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Abstract

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JEL Classification: G10; G20; G23

Keywords: cross-ownership, institutional investors, managerial learning, feedback effect of prices

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Abstract

Theory suggests that stock price guides managers in corporate decisions as managers learn from price. We reason that cross-ownership lowers information processing costs and increases industry specialization, improving revelatory price efficiency (Bond, Edmans, and Goldstein 2012). Consistent with our expectations, we find that a firm's investment-*q* sensitivity increases as its cross-ownership increases, suggesting that cross-ownership facilitates managerial learning from price and thus investment efficiency. We strengthen the causal inference by conducting a difference-in-differences analysis using financial institution mergers as an identification strategy. We also find that the increase in the investment-*q* sensitivity associated with cross-ownership is more pronounced for firms with a lower propensity of voluntary disclosure, for firms with managers of less private information, and for firms with higher stock liquidity. Overall, these results suggest that cross-ownership can induce more efficient corporate decisions by helping investors better produce private information and transmit it to stock price.

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I. Introduction

This study examines the effect of institutional cross-ownership of industry peers on revelatory price efficiency, the extent to which stock price reveals information for real efficiency, as reflected in the sensitivity of investment to stock price. Institutional cross-ownership (or interchangeably common ownership) occurs when an institutional shareholder of one firm owns shares of other firms in the same industry simultaneously. Prior research shows that it causes a change in firm behavior by altering shareholders' preferences of managerial actions. For example, cross-ownership can discourage a firm from competing against its rivals in the product market if the common owner blockholds both the firm and its rivals (Azar, Schmalz, and Tecu 2018; He and Huang 2017). Cross-ownership may also induce suboptimal investment at the firm level if common owners aim to maximize the value of their portfolio at the expense of the value of individual firms (Matvos and Ostrovsky 2008). However, when cross-ownership is concentrated in a set of firms in the same industry, to the extent that ownership concentration in a specific industry makes price more informative (in the sense that the information is new to firm managers and relevant to their investment decisions), it could help managers learn more from price, improving investment efficiency.[1] Consistent with this prediction, we find that a firm's investment becomes more sensitive to stock price as institutional cross-ownership of peer firms in the same industry increases. To our knowledge, our study is the first to document the effect of cross-ownership on a firm's real decisions, such as investments, through the channel of managerial learning.

Our study is based on the theory of financial markets, which suggests that managers can glean information from stock price about their firms as stock price, in aggregate, contains information from traders that managers do not have (e.g., Dow and Gorton 1997;

[1] We refer to firm managers as "managers" and institutional investors (or portfolio managers) as "investors" throughout the paper.

Subrahmanyam and Titman 1999; Dye and Sridhar 2002; Dow and Rahi 2003; Goldstein and Guembel 2008; Kau, Linck, and Rubin 2008). Contrary to the traditional notion of price informativeness associated with information flowing from the firm to the market, this theory suggests that information can also flow from the market to the firm through price formation, increasing price informativeness in the sense of revelatory price efficiency or RPE. Therefore, if traders can generate private information incremental to what managers know, stock price reflecting such information can guide managers in investment decisions with enhanced RPE (e.g., Bond, Edmans, and Goldstein 2012).[2] Consistent with the theory, empirical research finds evidence that managers learn and glean private information embedded in stock price when they make investment decisions (e.g., Luo 2005; Chen, Goldstein, and Jiang 2007; Bakke and Whited 2010).

The finance and accounting literature generally suggests that investors face capacity constraints in analyzing information (e.g., Blankespoor, deHann, and Marinovic 2020), and information processing costs could be higher particularly when dealing with a portfolio of firms across mixed industries (e.g., Cohen and Lou 2012; Frankel, Kothari, and Weber 2006). Therefore, compared to a situation where an investor owns shares of dissimilar firms in diverse industries, holding shares of peer firms with more similar operations would likely help her better process corporate information with lower costs (He and Huang 2017). As a result, cross-ownership could increase the investor's ability to generate private information unknown to managers for each firm in her portfolio. Moreover, cross-holding of peer firms increases investors' industry specialization, enhancing the precision of industry-wide private information to be used in firm valuation. Since industry information can have different implications for

[2] This argument does not require that managers be less informed than outsiders. Although managers are in general more informed than investors outside of their firms, they can still learn from outsiders to the extent that they do not have perfect information and, at the same time, the outsiders hold any incremental information relevant to the firm's projects.

different firms even within the same industry, this should further benefit investors in generating firm-specific private information, thus improving RPE (Zuo 2016).[3]

While the extant literature on cross-ownership focuses mainly on blockholders and their influence on firm policies (e.g., He and Huang 2017; Park et al. 2019), studies on market feedbacks do not require investors to be blockholders for managerial learning from price to occur. Holding no less than 5% of the firm's shares outstanding, blockholders can communicate private information, if any, to firm management directly (rather than reflecting it into stock price by trading) and trade the firm's shares passively. Therefore, unlike previous studies on cross-ownership, we restrict our attention to institutional investors who hold but do not blockhold the shares of a focal firm while blockholding the shares of the firm's peers operating in the same industry. With this measure of cross-ownership, a firm with higher cross-ownership would have a higher potential for private information to be better discovered and transmitted in aggregate to stock price through trading. In particular, to the extent that a cross-owner actively trades the shares of a focal firm, using information on the firm's competitors obtained privately through its blockholding ownership, the firm's managers would have a higher chance of gleaning information about their competitors from their own price, which in turn can have implications on their subsequent investment decisions.[4]

Accordingly, we predict to find a positive relation between cross-ownership and managerial learning from price as reflected in the investment-*q* sensitivity. However, we note that an opposite prediction is also possible. Concerned with the increased information advantage of common owners, other investors might optimally choose to stay away from commonly owned stocks and produce less private information. Consistent with this reasoning,

[3] For example, depending on each firm's manufacturing capacity, pricing strategy, or competitive advantage, some changes in industry landscapes may be more or less favorable to one firm than the other. Consistent with this notion, Kacperczyk, Sialm, and Zheng (2005) find that mutual fund managers exhibit superior performance after controlling for risk and style differences when their portfolios are industry-concentrated.

[4] Such information is less likely to be obtained from the competitor's stock price since the cross-owner blockholds the competitor and does not trade its stock actively.

a recent study by Massa, Schumacher, and Wang (2021) finds that institutional investors avoided holding stocks commonly held by BlackRock and Barclays Global Investors following their merger announcement, which resulted in a permanent decline in stock price and liquidity. We then would expect to find a negative relation between cross-ownership and the investment-*q* sensitivity if an increase in cross-ownership decreases the potential for other investors to reflect private information to stock price and thus RPE. Hence the effect of cross-ownership on managerial learning from stock price is a question to be tested empirically.

Based on 131,892 firm-years ranging from 1981 to 2019, we examine three dimensions of cross-ownership likely related to cross-owners' ability to generate and transmit private information on a focal firm: i.e., the total number of peer firms held by cross-owners, the total number of cross-owners holding both the focal and peer firms, and the average number of peer firms for each cross-owner. Consistent with our prediction, we find that all three measures of cross-ownership are significantly positively associated with the investment-*q* sensitivity, suggesting that managerial learning from price increases with a higher number of peer firms owned by the same institutions, with a higher number of institutions commonly owning the firm and its peer firms, and with a greater intensity of cross-holding activities of the cross-owner institutions. This effect is economically significant: an increase in cross-ownership from the bottom to the top decile increases the investment-*q* sensitivity by 4% to 8% across our specifications. After controlling for time-varying industry factors, this result is robust to using firm-fixed effects, ruling out a possibility that our finding is attributable to unobservable time-invariant firm-specific factors correlated with both cross-ownership and investment policy.[5]

To strengthen causal inferences, we conduct a difference-in-differences analysis using financial institution mergers as an identification strategy (e.g., He and Huang 2017; He, Huang,

[5] We reason that cross-ownership is likely determined more by time-varying industry factors than by time-constant firm factors because (1) it is measured based on investors' holdings in both the firm and its industry peers and (2) has increased over time in our sample period (as reported in Table 1). Hence, we use industry-year (combination) fixed effects in our main specification.

and Zhao 2019; Park et al. 2019). We define a firm as a treatment firm if the firm is held but not blockheld by one of the merging institutions during the quarter immediately before the merger announcement and the other merging institution does not blockhold the firm but blockholds at least one of the firm's industry peer firms during the same quarter. For a firm to be a control firm, we require it to be held but not blockheld by the same institution holding the treatment firm while the other merging institution blockholds none of the firm's industry peer firms. We find a significant increase in the investment-*q* sensitivity for treatment firms relative to control firms during the post-merger period, consistent with an increase in cross-ownership facilitating managerial learning from stock price as reflected in the investment-*q* sensitivity.

However, to establish the link between cross-ownership and managerial learning, it is necessary to ensure that the increase in the investment-*q* sensitivity we document above is not attributable to forecasting price efficiency or FPE. Bond, Edmans, and Goldstein (2012) distinguish RPE, the extent to which stock price reflects private information not possessed by managers, from FPE which refers to the extent to which the price of a given security accurately reflects its fundamental value.[6] Although managerial learning occurs from information flows from the market to the firm and hence RPE, to the extent that cross-ownership facilitates information flows from the firm to the market and increases total information in stock price, the increase in the investment-*q* sensitivity can be explained by FPE even in the absence of managerial learning. Focusing on blockholding cross-owners, Park et al. (2019) find that cross-ownership reduces a firm's concern for competition and proprietary information leakage, increasing voluntary disclosures, which raises a possibility that the finding of our study is at least partly due to information flows from the firm to the market, and hence FPE.[7]

[6] The distinction between the two different concepts of price efficiency is important because price can be efficient in the sense of FPE, but not in RPE (Bond, Edmans, and Goldstein 2012).

[7] A recent study by Jang, Kang, and Yezegel (2022) also suggest that blockholders' cross-ownership can lead to a higher investment-*q* sensitivity due to higher FPE associated with more disclosures.

While there is no evidence that cross-ownership by non-blockholders can also decrease the concern for competition and elicit more disclosures, to mitigate the possibility that our result is explained solely by FPE, we conduct the following two sets of subsample tests. First, information flows from the firm to the market would be greater for firms with a greater propensity for voluntary disclosure. Using a firm's issuance of earnings guidance as a proxy for voluntary disclosure, therefore, we split the sample into two groups based on whether the firm issues earnings guidance. If the effect of cross-ownership on the investment-*q* sensitivity is greater for firms with earnings guidance, the result in our main analysis would be attributable to FPE, rather than RPE. However, we find that while the investment-*q* sensitivity is on average higher for firms with earnings guidance (consistent with a positive relationship between voluntary disclosure and FPE), the effect of cross-ownership on the investment-*q* sensitivity is significantly greater for firms not issuing earnings guidance, alleviating the concern that the increase in the investment-*q* sensitivity associated with cross-ownership is mainly due to cross-ownership facilitating information flows from the firm to the market and hence FPE.

