anton and Polk, 2014; Azar, 2012 and 2016; Freeman, 2017; Hansen and Lott, 1996; He and Huang, 2017; He et al., forthcoming; Newham et al., 2018). It isn't clear, however, 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 the Appendix.

To conclude, the innovation behind the *GGL* measure is as follows: (i) it is a model-driven measure of the effect of common ownership on the incentives of managers to internalize externalities between two given companies; (ii) the measure is invariant to the specific nature of externalities between the firms; (iii) the measure explicitly accounts for the limited attention that investors can pay to their portfolio companies. This last feature is key, since 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.

1.3 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 some limitations. First, our measure does not allow for strategic interactions where a shift in manager m 's incentives 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., are actions by different managers taken simultaneously or sequentially, are they 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 may or may not be 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 might coordinate their attempts to exert influence by following the voting guidelines of proxy advisory firms such as the ISS or 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 since it 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, 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 might 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 may 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 adding them as additional inputs.

2. 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 U.S.-listed firm pairings between 1980 and 2012.⁷ For each year, we include all publicly-traded firms from the Compustat-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 $n*(n-1)/2$ 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 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,⁸ and following Ben-David et al. (2018),

⁷ 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.

⁸ As noted earlier, we use total shares for two reasons. One, total shares likely better capture the potential influence of each investor, and two, 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, like Vanguard, report all their holdings under "none" despite that they clearly maintain and exercise voting rights.

we combine the holdings of Blackrock’s various subsidiaries to the parent level.⁹ Some firms may 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 only be an owner of 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 which own both stocks and their ownership stakes in each stock. With these data, we then compute the *GGL* measure as outlined above in Section 1.

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 $g(\beta_{i,A}) = \beta_{i,A}$, while *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. In particular, with *GGL_{5%}*, we modify *GGL_{Linear}* by assuming that managers only care about investors that own at least 5% of their outstanding shares, and with *GGL_{Top5}*, we assume that managers only care 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.

3. 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

⁹ 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 since 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 like ISS), are also not independent, we do not aggregate these holdings since it is unclear how to identify these more nuanced violations of non-independence.

when measuring common ownership. To further highlight the importance of investor attention, we then 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.

3.1 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 latter regressions that analyze cross-sectional variation in common ownership. Beyond giving us 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 the next subsection.

The summary statistics in Table 1 show that there is substantial heterogeneity across stock pairs in the importance of common ownership for managerial incentives. As discussed in Section 1, *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 allows us to see that there is considerable skewness in the distribution of *GGL*. For example, the median stock pair has just 0% to 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. Moreover, 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, however, managers of the 99th percentile stock pair have 2.86 to 15.6 times the average incentive to internalize externalities, depending on the functional form assumptions one makes when calculating *GGL*.

3.2 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 Figure 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 1,656%. Interestingly, the smaller value-weighted increase suggests that the shift in incentives is smaller among stock pairs containing larger firms. This is confirmed in Figure 2, where we plot the average percent increase in managerial incentives for stock pairs where both stocks are either below or above the median market capitalization in that year. For stock pairs with above median-sized firms, managers' average incentive to internalize externalities increased by 2,295%, but for stock pairs with below median-sized 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 Figure 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 their 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., 2018) 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.

3.3 Impact of assets 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 Azar et al., 2016, 2018). Conceptually, however, it is unclear whether we should expect such mergers to shift managers' incentives. While the mergers likely increase ownership overlap, they might also reduce investor attention, and hence, managers' incentive to internalize the preferences of their investors, if 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. Specifically, we 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. Obviously, this calculation changes both the size of the stake that the merged entity owns in each company, but also the weight that each company receives in the merged entity portfolio. We then plot the histogram of the predicted changes for both GGL_{Linear} and $GGL_{FullAttention}$ in Figure 4.

We find that an asset manager merger does not necessarily increase managerial incentives to internalize externalities. As shown in Figure 4, all stock-pairs unsurprisingly experience an increase in $GGL_{FullAttention}$ since, 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 existed, 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 $\alpha_{i,A}$). However, 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.¹⁰

To further illustrate the ambiguous effect of asset manager merges on managers' incentives to internalize externalities, we repeat the exercise above using only stock pairs from the airline industry, which

¹⁰ Allowing for economies of scale in monitoring, by including AUM as an input for g , could mitigate this effect. However, our analysis illustrates that this mitigating factor would need be significant in order to offset this effect and increase managerial incentives to internalize externalities for all stock pairs.

was the subject of a recent study claiming to find evidence of common ownership inducing anticompetitive behaviors (Azar et al. 2018). Doing so, we find that 16% of all airline stock pairs experience a decline in managerial incentives as measured by GGL_{Linear} , and for another 33% of all pairs, the increase was either negligible (smaller than 2.5%) or zero. Importantly, the decline in GGL is also observed for stock pairs that include the largest airlines, including American and United. These findings cast doubt on the reasonableness of using the BGI/Blackrock merger in 2009 as a shock to the incentives of airline executives.

3.4 Relative importance of indexing versus activist investors

In addition to asset manager mergers, the rise of common ownership is also 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 only include the holdings of BGI, Blackrock, State Street, and Vanguard. We focus on the latter three institutions because in 2016 they alone accounted for 80% of all indexed mutual fund and ETF assets in the U.S., and indexed assets accounted for about 80% of each institution's overall assets under management.¹¹ And, we include BGI since 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 only include hedge funds that have engaged in some form of activism, as identified in the hedge fund activism dataset constructed by Brav, Jiang, Partnoy, and Thomas (2008) and Brav, Jiang, and Kim (2010).

At first blush, it looks like both activists and indexers have contributed to the growth in managerial incentives to internalize externalities. This is seen in the top panel of Figure 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 the top panel of Figure 5, both index and activist institutions appear important for the upward trend documented in Figure 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.)

¹¹ 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, 2018). We do not use the Bushee (2001) classification of "quasi-indexer" to designate passive institutions since this is not a meaningful classification of passive versus active: nearly two-thirds of institutions are classified as "quasi-indexers," while some obvious indexers, like Blackrock are not classified as a quasi-indexer.

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 the second and third panels of Figure 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 Figure 5, middle panel), and when using a concave function for modeling attention, they account for considerably more (bottom panel). The reason why 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 which contribute less to an investor’s portfolio. The opposite is true for the concave function.

While the relative contribution of indexers to the GGL measure is sensitive to how one models investor inattention, all three modeling assumptions suggest that their relative contribution is no more than 50% in recent years, and much lower earlier in our sample. This result illustrates that the link between indexing and managerial incentives to internalize externalities is not obvious. Our later findings of how managerial incentives shift with index inclusion, which are not sensitive this modeling choice, further emphasize this point. We now turn to that analysis.

4. 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. Rather we simply seek to establish and quantify basic correlations between potential determinants of common ownership, like index inclusion and industry structure, and managerial incentives. For example, we seek to answer questions like: “If a pair of stocks goes from both being included in the S&P 500 index to not both 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?”

4.1 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,

$$GGL_{ijt} = \beta X_{ijt} + \alpha_{ij} + \delta_t + \varepsilon_{ijt},$$

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} might be an indicator equal to 1 if both firms in pair ij are listed in the S&P 500 index in year t and 0 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 we only make use of 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, rather than at the stock-pair level, since clustering at the stock level provides more conservative standard errors.

4.2 Index inclusion

We begin our regression analysis by focusing on the potential importance of index inclusion. We focus on indexing since 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, 2016).

