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# **Common Ownership, Market Power, and Investment Efficiency**

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# Abstract

Common ownership occurs when the leading shareholders of industry competitors overlap. While most of the research on this topic has been focused on the U.S. equity market, the three papers presented in this thesis offer a fresh perspective by examining the common ownership phenomenon through a European lens and addressing gaps in the existing literature.

The first paper investigates the historical trend in institutional holdings and the determinants of common ownership among FTSE MIB's constituents. The findings show a significant increase in institutional holdings over time, resulting in a slight increase in common ownership links. The regression analysis reveals that changes in common ownership are positively and significantly associated with a firm's retail share and institutional portfolios' indexing level, providing insight into the drivers of this phenomenon.

The second paper makes theoretical and empirical contributions to the research on the anticompetitive effects of common ownership. Using a two-period duopoly model in which firms' customers face switching costs, I demonstrate that increased common ownership harms consumers by raising first-period prices above the equilibrium level obtained in the absence of common ownership. I also conduct an analysis to evaluate the welfare implications of the model. Finally, using the sample of FTSE MIB's constituents, I empirically show that the higher the level of switching costs faced by firms' customers, the stronger the positive relationship between common ownership and market power.

The third paper, using a broad sample of European listed firms, sheds light on the impact of common ownership on corporate finance decisions investigating the relationship between common ownership and investment efficiency. The results indicate a conditional negative (positive) association between common ownership and investments among firms that are more prone to over (under) invest. Additionally, the study shows that firms with higher common ownership with their industry peers are less likely to deviate from predicted investment levels.



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# Chapter 1

## Introduction

In the context of the equity market, common ownership refers to the situation where multiple investors or institutions collectively own significant stakes in multiple companies operating in the same industry.

Recent empirical work has documented the ubiquity of common ownership among publicly traded firms of developed economies, as well as its rapid rise in recent decades.

One factor contributing to the transformation of the equity investor landscape is the shift away from individual ownership towards investment in diversified funds managed by institutional investors who hold shares in multiple companies. As a result, formerly independent competitors now have common ownership and are partially controlled by a limited number of investors. For example, the top five beneficial owners of each of America's largest banks are now dominated by five institutions: BlackRock, Vanguard, State Street Global Advisers, Fidelity, and Berkshire Hathaway (Azar et al., 2016). Additionally, the seven largest beneficial owners of American Airlines hold almost half of the shares, and each of them is also among the top ten investors in American's direct competitors (Azar et al., 2018). As of 2015, the "Big Three" institutional investors - BlackRock, Vanguard, and State Street – together owned the largest share in 88% of S&P 500 firms and on average, their ownership in 1.662 U.S. listed firms was 17.6% of the corporation's stock.

This trend is expected to continue. Bebchuk and Hirst (2019) predict that the "Big Three" institutional investors will cast 40% of votes at S&P 500 firms by 2039, up from the current 25%.

These patterns are to some extent also present in Europe where BlackRock, with more than \$8 trillion in Assets under Management<sup>1</sup> (AuM), is the leading shareholder of 33 companies in the FTSE 100 (and among the top 5 shareholders of 89 of them) and holds the largest share also in one-third of the firms in the DAX-30. BlackRock is also the largest shareholder of

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<sup>1</sup> Assets under Management (AuM) refers to the market value of all investments and assets that an investment company manages on behalf of investors. Assets under management definitions and formulas vary by company. Some financial institutions include bank deposits, mutual funds and cash in their calculations. Others limit it to funds under discretionary management, where the investor assigns responsibility to the company.

notable banks such as HSBC, Deutsche Bank, Banco Popolare di Milano, and Banco Bilbao Vizcaya Argentaria. Vanguard, which manages over \$7 trillion in assets, is a close competitor and is experiencing even faster growth (Azar & Schmalz, 2017; Fichtner et al., 2017; Schmalz, 2018).

In parallel, the asset management industry has recently experienced a global shift from active to passive investment strategies, most prominently implemented through index funds and ETFs. These investment products allow individuals to achieve better and low-cost diversification and represented more than 80 percent of the equity assets of each of the three largest asset managers in 2016 (Fichtner et al., 2017). As a result of the popularity of these instruments, there has been a rise in overlapping holdings of large blocks of stock among almost all publicly traded firms, due to the natural diversification they provide among industry competitors.

These shifts have led to extensive investigation and analysis on whether common ownership can result in actions that hinder competition in highly concentrated industries (Azar et al., 2016, 2018; Kennedy et al., 2017; Koch et al., 2021; Dennis et al., 2022). The underlying idea is that common owners with shares in multiple competing firms would prefer to maximize their portfolios' profits as opposed to firm profits, encouraging firms to soften competition. While empirical path-breaking works in this field focused on the anticompetitive issue, more recent research has moved to examine the effects of common ownership on multiple firm outcomes such as knowledge spillovers and innovation, firms' coordination, mergers and acquisition activity, corporate finance decisions, financial reporting, and disclosure (Semov, 2017; Kini et al., 2019; Park et al., 2019; Kostovesky & Manconi, 2020; Xie & Gerakos, 2020; Antón et al., 2021; Chen et al., 2021; Di Giuli et al., 2021; Freeman, 2021).

The common ownership argument falls at the intersection of several disciplines, including economics, antitrust and securities laws, and corporate governance. For this reason, it has a lively debate among academics, legal practitioners, and policymakers, which developed initially in the U.S. but has since generated considerable interest in Europe.

Nevertheless, the existing empirical literature focuses on the U.S. and no similar studies (with a few exceptions) exist for Europe as of yet, although common ownership links on the other side of the Atlantic are pronounced enough to reasonably expect similar effects (Azar & Schmalz, 2017).

Overall, this thesis fills the gaps in the literature and examines the common ownership phenomenon through a European lens, thus responding to the scholars' request for more work on the European ownership pattern.

Starting from the evidence that Italian companies are ranked among the top four holdings in institutional investors' portfolios, in Chapter 2 I present the first work that, to the best of my knowledge, documents the common ownership pattern in Italy.

Specifically, I examine the historical trend in institutional investors' holdings as well as the determinants of common ownership in the FTSE MIB Index constituents from Q2 2009 to Q4 2020.

The analysis reveals a dramatic increase in institutional holdings over time and a subsequent slight increase in common ownership links among firms. Through the regression framework, I show that changes in common ownership are positively and significantly related to the retail share of a firm as well as to the indexing level of institutional investors' portfolios. Even though prior literature has sought to link the rise in common ownership to the consolidation in the asset management industry, it does not emerge any significant association with the holdings of the major institutional investors.

The paper presented in Chapter 3 contributes, both theoretically and empirically, to the debate on the anticompetitive outcomes of the common ownership links. Using a two-period duopoly model I show that in the presence of switching costs faced by firms' customers, an increased degree of common ownership softens competition raising the prices set by firms in the first period above the equilibrium level obtained in the absence of common ownership. The welfare analysis reveals that the socially optimal level of common ownership is determined by the relative weight users put on consumption rather than on returns from investments, and their degree of risk aversion. Finally, using the sample of FTSE MIB constituents from Q2 2011 to Q4 2020, I empirically show that the higher the level of switching costs faced by firms' customers, the higher the positive relationship between common ownership and market power. This effect is more evident in firms operating in highly concentrated industries. The empirical findings provide further insight into the conditions under which common ownership is harmful to markets, thus contributing to the development of possible policy responses to the anticompetitive concern.

The work presented in Chapter 4 shifts the attention from the Italian to the European context and represents the first study to provide evidence about the effects of within-industry common ownership in Europe using a broad sample of industries.

Specifically, this work contributes to the growing literature which examines the effect of common ownership on corporate finance decisions by empirically investigating for the first time the relationship between common ownership and investment efficiency. The research questions are addressed by exploiting a newly built ownership dataset including quarterly

holdings in European listed companies referred to individuals, corporations, governments, government agencies, and institutional investors.

The results show that higher common ownership is associated with lower (higher) investments among firms that show a greater propensity to over (under) invest. Moreover, firms which share greater common ownership links with their industry peers are less likely to deviate from the predicted investment level. To establish causality, I employ a Difference-in-Differences approach using financial institutions' mergers as exogenous shocks to common ownership. Overall, the results link the increase in investment efficiency to improved monitoring effectiveness and financial reporting quality.

When addressing the common ownership issue, antitrust laws and regulations should thus consider a framework within which the promotion of product market competition is weighted against the beneficial role of common ownership in promoting innovation sharing, efficiency, and cooperation among firms.

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## Chapter 2

# The Determinants of Common Ownership in Italian Companies

### Abstract

Common ownership in the last decades has become more prominent following the consolidation in the asset management industry and the rise in index investing. This paper documents the trend and changes in the common ownership level for the universe of FTSE MIB's constituents, by identifying possible explanations. I show that institutional investors' holdings have increased dramatically over time, both in terms of value and number of blockholdings, with the "Big Four" (BlackRock, Vanguard, Fidelity, and State Street) leading the pack. The regression results demonstrate that common ownership is positively and significantly related to the firm's retail share as well as to the institutional investors' "indexing" level, while it does not emerge any significant association with the "Big Four" holdings. This suggests that, even though the "Big Four" have dominated the public debate on this research area, the increasing similarity of investors' portfolios is the driving factor behind the variation in common ownership.

### 1. Introduction

This paper belongs to a recent fast-growing literature in finance and industrial organization that examines the effects of common ownership links on firms' behavior and their strategic decisions in product markets. When the leading shareholders of different corporations overlap, common ownership emerges. Such a relationship may occur between non-competing firms or vertically related firms but of particular concern is the ownership overlap between competitors in the same industry, the so-called "horizontal shareholding".

The point is that when ownership is separated, the firm's goal is to maximize its value through the maximization of its individual profits. However, with common ownership, the firm's value maximization no longer coincides with the maximization of the shareholders' returns because of their external interests in other firms.

In the latter case, the prediction is that firms' managers internalize the external interests of diversified shareholders, maximizing a combination of the profits of the common owned firms in a way that maximizes the portfolio value of their investors.

When commonly held firms operate in the same product market, the internalization of competitors' profits will induce those firms to compete less by raising prices, producing fewer units, reducing investments, innovating less, or decreasing the likelihood of entry into new markets (Azar et al., 2016; Azar et al., 2018; Newham et al., 2019; Xie & Gerakos, 2020; Antón et al., 2021; Lundin, 2021; Torshizi & Clapp, 2021).

The idea that diversified shareholders would place non-zero profit weights on competitors' profits is known as "the common ownership hypothesis".

The purpose of this study is not to directly test the common ownership hypothesis, but rather to analyze the trend and the historical variation in common ownership among Italian firms, by identifying plausible explanations. I choose the Italian context based on the findings of Rosati et al. (2020) which show that Italian companies are ranked among the top four in the portfolios of the major institutional investors. Furthermore, there is no comprehensive picture of the scope of common ownership in Italy to date.

Using quarterly data from the Italian firms included in the FTSE MIB Index from 2009 to 2020 I show a positive trend in institutional investors' holdings over time, both in terms of value and number of blockholdings, with the "Big Four" (BlackRock, Fidelity, Vanguard, and State Street) leading the pack.

I next examine the potential determinants underlying the changes in common ownership through a regression framework. Following Backus et al. (2021), I focus on the primitive component of the common ownership problem, the profit weights. The results show that the common ownership profit weights are strongly positively correlated with the proportion of shares held by retail investors and with the institutional investors' "indexing" level, while it does not emerge any significant association with the holdings of the "Big Four". These findings suggest that, rather than the rise of the "Big Four", the increasing similarity of investors' portfolios is the key driver of profit weights' variation over time.

This paper has several contributions. First, to the best of my knowledge, this is the first paper to document the common ownership pattern in Italy. Second, it provides evidence of the potential drivers behind the observed common ownership changes. Third, it constitutes the starting point for more in-depth research to ascertain the potential implications of such ownership trends, from product market outcomes and managerial incentives to market entry and R&D decisions.

The paper proceeds as follows. Section 2 examines the related literature. Section 3 gives some background on the changes in institutional common ownership in Europe and Italy. Section 4 explains the empirical method used to test the determinants of common ownership and presents the results. Section 5 concludes.

## **2. Related literature**

Whether and how partial ownership overlap affects corporate objectives has been the subject of a sizeable theoretical literature developed mainly in the 1970s and early 1980s. The maximization of its own value was considered the firm's main objective at least since Fisher (1930). Under the hypothesis of perfect competition and complete markets, Fisher asserts that a firm should be motivated to maximize profits regardless of its owners' investment preferences. In the 1970s the Fisher Separation Theorem give rise to a substantial literature that establishes the conditions under which a firm's shareholders unanimously support value maximization (Ekern, 1973; Ekern & Wilson, 1974; Radner, 1974; Grossman & Stiglitz, 1977; De Angelo, 1981).

However, the Fisher Separation Theorem, which Hart (1979) extends to incomplete markets, holds until firms are price takers. Indeed, with market power, under the hypothesis of imperfect competition, shareholders may not unanimously agree on the firm's value-maximizing behavior. Arrow's impossibility theorem (Arrow, 1950) and then Milne (1981) address the complexity of the question achieving the result that it does not exist a collective choice function that aggregates the diverging preferences of a group of shareholders. Therefore, the intuition that diversified shareholders, with holdings in several firms, may not unanimously agree on the value-maximizing objective, began to spread. The problem of the aggregation of the preferences of a heterogeneous group of agents proposed by Arrow was addressed by Rotemberg (1984) by relaxing some assumptions of the impossibility theorem. Under this configuration, the firm's objective function is calculated as the weighted average of shareholders' utilities and the weights are given by the amount of capital they have invested in the firm. A firm's equilibrium output resides between the collusive output level and the level predicted by simple profit maximization. The more the shareholders are diversified the more output falls toward the monopolistic level because of managers' collusive behaviors. Under the assumptions of symmetrical firms and identical owners, Rotemberg finds that

shareholders unanimously agree on the firm's objective function, including the owners who are not diversified among other firms, since they also benefit from managers' collusive behavior. In his concluding remarks Rotemberg explicitly warned about mutual funds, especially those concentrated among industry competitors, since they favor low-cost access to diversified investments thus inducing managers to soften competition to protect shareholders' interests.

Following Rotemberg's concerns, the theoretical framework underlying the common ownership hypothesis has recently received renewed attention because of increasing ownership concentration among the top investment managers and the massive shift of capital from actively managed mutual funds to index mutual funds and ETFs, jointly known as passive index funds.

Asset management firms now offer index funds that cover all industries and sector funds in each specific industry, so most industries likely have horizontal shareholdings.