Second, we examine whether our result varies with the amount of private information held by managers. While managers do not always trade on private information, prior research suggests that insider trading can still reveal some, though not all, of corporate information held by managers (e.g., Seyhun 1992; Meulbroek 1992; Damodaran and Liu 1993; Ke, Huddart, and Petroni 2003; Piotroski and Roulstone 2005). Hence, we split the sample into two groups based on insider trading profitability as a proxy for managers' private information. If our result is driven by cross-ownership facilitating information flows from the firm to the market, the effect of cross-ownership on the investment-*q* sensitivity would be greater in firms where managers hold a greater amount of private information. Interestingly, we find that although the investment-*q* sensitivity is on average higher for firms with higher insider trading profitability, the effect of cross-ownership is significantly stronger for firms with lower insider trading

profitability (i.e., managers with less private information and hence a greater need to learn from outsiders), a result more consistent with RPE than FPE.

To attribute our findings to RPE, it is also critical to rule out the likelihood that managers are learning from direct interactions with cross-owners. To the extent that managers can learn from institutional investors through direct interactions (Bottazzi, Da Rin, and Hellmann 2008; Brav et al. 2008; Zhang 2020), the positive effect of cross-ownership on the investment-*q* sensitivity could be attributable to cross-owners directly interacting with firm managers to convey private information. However, cross-owners in our study do not blockhold the shares of focal firms, and recent evidence by Lewellen and Lewellen (2022) suggests that institutional investors do not have strong financial incentives to be engaged. Nonetheless, to mitigate this possibility more formally, we conduct a subsample test where we split the sample into two groups based on liquidity. If managers learn from stock price, they would be better able to do so when their stocks are more liquid and thus easier to be traded. Hence, to the extent that cross-owners produce private information and transmit it to stock price, the effect of cross-ownership would be greater for firms with higher stock liquidity. However, such a result would not be expected if managers learn from direct interactions with the cross-owners. We find that while the investment-*q* sensitivity is on average higher for firms with higher stock liquidity, the effect of cross-ownership is significantly stronger also for firms with higher stock liquidity, a result more consistent with learning from stock price than direct interactions.

We also perform the following analyses to ensure that our finding is robust to alternative measures of cross-ownership. First, although we already require an institution not to blockhold a focal firm in defining cross-owners, to further alleviate the concern for the direct interaction channel, we re-define our measures of cross-ownership by requiring an institution to hold less than 2%, 1%, and 0.5% of the shares of a focal firm and find consistent results. Second, despite cross-ownership increasing over time, to the extent that passive funds have

also grown, a mere increase in cross-ownership does not necessarily produce a greater amount of private information (Kacperczyk, Nosal, Sundaresan 2022). To take into account temporal changes in market structures, therefore, we convert each measure of cross-ownership into decile rankings re-defined every year based on its distribution and find consistent results. Lastly, we also use the measures of cross-ownership employed in prior studies, such as those in Park et al. (2019) and He, Huang, and Zhao (2019), and continue to find consistent results, lending more credibility to our story suggesting a positive effect of cross-ownership on the investment-*q* sensitivity.

Prior research suggests several alternative channels that could potentially explain our results. First, firms facing fewer financing constraints can make investment more sensitive to stock price (Baker, Stein, and Wurgler 2003). Hence if cross-ownership helps reduce underinvestment by mitigating information asymmetry and financing constraints, it could result in a higher investment-*q* sensitivity. However, this channel is unlikely to explain our result since the main effect of cross-ownership on investment is negative across all our analyses, inconsistent with cross-ownership mitigating underinvestment.[8] Second, the agency literature suggests that managers, if not monitored properly, tend to make overinvestment (or engage in empire building) at the expense of shareholder value, suggesting that the increase in the investment-*q* sensitivity could be alternatively explained by cross-owners serving as corporate monitors inducing more efficient investment. However, in addition to controlling for institutional ownership, we exclude blockholders or large shareholders, one of the most effective corporate monitors, in identifying cross-owners, mitigating a possibility that our result is driven by a monitoring channel.[9] Lastly, to the extent that industry-wide overpricing

[8] Besides, when we split the sample into two groups based on several proxies for financing constraints such as leverage and size, we do not find evidence that the positive effect of cross-ownership on the investment-*q* sensitivity is more pronounced for firms with higher financing constraints (results untabulated).

[9] Moreover, in untabulated analyses, we do not find evidence that the positive effect of cross-ownership on the investment-*q* sensitivity is more pronounced for firms with higher agency conflicts where overinvestment is more

attracts institutional investors and hence increases cross-ownership, our results could be attributable to firms catering to investors' demand for investment to exploit overvaluation. However, industry-common shocks and resulting mispricing are unlikely to explain our result since we use industry-year (combination) fixed effects throughout our analyses.[10]

Our study contributes to a growing literature on institutional cross-ownership. This literature has so far focused mainly on the impact of blockholders' cross-ownership on intra-industry competition (e.g., He and Huang 2017; Azar, Schmalz, and Tecu 2018; Park et al. 2019) and monitoring (e.g., He, Li, and Yeung 2018; Kang, Luo, and Na 2018). However, a recent study by Lewellen and Lowry (2021) suggests that the industry coordination effects attributed to cross-ownership in this prior research is likely to be caused by confounding events. In contrast, we add to the literature by focusing on the ability of non-blockholding cross-owners to reflect private information in stock price. Although typical cross-ownership is too small to affect a firm's investment decision through a governance mechanism (Harford, Jenter, and Li 2011), our evidence suggests that cross-ownership can help firms improve investment efficiency by facilitating managerial learning from stock price. In addition, while investors and regulators are concerned with the anti-competitive incentives of cross-ownership resulting in negative externalities, we document evidence more consistent with positive externalities.

We also contribute to the literature on the real effects of financial markets, which suggests that managers learn information from stock price and use it when they make investment decisions (e.g., Luo 2005; Chen, Goldstein, and Jiang 2007; Foucault and Gehrig 2008; Bakke and Whited 2010; Foucault and Fresard 2012; Bond, Edmans, and Goldstein 2012;

likely (e.g., firms with lower institutional ownership, fewer dedicated institutional investors, higher G index, or higher free cash flows).

[10] Polk and Sapienza (2008) find a positive association between discretionary accruals (a proxy for mispricing) and abnormal investment, suggesting that managers increase investment to cater to investor demand when stocks are overvalued. However, when we split the sample into two groups based on discretionary accruals (a proxy for mispricing as in Polk and Sapienza (2008)), we do not find a differential effect of cross-ownership between the two groups (results untabulated), ruling out the catering story as an alternative channel for our result.

Edmans, Jayaraman, and Schneemeier 2017; Jayaraman and Wu 2019). We acknowledge it is not feasible to provide direct evidence of enhanced RPE associated with cross-ownership as there is no natural empirical proxy for RPE (Edmans, Jayaraman, and Schneemeier 2017).[11] However, the results from the subsample tests employed in this study mitigate the plausibility of alternative channels, suggesting that the increase in the investment-*q* sensitivity we document is more likely to be attributable to RPE than FPE. While the extant studies generally agree that investors hold private information unknown to managers, it has not been identified where their relative information advantage comes from. By focusing on institutional cross-ownership of peer firms, we add to this line of literature and demonstrate how a firm's ownership structure affects its propensity to learn incremental information from the stock market.

The remainder of this paper proceeds as follows. Section 2 describes data and research designs, Section 3 presents the results of our main analyses, and Section 4 discusses additional tests. Section 5 concludes.

II. Sample and Research Design

2.1 Data and Sample

We collect data from several sources: institutional holdings data from Thomson Reuters Institutional (13f) Holdings, financial data from Compustat, share price and returns data from CRSP, earnings guidance data from I/B/E/S, and insider trading data from Thomson Reuters Insider Filing Data. Our sample consists of 131,892 firm-years from 1981 to 2019 after excluding firm-year observations with missing values in variables required in our main

[11] Although prior studies find that managerial learning is more likely to occur for firms with higher price nonsynchronicity or higher PIN (Chen, Goldstein, and Jiang 2007), cross-ownership does not always increase price nonsynchronicity or PIN. To the extent that cross-owners generate industry-wide information unknown to managers, cross-ownership could decrease nonsynchronicity. Also, the private information transmitted to stock price by cross-owners will become publicly observable in price eventually over the year, making it hard to detect the effect on PIN.

specification. As reported in Table 1, the number of firm-year observations is lower in the first few years but remains relatively steady throughout the remaining sample period. Consistent with cross-ownership becoming more prevalent in recent years (Azar, Schmalz, and Tecu 2018), we also find that cross-ownership has increased over time in our sample period in all three proxies for this variable, as measured in the total number of unique peer firms held by cross-owners (*NumConnected*), the total number of cross-owners holding both the focal and peer firms (*NumCross*), and the average number of peer firms for each cross-owner (*AvgNum*).[12] We focus particularly on these three dimensions of cross-ownership because they are likely related to the cross-owner's ability to generate private information and transmit it to stock price through trading.[13]

Our measures of cross-ownership are similar to those used in He and Huang (2017), except that we require a cross-owner to hold but not blockhold the shares of a focal firm (i.e., holding less than 5% of the firm's shares outstanding) while blockholding the shares of the firm's industry peers. While our story relies on a channel of managerial learning of private information embedded in stock price transmitted by investors through trading, blockholders can communicate private information, if any, to firm management directly (rather than reflecting it into stock price by trading) and trade the firm's shares passively. Therefore, unlike He and Huang (2017) who identify cross-owners as institutions blockholding both the focal and peer firms, we require a cross-owner not to be a blockholder of a focal firm to mitigate the possibility that any increase in the investment-*q* sensitivity associated with cross-ownership is attributable to cross-owners directly communicating with or monitoring managers. However,

[12] Following He and Huang (2017), we first measure each variable at the end of each quarter and then calculate the average of the variable across the four quarters for each firm-year. We keep firm-years with zero cross-ownership in our sample as long as its total institutional ownership is non-missing (i.e., greater than zero).

[13] Private information is more likely to be discovered and transmitted to stock price when a higher number of peer firms are cross-held by institutions and when a higher number of institutions trade the focal firm's shares.

similar to He and Huang (2017), we still require a cross-owner to be a blockholder of a peer firm, where private information is better discovered through their ownership.