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 will be positively associated with our measures since the 13F filings data only covers 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 the next subsection, but their inclusion has little impact on the estimates. Likewise, controlling for additional stock characteristics, like 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 -stats exceeding 25) and economically large. For example, moving from both stocks not being in the S&P 500 to both stocks being included 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.

However, 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 indices (e.g., S&P 500, Russell 1000, and Nasdaq) is associated with, on average, an increase in managerial incentives to internalize externalities, while 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).

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 towards 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).

4.3 Industry structure and competition

Given the potential for anti-competitive behavior by firms that have common owners, we also assess how GGL may 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 3-digit 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.

Interestingly, 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 only statistically different from zero for $GGL_{Concave}$ [Table 3, Columns 1-5]. These findings provide little evidence that

managerial incentives to internalize externalities tends 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.

5. 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. However, the theory 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 directly from voting data. Measuring investor attention is challenging since it is typically unobserved, and because of this, the existing literature proxies for investor attention using actions that, in theory, are closely related to the allocation of attention. To estimate our attention function, we follow Iliev and Lowry (2015) and proxy for investor attention 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 outsource their voting to proxy advisors like ISS.

To approximate the g function, we estimate the likelihood that 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. Since the voting data is at mutual fund level but our ownership data is 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 g function are presented in Figure 6 and the precise details of the underlying estimation are given in the Appendix.

As can be seen from Figure 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 $GGL_{Concave}$.

None of our earlier findings are significantly affected by using this fitted attention function when constructing GGL . To illustrate this, we use the estimated attention function plotted in Figure 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 Figure 7), and that index inclusion can still be associated with a decline in GGL_{Fitted} (see Table 5). 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 only 49.6% of GGL_{Fitted} in 2012 is driven by the three large indexers, BGI/Blackrock, State Street, and Vanguard.

Interestingly, 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. In particular, for stocks in the same industry, increasing HHI by one standard deviation is associated with a 1.7% increase in GGL_{Fitted} (t -stat = 2.66; Table 5).

While it is tempting to label GGL_{Fitted} as our baseline measure for the effect of ownership overlap on managerial incentives, it is important to note that our nonparametric estimate of the g function has limitations. First, there are other means by which investors may affect firms' decisions beyond the voting outcomes we use to proxy for investor attention (e.g., direct communications, exit decision, etc.). Second, GGL_{Fitted} does not account for potential heterogeneity among investors in their level of attention. For example, the voting data does 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} may measure their level of attention with error. Future research that addresses these concerns could greatly improve the precision of the GGL measure.

6. Revisiting Azar et al. (2018) using GGL instead of $MHHID$

In this section, we revisit the findings of Azar et al. (2018) to determine whether using GGL might also affect 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 this recent literature. Azar et al. (2018) finds 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>, and the required airlines and ownership data that are not included in the replication package. While it is necessary to make a couple of minor modifications to their code (see the Appendix for details), we are able to obtain estimates that are very close to those reported in Azar et al., (2018). In particular, our estimated coefficients for *MHHID*'s association with airline fares are all positive, statistically significant, and match Azar et al. (2018)'s reported Table 3 estimates out to two decimal places. These point estimates are reported in the first row of Table 6, and our point estimates for the other controls reported in their Table 3 are provided in Appendix Table 1.

We then modify Azar et al.'s 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 1.1. 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 Azar et al.'s main specification with *GGL* results in significant changes in their findings. This is shown in Table 6, where we repeat the Table 3 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 only associated 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.

Interestingly, 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 Table 6, even the full attention version of *GGL* is uncorrelated with airline fares, suggesting that Azar et al.'s findings are instead driven by the other key difference between *GGL* and *MHHID*—*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*.¹²

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

In this last section, we assess the ability of our proposed common ownership measure to predict an outcome that could potentially be influenced by common ownership—target selection in an acquisition. If significant externalities exist between two firms, a common investor may wish them to merge so as to ensure that these externalities are internalized. To conduct this analysis, we estimate the following,

$$Acquisition_{ijt+1} = \beta GGL_{ijt} + \Gamma X_{ijt} + \alpha_{ij} + \delta_t + \varepsilon_{ijt},$$

where $Acquisition_{ijt+1}$ is an indicator variable that equals one if firm i acquires firm j in year $t+1$, and GGL_{ijt} is our bi-directional measure of how common ownership affects manager i 's incentive to internalize the impact of her actions on firm j in period t . To improve interpretation of β , we scale $Acquisition$ by its sample average, and to remove secular trends in mergers and ensure we are isolating variation in incentives for a given pair of firms over time, we include both year fixed effects, δ_t , and pair-direction fixed effects, α_{ij} . Following Harford et al. (2011), we also control for a variety of factors thought to influence target selection, X_{ijt} , including target market capitalization, target leverage, and the absolute difference in return on assets across firms, among other controls (see Table 7). Finally, we cluster the standard errors by firm i . A more complete description of the data we used to estimate this equation is provided in the Appendix.

We find that evidence that *GGL* does positively predict target selections. This is shown in Table 7. The coefficient on *GGL* is always positive, and is statistically significant when using $GGL_{FullAttention}$, GGL_{Linear} , $GGL_{Concave}$, or GGL_{Fitted} (Table 7, Columns 1, 2, 4, and 7; t -stats = 3.09, 1.70, 2.88, and 4.24, respectively). Interestingly, the t -stat 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 5). The point estimate on GGL_{Fitted} indicates that moving from no managerial incentives to internalize externalities

¹² Despite this advantage, the non-findings in Table 6 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, as discussed earlier, the merger has no clear impact on 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 23.6% increase in the likelihood of a merger (merger probability goes from 0.000206% to 0.000253%) relative to the sample average likelihood of a merger between any two firms in a given year. In unreported findings, 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 -stat.

While these findings are suggestive, they must be interpreted with caution. One possible interpretation of these findings is that GGL , particularly GGL_{Fitted} , accurately captures managerial incentives arising from common ownership and that these incentives influence target selection. On the other hand, it is also possible that some other unmodeled firm characteristics are associated with both target selection and GGL , and it is these omitted variables that drive the observed correlations. This second 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 where the impact of common investors on a particular outcome is known with certainty (i.e., there is a known benchmark the proposed measure should uncover empirically). To the best of our knowledge, this setting does not exist since theory gives no guidance on what levels of common ownership should matter empirically. That aside, GGL does have some appealing properties that suggest it will be more reflective of how common ownership impacts managerial incentives to internalize externalities. In particular, the measure is (1) 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 (2) 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 anti-competitive behaviors is ongoing; some empirical work suggests that it is linked to anti-competitive behavior by firms (e.g., Azar et al., 2016, 2018), while 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., 2016), 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 might affect the value of other stocks held by their investors. Existing measures of common ownership used in the literature tend to either be measures of ownership overlap that lack any theoretical connection to managerial incentives or measures that make strong assumptions about the nature of externalities and assume 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., 2017).

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 where not all investors are fully attentive and does so without making strong assumptions about the structure of externalities. In doing so, we illustrate that the assumed drivers of the rise of common ownership may have little impact on managerial incentives. For example, we show that both index ownership and asset manager mergers 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 the growth of index investing necessarily increase managers' incentives to internalize externalities, including studies claiming to find evidence that the recent rise of common ownership is reducing competition in some industries (e.g., Azar et al., 2016 and 2018).

Overall, our findings provide important context for recent empirical and theoretical work that argues 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.