Fichtner et al. (2017) find that BlackRock, Vanguard, and State Street constitute the largest shareholder in 88% of S&P 500 firms and remark that a peculiar feature of the passive index fund industry is its high level of concentration: in December 2016 the "Big Three" together stand for the 71 % of the entire ETF market and they manage over 90 % of all Assets under Management (AuM) in passive equity funds. In 1980, institutional investors controlled 34% of all U.S. common stock; by 2010, they owned 67%, and by 2012, 80% of all stock in S&P firms. This tendency is particularly impressive if we consider that the likelihood of two rival firms having a common shareholder owning at least 5% of each has grown from 16% in 1999 to 90% by the end of 2014.

The scope of the phenomenon is not limited to the U.S.: common ownership concentration is an international and fast-rising trend.

According to Schmalz (2018), with more than \$6 trillion in Assets under Management, BlackRock is not only the main investor in a growing percentage of US companies, but it is also the largest shareholder in a third of the FTSE 100 companies, as well as a top-5 shareholder of 89 of them, the largest shareholder of a third of the DAX-30 companies, etc. Vanguard is almost as big, with more than \$5 trillion in Assets under Management in a similarly diversified portfolio, and it's growing even faster.

Seldeslachts et al. (2017) document changes in the ownership of publicly traded German companies, showing that large foreign investors, including the "Big Three" and NBIM, have recently surpassed domestic investors in terms of both value and number of blockholdings, and now hold the top spots.

Despite the richness of the theoretical predictions and the broad scope of common ownership patterns in the real world, the empirical literature examining the theories' predictions is relatively young. Azar et al. (2018) is the first paper to empirically identify an effect of common ownership concentration on product prices. Specifically, they examine whether changes in common ownership concentration in a given airline route over time are associated with changes in ticket prices on the same route. According to their findings, the ticket prices for the average U.S. airline route are between 3% and 7% higher than they would be if the airlines were under separate ownership. Similar results have been found in other industries and using other econometric methods. In particular, Azar et al. (2016) find that the combination of common ownership and cross-ownership in U.S. banks leads to higher prices on retail deposit products and lower deposit interest rates.

These early papers have generated significant interest and debate, but they have also faced significant critiques. As a result, they have spurred further investigations and new research into the topic (Kennedy et al., 2017; Azar et al., 2018b; Eglund et al., 2019; Lewis & Chugh, 2019; Park & Seo, 2019; Dennis et al., 2022).

Much of the early empirical literature focus on prices. Several papers, both empirical and theoretical, have lately proposed alternative manifestations of the common ownership hypothesis. The existence of common ownership links between firms indeed may affect management incentives (Antón et al., 2022), market entry (Newham et al., 2019; Xie & Gerakos, 2020), knowledge spillovers and innovation (Kini et al., 2019; López & Vives, 2019; Vives, 2020; Antón et al., 2021), firms' coordination and supply chain management (Kostovetsky & Manconi, 2020; Freeman, 2021), firm's equity and debt markets (Antón & Polk, 2014; Boller & Scott Morton, 2020), shareholders proposals (He et al., 2019), disclosure and financial reporting quality (Park et al., 2019; He et al., 2020; Ramalingegowda et al., 2020). Common owners also affect corporate finance decisions through M&A activity (Matvos & Ostrovsky, 2008; Harford et al., 2011; Brooks et al., 2018), dividend payout policies (Di Giuli et al., 2021), financing of investment opportunities (Chen et al., 2021), cash management and capital structure (Semov, 2017; Ni & Yin, 2021).

This field of study is very active, and the preliminary evidence is very interesting. Before any major conclusions can be reached, further research in this field is required to examine various scenarios using more appropriate approaches. Our understanding of the scope and magnitude of any purported common ownership effects should precede and guide any discussion of policy responses, some of which are already underway (e.g., Elhauge, 2016, 2020; Posner et al., 2017; Patel, 2018; Scott Morton & Hovenkamp, 2018; Posner, 2021).

### **3. The debate on common ownership**

#### **3.1 The European perspective**

The topic of the anticompetitive implications of common ownership has generated a fierce debate that has involved not only researchers and academics but also legal practitioners and policymakers. It was initially focused on the United States, but it has recently sparked significant interest in the European Union to such an extent that the European Commission recently invoked the potential anticompetitive effects of common ownership as an “element of contest” in two merger decisions, the one between Dow and Dupont<sup>1</sup> and the one between Bayer and Monsanto<sup>2</sup>.

To date, the empirical studies on the competitive impacts of common ownership have been concentrated on the United States because, before performing some empirical research in the European scenario, it should be verified if the levels of common ownership across European companies are equivalent to those in the United States.

The main difference in processing European data compared to American data consists in the fact that each Country has its own ownership disclosure system, therefore there is no standardized disclosure regime at the European level. This is the reason why, before the release of Rosati et al. (2020), there was no comprehensive and detailed picture of the extent of common ownership in Europe. The dataset used by Rosati et al. (2020) includes ownership data for all companies active in the European Union between 2007 and 2016. The analysis reveals that, in 2007, 85.1 % of all shareholders own a share in only one company and that this percentage increased to 87.2% in 2016. Common investors, with ownership in more than one firm, thus accounted for 14.9% of all shareholders in 2007 and 12.8% in 2016. The number of listed companies with common shareholders holding at least 5% in each of them (the so-called blockholders) has increased from roughly 15.000 in 2007 to around 17.500 in 2016. In percentage terms, 67% of the companies in the dataset are common owned by blockholders. The portfolios of the investment funds BlackRock, Dimensional Fund, The Norwegian Sovereign Fund, and Vanguard currently include more than 20% of the listed companies active in Europe. They are followed by Axa, Deutsche Bank, Fidelity (FMR LLC), and JP Morgan Chase which hold between 12.5% and 16.2% of EU listed firms in 2016, a percentage that has decreased over the observation period. The average ownership share held ranges from 3% for

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<sup>1</sup> Dow/DuPont (Case M.7932).

<sup>2</sup> Bayer/Monsanto (Case M.8084).

BlackRock to 2% for Vanguard, with Invesco, Dimensional, and State Street holding an average percentage share between 1% and 1.5%. The examination of the portfolios' composition of the main common owners between 2007 and 2016 reveals that the main target country is the United Kingdom, followed by Germany, France, and Italy.

The authors also investigate the level of common ownership in five industries: oil and gas, electricity, mobile telecommunications, trading platforms, and beverages. In particular, the beverages sector is chosen for the empirical investigation. The results show an increase in the market power of firms that saw increased common ownership because of the merger between BlackRock and Barclays Global Investors in 2009. These results validate comparable conclusions obtained by scholars using U.S. data for other industries (Azar et al., 2016, 2018). At the time of writing, to the best of my knowledge, the above-mentioned study constitutes the first empirical investigation of the potential anticompetitive effects of common ownership using an extensive set of EU data and the first on the beverage manufacturing industry.

In terms of common ownership patterns in each EU Member State, Seldeslachts et al. (2017) is the first study to conduct a country-based analysis documenting the recent changes in common ownership of publicly traded German companies from 2007 to 2015.

In the next paragraph, I document the common ownership patterns of the FTSE MIB Index's constituents, starting from the evidence that Italian companies are among the top four EU countries in the portfolios of the main institutional investors and given that there is no developed picture of the extent of common ownership in Italy to date.

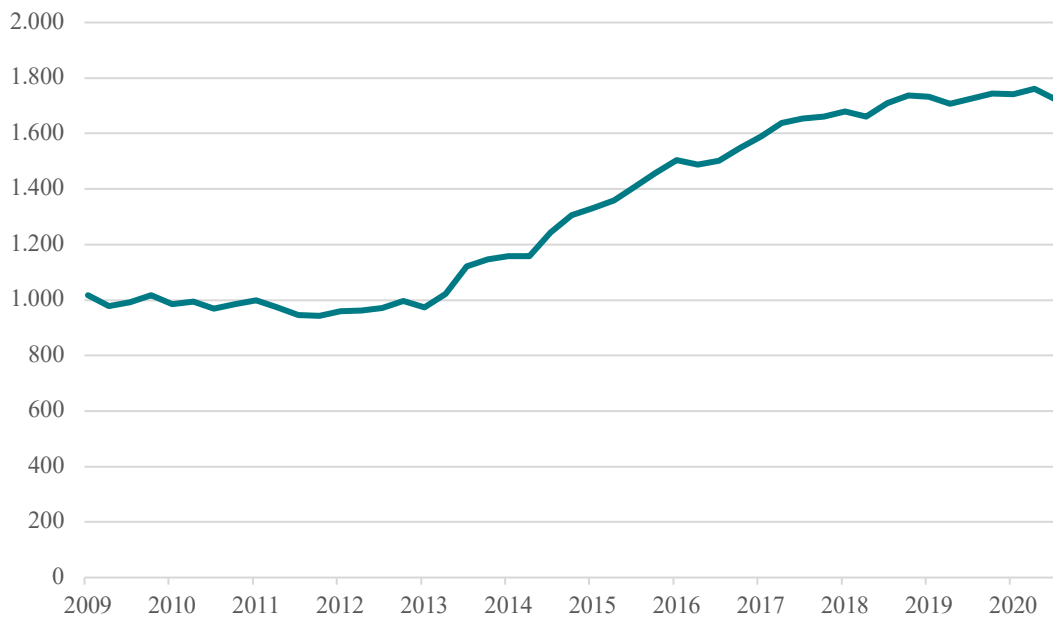
### **3.2 Changes in common ownership of Italian companies**

In a first step in showing investors and their holdings, Figure 1 depicts how the number of institutional investors owning at least one FTSE MIB constituent grew from around 1000 to 1730 from Q2 2009 to Q4 2020.

In Figure 2, I calculate the share of each firm held by institutional investors and report the straight average over index participants. This percentage has risen from less than 37% in the second quarter of 2009 to roughly 47% by the end of 2020, due in part to the increase in the number of institutional investors (see Figure 1).

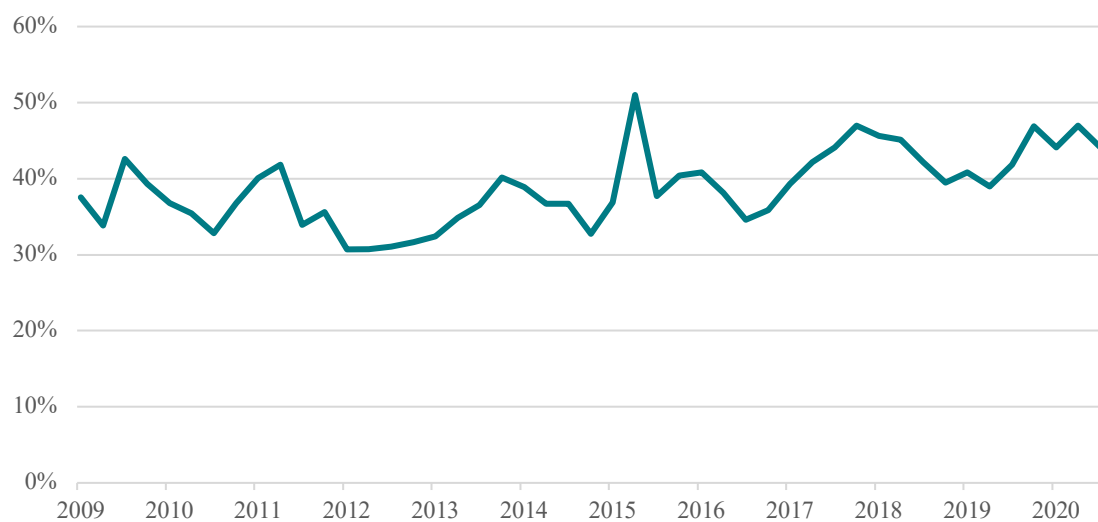
When we look at the ownership patterns of the major institutional investors in Figure 3, we can see that after the BlackRock-BGI acquisition in December 2009, BlackRock became the largest investor and grew rapidly. Indeed, by 2020, the value of its holdings had increased by more than 65%, reaching 25 billion euros.

**Figure 1: Number of institutional investors**



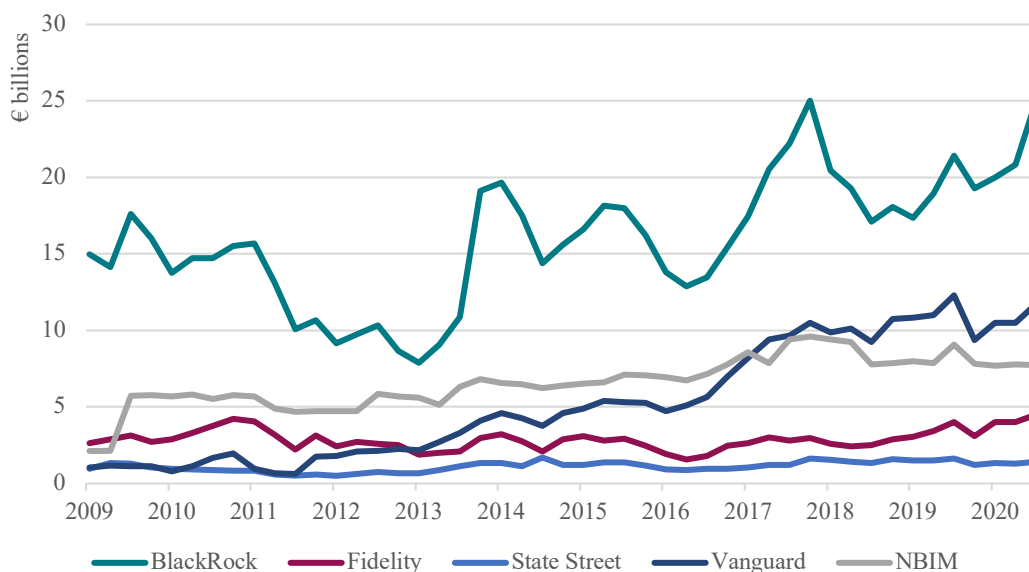
This figure reports the number of institutional investors that hold a share in at least one FTSE MIB constituent for each quarter during the period 2009-2020.