[Insert Table 1]

Panel A of Table 2 provides the descriptive statistics for our sample. When it comes to the measures of cross-ownership, the mean of *NumConnected*, *NumCross*, and *AvgNum* is 48.508, 11.234, and 5.463, respectively, suggesting that an average firm in our sample has 49 unique peer firms commonly held by 11 institutions, and each institution identified as a cross-owner on average holds the shares of 5 peer firms operating in the same industry. Compared to He and Huang (2017) who report a mean of 2.285, 0.604, and 1.043 for *NumConnected*, *NumCross*, and *AvgNum*, respectively, for their sample, our sample firms have a higher value of cross-ownership because we do not require cross-owners to blockhold a focal firm, allowing more institutions with smaller holdings to be identified as cross-owners. The average firm in our sample is further characterized by annual investment (*Inv*) being 45% of fixed assets while its *q* is 1.945 at the beginning of the year. The average firm also has operating cash flows (*CFO*) of 3.2% of total assets, firm size (*Size*) of 5.670 (i.e., the market value of common equity of $290 million), and institutional ownership (*InstOwn*) of 39.1% at the beginning of the year.

Panel B of Table 2 presents the Pearson correlation coefficients between the variables used in our main specification. Not surprisingly, all three measures of cross-ownership are positively correlated with each other, but their coefficients are diverse across each pair, such as 0.722, 0.589, and 0.074 between *NumConnected* and *NumCross*, between *NumConnected* and *AvgNum,* and between *NumCross* and *AvgNum*, respectively, suggesting that the three measures do not merely capture the same aspect of cross-ownership. The results in Panel B also show that all these measures of cross-ownership are negatively correlated with investment (*Inv*) while being positively correlated with *q*. Hence, if there is any increase in the investment-*q* sensitivity associated with an increase cross-ownership (as hypothesized in our study), it is

unlikely due to cross-ownership helping firms better respond to an increase in investment opportunities by allowing them to access capital more easily and mitigate underinvestment. However, the three measures of cross-ownership exhibit mixed correlations with other variables, such as operating cash flows (*CFO*), firm size (*Size*), and institutional ownership (*InstOwn*). For example, whereas *CFO* has a negative correlation with *NumConnected* and *AvgNum*, it is positively correlated with *NumCross*. While *Size* shows a positive correlation with *NumConnected* and *NumCross*, it is negatively correlated with *AvgNum*. Also, while *InstOwn* has a positive correlation with *NumConnected* and *NumCross*, it is negatively correlated with *AvgNum*. These results suggest that the association between cross-ownership and the investment-*q* sensitivity, if any, is unlikely to be a mere artifact of cross-ownership simply being highly correlated with *CFO*, *Size*, or *InstOwn*.

[Insert Table 2]

2.2 Research Design

We examine the effect of cross-ownership on the investment-*q* sensitivity using the following OLS model with industry-year (combination) fixed effects:

$$\begin{aligned} Inv \quad &= \beta_0 + \beta_1 q + \beta_2 CrossOwn + \beta_3 q \times CrossOwn + \beta_4 CFO + \beta_5 Size \\ &+ \beta_6 InstOwn + \beta_7 q \times InstOwn + \textit{Industry-Year Fixed Effects} + \varepsilon \end{aligned} \tag{1}$$

Inv is investment measured at the end of the firm's fiscal year, defined as capital expenditures scaled by lagged fixed assets. *q* is Tobin's *q* measured at the beginning of the fiscal year, defined as the market value of equity plus the book value of debt scaled by the book value of assets. *CrossOwn* refers to our measure of cross-ownership, one of *NumConnected*, *NumCross*, and *AvgNum* as described above at the beginning of the fiscal year. In our regression analyses, we assign decile rankings to this variable and standardize them to range from 0 to 1 for ease of interpretation. *q* × *CrossOwn*, a product of *q* and *CrossOwn*, is the main variable of interest in

our study. To the extent that cross-ownership increases RPE and facilitates managerial learning from stock price, the coefficient on this variable is expected to be significantly positive.[14]

Following prior studies, we include cash flows from operations, *CFO*, as a control variable as it is likely correlated with corporate investment. While *q* is a price-based measure of a firm's investment opportunities, prior studies include *CFO* as a benchmark (e.g., Edmans, Jayaraman, and Schneemeier 2017; Jayaraman and Wu 2019). *CFO* is measured at the beginning of the fiscal year, defined as earnings before extraordinary items plus depreciation and amortization scaled by lagged total assets. We also control for firm size, *Size*, measured as the natural logarithm of the market value of common equity outstanding at the beginning of the fiscal year. To tease out the effect of cross-ownership from that of institutional ownership in general, we further include *InstOwn* and *q* × *InstOwn* as additional control variables. *InstOwn* is the percentage of a firm's shares held by institutional investors measured at the beginning of the fiscal year, and *q* × *InstOwn* is a product of *q* and *InstOwn*. Similar to *CrossOwn*, we assign decile rankings to *InstOwn* based on its distribution and standardize this variable to range from 0 to 1 in regression analyses. Controlling for *InstOwn* and *q* × *InstOwn* mitigates a concern that any positive relation we expect to find between cross-ownership and the investment-*q* sensitivity could be attributable to institutional monitoring.

Finally, we reason that cross-ownership is likely determined more by time-varying industry factors than by time-constant firm factors because (1) it is constructed based on investors' stakes in both the firm and its industry peer firms and (2) has increased over time in our sample period (as reported in Table 1). Hence, we use industry-year (combination) fixed effects in our main specification. However, our results are robust to using firm-fixed effects

[14] Note that we measure a firm's *q* and its investment at the beginning and at the end of the fiscal year, respectively, consistent with managers learning from price in period *t-1* and subsequently making investments in period *t*. To the extent that information held by managers is already reflected in past investment, institutional investors' discovery of information known to managers (i.e., public information) is unlikely to cause a stronger sensitivity of investment (as of *t*) to beginning stock price (as of *t-1*) (Jayaraman and Wu 2019). As such, the positive coefficient on *q* × *CrossOwn* if any, is unlikely to be due to information flows from the firm to the market.

after controlling for time-varying industry factors, suggesting that our results are not biased by any firm-specific time-constant variables correlated with cross-ownership. We cluster standard errors by firms when using industry-year (combination) fixed effects and by industry-years when using firm-fixed effects. Appendix A provides definitions of all these variables.[15]

III. Empirical Results

3.1 Main Test: Institutional Cross-Ownership and Investment-Q Sensitivity

Table 3 presents the results from estimating equation (1), where *CrossOwn* refers to *NumConnected, NumCross,* and *AvgNum* in columns (1), (2), and (3), respectively. We find that the coefficient on *q* is significantly positive at the 1% level in all columns (coefficients of 0.086, 0.092, and 0.080 in columns (1), (2), and (3), respectively), consistent with prior research showing a positive relation between *q* and investment. The coefficient on *CrossOwn* is significantly negative at the 1% level in all columns (coefficients of -0.022, -0.033, and -0.008 in columns (1), (2), and (3), respectively), indicating that higher cross-ownership is associated with lower investments, possibly due to cross-ownership reducing overinvestment by helping firms better follow the market signal.[16] More importantly, the coefficient on *q* × *CrossOwn* is significantly positive at the 1% or 5% level across columns (coefficient of 0.006, 0.004, and 0.006 in columns (1), (2), and (3), respectively), suggesting that the investment-*q* sensitivity is higher for firms with higher cross-ownership. This effect is economically significant since an increase in cross-ownership from the bottom to the top decile increases the investment-*q* sensitivity by 4% to 8% across each measure of cross-ownership. Overall, the result is consistent with our prediction that institutional cross-owners of industry peers can

[15] Note that while the dependent variable (*Inv*) is measured in year *t*, all other variables in equation (1) are measured as of year *t-1*.

[16] Alternatively, it could also be due to cross-ownership reducing competition, resulting in underinvestment. However, this is not very plausible since we find that cross-ownership increases investment efficiency (as reflected in a higher investment-*q* sensitivity).

better generate private information and transmit it to stock price through trading, increasing the ability of stock price to guide managers.

When it comes to control variables, we find a significantly positive coefficient on *CFO* at the 1% level in all columns (coefficient of 0.149, 0.132, and 0.157 in columns (1), (2), and (3), respectively), consistent with a positive association with cash inflows and investment. The coefficient on *Size* is also significantly positive at the 1% or 5% level across columns (coefficient of 0.009, 0.021, and 0.006 in columns (1), (2), and (3), respectively), suggesting that larger-sized firms tend to make more investments. In addition, we find that while the coefficient on *InstOwn* is mixed, the coefficient on $q \times InstOwn$ is significantly negative at the 1% level in all columns (coefficient of -0.005, -0.005, and -0.004 in columns (1), (2), and (3), respectively), suggesting that unlike cross-ownership, a mere increase in institutional ownership does not facilitate managerial learning from stock price.

[Insert Table 3]

3.2 Firm-Fixed Effect Analysis

Given that a firm's cross-ownership is constructed based partly on investors' stakes in the focal firm, and not solely the investors' stakes in peer firms, if there are firm-specific factors correlated with cross-ownership attracting institutional investors, they can also affect the firm's investment decisions. Our regression includes *InstOwn* and $q \times InstOwn$ and thus controls for firm-specific factors attracting institutional investors. However, to further control for time-invariant unobservable firm factors correlated with *CrossOwn*, we now use firm-fixed effects. When using firm-fixed effects in place of industry-year (combination) fixed effects, it is critical to control for time-varying industry factors correlated with cross-ownership. This is because (1) cross-ownership is jointly determined by investors' stakes in peer firms as well as the focal firm, and (2) as reported in Table 1, it has increased over time during our sample period. We thus use *PeerCrossOwn* to capture time-varying industry factors as correlated with

CrossOwn,and include *PeerCrossOwn* and $q \times$ *PeerCrossOwn* as additional control variables. *PeerCrossOwn* is the equal-weighted average *CrossOwn* of peer firms included in calculating the focal firm's *CrossOwn* at the beginning of the fiscal year, and $q \times$ *PeerCrossOwn* is a product of q and *PeerCrossOwn*.[17]

Table 4 reports the results when we use firm- and year-fixed effects in place of industry-year (combination) fixed effects.[18] *CrossOwn* refers to *NumConnected, NumCross,* and *AvgNum* in columns (1), (2), and (3), respectively. Similarly, *PeerCrossOwn* is the average of *NumConnected, NumCross,* and *AvgNum* calculated across peer firms in columns (1), (2), and (3), respectively. Similar to the results reported in Table 3, we find a significantly positive coefficient on q at the 1% level in all columns (coefficients of 0.162, 0.151, and 0.158 in columns (1), (2), and (3), respectively), while the coefficient on *CrossOwn* is significantly negative at the 1% or 5% level (coefficients of -0.038, -0.058, and -0.010 in columns (1), (2), and (3), respectively). More importantly, we continue to find that the coefficient on $q \times$ *CrossOwn* is significantly positive (coefficient of 0.007, 0.005, and 0.004 at the 1%, 10%, and 5% level in columns (1), (2), and (3), respectively), again, consistent with cross-ownership increasing the investment-q sensitivity as it facilitates managerial learning from stock price.