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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. Specifically, let

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

The key difference from the expression in 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 just care about whether a proposal is passed or voted down, then η would be the identity function as in the main text. However, generally, managers might overweight the importance of large blocks and underweight the importance of small blocks.¹³

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

$$\begin{aligned} P_n(1, \mathbf{X}_{-n}) - P_n(0, \mathbf{X}_{-n}) + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \Leftrightarrow \\ \sum_{i=1}^I \eta(\alpha_{i,n}) [p_{i,n}(1, \mathbf{X}_{-n}) - p_{i,n}(0, \mathbf{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \Leftrightarrow \\ \sum_{i=1}^I \eta(\alpha_{i,n}) g(\beta_{i,n}) \rho [w_{i,n}(1, \mathbf{X}_{-n}) - w_{i,n}(0, \mathbf{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \Leftrightarrow \\ \sum_{i=1}^I \eta(\alpha_{i,n}) g(\beta_{i,n}) \rho [W_i(1, \mathbf{X}_{-n}) - W_i(0, \mathbf{X}_{-n})] + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \Leftrightarrow \\ \sum_{i=1}^I \eta(\alpha_{i,n}) g(\beta_{i,n}) \left[\sum_{m=1}^N \alpha_{i,m} \rho [\Delta_m(1, \mathbf{X}_{-n}) - \Delta_m(0, \mathbf{X}_{-n})] \right] + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \Leftrightarrow \\ \sum_{i=1}^I \eta(\alpha_{i,n}) g(\beta_{i,n}) \left[\sum_{m=1}^N \alpha_{i,m} \rho [\Delta_{m,n}(1) - \Delta_{m,n}(0)] \right] + \frac{B_n(1) - B_n(0)}{\lambda_n} &\geq 0 \end{aligned}$$

¹³ The function η can also be applied to the noise/retail votes, but it will not change any of the results.

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

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

For example, if

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

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 only aggregate across common owners of firm A and B who owns at least z percentage of the equity of firm A .¹⁴

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, rather than 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 this 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

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

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

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

Therefore,

¹⁴ Notice that $\eta(\alpha_{i,A}) \neq \alpha_{i,A}$ is another reason why in general $GGL(A, B) \neq GGL(B, A)$.

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

which can be rewritten as

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

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

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

Notice that 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 only requires 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 to be the same. This is a much weaker assumption. For example, under this assumption, the product market strategy employed by firm A can have different effect on each of its competitors. However, a change in that strategy should have the same differential effect on each competitor. Without this assumption, group-level measure cannot be unit free.

Finally, our measure at the group-level is the average of $GGL(A, \Gamma)$ across all firms in group Γ

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

where $|\Gamma|$ is the number of firms in set Γ . Therefore, $GGL(\Gamma)$ 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

There are many additional ways to measure common ownership at the stock pair level that are currently used in the literature. Four examples are:

$$\begin{aligned} Overlap_{Count}(A, B) &= \sum_{i \in I^{A,B}} 1, \\ Overlap_{Min}(A, B) &= \sum_{i \in I^{A,B}} \min\{\alpha_{i,A}, \alpha_{i,B}\}, \\ Overlap_{AP}(A, B) &= \sum_{i \in I^{A,B}} \alpha_{i,A} \frac{\bar{v}_A}{\bar{v}_A + \bar{v}_B} + \alpha_{i,B} \frac{\bar{v}_B}{\bar{v}_A + \bar{v}_B}, \\ Overlap_{HL}(A, B) &= \sum_{i \in I^{A,B}} \alpha_{i,A} \times \sum_{i \in I^{A,B}} \alpha_{i,B}, \end{aligned}$$

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 simply counts the number of common investors in stocks A and B , which is similar to He and Huang (2017) and He et al. (forthcoming), which count the number of common blockholders a firm has with other firms in the industry, where a common blockholder is defined as an investor that owns at least 5% of the outstanding shares in both the firm and one of its industry peers.¹⁵ To better capture the extent of common ownership across the two firms, the second measure, which is used by Newham et al. (2018), instead calculates the minimum ownership stake of each common investor and sums up these minimum stakes across common investors. The third measure was proposed in Anton 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 was proposed in Hansen and Lott (1996). This measure instead sums the total fraction of shares held by common investors in firm A and firm B and then multiplies the two together. Each of the last two measures has also been used in recent studies of common ownership (e.g., see Freeman, 2017).

While intuitive as measures of ownership overlap, all four measures have number of downsides as measures of common ownership. In particular, it isn't clear any of these measures represent an economically meaningful measure of common ownership's impact on managerial incentives. Additionally, both

¹⁵ He and Huang (2017) also construct and use an indicator for having a common blockholder with another firm in the industry, while Azar (2012, 2016) constructs an indicator for having any common investor at the pair-level.

$Overlap_{Count}$ 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. Specifically, 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. However, 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 only include voting data 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 the 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 than the ISS recommendation for that particular vote. We then construct dummy variables based off of deciles of institutions’ holding percentage, β . We use dummies to allow for maximum flexibility in terms of how the $g(\beta)$ may look, thereby imposing minimal functional form assumptions.

We estimate the following regression specification:

$$InstAgainstISS_{a,s,f,i,t} = \sum_{d=2}^{10} \beta_d HoldingDecileDummy_{i,s,t} + \alpha_{i,t} + \delta_{s,t} + \varepsilon_{a,s,f,i,t}$$

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. As can be seen, these estimates control for company \times 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 which may 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 \times 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 – 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 HPCC using the newest versions of ownership and airlines data.

1. Because parts of the Azar et al. code were designed to access files stored on a PC, it was necessary to change 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 Azar et al.’s 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 HPCC.
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 et al. replication to stop running because a small number of institution names in our 13F ownership data are different than what was used in Azar et al. (2018). An additional 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.

And, below are the additional modifications made to the code to incorporate *GGL* and re-estimate Azar et al.’s Table 3 regressions using a market-level *GGL* rather than *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 Azar et al.’s 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)’s hand-collected data on non-institutions. This is necessary

- since 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 the 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 et al.'s using the market-level *GGL* measure instead of the *MHHID*.

Appendix E – 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. First, our dataset 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 SDC for our underlying raw merger data on the bidder and target identity. Second, unlike Harford et al. (2011), we use all firm pairs in our data set, as opposed to merger pairs and a matched sample. Third, 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 $GGL_{i,j,t}$ as of Dec 31 in a given year (manager i 's incentive to internalize the impact of her actions on firm j in year t) and the likelihood of firm i acquiring firm j in year $t + 1$.