**Figure 2: Share of FTSE MIB Index owned by institutional investors**



This figure depicts the average total share of a firm owned by institutional investors. This corresponds to the institutional ownership share of the firm, and one hundred minus this number corresponds to the retail share. I report the straight average across index constituents, rather than a weighted average, for each quarter during the period 2009-2020

**Figure 3: Value held by selected institutional investors in FTSE MIB companies**



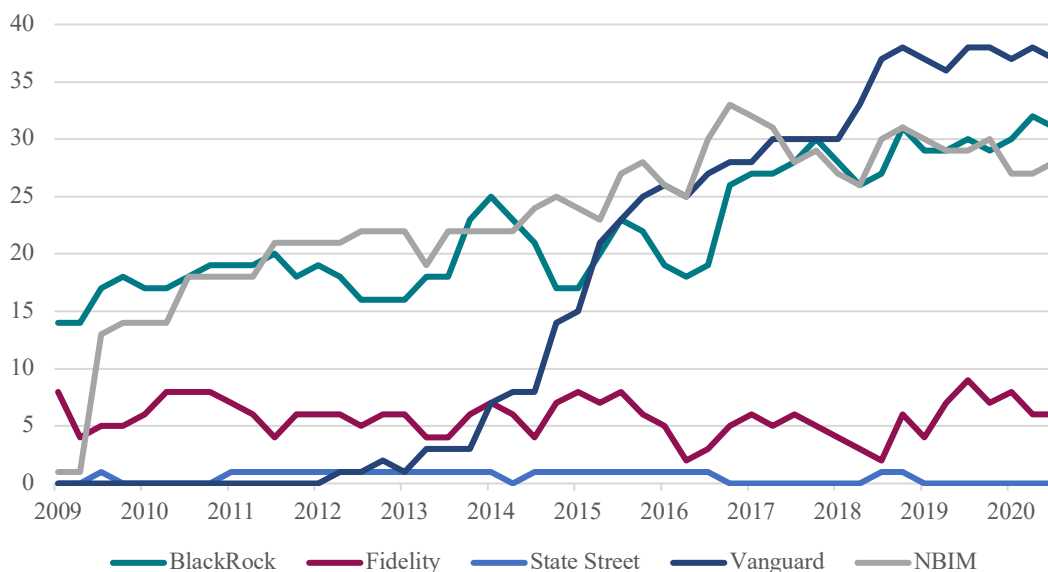
This figure depicts the average total value of a firm owned by selected institutional investors. I first calculate the sum of the selected investors' holdings in each FTSE MIB constituent for each quarter during the period 2009-2020, then I report the straight average across index constituents.

In the second quarter of 2009, Vanguard and State Street had nearly the same value in publicly traded Italian companies, valued at around 1 billion euros. While State Street followed a conservative expansion strategy, Vanguard's holdings have grown tenfold since then, reaching 11.7 billion at the end of 2020 and surpassing NBIM, Fidelity, and State Street. In 2020, NBIM (Norges Bank Investment Management), the world's largest sovereign wealth fund, had more than 7.7 billion Euros in FTSE MIB's constituents, about four times its holdings in mid-2009. Contrary to BlackRock, NBIM receives monthly capital inflows from the Norwegian Government Petroleum Fund and has not acquired any institutional investors to grow. Fidelity, for its part, reports an increase in holdings from 2.6 to 4.5 billion Euros throughout the observation period.

We can observe a similar pattern in terms of number of blockholdings. Throughout the paper, I consider as blockholdings ownership shares in a company greater than 1%, 3%, and 5% to be consistent with the previous literature (Fichtner et al., 2017; Seldeslachts et al., 2017).

With 14 holdings greater than 1% in June 2009, BlackRock had by far the largest network among the five investors analyzed here (see Figure 4). It was followed by Fidelity, which had eight holdings of more than 1%, and NBIM, which had one, while State Street and Vanguard had none. The situation began to change rapidly at the end of 2009. Between 2009 and 2020,

**Figure 4: Number of blockholdings >1% held by selected institutional investors**



This figure reports the number of firms in the FTSE MIB Index in which each institutional investor holds an ownership share greater or equal to 1% for each quarter from 2009 to 2020.

NBIM's network developed rapidly, from 1 to 28 blockholdings higher than 1%, while Vanguard expanded gradually over the same period. Fidelity had an average of five blockholdings throughout the observation period, whereas State Street had almost none. Vanguard had the greatest network by the end of 2020, with approximately 38 holdings higher than 1%, surpassing even BlackRock, which had 31 holdings.

When we look at blockholdings higher than 3% and 5%, the situation changes, reflecting the different strategies of the selected institutional investors (see Figure A1 and A2 in the Appendix). Indeed, BlackRock had the greatest network of blockholdings greater than 3% and 5% during the whole period, while both NBIM and Vanguard had zero blockholdings for most of the time. The Herfindahl-Hirschman Index of concentration of institutional investors' holdings (IHHI) is depicted in Figure A3 (see the Appendix). Here the investors' HHI is calculated as the sum of squared institutional investors' shares of the total market value of the FTSE MIB held by institutional investors. Higher values of the index denote a higher concentration. In the computation is considered only the fraction of the firm's market value owned by institutional investors, assuming that their presence is what connects firms and markets through the common ownership network.

As shown by the green line in Figure A3, concentration does not show a clear trend and, after a few peaks, has been hovering around 200 since the end of 2016. The grey line depicts the

level of investor concentration following the consolidation of the regional subsidiaries of the selected institutional investors or any other possible connected entity. During the period under consideration, the consolidation process results in an increase in investors' concentration of around 100.

## 4. The empirical analysis

### 4.1 The model

The regression framework, based on Backus et al. (2021) analysis of S&P 500 firms, aims at investigating the key variables affecting the common ownership pattern across Italian firms over time, as well as the direction of their influence.

In the main specification, I regressed the relative weight that firm  $f$  places on every dollar of profits accruing to firm  $g$  in its maximization problem at time  $t$  (the common ownership proxy) on a set of explanatory variables:

$$\begin{aligned} \kappa_{fg,t} = & \alpha_1 RetailShare_{f,t} + \alpha_2 \log(Market Cap)_{f,t} + \alpha_3 Gross Profit Margin_{f,t} \\ & + \alpha_4 BigFourHoldings_{f,t} + \alpha_5 L_{2,f,t}^{FIRMS} + \lambda_{fg} + v_t + \varepsilon_{f,t} \end{aligned}$$

The regression is performed through a within-estimator using panel data and includes firm-pair fixed effects,  $\lambda_{fg}$ , and quarter fixed effects,  $v_t$ . Firm-pair fixed effects allow me to look within the pair of firms  $\kappa_{fg,t}$ . I also include year dummies to account for any variation in the dependent variable that occurs over time and that is not attributed to the explanatory variables included in the model. Standard errors are clustered at firm-pair level.

### 4.2 The dependent variable: common ownership profit weights

In the regression model, the dependent variable is a key measure of common ownership that arises directly from the firm's optimization process. This measure indicates the weight placed

by the firm on each dollar of profits generated by the companies in which its shareholders have some interests.

The basic idea is that, when firms have common ownership, the maximization of the company's profit no longer coincides with the maximization of shareholders' returns due to their interests in other firms. Firm's value maximization thus will no longer correspond with the simple maximization of the firm's profit as the management will internalize the external interests of diversified shareholders.

To address this issue, the theoretical literature proposes a firm's objective function defined by the weighted average of the shareholders' utility, represented by their portfolios' profits<sup>3</sup>.

Rearranging this objective function, firm  $f$  will maximize the following expression

$$\pi_f + \sum_g \kappa_{fg} \pi_g \text{ with } \kappa_{fg} \equiv \frac{\sum_i \gamma_{fi} \beta_{gi}}{\sum_i \gamma_{fi} \beta_{fi}}$$

where  $\kappa_{fg}$  is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. If  $\kappa_{fg} = 0$  whenever  $f$  is different from  $g$  then we go back to the simple firm's own profit maximization. This measure was introduced by Azar (2012) and adopted by Azar and Vives (2021) as well as by Backus et al. (2021) and it is also a component of the MHHI measure of O'Brien and Salop (2000).

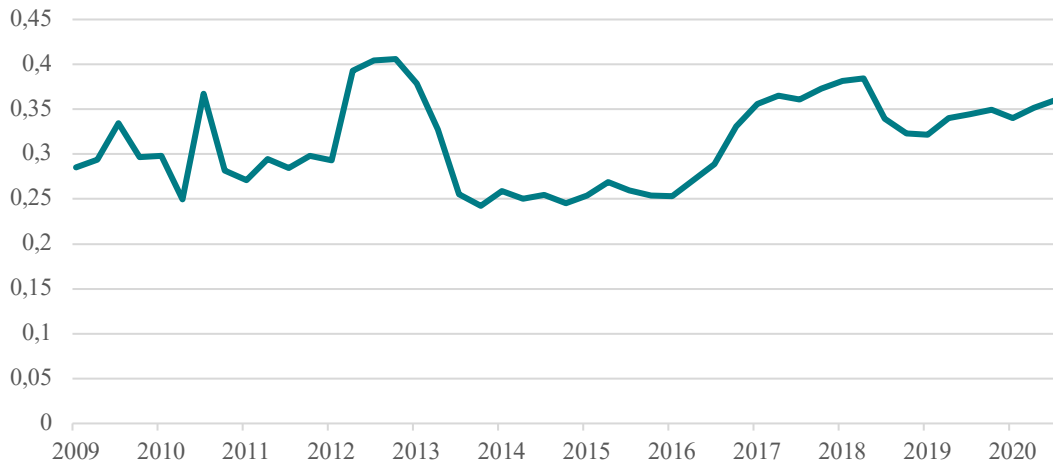
The so-called "profit-weight" depends on  $\beta_{fi}$  and  $\beta_{gi}$  which reflect the fraction of the total shares outstanding of firm  $f$  and  $g$  owned by shareholder  $i$ . This primitive measure of common ownership also includes  $\gamma_{fi}$ , which is the Pareto weight that a firm places on its shareholders. Given that the researcher cannot observe this weight, much of the literature relies on the proportion control assumption, which assumes  $\gamma_{fi} = \beta_{fi}$ .

Backus et al. (2021) present a useful decomposition of  $\kappa_{fg}$  into two components: the first show the link between this common ownership measure and institutional investors' indexing strategies, while the second highlights the relationship between  $\kappa_{fg}$  and institutional investors' concentration measured by  $IHHI_f = \sum_{i=1}^I \beta_{fi}^2$ . In the empirical findings, I go deeper into these relationships. Under the proportional control assumption  $\gamma_{fi} = \beta_{fi}$ , I compute the profit weights for each pair of FTSE MIB's constituents using quarterly data on institutional holdings from Q2 2009 to Q4 2020. Figure 5 depicts the average  $\kappa$  for each pair of firms, excluding

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<sup>3</sup> This model of firm behavior traces to Rotemberg (1984) and appears implicitly in the cross-ownership profit weights of Bresnahan and Salop (1986). In what follows I adopt the  $(\gamma, \beta)$  notation of O'Brien and Salop (2000), which studied the implied profit weights in the context of Cournot and Bertrand competition.

**Figure 5: Common ownership profit weights over time**



This figure depicts the mean implied profit weight across all pairs of firms in the FTSE MIB index by quarter, excluding own profit weights, which are normalized to 1.

their own profit weights, which are normalized to one. Until mid-2016, there was no discernible trend in the evolution of  $\kappa_{fg}$ , but since then a small upward tendency began, leading  $\kappa_{fg}$  from 0.26 to 0.36 in 2020.

### 4.3 The explanatory variables

The regression equation includes among the explanatory variables  $\log(\text{Market Cap})$ , the logarithm of firm' market capitalization at time  $t$  and  $\text{Retail share}$  that is the retail share of a company at time  $t$  equal to 1 minus the sum of institutional investors' holdings ( $\text{Retail share}_{f,t} = 1 - \sum_i \beta_{fi,t}$ ).

On the right side of the equation, I also considered the *Gross Profit Margin* of firm  $f$  at time  $t$ , calculated as  $\frac{\text{Revenue} - \text{COGS}}{\text{Revenue}}$ , and *BigFourHoldings* that is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, Fidelity and State Street in a firm  $f$  at time  $t$ .

The massive shift of capitals from actively managed products to passive index funds and ETFs has been one of the main drivers of the recent increased interest in the common ownership implications. This is the reason behind the inclusion among the explanatory variables of a firm-level measure of investors' portfolio similarity to the market portfolio ( $L_{2,f,t}^{\text{FIRMS}}$ ).

Following Backus et al. (2021), I construct for each quarter from Q2 2009 to Q4 2020 a set of  $\bar{\omega}_f = \frac{\sum_i \beta_{fi}}{\sum_{f,i} \beta_{fi}}$  to represent the market portfolio<sup>4</sup>, and then I calculated the normalized portfolio

weights  $\omega_{fi} = \frac{\beta_{fi}}{\sum_f \beta_{fi}}$ .

Using the  $L_2$  measure of similarity, I computed the distance between each investor's portfolio and the market portfolio

$$L_2(\omega_i, \bar{\omega}) = \frac{\sum_f \omega_{fi} \bar{\omega}_f}{\sqrt{\sum_f \omega_{fi}^2} \sqrt{\sum_f \bar{\omega}_f^2}} = \frac{\sum_f \omega_{fi} \bar{\omega}_f}{\|\omega_i\| \|\bar{\omega}\|}$$

The goal is to determine the extent to which each investor pursues indexed investment strategies on a scale of 0 to 1, with 1 being the highest indexing level. To achieve this, I computed the similarity coefficient between investor  $i$ 's portfolio,  $\tilde{\beta}_i$ , and the market portfolio,  $\bar{\beta}$ . For the firm-level variable's calculation,  $L_{2,f,t}^{FIRMS}$ , the  $L_2$  measure was weighted by the  $\beta_{fi}$  (the ownership share of investor  $i$  in firm  $f$ ). Panel A of Table A1 (see the Appendix) presents the summary statistics of the variables in the analysis while Panel B reports the correlation matrix.

#### 4.4 Data

The research question has been addressed using the sample of Italian companies included in the FTSE MIB Index from 30 June 2009 to 31 December 2020. The selected timeframe begins with the merger between Borsa Italiana and the London Stock Exchange (LSE) and with the formation of the FTSE MIB Index itself (called S&P Mib before June 2009). According to Thakor (2015), the second quarter of 2009 also coincides with the end of the Eurozone's recession. The FTSE MIB represents the benchmark stock market index for Borsa Italiana and, with a few exceptions<sup>5</sup>, consists of the 40 Italian companies with the highest capitalization, free float, and liquidity. The companies included in the index account for more than 80% of total market capitalization and nearly 90% of exchange value. I chose to focus on the FTSE MIB INDEX because it is intended to reflect the broader Italian economy, it is made up of widely owned companies, and many investment funds offer products that are linked to the constituent companies in some way. The database includes data on all FTSE MIB constituents

<sup>4</sup> I ignored all non-FTSE MIB securities from the calculation of portfolio weights.