Interestingly, while the coefficients on control variables are generally similar to those reported in Table 3, we additionally find a significantly negative coefficient on $q \times$ *PeerCrossOwn* at the 5% or 10% level across the columns, suggesting that managers are less guided by stock price when peer firms have higher cross-ownership and hence more informative stock price. This result is consistent with managers learning less (more) from their own price (from peers' price) with the increase in the informativeness of peers' price (in terms of RPE or private information unknown to managers) as it reduces the relative importance of

[17] Similar to *CrossOwn*, we assign decile rankings to *PeerCrossOwn* based on its distribution and standardize this variable to range from 0 to 1.
[18] Since we use firm-fixed effects, we cluster standard errors by industry-year (combination).

their own price as an investment signal (Foucault and Fresard 2014). Overall, the results in Table 4 reassure that our finding is robust to controlling for firm-fixed time-invariant unobservable variables potentially correlated with cross-ownership.

[Insert Table 4]

3.3 Identification Using Financial Institution Mergers

To strengthen causal inferences, we follow prior work and use financial institution mergers as a quasi-exogenous shock to cross-ownership (e.g., He and Huang 2017; He, Huang, and Zhao 2019; Park et al. 2019). More specifically, using the merger events listed in Table A1 of Appendix in He and Huang (2017), we define a firm as a treatment firm if (1) the firm is held but not blockheld by one of the merging institutions during the quarter immediately before the merger announcement and (2) the other merging institution does not hold the firm but blockholds at least one of the firm's industry peer firms during the same quarter. Hence, following the merger, the treatment firm is likely to experience an increase in cross-ownership unlikely due to a firm's choice to attract cross-owners. In contrast, we define a firm as a control firm if the firm is held but not blockheld by the same institution holding the treatment firm while the other merging institution blockholds none of the firm's industry peer firms. As noted in He and Huang (2017), since we do not use the post-merger holding information, the treatment vs. control classification is not contaminated by private information about the firms held by merged institutions.[19]

To conduct a difference-in-differences analysis, we focus on a firm's last fiscal quarter that ends before the merger announcement as the pre-merger period and the firm's first fiscal

[19] In an untabulated analysis, we confirm that all three measures of *CrossOwn* significantly increased for treatment firms from the pre-merger period (i.e., the last quarter that ends before the merger announcement) to the post-merger period (i.e., the first quarter that begins after the merger announcement). More importantly, we also find that the treatment firms' change in *CrossOwn* from the pre- to the post-merger period is significantly greater than that of control firms for *NumConnected* and *AvgNum*, and insignificantly greater for *NumCross*.

quarter that begins after the merger announcement as the post-merger period.[20] We then estimate the following equation and report the results in Table 5:

$$\begin{aligned} Inv \;=\; & \beta_0 + \beta_1 Treat + \beta_2 Post + \beta_3 Treat \times Post + \beta_4 q + \beta_5 q \times Treat \\ & + \beta_6 q \times Post + \beta_7 q \times Treat \times Post \; + \beta_8 CFO + \beta_9 Size + \beta_{10} InstOwn \\ & + \beta_{11} q \times InstOwn + Fixed\ Effects + \varepsilon \end{aligned} \qquad (2)$$

Inv is the firm's investment as defined previously except that we use quarterly data to capture the investment during the quarter. *Treat* is an indicator variable that equals one for treatment firms and zero for control firms. *Post* is an indicator variable that equals one for the post-merger period and zero for the pre-merger period. *Treat* × *Post*, *q* × *Treat*, *q* × *Post*, and *q* × *Treat* × *Post* are the products of *Treat* and *Post*, *q* and *Treat*, *q* and *Post*, and *q, Treat,* and *Post*, respectively, where *q* is Tobin's *q* measured at the beginning of each period. *CFO*, *Size*, *InstOwn* and *q* × *InstOwn* are defined the same as previously.

In Panel A of Table 5, we report the results estimating equation (2) using merger and industry fixed effects, merger and firm fixed effects, and merger-firm (combination) fixed effects in columns (1), (2), and (3), respectively.[21] The variable of interest is *q* × *Treat* × *Post*. We expect to find a significantly positive coefficient on this variable to the extent that the increase in cross-ownership attributable to financial institution mergers increases treatment firms' investment-*q* sensitivity relative to the changes experienced by control firms. Consistent with this expectation, we find that the coefficient on *q* × *Treat* × *Post* is significantly positive at the 1% or 5% level (coefficients of 0.010, 0.011, and 0.011 in columns (1), (2), and (3), respectively).

To address a possibility that changes in cross ownership around financial institution mergers are not homogeneous among treatment firms, we re-estimate equation (2) after

[20] Institutions' ownership in firms may change for reasons unrelated to the mergers over one year after the mergers. Hence, to minimize the noise arising from longer horizons, we restrict our analyses to one quarter before and after the merger announcements.

[21] In column (3), *Treat* is subsumed by firm-merger (combination) dummies.

replacing *Treat* with *CrossOwn Change* and report the results in Panel B of Table 5 (again, using merger and industry fixed effects, merger and firm fixed effects, and merger-firm (combination) fixed effects in columns (1), (2), and (3), respectively). *CrossOwn Change* is defined as the decile ranking of change in *CrossOwn* (i.e., *CrossOwn* in the post-merger period minus *CrossOwn* in the pre-merger period) for treatment firms and zero for control firms. To the extent that a greater increase in cross-ownership results in a higher investment-*q* sensitivity after financial institution mergers, we expect to find a significantly positive coefficient on $q \times$ *CrossOwn Change* $\times$ *Post.* Consistent with this expectation, we find that the coefficient on this variable is significantly positive at the 1% or 5% level (coefficients of 0.011, 0.012, and 0.013 in columns (1), (2), and (3), respectively) when *CrossOwn Change* is measured based on the change in *NumConnected* before and after the financial institution mergers. Also, in further analyses, we find similar results when *CrossOwn Change* is measured based on *NumCross* (significantly positive coefficients of 0.013, 0.013, and 0.014 in columns (1), (2), and (3), respectively) and *AvgNum* (significantly positive coefficients of 0.012, 0.014, and 0.014 in columns (1), (2), and (3), respectively). Overall, these results reinforce our causal inference that cross-ownership increases investment efficiency as reflected in the stronger investment-*q* sensitivity.

[Insert Table 5]

IV. Additional Analyses

4.1 Forecasting Vs. Revelatory Price Efficiency

To establish the link between cross-ownership and managerial learning, it is necessary to ensure that the increase in the investment-*q* sensitivity we document above is not attributable to forecasting price efficiency or FPE. Bond, Edmans, and Goldstein (2012) distinguish revelatory price efficiency (RPE) from forecasting price efficiency (FPE). While FPE is the

traditional efficiency with which the price of a given security accurately reflects its fundamental value, RPE refers to the extent to which price reveals information necessary for real efficiency for a decision-maker (such as a firm manager). Hence managerial learning from price occurs when price is more efficient with private information in the sense of RPE, where the information flows from the market to the firm. However, to the extent that cross-ownership facilitates information flows from the firm to the market and increases total information in stock price, the increase in the investment-*q* sensitivity can be alternatively explained by FPE even in the absence of managerial learning. While focusing on blockholding cross-owners, Park et al. (2019) find that cross-ownership reduces a firm's concern for competition and proprietary information leakage, increasing voluntary disclosure, which raises a possibility that the result in our main analysis is at least partly due to information flows from the firm to the market and hence FPE.

While there is no evidence that cross-ownership by non-blockholders can also decrease the concern for competition and elicit more disclosures, to mitigate the possibility that our result is explained solely by FPE, we first conduct a subsample test based on disclosure activities. Given that information flows from the firm to the market would be likely greater for firms with a greater propensity of voluntary disclosure, to the extent that the effect of cross-ownership is greater for firms with lower voluntary disclosure, the increase in the investment-*q* sensitivity associated with cross-ownership, the main finding of our study, would be less attributable to FPE. To test whether this is the case, we use a firm's issuance of earnings guidance as a proxy for voluntary disclosures and split the sample into two groups based on whether the firm issued earnings guidance at least once during the year.

Table 6 reports the results of this analysis using *NumConnected* in columns (1) and (2), *NumCross* in columns (3) and (4), and *AvgNum* in columns (5) and (6). Across all three measures of cross-ownership, we find that the coefficient on *q* is larger for firms with high

disclosure than those with low disclosure, consistent with voluntary disclosure increasing FPE and hence the investment-*q* sensitivity. However, the coefficient on *q* × *CrossOwn* is significantly positive only for firms with low disclosure across all three measures of cross-ownership, suggesting that the increase in the investment-*q* sensitivity associated with cross-ownership is unlikely to be through a channel of FPE. Moreover, when testing the difference in this coefficient between the high and low disclosure subsamples, we find that the difference is significant for *NumConnected* and *NumCross* at the 5% and 10% level, respectively. Overall, the results in Table 6 alleviate the concern that the increase in the investment-*q* sensitivity is mainly due to cross-ownership facilitating information flows from the firm to the market and hence FPE.

[Insert Table 6]

We also examine whether our result varies with the amount of private information held by managers. Given that information flows from the firm to the market would be likely greater when managers are more informed about their own firms, to the extent that the effect of cross-ownership is greater for firms where managers hold less amount of private information (i.e., when managers have a greater need to learn), the increase in the investment-*q* sensitivity associated with cross-ownership, the main finding of our study, would be less attributable to FPE. To test whether this is the case, we use insider trading profitability as a proxy for managers' private information. While managers do not always trade on private information, prior research suggests that insider trading can still reveal some, though not all, of corporate information held by managers (e.g., Seyhun 1992; Meulbroek 1992; Damodaran and Liu 1993; Ke, Huddart, and Petroni 2002; Piotroski and Roulstone 2005). Hence we split the sample into two groups based on the sample median of insider trading profitability, which we calculate using the 3-month returns of shares purchased minus those sold following transactions made by the firm's top executives.