Average percent change in $GGL_{FullAttention}$ since 1980

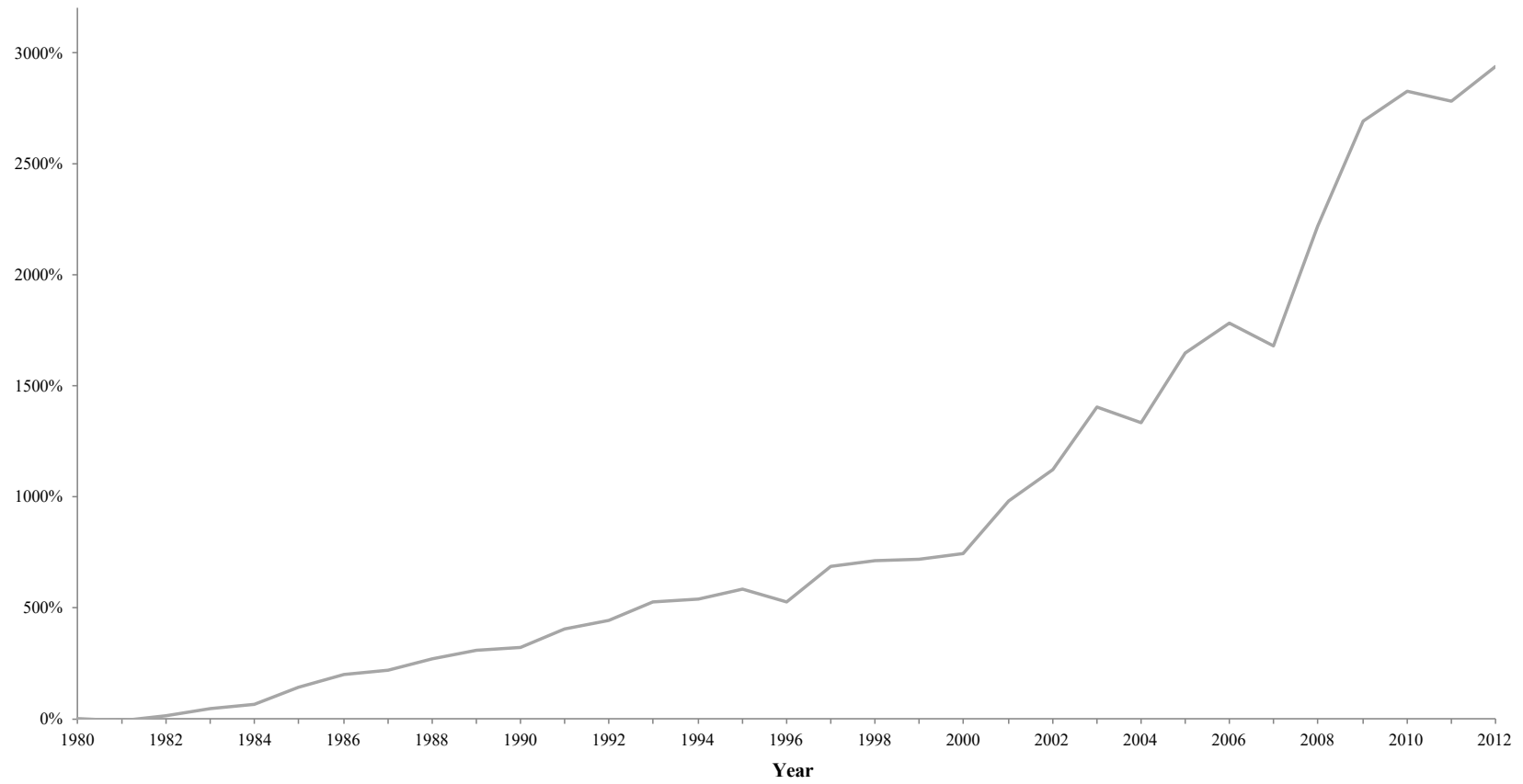


Figure 1: Percent change in managers' incentive to internalize externalities since 1980 when assuming full attention

This figure plots the percent change average $GGL_{FullAttention}$ since 1980. Details of how this measure is constructed are provided in Section 1.

Average percent change in $GGL_{FullAttention}$ since 1980

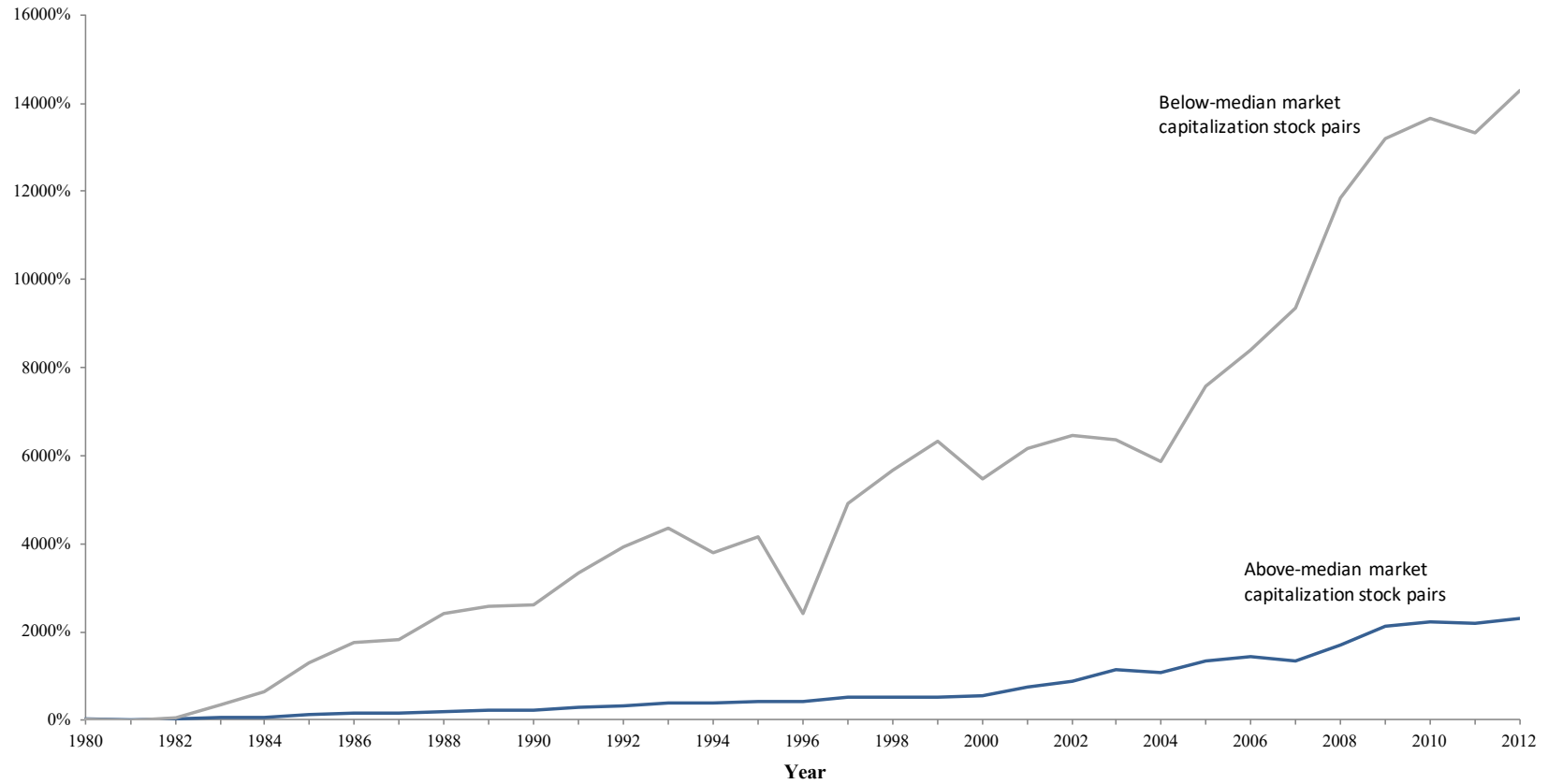


Figure 2: Percent change in $GGL_{FullAttention}$ since 1980 by market capitalization

This figure plots the percent change in the average $GGL_{FullAttention}$ since 1980 for stock pairs where both stocks are below the median market capitalization that year and for stock pairs where both stocks are above the median market capitalization that year. Details of how $GGL_{FullAttention}$ is constructed is provided in Section 1.