<sup>5</sup> From October 2013 to December 2013 and from January 2016 to March 2016 the index included 41 firms.

excluding delisted firms and shares revoked following an OPA or acquisition when the acquirer is not included in the index.

As mentioned earlier, there is not a uniform ownership disclosure system for institutional investors in the EU that applies to all EU Member States. As a result, the Refinitiv Eikon database was my primary source for quarterly investors' holdings. Refinitiv Eikon gathers these data from companies, Consob, Borsa Italiana, and financial media.

I restricted the ownership data to institutional investors' holdings, including investment managers and brokerage firms<sup>6</sup>. In this way, the retail share of a company is represented by the complement to 1 of the institutional investors' holdings.

The Refinitiv Eikon database has also been used to obtain financial statements and firm-specific information, such as firms' market capitalization.

## 4.5 Results

The regression results are presented in Table 1. According to the formula introduced by Backus et al. (2021), when the retail share of a company increases, and therefore investors' concentration reduces, the weight that a firm places on its competitors' profits increases. The intuition is that, under the proportional control assumption, retail investors have a marginal influence on corporate strategic decisions, which implies that as the retail share increases, investors' concentration (*IHHI*) decreases and the firm's control relies on a small number of institutional investors with a greater influence. The positive coefficient of the variable *Retail Share* across all specifications confirms this association.

I also find a significant positive correlation between the  $\log(\text{MarketCap})$  of firm  $f$  and the dependent variable. This is due to the inclusion of the Italian companies with the higher market capitalization in the FTSE MIB Index and testify the related increase in common institutional ownership.

Across all specifications, I observe a robust positive correlation between quarterly *Gross Profit Margin* of firm  $f$  and  $\kappa$ . Institutional investors do not randomly invest and

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<sup>6</sup> Investment managers include banks and trustees, endowment funds, finance companies, foundations, government agencies, hedge funds, investment advisors, insurance companies, pension funds, private equity, venture capital, sovereign wealth funds, investment management companies, miscellaneous investment managers. Brokerage firms include research firms and independent research firms.

**Table 1: Correlations with  $\kappa_{fg}$** 

Dependent variable	$\kappa_{fg}$			
	(1)	(2)	(3)	(4)
<i>Retail Share</i>	1.518*** (0.106)	1.345*** (0.0805)	1.484*** (0.102)	1.370*** (0.0883)
<i>log(MarketCap)</i>	0.123*** (0.0225)	0.105*** (0.0263)	0.0906*** (0.0230)	0.125*** (0.0313)
<i>Gross Profit Margin</i>	0.0807*** (0.0228)	0.0735*** (0.0205)	0.0543*** (0.0166)	0.0983*** (0.0199)
<i>Indexing (<math>L_{2,f,t}^{FIRMS}</math>)</i>		2.441*** (0.138)	2.356*** (0.124)	2.463*** (0.143)
<i>Big Four Holdings</i>	0.469*** (0.107)		-0.257*** (0.0789)	
$\beta_{fi}BlackRock$				-0.693*** (0.106)
$\beta_{fi}Fidelity$				0.0942 (0.216)
$\beta_{fi}Vanguard$				-0.913 (1.253)
$\beta_{fi}State Street$				-1.057* (0.620)
<i>Constant</i>	-1.313*** (0.144)	-2.252*** (0.186)	-2.258*** (0.187)	-2.343*** (0.209)
Observations	31,730	31,730	31,730	31,730
R-squared	0.123	0.329	0.335	0.336
Number of Firm Pairs	1,667	1,667	1,667	1,667
Firm-Pair FE	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES
S.E. Robust	YES	YES	YES	YES

This table reports the regression results of a fixed effects model with panel data predicting common ownership. Common ownership is proxied by  $\kappa_{fg}$ , which is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. *Retail share* is the retail share of a company at time  $t$ . *log(MarketCap)* is the logarithm of firm's market capitalization at time  $t$ . The *Gross Profit Margin* of firm  $f$  at time  $t$  is calculated as the difference between revenue and COGS divided by revenue. *Big Four Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, Fidelity, and State Street in a firm  $f$  at time  $t$ .  $\beta_{fi}BlackRock$  (*Fidelity*, *Vanguard*, *State Street*) are the individual holdings of the "Big Four" in firm  $f$  at time  $t$ . *Indexing* ( $L_{2,f,t}^{FIRMS}$ ) is the firm-level similarity measure calculated weighting the similarity coefficient between each investor's portfolio and the market portfolio by the ownership share of each investor in firm  $f$ . All regressions include firm-pair fixed effects and quarter fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

there are elements to suppose that correlations between common ownership and a firm’s margins do not necessarily have a causal interpretation because “reverse causality” may play a role. Specifically, institutional investors may be attracted by firms with higher price-cost margins, which leads to greater overlapping ownership; alternatively, common ownership may allow firms to obtain higher margins. Since causality may work in both directions, the coefficient of the variable *Gross Profit Margin* is causally uninterpretable.

In Column (1), I include the variable *Big Four Holdings* which is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, Fidelity, and State Street in a firm  $f$  at time  $t$  and I find a positive correlation at 1% significance level. I obtain a strong relationship between profit weights and the firm-level similarity measure. Column (2) shows that for every percentage point that each firm's investors’ portfolios become more indexed, we can expect a 2.4% average increase in the relative weights that firm  $f$  places on all other firms  $g$ ’s profits.

In Column (3) it can be noticed that when I include the firm-level indexing variable, the coefficient of *Big Four Holdings* becomes negative.

In Column (4), it is observed that the coefficients of the “Big Four” individual holdings are negative when statistically significant. This suggests that, even though the “Big Four” have dominated the public debate on common ownership, the increase in their holdings may not be the driving factor behind its variation.

Additional regression specifications will be provided in the following Section.

#### 4.6 Additional specifications

In this Section, I present some robustness checks for the regressions in Table 1.

All the specifications in Table 2 include firm-pair fixed effects,  $\lambda_{fg}$ , and either quarter fixed effects,  $v_t$ , or a time trend. Standard errors are clustered at firm-pair level. Among the explanatory variable I include  $\log(\text{Market Cap})$  and  $\frac{1}{1-\text{Retail share}}$ .

Backus et al. (2021) show that as the retail share increases, the influence of institutional investors grows in proportion to the inverse of the institutional share. Thus, we expect that

$$\kappa_{fg} \text{ is proportional to } \frac{1}{1-\text{Retail share}_f} \left( \kappa_{fg} \propto \frac{1}{1-\text{Retail share}_f} \right).$$

Columns (1) and (3) include the market-level  $L_2$  measure generated by taking a weighted average of the  $L_2$  measure using investors’ Assets under Management.

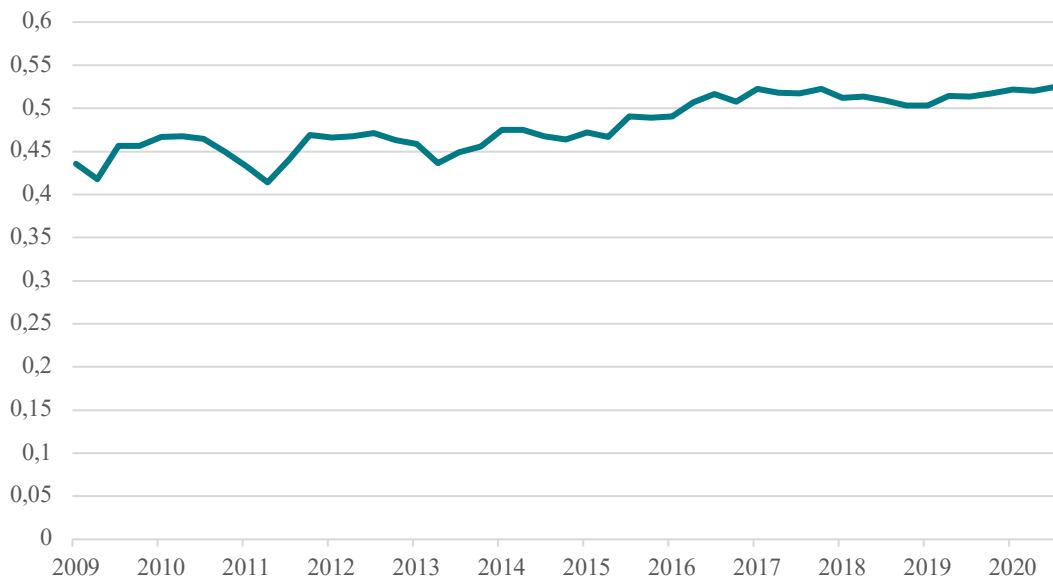
Figure 6 depicts the weighted average of the similarity coefficients, with the weights represented by investors' Assets under Management ( $L_{2,t}^{AUM}$ )<sup>7</sup>. The graph shows how the similarity coefficient increases over time, indicating that the investors' portfolios become increasingly similar to the market portfolio. This finding is early evidence that the increasing indexing level of investors' portfolios could be one of the primary drivers of changes in common ownership profit weights over time.

In Column (3) the firm-level similarity measure  $L_{2,f,t}^{FIRMS}$  is introduced in polynomial form by adding the squared value of the variable among the regressors.

Results, reported in Table 2, show that profit weights are positively correlated with time trend, consistently with Figure 5. As before, I also observe a strong positive correlation between  $\kappa_{fg}$  and both *Retail share* and  $\log(\text{Market Cap})$ .

Column (1), as well as Column (3), shows a strong relationship between profits weights and the market-level similarity measure, such that for every percentage point that each firm's investors' portfolios become more indexed, we can expect a 0.4% average increase in the relative weights that firm  $f$  places on all other firms  $g$ 's profits. The negative coefficient on the squared  $L_{2,f,t}^{FIRMS}$  similarity measure reveals that the relationship between the indexing level of institutional investors and  $\kappa_{fg,t}$  is increasing but a decreasing rate.

**Figure 6 : Investor similarity  $L_2$  (AuM weighted)**



This figure depicts the  $L_2$  measure at market-level. I compute the  $L_2$  similarity measure between each investor's portfolio and the market portfolio for each quarter from 2009 to 2020 and then I take an Asset under Management (AuM) weighted average.

<sup>7</sup> Restricted to the set of FTSE MIB constituents.

**Table 2: Correlations with  $\kappa_{fg}$ - Robustness checks**

Dependent variable	$\kappa_{fg}$			
	(1)	(2)	(3)	(4)
<i>Quarter</i>	6.06e-05*** (4.11e-06)	1.36e-05*** (3.57e-06)		
<u>1</u>	0.0739***	0.0597***	0.0754***	0.0599***
<i>1 – Retail share</i>				
	(0.00395)	(0.00350)	(0.00396)	(0.00348)
<i>log(MarketCap)</i>	0.138*** (0.0173)	0.0398** (0.0169)	0.111*** (0.0198)	0.0231 (0.0188)
<i>Aggregate Indexing (<math>L_{2,t}^{AUM}</math>)</i>	0.415*** (0.0538)		2.753*** (0.167)	
<i>Indexing (<math>L_{2,f,t}^{FIRMS}</math>)</i>		3.327*** (0.374)		3.364*** (0.375)
<i>Indexing<sup>2</sup> (<math>L_{2,f,t}^{2FIRMS}</math>)</i>		-1.530*** (0.340)		-1.529*** (0.338)
<i>Constant</i>	-1.995*** (0.117)	-1.640*** (0.128)	-1.825*** (0.114)	-1.337*** (0.123)
Observations	45,619	45,619	45,619	45,619
R-squared	0.358	0.440	0.367	0.444
Number of Firms Pairs	2,052	2,052	2,052	2,052
Firm-Pair FE	YES	YES	YES	YES
Quarter FE	NO	NO	YES	YES
S.E. Robust	YES	YES	YES	YES

This table reports the regression results of a fixed effects model with panel data predicting common ownership. *Quarter* is a time variable for each quarter from 30/06/2009 to 31/12/2020. Common ownership is proxied by  $\kappa_{fg}$ , which is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. *Retail share* is the retail share of a company at time  $t$ . *log(MarketCap)* is the logarithm of firm's market capitalization at time  $t$ . *Indexing* ( $L_{2,f,t}^{FIRMS}$ ) is the firm-level similarity measure calculated weighting the similarity coefficient between each investor's portfolio and the market portfolio by the ownership share of each investor in firm  $f$ . *Aggregate indexing* ( $L_{2,t}^{AUM}$ ) is the market-level similarity measure calculated weighting the similarity coefficient between each investor's portfolio and the market portfolio by investors' Assets under Management at time  $t$ . All regressions include firm-pair fixed effects. Quarter fixed effects are included when indicated. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

## 5. Conclusion

This paper contributes to the common ownership literature by analyzing the empirical variation in common ownership across FTSE MIB's constituents and its potential drivers.

Institutional investors' holdings in the top Italian firms have grown dramatically in the last decade and even if institutional holdings still don't dominate Italian companies, with an average of 44% holdings in FTSE MIB's firms, the common ownership level between firm pairs through the major institutional investors is growing over time.

In the regression framework, I focus on a fundamental component of the common ownership problem, the profit weights ( $\kappa_{fg}$ ), and I specifically investigate the sources that are responsible for driving their pattern.

First, using ownership data of the FTSE MIB's constituents from Q2 2009 to Q4 2020 I demonstrate that there is no clear trend in the evolution of profit weights until mid-2016 when a minor upward trend begins, leading the average  $\kappa_{fg}$  from 0.26 to 0.36 in 2020.

Second, I find a strong positive link between the indexing level of institutional investors and  $\kappa_{fg}$ . This could suggest that the growing similarity of investors' portfolios, linked to the rise of index investing, is the primary driver of the profit weights' fluctuations over time.

Third, I demonstrate that the relationship between  $\kappa_{fg}$  and the ownership shares of the "Big Four" institutional investors is ambiguous leading to the conclusion that the rise in their holdings may not be driving the trend of  $\kappa_{fg}$ .

Fourth, I find a strong positive relationship between  $\kappa_{fg}$  and the retail share: when the retail share of a firm grows, the ownership concentration decreases and the power in the hands of the institutional investors increases. The weight that a firm posits on its competitors' profits increase in proportion to the inverse of the institutional share.

Future research might look at the trend of average profit weights  $\kappa_{fg}$  over time when both firms  $f$  and  $g$  operate in the same market. The average profit weights calculated in two different industries could also be compared. Afterward, it can be assessed whether the qualitative and quantitative patterns are similar to those observed in the FTSE MIB Index.

Broadly speaking, the scarce existing literature shows that the extent of common ownership seems to be less in Europe as compared to the United States. However, further research analyzing ownership patterns in other European countries outside Italy as well as in other jurisdictions beyond the U.S. would be valuable and should be conducted.