Table 7 reports the results of this analysis using *NumConnected* in columns (1) and (2), *NumCross* in columns (3) and (4), and *AvgNum* in columns (5) and (6). Across all three measures of cross-ownership, we find that the coefficient on q is larger for firms with managers of high private information than those of low private information, again, consistent with information flows from the firm to the market increasing FPE and hence the investment-q sensitivity. However, the coefficient on $q \times CrossOwn$ is significantly positive only for firms with managers of low private information (i.e., those with a greater need to learn) across all three measures of cross-ownership, suggesting that the increase in the investment-q sensitivity associated with cross-ownership is unlikely to be achieved through a channel of FPE. Moreover, when testing the difference in this coefficient between the high and low private information subsamples, we find that the difference is significant for *NumConnected* and *NumCross*, both at the 1% level. Overall, similar to those in Table 6, the results in Table 7 also alleviate the concern that the increase in the investment-q sensitivity is mainly due to cross-ownership facilitating information flows from the firm to the market and hence FPE.

[Insert Table 7]

4.2 Learning from Direct Interactions Vs. Stock Price

Studies find that manager can learn from institutional investors through direct interactions (Bottazzi, Da Rin, and Hellmann 2008; Brav et al. 2008; Zhang 2020). If cross-owners have a significant influence on firm policy (e.g., He and Huang 2017; Park et al. 2019), they can also talk to managers directly to convey private information advisable to managers for the firm's investment decisions. If so, then the increase in the investment-q sensitivity associated with cross-ownership, the main finding of our study, can be attributable to cross-owners directly interacting with managers rather than managers learning from stock price. However, cross-owners in our study do not blockhold the shares of focal firms, and recent evidence by Lewellen and Lewellen (2022) suggests that institutional investors do not have

strong financial incentives to be engaged. Hence it is not clear that our finding is due to direct interactions.

Nonetheless, to mitigate this possibility more formally, we again conduct a subsample test where we split the sample into two groups based on liquidity (Amihud 2002). The managerial learning literature suggests that investors' private information is transmitted to stock price through trading, and the potential for stock price to reflect such information is increasing when the stocks are more liquid and thus easier to be traded. Hence, if the increase in the investment-*q* sensitivity is due to managers learning from stock price, we expect the effect to be greater for firms with higher liquidity. However, to the extent that it is mainly due to the direct interactions of cross-owners with firm management, we do not expect to see any difference in the effect between firms with higher and lower liquidity.

Table 8 report the results of this analysis using *NumConnected* in columns (1) and (2), *NumCross* in columns (3) and (4), and *AvgNum* in columns (5) and (6). Across all three measures of cross-ownership, we find that the coefficient on *q* is larger for firms with managers of high liquidity than those of low liquidity, consistent with liquidity helping increase price efficiency (either FPE or RPE) and the investment-*q* sensitivity. More importantly, we also find that the coefficient on $q \times CrossOwn$ is significantly positive only for firms with high liquidity. Further, when testing the difference in this coefficient between the high and low liquidity subsamples, we find that the difference is significant for *NumConnected* and *AvgNum* at the 5% and 10% level, respectively. Overall, the results in Table 8 suggest that the increase in the investment-*q* sensitivity associated with cross-ownership is more likely through the channel of learning from price rather than via direct interactions.

[Insert Table 8]

4.3 Robustness Test

We perform several additional tests to assess whether our results are robust to alternative constructions of cross-ownership. First, while we already exclude institutions blockholding a focal firm in identifying cross-owners, to further mitigate the possibility that our result is attributable to direct communications or direct monitoring by large shareholders, we re-define our measures of cross-ownership by requiring an institution to hold less than 2%, 1%, and 0.5% of the shares of a focal firm (while still blockholding peer firms) and report the results in Panels A, B, and C of Table 9, respectively. In all Panels, across all three measures of *CrossOwn*, namely *NumConnected*, *NumCross*, and *AvgNum* in columns (1), (2), and (3), respectively, we continue to find a significantly positive coefficient on $q \times CrossOwn$. Overall, the results in Table 9 suggest that our finding is robust to excluding large shareholders with higher ability of direct communication or direct monitoring.

[Insert Table 9]

Second, despite cross-ownership increasing over time (as shown in Table 1), to the extent that passive funds have also grown, a mere increase in cross-ownership does not necessarily produce a greater amount of private information (Kacperczyk, Nosal, Sundaresan 2022). While the increase in cross-ownership by passive funds should work against our finding, to control for temporal changes in market structures, we convert each measure of cross-ownership into decile rankings re-defined every year based on its distribution, further standardized to take values ranging from 0 to 1. Table 10 presents the results using *CrossOwn* re-defined based on its within-year decile rankings, where *CrossOwn* refers to *NumConnected, NumCross,* and *AvgNum* in columns (1), (2), and (3), respectively. We find that the coefficient on $q \times CrossOwn$ is positive and significant at the 1% level in columns (1) and (3), while falling short of conventional significance in column (2). Overall, the results in Table 10 suggests that our finding is robust to using measures of cross-ownership that take into account temporal changes in market structures.

[Insert Table 10]

Third, we use the measures of cross-ownership employed in other studies, such as those in Park et al. (2019) and He, Huang, and Zhao (2019), and report the results in Table 11.[22] Column (1) reports the result where *CrossOwn* refers to *Common Dummy*. This variable is used in He and Huang (2017) and Park et al. (2019), defined as an indicator variable that equals one if the firm has at least one cross-owner during the year and zero otherwise. Column (2) reports the result where we use *MV Common Firms* from Park et al. (2019) for *CrossOwn*, which is defined as the sum of the market value of the shares of the peer firms held by cross-owners that simultaneously own the focal firm during the same period. Column (3) reports the result where *CrossOwn* refers to $HoldingPeers^{EW}$. This variable is introduced in He, Huang, and Zhao (2019), calculated as the product of an institution's ownership in the focal firm and the same institution's aggregate ownership in its peer firms, summed over all institutions holding the share of the focal firm. Lastly, column (4) reports the result where we use $HoldingPeers^{VW}$, also from He, Huang, and Zhao (2019), constructed similarly to $HoldingPeers^{EW}$ except that the institution's ownership in peer firms is weighted by the firms' market cap.[23] In all columns (1) through (4), we continue to find a significantly positive coefficient on $q \times CrossOwn$ at the 1% or 5% level, suggesting that our results are robust to using the alternative measures of cross-ownership employed in other studies.

[Insert Table 11]

4.4 Alternative Explanations

[22] In constructing those variables following prior work, to be more suitable for our study, we continue to require cross-owners to hold but not blockhold the shares of a focal firm while blockholding the shares of its peer firms in the same industry.

[23] More specifically, if a focal firm has P number of peer firms (p = 1, 2, …, and P) and is partly owned by I number of institutions (i = 1, 2, …, and I), the focal firm's $HoldingPeers^{EW}$ at time t is measured as $\sum_{i=1}^{I}[\alpha_{i,f,t} \times \sum_{p=1}^{p} \alpha_{i,p,t}]$, where $\alpha_{i,f,t}$ is institution i's fractional ownership in the focal firm f at time t, and $\alpha_{i,p,t}$ is institution i's fractional ownership in the focal firm's peer p at time t. Also, the focal firm's $HoldingPeers^{VW}$ at time t is measured as $\sum_{i=1}^{I}[\alpha_{i,f,t} \times \sum_{p=1}^{p} \alpha_{i,p,t} \frac{M_p}{\bar{M}}]$, where $\frac{M_p}{\bar{M}}$ is given as a weight: M_p is the market cap of the focal firm's peer p at time t, and $\bar{M}$ is the mean of M_p across all peers of the focal firm at time t. See He, Huang, and Zhao (2019) for further intuition into these measures.

Prior research suggests several alternative channels that could potentially explain our results. First, firms facing fewer financing constraints can make investment more sensitive to stock price (Baker, Stein, and Wurgler 2003). Therefore, to the extent that cross-ownership can mitigate information asymmetry and hence underinvestment, it would allow firms to raise capital with a lower cost in response to an increase in growth opportunities, likely resulting in a higher investment-*q* sensitivity. This could particularly be the case if cross-ownership improves disclosure policies, prompting managers to release more information voluntarily to the market and reducing information asymmetry (Park et al. 2019). However, this channel is unlikely to explain our result since the main effect of cross-ownership on investment is consistently negative across all our analyses, inconsistent with cross-ownership mitigating underinvestment. Moreover, if our result is attributable to cross-ownership reducing information asymmetry and financing costs, we would find a greater effect of cross-ownership for firms facing higher financing constraints. However, when we split the sample into two groups based on several proxies for financing constraints, we do not find a differential effect of cross-ownership between firms with higher and lower financing constraints (results untabulated), alleviating the possibility that our results are due to cross-ownership decreasing information asymmetry and financing costs.

Prior research also identifies agency costs as another channel leading to investment inefficiencies (e.g., Shleifer and Vishny 1989). The agency literature generally suggests that managers, if not monitored properly, tend to make self-serving investments at the expense of shareholder value, often characterized as empire-building, such as overinvestment or inefficient capital transfers to segments with lower growth opportunities. Therefore, to the extent that cross-ownership improves monitoring, our results could be attributable to cross-

ownership reducing agency conflicts and hence overinvestment. [24] However, in addition to controlling for institutional ownership, our results are robust to excluding blockholders or large shareholders, one of the most effective corporate monitors, in identifying cross-owners. Moreover, in untabulated analyses, we do not find evidence that the effect of cross-ownership is more pronounced for firms with higher agency conflicts where overinvestment is more likely (e.g., firms with lower institutional ownership, fewer dedicated institutional investors, higher G index, or higher free cash flows), mitigating a possibility that our results are driven by a monitoring channel of cross-ownership.

Lastly, Polk and Sapienza (2008) find a positive association between discretionary accruals (a proxy for mispricing) and abnormal investment, suggesting that managers increase investment to cater to investor demand when stocks are overvalued. While we are not aware of evidence that cross-ownership triggers mispricing, to the extent that industry-wide overpricing attracts institutional investors and hence increases cross-ownership (through industry common shocks), our results could be attributable to firms catering to investors' demand for investment to exploit overvaluation. However, industry-common mispricing is unlikely to explain our results since we use industry-year (combination) fixed effects in our analyses, where peer firms in the same industry and the same year are used as the benchmark.[25] Besides, if our results are attributable to cross-ownership triggering mispricing and causing firms to cater to investor demand for investment, we would find a greater effect of cross-ownership for firms with higher mispricing. However, when we split the sample into two groups based on discretionary accruals (a proxy for mispricing as in Polk and Sapienza (2008)), we do not find a differential effect of

[24] He, Huang, and Zhao (2019) find that cross-ownership creates governance externalities. Edmans, Levit, and Reilly (2019) also suggest that when an investor owns multiple firms, it can strengthen governance through both voice and exit even when firms are in unrelated industries.