Average percent increase in *GGL* measure since 1980

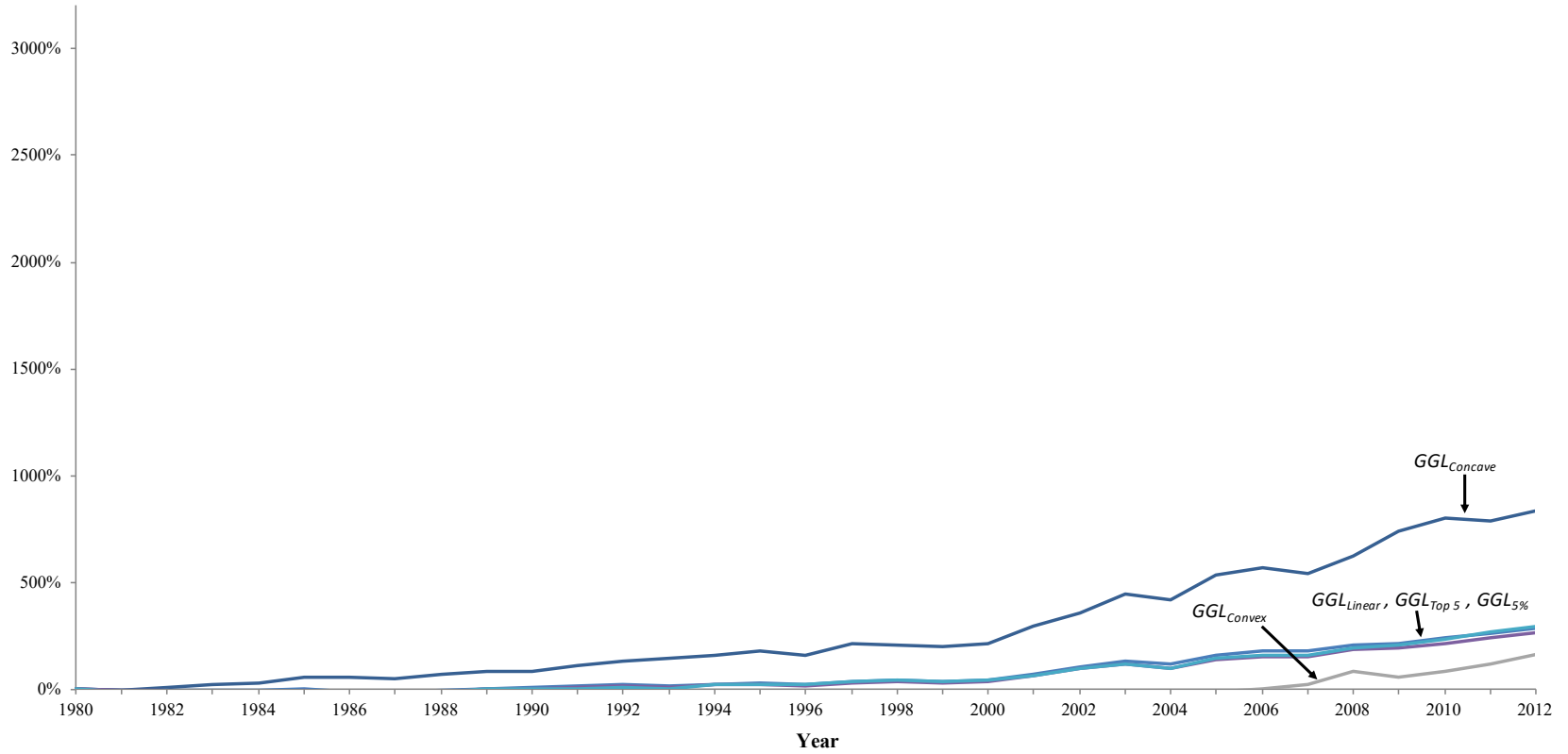


Figure 3: Percent change in managers' incentive to internalize externalities since 1980 when allowing for investor inattention

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 can be found in Section 1.

Number of occurrences

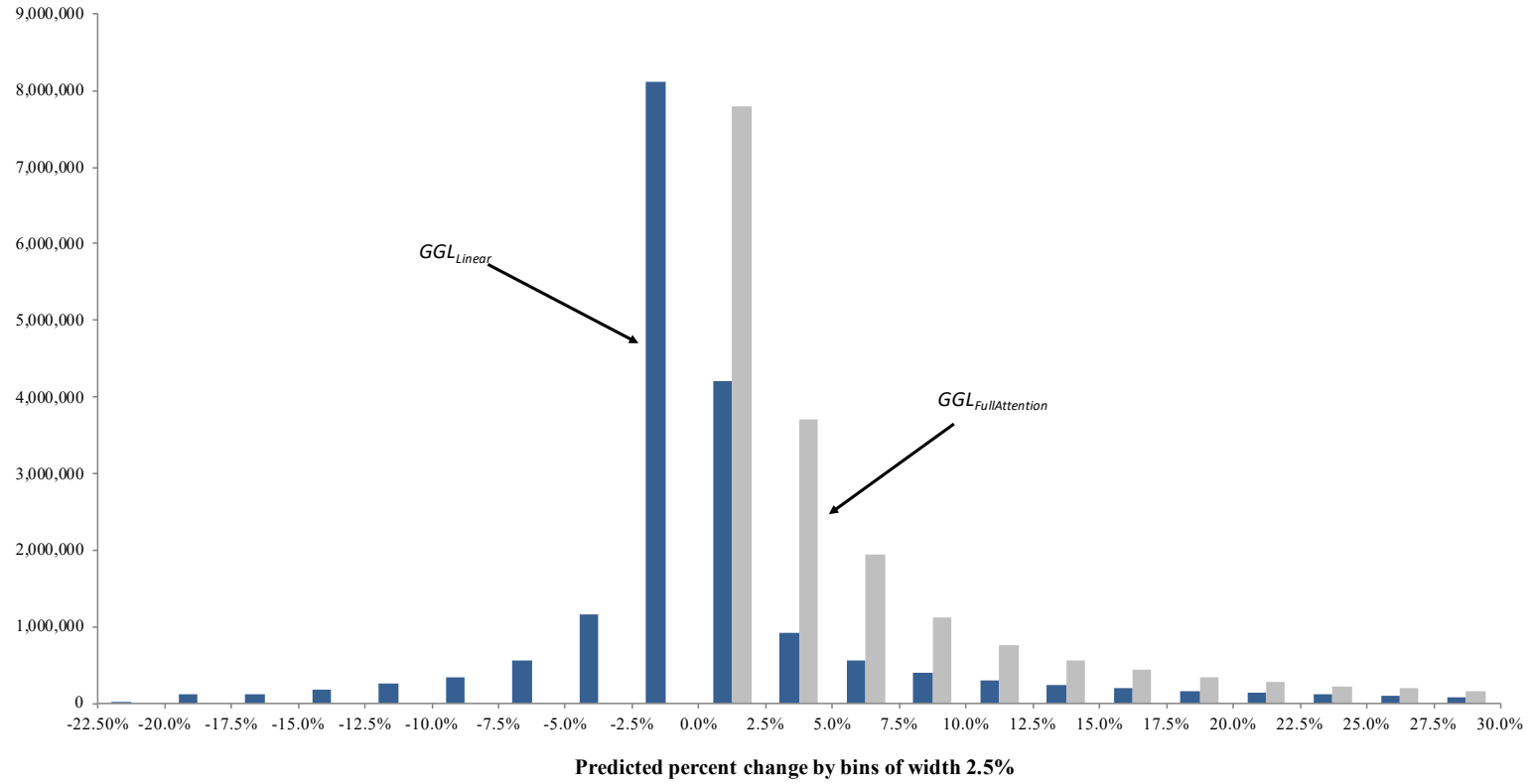
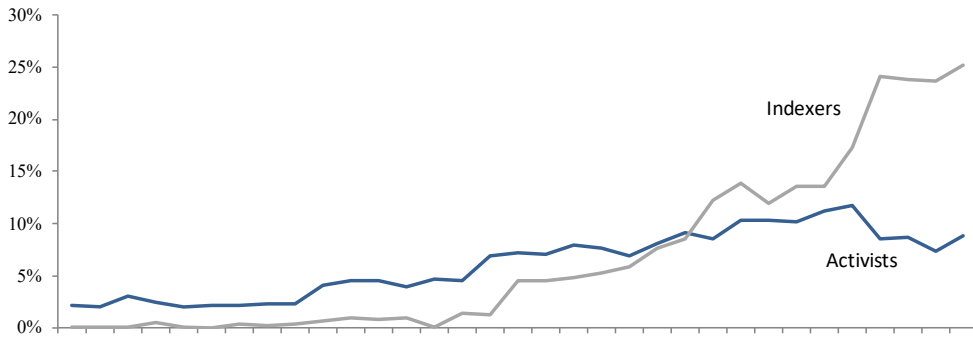