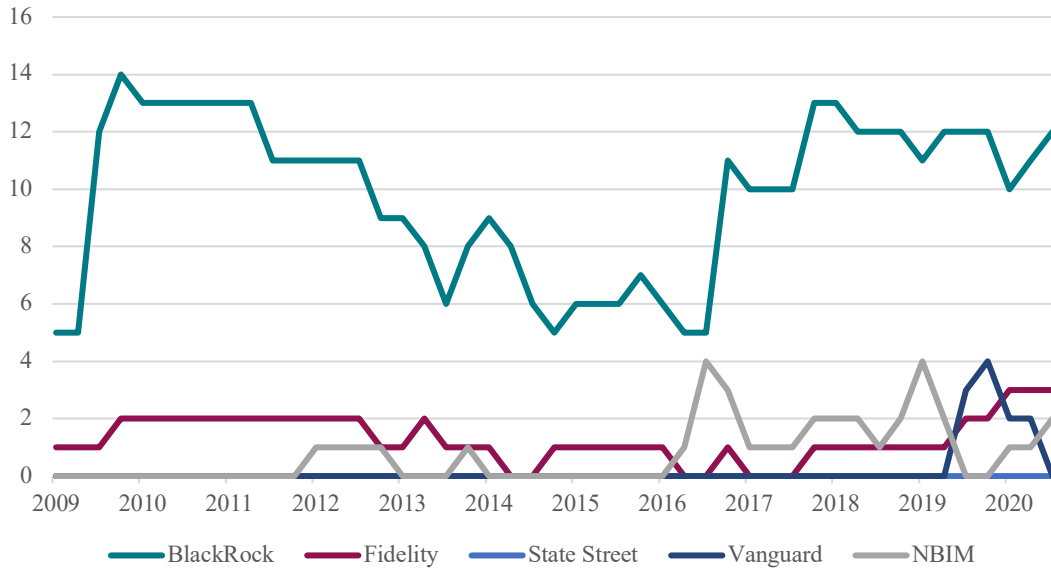
Indeed, antitrust authorities worldwide have begun to examine the competitive consequences of common ownership links. To minimize their antitrust liability in concentrated markets, large investors can limit their holdings in competing firms to a small percentage of the outstanding stocks (for instance, 1%), or focus their holdings in only one firm per industry (Elhauge, 2016; Posner, 2021). Posner et al. (2017) demonstrate quantitatively that such selective investments have minimal impact on diversification benefits while increasing economic efficiency in more competitive product markets. These policy responses do not necessarily mean that index funds, which we have seen to be among the main potential drivers of common ownership, are already illegal under antitrust law. Only a fraction of institutional investors is indexed, and index funds may not have enough shares to create anticompetitive common ownership on their own in concentrated markets.

Nonetheless, index funds have grown rapidly, becoming increasingly active in influencing corporate governance decisions by managing their shares. To avoid anticompetitive issues, they must either stop growing and relinquish any voting influence or change their investment strategy and become indexed across industries rather than within the same industry.

Policymakers facing those who claim legal intervention should examine the recent developments in the literature on the anticompetitive effects of common ownership which could justify investigation, information-gathering, and readiness to intervene, if not a policy response.

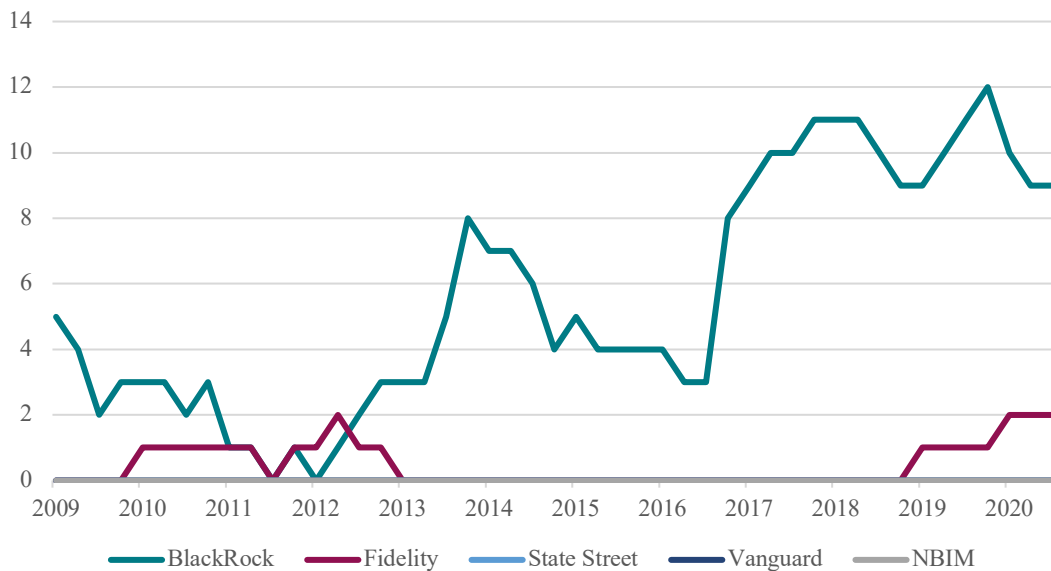
## Appendix

**Figure A1: Number of blockholdings >3% held by selected institutional investors**



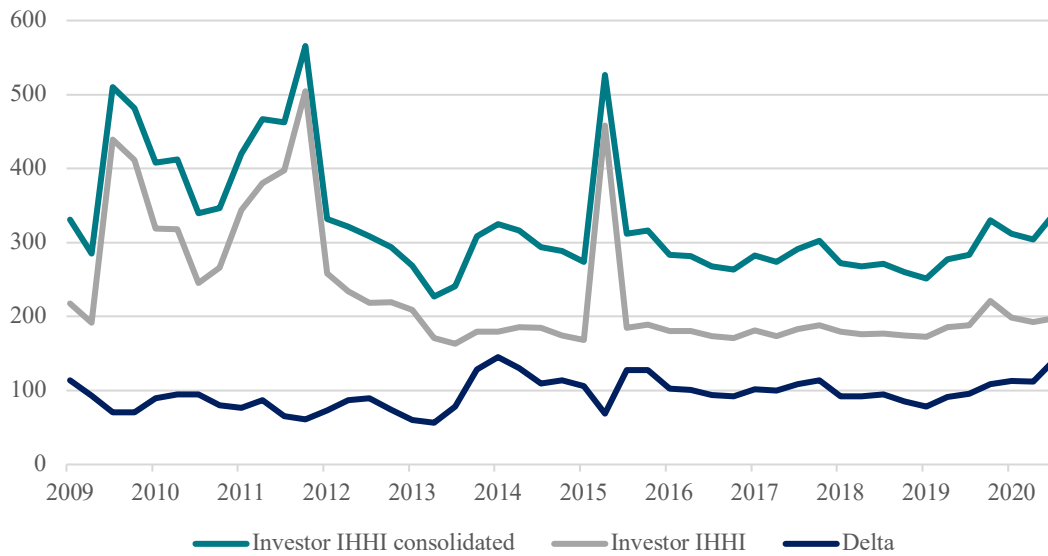
This figure reports the number of firms in the FTSE MIB Index in which each institutional investor holds an ownership share greater or equal to 3% for each quarter from 2009 to 2020.

**Figure A2: Number of blockholdings >5% held by selected institutional investors**



This figure reports the number of firms in the FTSE MIB Index in which each institutional investor holds an ownership share greater or equal to 5% for each quarter from 2009 to 2020.

**Figure A3: Herfindahl-Hirschman Index (HHI) of institutional investors' holding**



This figure reports the Herfindahl-Hirschman Index (HHI) of institutional investors' holdings. The investors' HHI (IHHI) is calculated as the sum of squared institutional investors' shares of the total market value of the FTSE MIB held by institutional investors. The green line depicts the level of concentration considering all institutional investors as single entities. The grey line depicts the level of investor concentration following the consolidation of the regional subsidiaries of the selected institutional investors (BlackRock, Fidelity, State Street, Vanguard, NBIM) or any other possible connected entity.

**Table A1: Panel A – Summary statistics**

Variable	Mean	Standard Deviation	25 <sup>th</sup> percentile	Median	75 <sup>th</sup> percentile	N
$\kappa_{fg}$	0.336	0.461	0.0733	0.0733	0.424	54,358
<i>Retail Share</i>	0.738	0.135	0.665	0.665	0.823	84,376
<i>log(MarketCap)</i>	3.835	0.462	3.502	3.502	4.199	45,619
<i>Gross Profit Margin</i>	0.534	0.235	0.355	0.355	0.689	55,014
<i>Indexing (<math>L_{2,f,t}^{FIRMS}</math>)</i>	0.479	0.0881	0.423	0.423	0.539	84,429
<i>Big Four Holdings</i>	0.0634	0.0514	0.0243	0.0243	0.0846	84,376
$\beta_{fi}$ BlackRock	0.0403	0.0393	0.0103	0.0103	0.0630	84,376
$\beta_{fi}$ Fidelity	0.00717	0.0144	0.000246	0.000246	0.00707	84,376
$\beta_{fi}$ Vanguard	0.0137	0.0136	0.00340	0.00340	0.0186	84,376
$\beta_{fi}$ State Street	0.00224	0.00371	0.000664	0.000664	0.00269	84,376
<i>Aggregate Indexing (<math>L_{2,t}^{AUM}</math>)</i>	0.478	0.0350	0.456	0.456	0.513	132,023

**Table A2: Panel B – Correlation matrix**

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
$\kappa_{fg}$	1										
<i>Retail Share</i>	0,350	1									
<i>log(MarketCap)</i>	0,125	-0,011	1								
<i>Gross Profit Margin</i>	-0,093	-0,095	0,031	1							
<i>Indexing (<math>L_{2,f,t}^{FIRMS}</math>)</i>	0,374	-0,037	0,234	0,032	1						
<i>Big Four Holdings</i>	-0,143	-0,545	0,310	0,072	0,279	1					
<i>BlackRock</i>	-0,136	-0,477	0,323	0,102	0,225	0,892	1				
<i>Fidelity</i>	-0,123	-0,287	0,020	-0,044	0,001	0,480	0,143	1			
<i>Vanguard</i>	0,009	-0,241	0,200	0,054	0,376	0,513	0,259	0,111	1		
<i>State Street</i>	-0,031	-0,353	0,123	-0,045	0,163	0,458	0,314	0,158	0,330	1	
<i>Aggregate Indexing (<math>L_{2,t}^{AUM}</math>)</i>	0,060	-0,117	0,127	0,045	0,343	0,273	0,115	0,055	0,630	0,099	1

Panel A provides summary statistics of the key variables used in the analyses. Panel B reports the Pearson correlations for these variables.  $\kappa_{fg}$  is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. *Retail share* is the retail share of a company at time  $t$ . *log(MarketCap)* is the logarithm of a firm's market capitalization at time  $t$ . The *Gross Profit Margin* of firm  $f$  at time  $t$  is calculated as the difference between revenue and COGS divided by revenue. *Big Four Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, Fidelity, and State Street in a firm  $f$  at time  $t$ .  $\beta_{fi}$  *BlackRock (Fidelity, Vanguard, State Street)* are the individual holdings of the "Big Four" in firm  $f$  at time  $t$ . *Indexing ( $L_{2,f,t}^{FIRMS}$ )* is the firm-level similarity measure calculated weighting the similarity coefficient between each investor's portfolio and the market portfolio by the ownership share of each investor in firm  $f$ . *Aggregate indexing ( $L_{2,t}^{AUM}$ )* is the market-level similarity measure calculated weighting the similarity coefficient between each investor's portfolio and the market portfolio by investors' Assets under Management at time  $t$ .

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## Chapter 3

# Anticompetitive Effects of Common Ownership in Markets with Switching Costs: Theory and Evidence

### Abstract

A growing number of studies suggest that institutional investors' common ownership has caused competition among industry rivals to decrease. This paper evaluates the effects of common ownership on firms' market power in a competitive environment with switching costs. Using a two-period duopoly, I show that an increased degree of common ownership is harmful to consumers since it relaxes the intensity of product market competition in the first period, when firms are supposed to compete for a market share that is valuable later when their customers are locked-in by switching costs. The welfare analysis reveals that the socially optimal level of common ownership is influenced by two factors: the degree of risk aversion and the relative weight society places on consumption versus returns on savings through investment in institutional investors' funds. Finally, using panel data of FTSE MIB's constituents between 2011 and 2020, I find that the higher the switching costs faced by firms' customers, the greater the positive effect of common institutional ownership on a firm's markup. Results from additional analyses suggest that this effect is more pronounced in highly concentrated industries.

### 1. Introduction

Common ownership occurs when a common set of investors hold shares in multiple firms within an industry. As has been extensively documented, this type of ownership structure is becoming increasingly prominent as a result of the consolidation in the asset-management industry and the rise in index investing (Fichtner et al., 2017).

While common ownership may offer benefits to investors, such as diversification and risk reduction, it also raises concerns about its potential anticompetitive effects. Under common ownership, firms may have less incentive to compete aggressively with each other, as their common owners have a strong interest in maximizing their collective profits rather than the

individual profits of each firm. As a result, common ownership may lead to higher prices, encouraging cooperation between firms.

Moreover, the anticompetitive effects of common ownership may be particularly pronounced in industries that are already highly concentrated, as a few institutional investors may hold significant stakes in multiple firms and exert substantial influence over market outcomes (Schmalz, 2018).

Recent studies have highlighted the potential anticompetitive effects of common ownership in specific industries. Azar et al. (2018) find that common ownership of airlines by institutional investors led to higher ticket prices and reduced capacity. However, Kennedy et al. (2017) and Dennis et al. (2022) find no evidence that common ownership raises ticket prices after accounting for the endogeneity of market shares in the measure of market concentration.<sup>1</sup> Studying the U.S. banking sector, Azar et al. (2016) find that the combination of common ownership and cross-ownership leads to higher prices on retail deposit products and lower deposit interest rates. While Azar et al. (2016, 2018) both look at a single highly regulated industry with high barriers to entry, low variability and discrimination in prices, and high regulatory oversight, Koch et al. (2021) conduct a study across a broad sample of industries and find that greater common institutional ownership is neither related to significantly higher industry profitability and product market prices nor negatively associated with measures of non-price competition. Rosati et al. (2020) is the first work to conduct an empirical analysis on the EU beverage sector finding a positive effect of common ownership on firms' profitability.

The recent findings drew a lot of attention and started a strong debate regarding benefits and costs related to common ownership, as well as potential policy implications and antitrust remedies (Elhauge, 2016, 2017, 2020; Posner et al., 2017; Scott Morton & Hovenkamp, 2018; Posner, 2021).