[25] To further address a potential concern of industry common shocks, for each industry-year, we measure industry returns (i.e., the equal-weighted or value-weighted average of annual returns of all firms operating in the same two-digit SIC industry) and include its interaction with q as an additional control variable. With industry factors controlled for, we continue to find a positive effect of cross-ownership on the investment-q sensitivity, alleviating the possibility that our results are driven by industry common shocks (results untabulated).

cross-ownership between the two groups (results untabulated), ruling out the catering story as an alternative channel for our results.

V. Conclusion

Institutional cross-ownership has become a growing area of interest to researchers in finance and accounting recently, and several recent papers show that institutional cross-ownership plays a significant role in product market competition, corporate governance, and disclosure policies. We argue that cross-ownership of industry peers helps institutions reduce information processing costs and increase industry specialization, which increases revelatory price efficiency or RPE, the potential for managers to learn private information embedded in stock price. Consistent with our expectation, we find that cross-ownership is significantly positively associated with the investment-*q* sensitivity. Using financial institution mergers as an identification strategy, we also find a significant increase in the investment-*q* sensitivity for treatment firms (those receiving a positive shock to cross-ownership) relative to control firms during the post-merger period, consistent with an increase in cross-ownership facilitating managerial learning from stock price as reflected in the investment-*q* sensitivity.

In addition, we find that the increase in the investment-*q* sensitivity associated with cross-ownership is more pronounced for firms with a lower propensity of voluntary disclosure (i.e., where information flows from the firm to the market are less likely) and for firms with managers holding less private information (i.e., where managers have a greater need to learn), suggesting our finding is more consistent with cross-ownership increasing RPE rather than FPE. We also find that our results are more pronounced for firms with higher stock liquidity, suggesting that the increase in the investment-*q* sensitivity associated with cross-ownership is more likely due to cross-owners transmitting private information to stock price through trading rather than directly talking to firm management to convey private information.

Our study contributes to a recent and growing literature on institutional cross-ownership. While the literature has so far focused mainly on the impact of blockholders' cross-ownership on intra-industry competition or monitoring, we add to the cross-ownership literature by focusing on the ability of cross-owners in general, excluding blockholders, to reflect private information in stock price. We also contribute to the literature on managerial learning and investment-*q* sensitivity. While the extant studies generally agree that investors hold private information unknown to managers, it has not been identified where their relative information advantage comes from. By focusing on institutional cross-ownership of peer firms, we add to this line of literature and demonstrate how a firm's ownership structure affects its propensity to learn incremental information from the stock market.

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Appendix A – Variable Definitions

Variables for Main Analysis	
NumConnected	The total number of unique peer firms held by cross-owners measured each quarter, averaged across the four quarters during the year.
NumCross	The total number of cross-owners holding both the focal and peer firms measured each quarter, averaged across the four quarters during the year.
AvgNum	The average number of peer firms for each cross-owner measured each quarter, averaged across the four quarters during the year.
Inv	Investment defined as capital expenditures (data item CAPX) scaled by fixed assets (data item PPENT).
q	Tobin's *q* defined as the market value of equity plus the book value of debt (data item AT minus data item CEQ) scaled by the book value of assets (data item AT).
CFO	Cash flows from operations defined as earnings before extraordinary items (data item IB) plus depreciation and amortization (data item DP) scaled by total assets (data item AT).
Size	Firm size defined as the log of the market value of equity, where the market value of equity is defined as shares outstanding (data item CSHO) times closing share price (data item PRCC_F).
InstOwn	Institutional ownership defined as the percentage of a firm's shares held by institutional investors.
Variables for Robustness Test	
Common Dummy	An indicator variable that equals one if the firm has at least one cross-owner in any of the four quarters during the year and zero otherwise.
MV Common Firms	The sum of the market value of the shares of the peer firms held by cross-owners that simultaneously own the focal firm each quarter, averaged across the four quarters during the year.
HoldingPeersEW	The product of an institution's ownership in the focal firm and the same institution's aggregate ownership in its peer firms, summed over all institutions holding the share of the focal firm each quarter, averaged across the four quarters during the year.
HoldingPeersVW	The product of an institution's ownership in the focal firm and the same institution's aggregate market cap-weighted ownership in its peer firms, summed over all institutions holding the share of the focal firm each quarter, averaged across the four quarters during the year.

Table 1 Sample Distribution by Year

This table reports the yearly sample distribution and mean (median) of *NumConnected*, *NumCross*, and *AvgNum*. See Appendix A for the variable definitions. This variable is winsorized at the 1% and 99% levels.

Year	No. Obs.	*NumConnected*		*NumCross*		*AvgNum*	
		Mean	Median	Mean	Median	Mean	Median
1981	1,838	1.64	0.00	2.12	0.00	0.38	0.00
1982	1,858	1.71	0.00	2.17	0.00	0.43	0.00
1983	1,980	2.14	0.00	2.45	0.00	0.56	0.00
1984	2,170	3.42	1.00	2.96	1.00	0.83	1.00
1985	2,231	4.66	1.00	3.58	1.00	1.15	1.00
1986	2,368	6.66	2.00	4.03	1.50	1.71	1.05
1987	2,483	10.04	4.00	4.65	2.00	2.42	1.44
1988	2,564	11.99	5.25	4.96	2.25	2.90	1.63
1989	2,521	12.62	5.75	5.07	2.25	3.27	1.63
1990	2,527	14.21	7.00	5.33	2.75	3.50	1.80
1991	2,500	15.66	8.25	5.99	3.00	3.61	2.00
1992	2,578	17.11	9.25	6.32	3.50	3.71	2.13
1993	2,868	19.24	10.00	6.94	3.75	3.55	2.25
1994	3,086	21.56	12.25	7.49	4.25	3.77	2.43
1995	3,309	23.36	13.25	8.14	4.75	3.62	2.51
1996	3,658	25.32	14.25	8.63	5.00	3.62	2.68
1997	3,924	28.69	16.75	9.27	5.58	3.79	3.00
1998	4,137	31.11	17.25	9.76	5.75	3.90	3.02
1999	4,007	32.07	17.75	10.13	6.00	3.72	2.90
2000	3,998	37.92	21.25	11.18	7.00	4.01	3.02
2001	3,972	44.07	23.25	12.29	7.75	4.15	3.31
2002	3,993	49.09	27.00	13.32	8.50	4.51	3.42
2003	3,937	52.88	30.50	13.77	9.50	4.86	3.76
2004	4,395	54.66	35.00	13.88	9.75	5.46	4.21
2005	4,452	59.91	39.38	14.64	11.00	5.58	4.41
2006	4,499	63.15	42.75	15.03	11.50	5.80	4.54
2007	4,487	71.30	50.25	16.85	13.00	6.13	4.86
2008	4,506	78.59	57.75	18.92	15.00	6.04	4.95
2009	3,935	82.37	63.00	18.43	14.75	6.76	5.13
2010	3,794	72.08	52.75	15.33	11.88	7.51	5.38
2011	3,819	66.24	47.33	15.33	12.00	6.53	5.00
2012	3,849	75.50	52.25	15.33	12.75	8.02	5.73
2013	3,704	77.22	54.50	14.53	11.75	8.97	6.10
2014	3,805	75.87	51.75	14.00	11.00	8.64	5.80
2015	3,704	76.73	50.25	12.51	9.75	8.78	5.63
2016	3,739	78.91	49.50	11.74	9.25	9.46	5.84
2017	3,463	78.87	50.33	11.57	9.00	9.83	5.84
2018	3,597	94.93	61.25	13.72	11.00	12.00	6.59
2019	3,637	104.53	72.00	14.84	11.50	12.68	6.79

Table 2 Descriptive Statistics

This table reports the descriptive statistics of the variables used in our analyses. Panel A for summary statistics and Panel B for Pearson correlation coefficients. See Appendix A for variable definitions. All continuous variables are winsorized at the 1% and 99% levels. In Panel B, significance levels are in parentheses.

Panel A Summary Statistics

	N	Mean	Std. Dev.	P25	Median	P75
NumConnected	131,892	48.508	60.554	5.000	22.250	70.000
NumCross	131,892	11.234	12.039	2.250	7.000	16.000
AvgNum	131,892	5.463	6.668	1.611	3.333	6.633
Inv	131,892	0.453	1.182	0.108	0.203	0.378
q	131,892	1.945	1.585	1.058	1.390	2.142
CFO	131,892	0.032	0.183	0.012	0.071	0.119
Size	131,892	5.670	2.227	4.041	5.562	7.179
InstOwn	131,892	0.391	0.299	0.115	0.348	0.642

Panel B Pearson Correlation Coefficients

	NumConnected	*NumCross*	*AvgNum*	*Inv*	*q*	*CFO*	*Size*
NumCross	0.722						
	(p<0.01)						
AvgNum	0.589	0.074					
	(p<0.01)	(p<0.01)					
Inv	-0.009	-0.029	-0.011				
	(p<0.01)	(p<0.01)	(p<0.01)				
q	0.170	0.167	0.048	0.142			
	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)			
CFO	-0.100	0.092	-0.217	-0.004	-0.205		
	(p<0.01)	(p<0.01)	(p<0.01)	(p=0.14)	(p<0.01)		
Size	0.350	0.641	-0.080	0.007	0.170	0.242	
	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.05)	(p<0.01)	(p<0.01)	
InstOwn	0.354	0.563	-0.043	-0.040	0.045	0.162	0.547
	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)	(p<0.01)

Table 3 Main Test: Institutional Cross-Ownership and Investment-*q* Sensitivity

This table reports the results from the regression of investment (*Inv*) estimating equation (1) using *NumConnected*, *NumCross*, and *AvgNum* as a measure of cross-ownership (*CrossOwn*) in Columns (1), (2), and (3), respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) *NumConnected* *for CrossOwn*	(2) *NumCross* *for CrossOwn*	(3) *AvgNum* *for CrossOwn*
q	0.086***	0.092***	0.080***
	(0.008)	(0.008)	(0.008)
CrossOwn	-0.022***	-0.033***	-0.008***
	(0.004)	(0.005)	(0.003)
q* × *CrossOwn	**0.006*** **	**0.004** **	**0.006*** **
	(0.002)	**(0.002)**	**(0.002)**
CFO	0.149***	0.132***	0.157***
	(0.032)	(0.031)	(0.032)
Size	0.009***	0.021***	0.006**
	(0.003)	(0.003)	(0.003)
InstOwn	-0.002	0.003	-0.008***
	(0.003)	(0.004)	(0.003)
q × *InstOwn*	-0.005***	-0.005***	-0.004***
	(0.002)	(0.002)	(0.001)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195