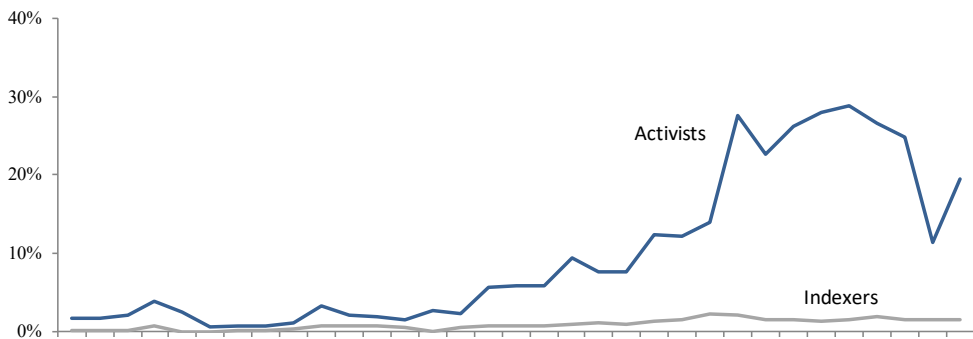
Figure 4: Histogram of predicted changes in managers' incentives to internalize externalities following the BGI/Blackrock merger in 2009

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.

Proportion of GGL_{Linear}



Proportion of GGL_{Convex}



Proportion of $GGL_{Concave}$

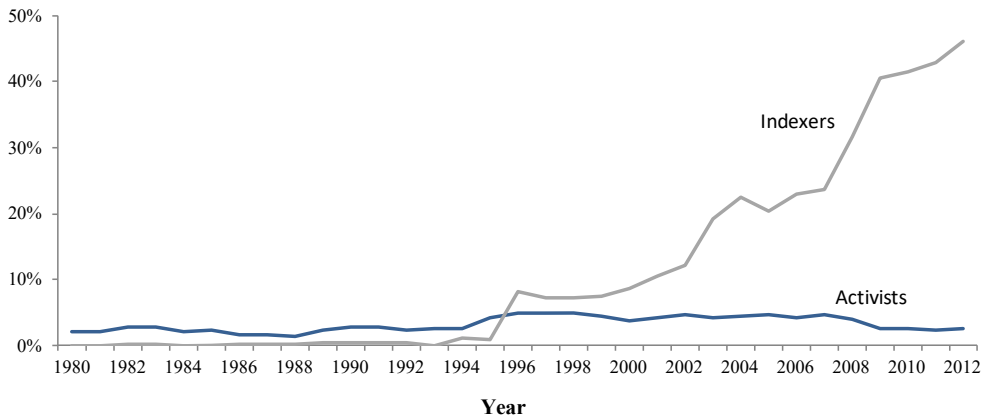


Figure 5: Proportion of GGL attributable to index and activist investors by year

This figure plots the proportion of GGL_{Linear} (top panel), GGL_{Convex} (middle panel), and $GGL_{Concave}$ (bottom panel) 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 only use the holdings of BGI, Blackrock, State Street, and Vanguard, while for activists, we only include the holdings of hedge funds that have engaged in some form of activism, as identified in Brav et al., 2008 and 2010.

Likelihood of disagreeing with ISS

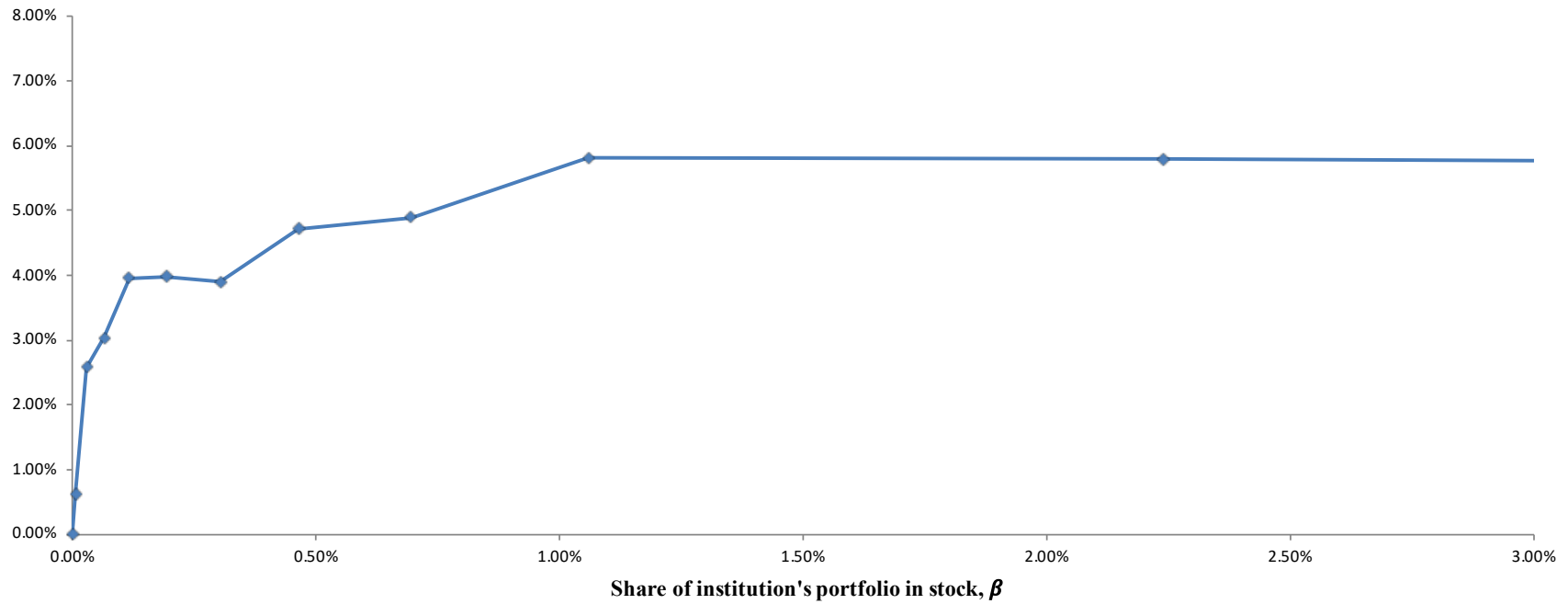


Figure 6: Fitted $g(\beta)$ function, as estimated from voting data

This figure plots the point estimates from the the fund-investor-level regression of an indicator for disagreement with ISS onto decile indicators 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 above figure, where $g(\beta)$ is set equal to zero for $\beta = 0$. More details of the underlying estimation are provided in Section 5 and the Appendix.