This paper is related to the above cited literature and investigates the effect of common ownership on market power and welfare in a competitive environment in which firms' customers face switching costs.

Switching costs refer to the monetary and psychological costs that consumers incur when they switch from one supplier to another, such as the costs of finding a new supplier, learning how to use new products or services, and possibly paying penalties or termination fees, such as in the case of changing bank or mobile service provider (Farrell & Klemperer, 2007).

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<sup>1</sup> See Azar et al. (2018b) for the reply.

Two-period duopoly models of competition in markets with switching costs, such as those in Klemperer (1987, 1995), predict that customers in the second period are “locked-in” by switching costs that they face due to their first-period purchases. In the first period, thus firms are incentivized to vigorously compete and set prices that are lower than subsequently in order to attract new customers and acquire a market share that will be valuable later, thanks to repeated purchases. When switching costs are high, consumers are less likely to switch to another firm, thus in the second period firms gain market power and charge higher prices to harvest profits by exploiting their current base of customers.

In such a model, because of the anticompetitive incentive of common owners, I hypothesize that the presence of common ownership between firms partially offsets the competition in the first period, leading to the determination of first-period equilibrium prices higher than those determined absence of common ownership.

I address this research question by developing a theoretical model which applies the two-period duopoly setting of competitive environment with switching costs defined by Klemperer (1987, 1995) to the framework with common ownership developed by Shy and Stenbacka (2020). This approach is part of the category of models which examines the effects of common ownership on market outcomes using an industrial economics approach<sup>2</sup>.

The first theoretical result confirms my prediction, showing that greater common ownership between firms harms consumers because it reduces the intensity of product market competition in the first period, leading to an equilibrium price that is higher than the one obtained by Klemperer (1987, 1995) in the original setting without common ownership.

To evaluate the welfare implications of the model, I perform a welfare analysis using a configuration with two groups of agents: consumers and savers, who invest their money in institutional investors’ funds which in turn use this money to acquire ownership share in the firms in the duopoly. The welfare analysis reveals that the socially optimal level of common ownership is influenced by two factors: the degree of risk aversion and the relative weight society places on consumption versus returns on savings through investments in institutional investors’ funds. In case of risk neutrality, I find that the socially optimal level of common ownership is determined by the relative weight given to final good consumption. In other words, if the weight given to consumers’ utility is strictly greater than the weight given to savers’ utility then a reduction in the level of common ownership increases the expected social

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<sup>2</sup> This category of models also includes O'Brien and Salop (2000), López and Vives (2019), and Shy and Stenbacka (2019), and it is extensively surveyed in Vives (2020) as well as Schmalz (2018).

welfare. Vice versa if the weight given to investors' utility is strictly greater than the weight given to consumers' utility.

On the other hand, for the class of utility functions with constant relative risk aversion (CRRA), I show analytically that increasing the degree of risk aversion increases the socially optimal degree of common ownership. The idea is that if there is a higher level of common ownership, institutional investors will offer more diversified investment portfolios to their savers, and the value that savers place on diversification will increase with the degree of risk aversion.

Next, I present two extensions of the baseline model. The first extension releases the hypothesis that the dominant investor in each firm owns more than 50% of the stocks and allows institutional investors with small ownership shares to join the firm. Even so, I demonstrate that lower market competition favors the interests of horizontal shareholders. The second extension shows that the anticompetitive effects of common ownership do not harm the interest of undiversified shareholders.

The theoretical model and its extensions are based on a two-period duopoly model with switching costs in which, as anticipated before, firms exercise market power over their base of locked-in customers in the second period while in the first period, they set lower prices than if there were no switching costs to acquire a market share valuable in the future.

Such a model, however, does not give any information on what happens to competition over many periods when old locked-in customers are mixed with new customers and firms cannot price discriminate between the two groups. Beggs and Klemperer (1992) extend the conclusions of Klemperer (1987, 1995) to an infinite model of competition with switching costs, where a proportion of new consumers enter, and a fraction of old customers exit the market at each period. Firms thus must balance the temptation to exploit the old consumer base by applying higher prices, with the desire to attract new consumers and apply lower prices. The authors show that the temptation to harvest profits by exploiting the old customers outweighs the desire to attract the new ones and conclude that prices are higher in the presence of switching costs than in their absence. This conclusion is supported by more recent empirical literature on the influence of switching costs on market power (Ioannidou & Ongena, 2010; Barone et al., 2011; Egarius & Weill, 2016; He & Siebert, 2021).

In the second part of the paper, I rely on the theoretical literature on multi-period competition in a market with switching costs as well as on the empirical literature on the influence of switching costs on firms' market power, to test the hypothesis that the positive correlation between common ownership and market power is stronger when customers face switching

costs. This represents an empirical test of the first result obtained in my two-period theoretical model adapted to real-world multi-period competition.

To address this research question, I use data from the sample of Italian firms included in the FTSE MIB Index for the period 2011-2020 and I employ the approach proposed by Shy (2002) for the estimation of the switching costs.

In the baseline model, I use firms' markup as a proxy of market prices and I measure common ownership through the so-called "profit weights", introduced by Azar (2012) and adopted by Azar and Vives (2021), Backus et al. (2021), Rosati et al. (2020), Boller and Scott Morton (2020).

The regression results confirm the prediction that the higher the switching costs, the greater the effect of common ownership on markup. I also find that the effect of common ownership on market power is larger in firms operating in highly concentrated industries than in firms operating in industries with low concentration. The results are robust to alternative measures of the dependent variable and hold when other common ownership proxies are used.

The contributions of this paper are twofold. First, it contributes to the theoretical literature on the effects of common ownership on market outcomes that use an industrial economic approach, by providing a welfare analysis in a new competitive environment with switching costs, where the portfolio-diversification benefits associated with an increase in common ownership are weighed against its the anticompetitive effects that harm consumers utility.

Second, this paper contributes to the growing debate on the anticompetitive effects of common ownership as well as to the empirical literature on the effects of switching costs on market power, providing evidence that the positive relationship between common ownership and market power is more pronounced when firms' consumers face switching costs.

The remainder of this paper is as follows. Section 2 develops the theoretical model. Section 3 presents the research design, empirical proxies, and sample selection. The empirical results are outlined in Section 4. Robustness checks are presented in Section 5. Section 6 concludes.

## **2. The model**

This theoretical model examines a two-period duopoly with differentiated products in which consumers are partially "locked-in" by switching costs they incur in the second period (Klemperer, 1987, 1995).

Because firms compete for market share that is valued later, prices are lower in the first period than they are later. However, prices in both periods may be higher than they would be in a market with no switching costs

The market consists of two firms  $A$  and  $B$  and  $N$  consumers. Throughout I will denote firm  $F$ 's period- $t$  price by  $p_t^F$ , quantity by  $q_t^F$ , profit by  $\pi_t^F$ , total profit by  $\pi^F$ , market share by  $\sigma_t^F = q_t^F / \sum_J q_t^J$  and per period discount factor by  $\delta$ .

## 2.1 Competition for market share

The model consists of two periods: in the first period consumers are not tied to any firm, while in the second period, they develop switching costs due to their purchases in the first period. In the second period thus, firms gain some market power. The firm's products are close substitutes but not identical, which means that a client will buy from one supplier at any time. For any given market share gained in the first period, the usual strategy for solving a two-period model is to first solve for firms' best second-period behavior and thus for firms' second-period profits. To put it another way, I solve for the functions  $\pi_2^F(\sigma^F)$  that define  $F$ 's second-period profits as a function of its first-period market share,  $\sigma_1^F = \sigma^F$ .

### 2.1.1 Competition in the second period

In the second period, I assume that each of  $N$  consumers has a reservation price  $R$  for one unit of a good produced by the two firms  $A$  and  $B$  at the same and constant marginal cost  $c$ .

The fraction of consumers which has previously purchased (in period 1) firm  $A$ 's products,  $\sigma^A$ , must pay a switching cost,  $s$ , to purchase products from  $B$ , whereas a fraction  $\sigma^B = 1 - \sigma^A$  must pay  $s$  to purchase from  $A$ . Suppose that  $s \geq R - c > 0$ . This is a "mature market" in which consumers' switching costs have already been determined in period 1. I also assume that there is no product differentiation in period 2. The Nash equilibrium, in either price or quantity competition, yields firms' joint-profit-maximization outcome if  $s$  is large enough. The underlying economic intuition is that firm  $A$  would be able to attract  $B$ 's clients only if it lowers its price by least  $s$  below  $B$ 's price.

If  $A$  charged the same price to all of its customer base, such a substantial price drop would result in a reduction of  $A$ 's profits from its own captive customers greater than the increase in

profits obtained from the consumers attracted from  $B$ . For this reason,  $A$  would be better off acting as a monopolist against its own customer base.

In the second period thus both firms set prices,  $p_2^A$  and  $p_2^B$ , simultaneously and non-cooperatively like a monopolist would set

$$p_2^A = p_2^B = R$$

and earn profits

$$\pi_2^A = \sigma^A N(R - c) \text{ and } \pi_2^B = \sigma^B N(R - c) \quad (1)$$

### 2.1.2 Competition in the first period

In the first period, each firm sets its price while considering not just the impact on its first-period profitability, but also the impact on its first-period market share and, as a result, its second-period profitability. Firm  $A$  determines its price  $p_1^A$  in order to maximize its entire future discounted profits, while considering firm  $B$ 's first-period price  $p_1^B$  as given

$$\pi^A(p_1^A, p_1^B) = \pi_1^A(p_1^A, p_1^B) + \delta \pi_2^A(\sigma^A(p_1^A, p_1^B)) \quad (2)$$

Firm  $A$  seeks to maximize  $\pi^A(p_1^A, p_1^B)$  respect to its first-period price, this means that the equilibrium condition is obtained by setting the first derivative of  $\pi^A(p_1^A, p_1^B)$  with respect to  $p_1^A$  equal to zero

$$0 = \frac{\partial \pi^A}{\partial p_1^A} + \delta \frac{\partial \pi_2^A}{\partial \sigma^A} \frac{\partial \sigma^A}{\partial p_1^A}$$

Now, it can be easily seen that firm  $A$ 's first-period market share is decreasing in its first-period price,  $\frac{\partial \sigma^A}{\partial p_1^A} < 0$ , and that firm  $A$ 's second-period profits are increasing in its first-period market share,  $\frac{\partial \pi_2^A}{\partial \sigma^A} > 0$ , then I have  $\frac{\partial \pi^A}{\partial p_1^A} > 0$ . As a result,  $p_1^A$  is below the price at which  $\frac{\partial \pi_1^A}{\partial p_1^A} = 0$ . In other words, if the firm did not take into account the effect of switching costs on its profits in the second period,  $p_1^A$  would be higher than it currently is.

Assume that  $N$  customers perceive the firms' products to be differentiated in period 1 and that the consumers are uniformly distributed along a line segment  $[0,1]$ , with firms  $A$  and  $B$  at 0 and 1, respectively (maximal differentiation).

A consumer located at  $y$  has a transportation cost of  $Ty$  when using  $A$ 's product or  $T(1 - y)$  when using  $B$ 's product. The goods cannot be stored. Firms and consumers adopt the same per period discount factor  $\delta \leq 1$ . In periods 1 and 2, firms have equal and constant marginal costs equal to  $c$ .

Given that  $p_2^A = p_2^B = R$ , a consumer's second-period utility is the same regardless of whether she buys from firm  $A$  or firm  $B$  in the first period. As a result, a consumer located at  $y$  purchases from  $A$  in period 1 if

$$U - p_1^A - Ty \geq U - p_1^B - T(1 - y)$$

From this I get

$$y \leq \frac{1}{2} + \frac{p_1^B - p_1^A}{2T}$$

and

$$\hat{y} = \frac{1}{2} + \frac{p_1^B - p_1^A}{2T} = \sigma^A \quad (3)$$

The variable  $\hat{y}$  represents the quantity demanded by each customer at firm  $A$  and symmetrically at firm  $B$ .  $A$ 's total profits over both periods are calculated using (1) and (2) as

$$\pi^A(p_1^A, p_1^B) = \sigma^A N(p_1^A - c) + \delta \sigma^A N(R - c)$$

with  $q_1^A = \sigma^A N$  and  $\sigma^A = \frac{1}{2} + \frac{p_1^B - p_1^A}{2T}$ . Substituting these expressions in (2) I obtain

$$\begin{aligned} \pi^A(p_1^A, p_1^B) &= \frac{N}{2T} [(T + p_1^B - p_1^A)(p_1^A - c) + \delta(T + p_1^B - p_1^A)(R - c)] \\ \pi^B(p_1^A, p_1^B) &= \frac{N}{2T} [(T + p_1^A - p_1^B)(p_1^B - c) + \delta(T + p_1^A - p_1^B)(R - c)] \end{aligned} \quad (4)$$

To calculate the equilibrium prices  $p_1^A$  and  $p_1^B$  I set

$$\frac{\partial \pi^A(p_1^A, p_1^B)}{\partial p_1^A} = \frac{N}{2T} [T + p_1^B - 2p_1^A + c - \delta(R - c)] = 0$$

$$\frac{\partial \pi^B(p_1^A, p_1^B)}{\partial p_1^B} = \frac{N}{2T} [T + p_1^A - 2p_1^B + c - \delta(R - c)] = 0$$

From this I get

$$p_1^A = p_1^B = T + c - \delta(R - c) \quad (5)$$

and  $p_1^A < p_2^A$ .

Substituting (5) into (3) I obtain  $\sigma^A = \sigma^B = \frac{1}{2}$  and  $q_1^A = q_1^B = \frac{N}{2}$

Following Klemperer, the consumers' first-period surplus from buying from firm  $A$  and  $B$  in the first period is

$$CS_1 = \underbrace{\frac{N}{2} [R - p_1^A - Ty]}_{CS_1^A} + \underbrace{\frac{N}{2} [R - p_1^B - T(1 - y)]}_{CS_1^B}$$

$$CS_1 = N \left( R - p_1^A - \frac{T}{2} \right)$$

The formula above considers only the consumers' surplus in the first period. Since in the second period  $p_2^A = p_2^B = R$ , the second-period consumers' surplus from buying from  $A$  or  $B$  is negative and equal to the transportation cost.