Table 4 Firm-Fixed Effect Model

This table reports the results from the regression of investment (*Inv*), where we replace industry-year (combination) fixed effects with firm and year fixed effects. *NumConnected*, *NumCross*, and *AvgNum* are used as a measure of cross-ownership (*CrossOwn*) in Columns (1), (2), and (3), respectively. We add *PeerCrossOwn* and *q* × *PeerCrossOwn* as additional control variables to equation (1) to control for time-varying industry factors correlated with cross-ownership. *PeerCrossOwn* is the equal-weighted average *CrossOwn* of peer firms included in calculating the focal firm's *CrossOwn*, and *q* × *PeerCrossOwn* is a product of *q* and *PeerCrossOwn*. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn, InstOwn,* and *PeerCrossOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for industry-year clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) *NumConnected* *for CrossOwn*	(2) *NumCross* *for CrossOwn*	(3) *AvgNum* *for CrossOwn*
q	0.162***	0.151***	0.158***
	(0.014)	(0.014)	(0.015)
CrossOwn	-0.038***	-0.058***	-0.010***
	(0.006)	(0.007)	(0.004)
q* × *CrossOwn	**0.007*** **	**0.005***	**0.004****
	(0.003)	**(0.003)**	**(0.002)**
CFO	0.384***	0.366***	0.391***
	(0.036)	(0.036)	(0.037)
Size	0.018**	0.041***	0.012*
	(0.008)	(0.008)	(0.008)
InstOwn	-0.012***	-0.004	-0.019***
	(0.005)	(0.006)	(0.005)
q × *InstOwn*	-0.012***	-0.012***	-0.010***
	(0.002)	(0.003)	(0.002)
PeerCrossOwn	0.039***	0.032***	0.010**
	(0.006)	(0.005)	(0.005)
q × *PeerCrossOwn*	-0.006**	-0.003*	-0.004**
	(0.003)	(0.002)	(0.002)
Fixed Effects	Firm and Year	Firm and Year	Firm and Year
No. Obs.	117,393	117,393	117,393
Adjusted R^2	0.338	0.339	0.337

Table 5 Analysis Using Financial Institution Mergers

This table reports the results of the analysis using financial institution mergers. In Panel A, we report the results from the difference-in-differences analysis estimating equation (2), where columns (1), (2), and (3) report the results with merger and industry fixed effects, merger and firm fixed effects, and merger-firm (combination) fixed effects, respectively. *Treat* is an indicator variable that equals one for treatment firms and zero for control firms. A firm is classified as a treatment firm if the firm is held but not blockheld by one of the merging institutions during the quarter immediately before the merger announcement and the other merging institution does not hold the firm but blockholds at least one of the firm's industry peer firms during the same quarter. A firm is classified as a control firm if the firm is held but not blockheld by the same institution holding the treatment firm while the other merging institution blockholds none of the firm's industry peer firms. *Post* is an indicator variable that equals one for the firm's first fiscal quarter that begins after the merger announcement and zero for the last fiscal quarter that ends before the merger announcement. *Treat* × *Post* is a product of *Treat* and *Post*. *q* is Tobin's *q*. *q* × *Treat*, *q* × *Post*, and *q* × *Treat* × *Post* are the products of *q* and *Treat*, *q* and *Post*, and *q*, *Treat* and *Post*, respectively. In Panel B, we report the results when replacing *Treat* with *CrossOwn Change* in equation (2). *CrossOwn Change* is defined as the decile ranking of change in *CrossOwn* (i.e., *CrossOwn* in the post-merger period minus *CrossOwn* in the pre-merger period) for treatment firms and zero for control firms. Again, columns (1), (2), and (3) report the results with merger and industry fixed effects, merger and firm fixed effects, and merger-firm (combination) fixed effects, respectively. See Appendix A for variable definitions for other variables. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for merger-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5 Analysis Using Financial Institution Mergers, Continued

Panel A: Difference-in-Differences Analysis

	(1)	(2)	(3)
q* × *Treat* × *Post	**0.010*** **	**0.011*** **	**0.011** **
	(0.004)	**(0.004)**	**(0.005)**
Treat	-0.006	-0.001	
	(0.006)	(0.006)	
Post	0.025*	0.021	0.017
	(0.013)	(0.014)	(0.018)
Treat × *Post*	0.017*	0.013	0.013
	(0.009)	(0.009)	(0.012)
q	0.027***	0.021***	0.019*
	(0.003)	(0.004)	(0.011)
q × *Treat*	-0.005	-0.009***	-0.014
	(0.003)	(0.003)	(0.010)
q × *Post*	-0.005	-0.003	0.000
	(0.003)	(0.003)	(0.004)
CFO	0.076**	0.181***	0.101**
	(0.029)	(0.028)	(0.047)
Size	-0.008***	0.025***	0.008
	(0.001)	(0.003)	(0.005)
InstOwn	-0.012*	-0.038**	-0.156***
	(0.007)	(0.016)	(0.050)
q × *InstOwn*	0.005	-0.013***	-0.021**
	(0.003)	(0.004)	(0.009)
Fixed Effects	Merger and Industry	Merger and Firm	Merger-Firm
No. Obs.	83,806	83,806	83,806
Adjusted R^2	0.191	0.475	0.700

Table 5 Analysis Using Financial Institution Mergers, Continued

Panel B: Analysis using the Change in *CrossOwn* before and after Mergers

	(1)	(2)	(3)
Using NumConnected for CrossOwn			
q* × *CrossOwn Change* × *Post	**0.011*** **	**0.012*** **	**0.013** **
	(0.003)	**(0.003)**	**(0.005)**
Controls	Included	Included	Included
Fixed Effects	Merger and Industry	Merger and Firm	Firm-Merger
No. Obs.	83,806	83,806	83,806
Adjusted R^2	0.191	0.475	0.700
Using NumCross for CrossOwn			
q* × *CrossOwn Change* × *Post	**0.013*** **	**0.013*** **	**0.014** **
	(0.003)	**(0.003)**	**(0.005)**
Controls	Included	Included	Included
Fixed Effects	Merger and Industry	Merger and Firm	Firm-Merger
No. Obs.	83,806	83,806	83,806
Adjusted R^2	0.191	0.474	0.699
Using AvgNum for CrossOwn			
q* × *CrossOwn Change* × *Post	**0.012*** **	**0.014*** **	**0.014** **
	(0.004)	**(0.004)**	**(0.006)**
Controls	Included	Included	Included
Fixed Effects	Merger and Industry	Merger and Firm	Firm-Merger
No. Obs.	83,806	83,806	83,806
Adjusted R^2	0.191	0.475	0.699

Table 6 Subsample Test Based on Voluntary Disclosure

This table reports the results from the subsample test, where we split the sample into two groups based on earnings guidance as a proxy for voluntary disclosure (i.e., high vs. low disclosure subsamples). We assign a firm into a high disclosure subsample if it issued earnings guidance at least once during the year and a low disclosure subsample otherwise. Columns (1) and (2) report the results using *NumConnected* as a measure of cross-ownership (*CrossOwn*) based on high and low disclosure subsamples, respectively. Columns (3) and (4) report the results using *NumCross* as a measure of cross-ownership (*CrossOwn*) based on high and low disclosure subsamples, respectively. Columns (5) and (6) report the results using *AvgNum* as a measure of cross-ownership (*CrossOwn*) based on high and low disclosure subsamples, respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6 Subsample Test Based on Voluntary Disclosure, Continued

	(1)	(2)	(3)	(4)	(5)	(6)
	NumConnected for CrossOwn		*NumCross for CrossOwn*		*AvgNum for CrossOwn*	
	High Disclosure	*Low Disclosure*	*High Disclosure*	*Low Disclosure*	*High Disclosure*	*Low Disclosure*
q	0.156***	0.093***	0.153***	0.097***	0.143***	0.092***
	(0.022)	(0.010)	(0.021)	(0.010)	(0.026)	(0.011)
CrossOwn	-0.013*	-0.019***	-0.029***	-0.037***	-0.001	-0.004
	(0.007)	(0.005)	(0.009)	(0.006)	(0.007)	(0.004)
q* × *CrossOwn	**-0.000**	**0.005***	**-0.000**	**0.004***	**0.002**	**0.004***
	(0.003)	**(0.002)**	**(0.003)**	**(0.003)**	**(0.003)**	**(0.002)**
CFO	-0.015	0.163***	-0.024	0.142***	-0.007	0.169***
	(0.057)	(0.044)	(0.057)	(0.043)	(0.057)	(0.045)
Size	-0.005	0.005	0.012*	0.022***	-0.008	0.002
	(0.005)	(0.004)	(0.007)	(0.005)	(0.005)	(0.003)
InstOwn	0.002	-0.004	0.009	0.005	-0.001	-0.010***
	(0.006)	(0.004)	(0.007)	(0.005)	(0.006)	(0.004)
q × *InstOwn*	-0.010***	-0.004	-0.010***	-0.004	-0.010***	-0.002
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)
	test for diff. in q × CrossOwn b/w col. (1) and (2): p=0.05		***test for diff. in q × CrossOwn b/w col. (3) and (4): p=0.06***		***test for diff. in q × CrossOwn b/w col. (5) and (6): p=0.26***	
Fixed Effects	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year
No. Obs.	34,096	70,178	34,096	70,178	34,096	70,178
Adjusted R^2	0.255	0.172	0.256	0.173	0.255	0.172

Table 7 Subsample Test Based on Managers' Private Information

This table reports the results from the subsample test, where we split the sample into two groups based on the sample median of insider trading profitability as a proxy for managers' private information (i.e., high vs. low private information subsamples). We calculate insider trading profits using the 3-month returns of shares purchased minus those sold following transactions made by the firm's top executives. Columns (1) and (2) report the results using *NumConnected* as a measure of cross-ownership (*CrossOwn*) based on high and low insider trading profitability subsamples, respectively. Columns (3) and (4) report the results using *NumCross* as a measure of cross-ownership (*CrossOwn*) based on high and low insider trading profitability subsamples, respectively. Columns (5) and (6) report the results using *AvgNum* as a measure of cross-ownership (*CrossOwn*) based on high and low insider trading profitability subsamples, respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7 Subsample Test Based on Managers' Private Information, Continued