Number of occurrences

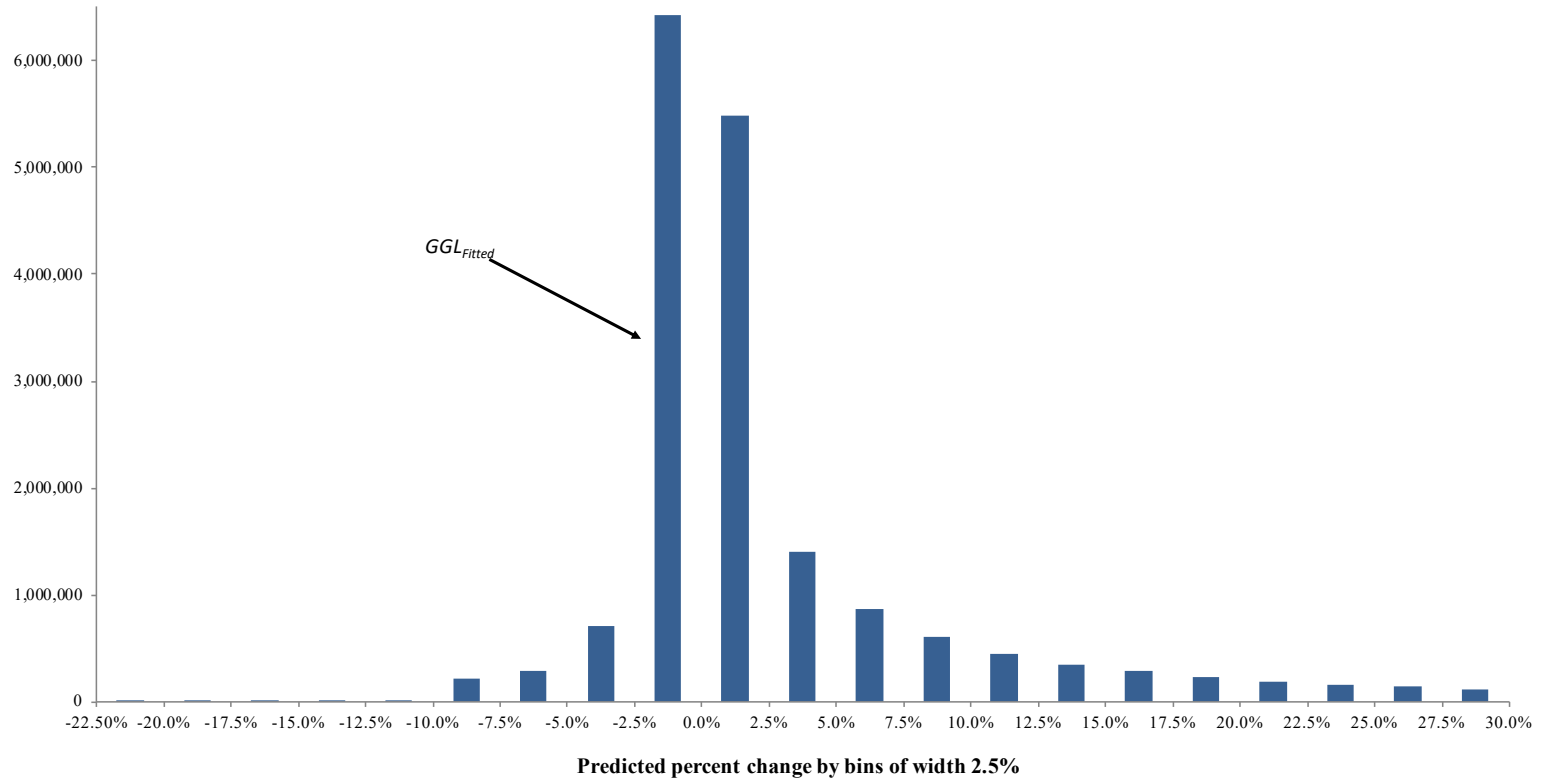


Figure 7: Histogram of predicted changes in GGL_{Fitted} following the BGI/Blackrock merger in 2009

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 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.

Table 1: Summary Statistics

This table reports summary statistics from 1998-2012 for common ownership variables and variables that are later used as explanatory variables. The ownership variables are defined in Section 1 of the paper, and as discussed in Section 1, all *GGL* variables are scaled by their sample average. The explanatory variables are composed of index indicator variables (coded 1 if both firms are in an index and 0 otherwise), average institutional ownership across the pair, and average size (average log assets of the two firms). Average Industry HHI is the average HHI of the industries, based on a 3-digit SIC code industry classification, of each of the firms in a pair. The industry dummy is 1 if both firms in a pair belong to the same 3-digit SIC industry and is 0 otherwise.

Common Ownership Variables	<i>N</i>	Mean	Std Dev	P1	P10	P25	P50	P75	P90	P99
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	3.30E-09	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	<i>N</i>	Mean	Std Dev	P1	P10	P25	P50	P75	P90	P99
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 HHI of Industries	447,358,398	0.027	0.046	0.001	0.003	0.006	0.013	0.029	0.061	0.225

Table 2: GGL with Full Attention

This table reports regression estimates of the relationship 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 1 if both stocks are in that particular index and 0 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 HHI of the industries, based on a 3-digit SIC code industry classification, for the two stocks in the pair. The industry dummy is 1 if stocks in a pair belong to the same industry and is 0 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.

	<i>Dependent variable =</i>	$GGL_{FullAttention}$
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 _{it}		0.09*** [10.84]
Average of Industry HHI _{ijt}		0.08* [1.80]
Both in Same Industry Dummy _{ijt}		0.02 [1.20]
Average of Industry HHI _{ijt} * Both in Same Industry Dummy _{ijt}		0.13 [1.55]
Pair Direction FE		Yes
Time FE		Yes
R ²		0.692
N		447,358,398

Table 3: GGL Measures That Do Not Assume Full Attention

This table reports regression estimates of the relationship 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 1 if both stocks i and j are in that particular index in year t and 0 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 HHI of the industries, based on a 3-digit SIC code industry classification, for the two stocks in the pair. The industry dummy is 1 if stocks in a pair belong to the same industry and is 0 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. *, **, *** indicate significance at the 10%, 5%, 1% levels, respectively.