The overall consumers surplus will be equal to

$$CS = CS^A + CS^B$$

$$CS = CS_1^A + \delta CS_2^A + CS_1^B + \delta CS_2^B$$

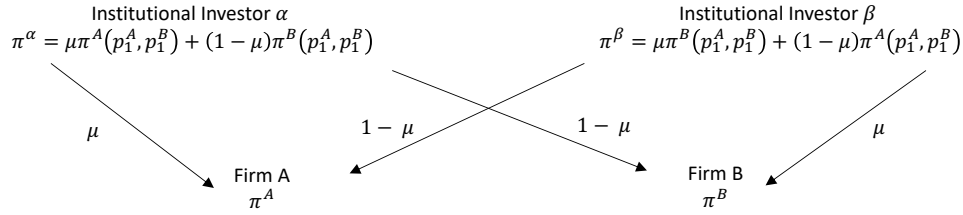
$$CS = \frac{N}{2} \{ [R - p_1^A - Ty] + \delta [R - p_2^A - Ty] \} + \frac{N}{2} \{ [R - p_1^B - T(1 - y)] + \delta [R - p_2^B - T(1 - y)] \}$$

$$CS = N(R - p_1^A) - \frac{NT}{2} (1 + \delta)$$

## 2.2 Common ownership, risks, and sequence of events

Firms  $A$  and  $B$  are common owned by two institutional investors,  $\alpha$  and  $\beta$ . Investor  $\alpha$  owns a weak majority share in firm  $A$  equal to  $\mu$  (with  $\mu \in [\frac{1}{2}, 1]$ ) in firm  $A$  and investor  $\beta$  owns the same ownership share in firm  $B$ .

Institutional investors' profits are calculated as



The possibility that firms may fail is considered within the model by defining three probabilities:  $\phi^{II}$  denotes the probability that both firms fail,  $\phi^I$  is the probability that only one firm fails while  $\phi^0$  represents the probability that neither firm fails.

Since  $\phi^I$  denotes two possible events (the probability that firm  $A$  survives while firm  $B$  fails and vice versa), then

$$\phi^{II} + 2\phi^I + \phi^0 = 1 \quad (6)$$

I suppose that the firm's majority shareholder, respectively investor  $\alpha$  for firm  $A$  and investor  $\beta$  for firm  $B$ , can determine the firm's price level by exerting either indirect or direct influence on the company through the corporate governance mechanisms defined by Azar et al. (2018). This means that investor  $\alpha$  has control over firm  $A$ 's price definition process while accounting for its minority share in firm  $B$ . The same is true if we consider the power of the institutional investor  $\beta$  over firm  $B$ . The following is the sequence of events:

- First Stage: based on the probabilities indicated above, the fate of each producing firm is determined.
- Second stage: if neither firm  $A$  or  $B$  fail, investor  $\alpha$  determines firm  $A$ 's price and investor  $\beta$  determines firm  $B$ 's price.

## 2.3 Equilibrium in the product market

According to the sequence of events defined above, in the first stage four possible events could occur. With probability  $\phi^{II}$  both firms fail and leave the market. This is the simplest case in which firms' and institutional investors' profits as well as consumers' surplus are all equal to zero

$$\begin{aligned}\pi^{AII} = \pi^{BII} = \pi^{\alpha II} = \pi^{\beta II} &= 0 \\ CS^{II} &= 0\end{aligned}\quad (7)$$

With probability  $\phi^I$  firm  $A$  survives and firm  $B$  leaves the market and vice versa. Assuming that no company enters the market during the second stage, the remaining firm will establish

$$p_1^{ii} = p_2^{ii} = R \text{ with } i = A, B \text{ and } R = \text{reservation price of the consumers.}$$

If firm  $B$  fails then  $\sigma^{BIf} = 0$  and  $\sigma^{AI} = 1$ , thus  $q^A = N$ . In this situation,  $CS^I = 0$  since the price set by the firm is equal to the reservation price of the consumers.

In this situation

$$\begin{aligned}\pi^{AI} &= q^A(p_1^{AI} - c) \\ \pi^{AI} &= N(R - c) \\ \pi^{BIf} &= 0\end{aligned}$$

$$\pi^{\alpha I} = \mu\pi^{AI}(p_1^{AI}, p_1^{BI}) + (1 - \mu)\pi^{BI}(p_1^{AI}, p_1^{BI})$$

$$\begin{aligned}\pi^{\alpha I} &= \mu\pi^{AI}(p_1^{AI}, p_1^{BI}) = \mu N(R - c) \\ \pi^{\beta I} &= (1 - \mu)\pi^{AI}(p_1^{AI}, p_1^{BI}) = (1 - \mu)N(R - c)\end{aligned}\quad (8.1)$$

Vice versa, if firm  $A$  fails

$$\begin{aligned}\pi^{BI} &= q^{BI}(p_1^{BI} - c) \\ \pi^{BI} &= N(R - c) \\ \pi^{AIf} &= 0\end{aligned}$$

$$\pi^{\beta I} = \mu\pi^{AI}(p_1^{AI}, p_1^{BI}) + (1 - \mu)\pi^{BI}(p_1^{AI}, p_1^{BI})$$

$$\pi^{\beta I} = \mu\pi^{AI}(p_1^{AI}, p_1^{BI}) = \mu N(R - c)\quad (8.2)$$

$$\pi^{\alpha I} = (1 - \mu)\pi^{AI}(p_1^{AI}, p_1^{BI}) = (1 - \mu)N(R - c)$$

Finally, neither firm fails with probability  $\phi^0$  resulting in a market characterized by two competing firms. The maximization problem for the two investors become

$$\begin{cases} \frac{\partial \pi^{\alpha}}{\partial p_1^A} = \mu \frac{\partial \pi^A}{\partial p_1^A} + (1 - \mu) \frac{\partial \pi^B}{\partial p_1^A} = 0 \\ \frac{\partial \pi^{\beta}}{\partial p_1^B} = \mu \frac{\partial \pi^B}{\partial p_1^B} + (1 - \mu) \frac{\partial \pi^A}{\partial p_1^B} = 0 \end{cases}$$

$$\frac{\partial \pi^A}{\partial p_1^A} = \frac{N}{2T} [T + p_1^B - 2p_1^A + c - \delta(R - c)]$$

$$\frac{\partial \pi^A}{\partial p_1^B} = \frac{N}{2T} [p_1^A - c]$$

$$\frac{\partial \pi^B}{\partial p_1^A} = \frac{N}{2T} [p_1^B - c]$$

$$\frac{\partial \pi^B}{\partial p_1^B} = \frac{N}{2T} [T + p_1^A - 2p_1^B + c - \delta(R - c)]$$

Solving the system, I get the equilibrium prices

$$p_1^{A0} = p_1^{B0} = \frac{\mu T}{2\mu - 1} + c - \delta(R - c)$$

If  $\mu = 1$ , when there is no common ownership, I get the same prices obtained by Klemperer (1987,1995) in Eq. (5).

If  $\mu \in (\frac{1}{2}; 1)$ ,  $p_1^{A0}$  is always strictly higher than Klemperer's equilibrium price ( $p_1^{A0} > p_1^A$ ) and increases as the parameter  $\mu$  decreases (as shown by the negative sign of the first-order derivative).

This means that an increasing level of common ownership ( $\mu$  decreases) always raises prices above the equilibrium level found by Klemperer's baseline model without common ownership. As a result, as the level of common ownership increases, the incentive to compete decreases.

I also proved that  $p_1^{A0}$  is lower than the price at which  $\frac{\partial \pi_1^A}{\partial p_1^A} = 0$ . That is, in the presence of switching costs, the equilibrium price is lower than what the firm would have set if it had ignored the impact of switching costs on its profits in the subsequent period:

$$p_1^{imax} = \frac{\mu T}{2\mu - 1} + c > \frac{\mu T}{2\mu - 1} + c - \delta(R - c)$$

Now if  $p_1^{A0} = p_1^{B0}$  then for (3)  $\sigma^{A0} = \sigma^{B0} = \frac{1}{2}$  and  $q_1^{A0} = q_1^{B0} = \frac{N}{2}$

Substituting I obtain these expressions

$$\begin{aligned} \pi^{\alpha 0} = \pi^{\beta 0} = \pi^{A0} = \pi^{B0} &= \frac{N}{2} \frac{\mu T}{(2\mu - 1)} \\ CS^0 &= N(R - p_1^A) - \frac{NT}{2}(1 + \delta) \end{aligned} \quad (9)$$

### Result 1

$$\frac{\partial p_1^{A0}}{\partial \mu} = \frac{\partial p_1^{B0}}{\partial \mu} = -\frac{T}{(2\mu - 1)^2} < 0$$

$$\frac{\partial \pi^{\alpha 0}}{\partial \mu} = \frac{\partial \pi^{\beta 0}}{\partial \mu} = \frac{\partial \pi^{A0}}{\partial \mu} = \frac{\partial \pi^{B0}}{\partial \mu} = -\frac{N}{2} \frac{T}{(2\mu - 1)^2} < 0$$

$$\frac{\partial CS^0}{\partial \mu} = -N \frac{\partial p_1^A}{\partial \mu} = N \frac{T}{(2\mu - 1)^2} > 0$$

- Market prices ( $p_1^{A0} = p_1^{B0}$ ) and profits earned by the two institutional investors ( $\pi^{\alpha 0} = \pi^{\beta 0}$ ) decrease as the majority share of both investors increases.
- Market prices and profits earned by the two institutional investors are maximized (approach  $+\infty$ ) when  $\mu = \frac{1}{2}$ , that is when both investors own the same percentage of the firm's shares, and they are minimized when  $\mu = 1$ , that is when one institutional investor owns 100% of the stock in a firm.

## 2.4 Welfare evaluations of common ownership

To evaluate the welfare implications of the model, following Shy and Stenbacka (2019), I suppose that the market consists of two groups of agents: a group of consumers and a group of savers who invest their money in the institutional investors' funds  $\alpha$  and  $\beta$ .

The social welfare function is represented by the weighted average of the utility of the two groups with the weights represented by  $\omega$  and  $1 - \omega$ , where  $\omega \in (0; 1)$  is the relative weight given to consumers' utility.

The expected total welfare function,  $EW$ , is

$$EW = \underbrace{\omega EU(CS)}_{EW_c} + (1 - \omega) \underbrace{[EU(\pi^\alpha) + EU(\pi^\beta)]}_{EW_s} \quad (10)$$

Where  $E$  is the expected value operator and  $U$  is a differentiable and weakly concave utility function. Consumers' expected welfare ( $EW_c$ ) is a function of consumers' surplus ( $CS$ ), while savers' expected welfare ( $EW_s$ ) depends on the profits realized by the two investment funds, respectively  $\pi^\alpha$  and  $\pi^\beta$ .

Consumers' surplus as well as  $\pi^\alpha$  and  $\pi^\beta$  are realized according to the probabilities (6) and correspond to the event realizations in (7), (8.1), (8.2) and (9)

Now the goal is to analyze the changes in the expected welfare function relative to changes in the common ownership level  $\mu$ . The expected consumer surplus is

$$EU(CS) = \phi^{II}U(CS^{II}) + 2\phi^I U(CS^I) + \phi^0 U(CS^0)$$

$$EU(CS) = 2\phi^I U(CS^I) + \phi^0 U(CS^0)$$

The effect of the change in the level of common ownership on  $EU(CS)$  is given by

$$\begin{aligned} \frac{\partial EU(CS)}{\partial \mu} &= 2\phi^I \frac{\partial U(CS^I)}{\partial \mu} + \phi^0 \frac{\partial U(CS^0)}{\partial \mu} \\ \frac{\partial EU(CS)}{\partial \mu} &= \phi^0 \frac{\partial U(CS^0)}{\partial \mu} \\ \frac{\partial EU(CS)}{\partial \mu} &= \phi^0 U'(CS^0) \frac{\partial CS^0}{\partial \mu} \end{aligned}$$

$$\frac{\partial EU(CS)}{\partial \mu} = \phi^0 U'(CS^0) N \frac{T}{(2\mu-1)^2} > 0 \quad (11)$$

Now I can calculate the expected utility of savers as

$$EU(\pi^\alpha) + EU(\pi^\beta) = \phi^I [U(\pi^{\alpha I}) + U(\pi^{\beta I})] + 2\phi^I [U(\pi^{\alpha I}) + U(\pi^{\beta I})] + \phi^0 [U(\pi^{\alpha 0}) + U(\pi^{\beta 0})]$$

$$[EU(\pi^\alpha) + EU(\pi^\beta)] = 2\phi^I [U(\pi^{\alpha I}) + U(\pi^{\beta I})] + \phi^0 [U(\pi^{\alpha 0}) + U(\pi^{\beta 0})]$$

Differentiation with respect to  $\mu$  yields

$$\begin{aligned} \frac{\partial [EU(\pi^\alpha) + EU(\pi^\beta)]}{\partial \mu} &= 2\phi^I [U(\pi^{\alpha I}) + U(\pi^{\beta I})] + \phi^0 [U(\pi^{\alpha 0}) + U(\pi^{\beta 0})] \quad (12) \\ &= 2\phi^I N(R-c) [U'(\mu N(R-c)) - U'((1-\mu)N(R-c))] + 2\phi^0 U' \left( \frac{N}{2} \frac{\mu T}{(2\mu-1)} \right) \left( -\frac{N}{2} \frac{T}{(2\mu-1)^2} \right) < 0 \end{aligned}$$

The first term of the expression is equal to zero if we consider risk-neutral savers while it becomes negative if we consider risk-averse agents. The second term is always less than zero if  $\mu > \frac{1}{2}$ .

## Result 2

From the above analysis, I can conclude that a reduction in the level of common ownership (higher  $\mu$ ) and thus a more concentrated ownership structure

- benefits consumers and determines an increase in the expected consumer surplus.
- decreases the expected utility of savers associated with the profits realized by the two institutional investors.

### 2.4.1 Welfare evaluation with risk neutrality

To evaluate the impact of changes in the common ownership level of the two firms on the expected total welfare function, I begin by examining the scenario of risk neutrality. This

implies that the marginal utility of both consumption and investment returns from the funds of the two institutional investors is constant.

Using the formulas (10) (11) and (12), the impact of changes in  $\mu$  on EW is given by

$$\begin{aligned}
\frac{\partial EW}{\partial \mu} &= \omega \frac{\partial EU(CS^0)}{\partial \mu} + (1 - \omega) \left[ \frac{\partial EU(\pi^{\alpha^0}) + \partial EU(\pi^{\beta^0})}{\partial \mu} \right] \\
&= \omega \phi^0 \frac{NT}{(2\mu - 1)^2} + (1 - \omega) \phi^0 \left( -\frac{NT}{(2\mu - 1)^2} \right) \\
&= 2\omega \phi^0 \frac{NT}{(2\mu - 1)^2} - \phi^0 \frac{NT}{(2\mu - 1)^2} \\
&= \phi^0 \frac{NT}{(2\mu - 1)^2} (2\omega - 1)
\end{aligned}$$

The last expression is equal to zero if and only if  $\omega = \frac{1}{2}$ .