	(1)	(2)	(3)	(4)	(5)	(6)
	NumConnected for CrossOwn		*NumCross for CrossOwn*		*AvgNum for CrossOwn*	
	High Private Info	*Low Private Info*	*High Private Info*	*Low Private Info*	*High Private Info*	*Low Private Info*
q	0.143***	0.095***	0.151***	0.091***	0.129***	0.095***
	(0.018)	(0.013)	(0.020)	(0.012)	(0.020)	(0.014)
CrossOwn	-0.011	-0.027***	-0.020***	-0.038***	-0.005	-0.010**
	(0.007)	(0.006)	(0.008)	(0.009)	(0.006)	(0.004)
q* × *CrossOwn	**0.002**	**0.007****	**-0.001**	**0.010*****	**0.004**	**0.005****
	(0.004)	**(0.003)**	**(0.003)**	**(0.004)**	**(0.004)**	**(0.002)**
CFO	0.160**	0.147***	0.150**	0.126***	0.168**	0.154***
	(0.069)	(0.043)	(0.067)	(0.044)	(0.072)	(0.043)
Size	-0.014***	0.022***	-0.000	0.032***	-0.016***	0.017***
	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)
InstOwn	0.003	-0.001	0.005	0.007	0.001	-0.008
	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)
q × *InstOwn*	-0.008***	-0.007***	-0.007**	-0.010***	-0.008***	-0.005**
	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)
	test for diff. in q × CrossOwn b/w col. (1) and (2): p=0.01		***test for diff. in q × CrossOwn b/w col. (3) and (4): p=0.01***		***test for diff. in q × CrossOwn b/w col. (5) and (6): p=0.21***	
Fixed Effects	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year
No. Obs.	49,481	49,320	49,481	49,320	49,481	49,320
Adjusted R^2	0.247	0.249	0.248	0.249	0.248	0.249

Table 8 Subsample Test Based on Stock Liquidity

This table reports the results from the subsample test, where we split the sample into two groups based on the sample median of stock liquidity (i.e., high vs. low liquidity). We calculate stock liquidity as an inverse measure of Amihud's (2002) illiquidity. Columns (1) and (2) report the results using *NumConnected* as a measure of cross-ownership (*CrossOwn*) based on high and low liquidity subsamples, respectively. Columns (3) and (4) report the results using *NumCross* as a measure of cross-ownership (*CrossOwn*) based on high and low liquidity subsamples, respectively. Columns (5) and (6) report the results using *AvgNum* as a measure of cross-ownership (*CrossOwn*) based on high and low liquidity subsamples, respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 8 Subsample Test Based on Stock Liquidity, Continued

	(1)	(2)	(3)	(4)	(5)	(6)
	NumConnected for CrossOwn		*NumCross for CrossOwn*		*AvgNum for CrossOwn*	
	High Liquidity	*Low Liquidity*	*High Liquidity*	*Low Liquidity*	*High Liquidity*	*Low Liquidity*
q	0.109***	0.092***	0.115***	0.096***	0.096***	0.094***
	(0.013)	(0.012)	(0.014)	(0.012)	(0.013)	(0.014)
CrossOwn	-0.030***	-0.012**	-0.052***	-0.006	-0.008	-0.006
	(0.008)	(0.005)	(0.008)	(0.007)	(0.007)	(0.004)
q* × *CrossOwn	**0.009*** **	**-0.002**	**0.008*** **	**-0.004**	**0.011*** **	**-0.001**
	(0.003)	**(0.002)**	**(0.003)**	**(0.003)**	**(0.003)**	**(0.002)**
CFO	-0.051	0.206***	-0.076	0.202***	-0.032	0.212***
	(0.066)	(0.036)	(0.066)	(0.036)	(0.066)	(0.036)
Size	-0.020***	0.047***	-0.003	0.049***	-0.023***	0.042***
	(0.004)	(0.006)	(0.005)	(0.007)	(0.004)	(0.006)
InstOwn	-0.000	-0.015***	0.009	-0.016***	-0.006	-0.017***
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
q × *InstOwn*	-0.011***	0.001	-0.011***	0.003	-0.010***	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
	test for diff. in q × CrossOwn b/w col. (1) and (2): p=0.05		***test for diff. in q × CrossOwn b/w col. (3) and (4): p=0.12***		***test for diff. in q × CrossOwn b/w col. (5) and (6): p=0.01***	
Fixed Effects	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year	Industry-Year
No. Obs.	57,038	57,057	57,038	57,057	57,038	57,057
Adjusted R^2	0.291	0.287	0.292	0.287	0.292	0.287

Table 9 Cross-Ownership Measures with Large Shareholders Excluded

This table reports the results from the regression of investment (*Inv*) estimating equation (1) using *NumConnected*, *NumCross*, and *AvgNum* redefined by excluding the focal firm's large shareholders as a measure of cross-ownership (*CrossOwn)* in Columns (1), (2), and (3), respectively. Panels A, B, and C report the results where we require cross-owners to hold less than 2%, 1%, and 0.5% of the shares outstanding of a focal firm, respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Cross-Owners Holding Less Than 2% of the Shares Outstanding of a Focal Firm

	(1) *NumConnected for CrossOwn*	(2) *NumCross for CrossOwn*	(3) *AvgNum for CrossOwn*
q	0.089***	0.092***	0.081***
	(0.008)	(0.008)	(0.009)
CrossOwn	-0.016***	-0.026***	-0.004
	(0.004)	(0.004)	(0.003)
q* × *CrossOwn	**0.005*** **	**0.004** **	**0.005*** **
	(0.002)	**(0.002)**	**(0.002)**
CFO	0.146***	0.133***	0.152***
	(0.032)	(0.031)	(0.032)
Size	0.009***	0.019***	0.006**
	(0.003)	(0.003)	(0.003)
InstOwn	-0.005	-0.000	-0.008***
	(0.003)	(0.003)	(0.003)
q × *InstOwn*	-0.005***	-0.005***	-0.004***
	(0.002)	(0.002)	(0.001)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195

Table 9 Cross-Ownership Measures with Large Shareholders Excluded, Continued

Panel B: Cross-Owners Holding Less Than 1% of the Shares Outstanding of a Focal Firm

	(1) *NumConnected for CrossOwn*	(2) *NumCross for CrossOwn*	(3) *AvgNum for CrossOwn*
q	0.090***	0.092***	0.083***
	(0.008)	(0.008)	(0.008)
CrossOwn	-0.016***	-0.026***	-0.003
	(0.003)	(0.004)	(0.003)
q* × *CrossOwn	**0.004*** **	**0.004** **	**0.005*** **
	(0.002)	**(0.002)**	**(0.001)**
CFO	0.144***	0.131***	0.150***
	(0.032)	(0.031)	(0.032)
Size	0.010***	0.020***	0.005**
	(0.003)	(0.003)	(0.003)
InstOwn	-0.005*	-0.002	-0.008***
	(0.003)	(0.003)	(0.003)
q × *InstOwn*	-0.004***	-0.004***	-0.004***
	(0.001)	(0.002)	(0.001)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195

Table 9 Cross-Ownership Measures with Large Shareholders Excluded, Continued

Panel C: Cross-Owners Holding Less Than 0.5% of the Shares Outstanding of a Focal Firm

	(1) *NumConnected for CrossOwn*	(2) *NumCross for CrossOwn*	(3) *AvgNum for CrossOwn*
q	0.093***	0.093***	0.087***
	(0.008)	(0.008)	(0.009)
CrossOwn	-0.019***	-0.025***	-0.006**
	(0.003)	(0.004)	(0.003)
q* × *CrossOwn	**0.003****	**0.003***	**0.004*****
	(0.001)	**(0.002)**	**(0.001)**
CFO	0.141***	0.129***	0.150***
	(0.032)	(0.031)	(0.032)
Size	0.013***	0.021***	0.006**
	(0.003)	(0.003)	(0.003)
InstOwn	-0.005*	-0.003	-0.008***
	(0.003)	(0.003)	(0.003)
q × *InstOwn*	-0.004***	-0.004**	-0.004***
	(0.001)	(0.002)	(0.001)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195

Table 10 Cross-Ownership Measures Based on Within-Year Decile Rankings

This table reports the results from the regression of investment (*Inv*) estimating equation (1) using *NumConnected*, *NumCross*, and *AvgNum* redefined based on the variable's within-year decile ranking as a measure of cross-ownership (*CrossOwn)* in Columns (1), (2), and (3), respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) *NumConnected* *for CrossOwn*	(2) *NumCross* *for CrossOwn*	(3) *AvgNum* *for CrossOwn*
q	0.088***	0.095***	0.078***
	(0.008)	(0.008)	(0.008)
CrossOwn	-0.014***	-0.025***	-0.004
	(0.003)	(0.004)	(0.003)
q* × *CrossOwn	**0.004*** **	**0.002**	**0.005*** **
	(0.002)	**(0.002)**	**(0.001)**
CFO	0.143***	0.135***	0.150***
	(0.033)	(0.032)	(0.033)
Size	0.007**	0.021***	0.006**
	(0.003)	(0.003)	(0.003)
InstOwn	-0.003	0.002	-0.007***
	(0.003)	(0.003)	(0.003)
q × *InstOwn*	-0.004***	-0.004*	-0.003**
	(0.002)	(0.002)	(0.001)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195

Table 11 Cross-Ownership Measures Used in Other Studies

This table reports the results from the regression of investment (*Inv*) estimating equation (1) using *Common Dummy*, *MV Common Firms*, *HoldingPeersEW*, and *HoldingPeersVW* as a measure of cross-ownership (*CrossOwn*) in Columns (1), (2), (3), and (4), respectively. See Appendix A for variable definitions. For ease of interpretation, *CrossOwn* and *InstOwn* are converted into decile rankings and standardized to range from 0 to 1. All continuous variables are winsorized at the 1% and 99% levels. All p-values are two-sided and calculated based on standard errors adjusted for firm-clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) *Common Dummy for CrossOwn*	(2) *MV Common Firms for CrossOwn*	(3) *HoldingPeers^{EW} for CrossOwn*	(4) *HoldingPeers^{VW} for CrossOwn*
q	0.069***	0.091***	0.091***	0.090***
	(0.013)	(0.008)	(0.007)	(0.007)
CrossOwn	-0.074***	-0.015***	-0.019***	-0.020***
	(0.027)	(0.004)	(0.004)	(0.004)
q* × *CrossOwn	**0.044*** **	**0.004** **	**0.006*** **	**0.006*** **
	(0.014)	**(0.002)**	**(0.002)**	**(0.002)**
CFO	0.148***	0.150***	0.155***	0.155***
	(0.031)	(0.032)	(0.032)	(0.032)
Size	0.006**	0.008***	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)
InstOwn	-0.007***	-0.004	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
q × *InstOwn*	-0.004***	-0.005***	-0.006***	-0.006***
	(0.001)	(0.002)	(0.002)	(0.002)
Fixed Effects	Industry-Year	Industry-Year	Industry-Year	Industry-Year
No. Obs.	131,892	131,892	131,892	131,892
Adjusted R^2	0.195	0.195	0.195	0.195