	Dependent 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*** [12.26]	0.82 [0.65]	2.58*** [21.95]	2.50*** [10.62]	2.03*** [7.63]
Both Russell 2000 Dummy _{ijt}	-0.26*** [-9.87]	-0.30* [-1.75]	-0.12*** [-10.08]	-0.27*** [-8.47]	-0.28*** [-7.09]
Both Russell 1000 Dummy _{ijt}	0.94*** [16.09]	-0.19 [-0.80]	1.06*** [31.53]	0.84*** [13.35]	0.79*** [10.49]
Both S&P 400 Dummy _{ijt}	0.03 [0.42]	-0.26 [-0.75]	0.43*** [8.28]	-0.02 [-0.22]	0.03 [0.21]
Both S&P 600 Dummy _{ijt}	-0.12** [-2.57]	-0.87*** [-3.08]	0.42*** [13.52]	-0.17*** [-3.13]	-0.13* [-1.87]
Both Nasdaq Index Dummy _{ijt}	2.61*** [8.61]	0.43 [1.46]	1.91*** [11.88]	2.35*** [7.98]	2.24*** [6.66]
Average Institutional Ownership _{ijt}	5.50*** [26.76]	7.87*** [5.80]	4.76*** [61.34]	5.71*** [23.41]	6.67*** [21.61]
Average Size _{it}	0.16*** [3.61]	-0.19 [-1.01]	0.20*** [11.94]	0.11** [2.27]	-0.03 [-0.51]
Average of Industry HHI _{ijt}	0.21* [1.65]	1.72 [1.44]	0.05 [0.79]	0.24* [1.66]	0.35** [2.00]
Both in Same Industry Dummy _{ijt}	0.22 [0.95]	1.05 [0.52]	0.03 [0.87]	0.21 [0.73]	0.25 [0.69]
Avg. of Industry HHI _{ijt} * Both in Same Industry Dummy _{ijt}	4.22 [1.06]	31.76 [0.89]	0.65* [1.75]	5.68 [1.15]	7.24 [1.13]
Pair Direction FE	Yes	Yes	Yes	Yes	Yes
Time FE _t	Yes	Yes	Yes	Yes	Yes
R ²	0.652	0.605	0.639	0.651	0.651
N = 447,358,398					

Table 4: Common Investor Portfolio Weights and Index Inclusion

This table reports regression estimates of the relationship 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 1 if both stocks are in that particular index and 0 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 HHI of the industries, based on a 3-digit SIC code industry classification, for the two stocks in the pair. The industry dummy is 1 if stocks in a pair belong to the same industry and is 0 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.

	<i>Dependent variable =</i>	$Beta^{Sum}$
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 _{it}		0.76*** [9.98]
Average of Industry HHI _{ijt}		-0.14 [-0.71]
Both in Same Industry Dummy _{ijt}		-0.01 [-0.10]
Average of Industry HHI _{ijt} * Both in Same Industry Dummy _{ijt}		0.25 [0.61]
Pair Direction FE		Yes
Time FE		Yes
R ²		0.841
N		447,358,398

Table 5: GGL With Fitted Attention Function

This table reports regression estimates of the relationship 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 5. Index dummy variables are coded 1 if both stocks i and j are in that particular index in year t and 0 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 HHI of the industries, based on a 3-digit SIC code industry classification, for the two stocks in the pair. The industry dummy is 1 if stocks in a pair belong to the same industry and is 0 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.

	<i>Dependent variable =</i>	<i>GGL_{Fitted}</i>
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 _{it}		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 FE		Yes
Time FE _t		Yes
R ²		0.633
N		447,358,398

Table 6: Replication of Table 3 in Azar et al. (2018) using *GGL*

This table reports our replication of the findings found 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 created using the replication package posted by Azar et al., 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 the Appendix. Standard errors are reported in parentheses. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

<i>Common ownership variable</i>	Dependent Variable: Log(Average Fare)					
	Market-Carrier Level			Market Level		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>MHHID</i>	0.195*** (0.0464)	0.219*** (0.0393)	0.147*** (0.0380)	0.324*** (0.0452)	0.313*** (0.0403)	0.200*** (0.0360)
<i>GGL</i> <i>Linear</i>	0.0025 (0.0036)	0.0004 (0.0034)	-0.0010 (0.0034)	0.0039 (0.0039)	0.0024 (0.0039)	-0.0004 (0.0037)
<i>GGL</i> <i>Convex</i>	-0.0003 (0.0009)	-0.0003 (0.0012)	-0.0014 (0.0012)	0.0006 (0.0009)	0.0005 (0.0014)	-0.0013 (0.0014)
<i>GGL</i> <i>Concave</i>	0.0121 (0.0121)	0.0016 (0.0091)	0.0051 (0.0088)	0.0067 (0.0129)	0.0017 (0.0105)	0.0054 (0.0095)
<i>GGL</i> <i>Top5</i>	0.0052 (0.0039)	0.0025 (0.0033)	0.0015 (0.0034)	0.0064 (0.0041)	0.0042 (0.0037)	0.0020 (0.0037)
<i>GGL</i> <i>5%</i>	0.0062 (0.0039)	0.0036 (0.0031)	0.0025 (0.0033)	0.0075* (0.0041)	0.0055 (0.0035)	0.0031 (0.0036)
<i>GGL</i> <i>Fitted</i>	0.0118 (0.0114)	0.0009 (0.0091)	0.0053 (0.0088)	0.0046 (0.0122)	0.0005 (0.0107)	0.0059 (0.0097)
<i>GGL</i> <i>FullAttention</i>	0.0050 (0.0105)	-0.0046 (0.0089)	0.0000 (0.0087)	-0.0043 (0.0114)	-0.0072 (0.0107)	-0.0009 (0.0098)
Log(Distance) * Year-Quarter FE		X	X		X	X
Year-Quarter FE	X	X	X	X	X	X
Market-Carrier FE	X	X	X			
Market FE				X	X	X

Table 7: Managerial Incentives Arising from Common Ownership and Mergers

This table reports regression estimates of the relationship 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 0 or 1 depending on whether stock i acquires firm j 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. 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.

	Dependent variable = Indicator for acquisition of firm j by firm i in year $t+1$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$GGL_{FullAttention,ijt}$	0.176*** [3.09]						
$GGL_{Linear,ijt}$		0.003* [1.70]					
$GGL_{Convex,ijt}$			0.00004 [0.89]				
$GGL_{Concave,ijt}$				0.084*** [2.88]			
$GGL_{Top5,ijt}$					0.002 [1.52]		
$GGL_{5\%ijt}$						0.001 [1.30]	
$GGL_{Fitted,ijt}$							0.236*** [4.24]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pair Direction FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE _{t}	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.498	0.498	0.498	0.498	0.498	0.498	0.498
N = 334,800,852							

Appendix Table 1: Replication of Table 3 in Azar et al. (2018)

This table reports our replication of the findings found in Table 3 of Azar et al. (2018) using the replication package posted by Azar et al. on the *Journal of Finance* website. This replication package can be downloaded 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 13F and airlines data, which is 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 the Appendix. Standard errors are reported in parentheses. * indicates significance at the 10% level, ** at the 5% level, and *** at the 1% level.

	Dependent Variable: Log(Average Fare)					
	Market-Carrier Level			Market Level		
	(1)	(2)	(3)	(4)	(5)	(6)
MHHI delta	0.195*** (0.0464)	0.219*** (0.0393)	0.147*** (0.0380)	0.324*** (0.0452)	0.313*** (0.0403)	0.200*** (0.0360)
HHI	0.222*** (0.0248)	0.231*** (0.0249)	0.164*** (0.0211)	0.365*** (0.0317)	0.359*** (0.0314)	0.256*** (0.0243)
Number of Nonstop Carriers			-0.0105*** (0.00264)			-0.00822** (0.00354)
Southwest Indicator			-0.119*** (0.00930)			-0.150*** (0.0135)
Other LCC Indicator			-0.0595*** (0.00732)			-0.0992*** (0.00992)
Share of Passengers Traveling Connect, Market Level			0.123*** (0.0169)			0.169*** (0.0191)
Share of Passengers Traveling Connect			0.105*** (0.0139)			
Log(Population)			0.306*** (0.106)			0.344*** (0.122)
Log(Income per Capita)			0.370*** (0.103)			0.312*** (0.109)
Log(Distance) * Year-Quarter FE		X	X		X	X
Year-Quarter FE	X	X	X	X	X	X
Market-Carrier FE	X	X	X			
Market FE				X	X	X
Observations	1,237,878	1,237,878	1,209,791	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	46510	46510	45244			
Number of markets				7190	7190	6911