### Result 3

- If  $\omega > \frac{1}{2} \Rightarrow \frac{\partial EW}{\partial \mu} > 0$

This means that if the weight given to consumers' utility is greater than  $\frac{1}{2}$  then decreased common ownership concentration (lower  $\mu$ ) implies a reduction in the expected social welfare.

- If  $\omega < \frac{1}{2} \Rightarrow \frac{\partial EW}{\partial \mu} < 0$

This means that if the weight given to consumers' utility is lower than  $\frac{1}{2}$  then decreased common ownership concentration (lower  $\mu$ ) implies an increase in the expected social welfare. In other words, if the weight given to consumers' utility is strictly greater than the weight given to investors' utility then a reduction in the level of common ownership, thus a shift towards a more separated ownership structure, increases the expected social welfare. Vice versa, if the weight given to investors' utility is strictly greater than the weight given to consumers' utility.

### 2.4.2 Welfare evaluation with risk aversion

In this Section I consider the case in which consumers and savers are risk-averse. The computations are based on the class of utility functions with Constant Relative Risk Aversion (CRRA). In particular, the utility function assumes the following expression

$$U(y) = y^\theta \text{ for } 0 < \theta \leq 1$$

The feature of constant relative risk aversion implies that the Arrow-Pratt measure  $y \frac{u''(y)}{u'(y)}$  is a constant. In this specification it is equal to

$$-y \frac{u''(y)}{u'(y)} = 1 - \theta$$

The higher the risk aversion coefficient ( $1 - \theta$ ), the greater the agents' risk aversion. As a result, the greater is  $\theta$  the lower the coefficient of risk aversion, then a lower value of  $\theta$  is associated to more risk-averse agents. If  $\theta = 1$ , we are back to the scenario of risk neutrality. Substituting the utility function  $U(y) = y^\theta$  on the total expected welfare function (10) and using the three event realizations (7), (8.1), (8.2) and (9) I get the following expression

$$EW = \omega \left[ \phi^0 \left( N(R - p_1^A) - \frac{NT}{2}(1 + \delta) \right)^\theta \right] \\ + (1 - \omega) \left\{ 2\phi^1 \left[ (\mu N(R - c))^\theta + ((1 - \mu)N(R - c))^\theta \right] + 2\phi^0 \left[ \left( \frac{N}{2} \frac{\mu T}{(2\mu - 1)} \right)^\theta \right] \right\}$$

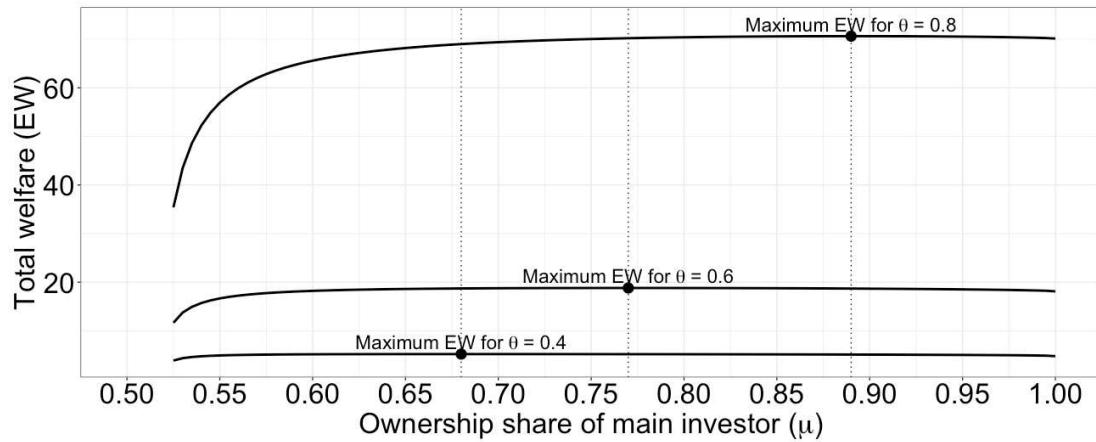
The first-order derivative of  $EW$  with respect to  $\mu$  yields a high-order polynomial. Therefore, I use numerical simulations to show how greater risk aversion (a drop in  $\theta$ ) affects the level of  $\mu$  which maximize the expected total welfare ( $\mu^*$ ).

Figure 1 shows three lines that illustrate different levels of risk aversion. The top line is depicted for  $\theta = 0.8$  and represents consumers with low risk aversion.

When considering a consumer's relative weight of  $\omega = 0.85$ , the ownership share that maximizes welfare is  $\mu^* = 0.89$  indicating that some degree of investor portfolio diversification between the two firms is the social optimum. The middle line illustrates total welfare with increased risk aversion ( $\theta = 0.6$ ), where a shift towards a greater level of common ownership ( $\mu^* = 0.77$ ) is socially optimal. The bottom curve represents the greatest level of risk aversion ( $\theta = 0.4$ ). In this scenario, the socially optimal ownership structure is characterized by more diversification with  $\mu^* = 0.68$ . Overall, these simulations imply that in

the social optimum, more risk aversion (lower  $\theta$ ) leads to a higher degree of common ownership (lower  $\mu^*$ ).

**Figure 1: Expected total welfare**



Expected total welfare  $EW$  is defined as a function of the magnitude of majority shares  $\mu$  and the risk aversion parameter  $\theta \in \{0.4, 0.6, 0.8\}$ .

#### Result 4

Assuming  $\omega = 0.85$  and  $\phi^{II} = \phi^I = \phi^0 = 0.25$ , then an increase in risk aversion (lower  $\theta$ ) increases the socially optimal degree of common ownership (lower  $\mu^*$ ).

The idea behind Result 4 can be expressed as follows: when there is a higher level of common ownership among institutional investors, they can offer more diversified investment portfolios to their savers. The value that these savers gain from diversification increases as they become more risk-averse. This is the reason why the socially optimal level of common ownership also increases with risk aversion. It is important to note that the optimal level of common ownership balances the benefits of diversification against the negative effects on consumers' welfare, and this balance is influenced by the parameter  $\omega$ . This trade-off explains why the simulations shown in Figure 1 produce interior solutions for the optimal level of common ownership.

## 2.5 Extensions

### 2.5.1 Small ownership shares

The baseline model assumes that the firms  $A$  and  $B$  are common owned by two institutional investors,  $\alpha$  and  $\beta$ , and that the majority shareholder owns a share equal to  $\mu \in [\frac{1}{2}, 1]$  in the firm. However, such an ownership configuration is rarely observed empirically because institutional investors' share of common owned firms operating in the same industry generally does not exceed 10%.

In this Section, I present an extension of the baseline model that best fits the empirical evidence I mentioned above. Formally, I suppose that the institutional investor  $\alpha$  owns a share of firm  $A$  equal to  $\mu_H$  and a share of firm  $B$  equal to  $\mu_L$  (with  $\mu_H > \mu_L$ ). Investor  $\beta$ , on the other hand, owns a share equal to  $\mu_L$  in firm  $A$  and a share equal to  $\mu_H$  in firm  $B$ .

Under the assumption that  $\mu_H + \mu_L < 1$ , I consider the residual ownership share in each firm held by several individuals who use passive investment strategies. This assumption allows the dominant investor, with an ownership share equal to  $\mu_H$ , to retain control over business strategies, as it occurs in the baseline model.

According to such model, the investors' maximization problem becomes

$$\max_{p_1^A} \pi^\alpha = \mu_H \pi^A(p_1^A, p_1^B) + \mu_L \pi^B(p_1^A, p_1^B) \quad (13)$$

$$\max_{p_1^B} \pi^\beta = \mu_L \pi^A(p_1^A, p_1^B) + \mu_H \pi^B(p_1^A, p_1^B) \quad (14)$$

which consists in solving the following system

$$\begin{cases} \frac{\partial \pi^\alpha}{\partial p_1^A} = \mu_H \frac{\partial \pi^A}{\partial p_1^A} + \mu_L \frac{\partial \pi^B}{\partial p_1^A} = 0 \\ \frac{\partial \pi^\beta}{\partial p_1^B} = \mu_L \frac{\partial \pi^A}{\partial p_1^B} + \mu_H \frac{\partial \pi^B}{\partial p_1^B} = 0 \end{cases} \quad (15)$$

To obtain  $\frac{\partial \pi^\alpha}{\partial p_1^A}$  and  $\frac{\partial \pi^\beta}{\partial p_1^B}$ , the following partial derivatives must be solved:

$$\frac{\partial \pi^A}{\partial p_1^A} = \frac{N}{2T} [T + p_1^B - 2p_1^A + c - \delta R + \delta c]$$

$$\begin{aligned}\frac{\partial \pi^B}{\partial p_1^A} &= \frac{N}{2T} [p_1^B - c + \delta R - \delta c] \\ \frac{\partial \pi^A}{\partial p_1^B} &= \frac{N}{2T} [p_1^A - c + \delta R - \delta c] \\ \frac{\partial \pi^B}{\partial p_1^B} &= \frac{N}{2T} [T + p_1^A - 2p_1^B + c - \delta R + \delta c]\end{aligned}$$

Substituting these expressions into (15) I have

$$\begin{cases} \frac{\partial \pi^\alpha}{\partial p_1^A} = \mu_H \frac{N}{2T} [T + p_1^B - 2p_1^A + c - \delta R + \delta c] + \mu_L \frac{N}{2T} [p_1^B - c + \delta R - \delta c] = 0 \\ \frac{\partial \pi^\beta}{\partial p_1^B} = \mu_L \frac{N}{2T} [p_1^A - c + \delta R - \delta c] + \mu_H \frac{N}{2T} [T + p_1^A - 2p_1^B + c - \delta R + \delta c] = 0 \end{cases}$$

Solving the system, I obtain the two firms' optimal prices at  $t = 1$

$$p_1^A = p_1^B = \frac{\mu_H T}{\mu_H - \mu_L} + c - \delta(R - c) \quad (16)$$

If  $\mu = 1$ , thus in the absence of common ownership, I get the same prices obtained in Klemperer (1987,1995) in Eq. (5).

Given that  $\mu_H \geq \mu_H - \mu_L$  then  $\frac{\mu_H}{\mu_H - \mu_L} \geq 1$ . This means that, in the presence of a certain level of common ownership, equilibrium prices in (16) are always strictly greater than the equilibrium prices found in Klemperer. As a result, increasing common ownership reduces firms' incentive to compete.

Substituting (16) into firms' profits in (4) I obtain firm *A* and firm *B*'s optimal profits

$$\pi^A = \pi^B = \frac{NT}{2} \frac{\mu_H}{\mu_H - \mu_L} \quad (17)$$

Putting (17) into (13) and (14) I obtain the optimal institutional investors' profits

$$\pi^\alpha = \pi^\beta = \frac{NT}{2} \frac{\mu_H(\mu_H + \mu_L)}{\mu_H - \mu_L} \quad (18)$$

Using the following formula introduced above

$$CS^0 = N(R - p_1^A) - \frac{NT}{2}(1 + \delta) \quad (19)$$

I can calculate the consumer's surplus substituting (16) into (19)

$$CS^0 = N\left[R - \left(\frac{\mu_H T}{\mu_H - \mu_L} + c - \delta(R - c)\right)\right] - \frac{NT}{2}(1 + \delta) \quad (20)$$

Note that this extension considers only the case in which with probability  $\phi^0$  none of the two firms fails. Now that I have all the major measures, I can show how they respond to changes in the level of common ownership.

The first-order derivative of (20) with respect to  $\mu_H$  and  $\mu_L$  yields

$$\frac{\partial CS^0}{\partial \mu_H} = NT \frac{\mu_L}{(\mu_H - \mu_L)^2} > 0$$

$$\frac{\partial CS^0}{\partial \mu_L} = -NT \frac{\mu_H}{(\mu_H - \mu_L)^2} < 0$$

The sign of the two first derivatives is consistent with the result obtained in the baseline model: consumers' surplus increases with more specialized ownership by the two institutional investors and decreases with increasing common ownership.

Indeed, since  $\mu_H - \mu_L > 0$ , if  $\mu_H$  increases and take more share from the other non-passive investor than from the other passive investors, the increase of  $\mu_H$  lead to more unequal ownership shares, thus to more specialized ownership. Vice versa, if  $\mu_L$  increases.

Consequently, a move toward more common ownership is detrimental to consumers.

Differentiating (16), (17) and (18) with respect to  $\mu_H$  I obtain

$$\frac{\partial p_1^A}{\partial \mu_H} = \frac{\partial p_1^B}{\partial \mu_H} = -T \frac{\mu_L}{(\mu_H - \mu_L)^2} < 0 \quad \text{that is } \uparrow \mu_H \Rightarrow \downarrow p_1^A \Rightarrow \downarrow p_1^B$$

$$\frac{\partial \pi^A}{\partial \mu_H} = \frac{\partial \pi^B}{\partial \mu_H} = -\frac{NT}{2} \frac{\mu_L}{(\mu_H - \mu_L)^2} < 0 \quad \text{that is } \uparrow \mu_H \Rightarrow \downarrow \pi^A \Rightarrow \downarrow \pi^B$$

$$\frac{\partial \pi^\alpha}{\partial \mu_H} = \frac{\partial \pi^\beta}{\partial \mu_H} = -\frac{NT}{2} \frac{\mu_L(\mu_H + \mu_L)}{(\mu_H - \mu_L)^2} < 0 \quad \text{that is } \uparrow \mu_H \Rightarrow \downarrow \pi^\alpha \Rightarrow \downarrow \pi^\beta$$

This means that when  $\mu_H$  increases the investor with the greater ownership share takes more shares from the other non-passive investor than from the other passive investors. This results in more *unequal* ownership shares between the two investors (*decreasing* common ownership) and incentivizes the firms to reduce prices because of greater competition. The profits of both firms and investors are reduced as prices fall. Increased market competition thus hurts the interests of horizontal shareholders.

Now differentiating (16), (17), and (18) with respect to  $\mu_L$  I obtain

$$\frac{\partial p_1^A}{\partial \mu_L} = \frac{\partial p_1^B}{\partial \mu_L} = T \frac{\mu_H}{(\mu_H - \mu_L)^2} > 0 \quad \text{that is } \uparrow \mu_L \Rightarrow \uparrow p_1^A \Rightarrow \uparrow p_1^B$$

$$\frac{\partial \pi^A}{\partial \mu_L} = \frac{\partial \pi^B}{\partial \mu_L} = \frac{NT}{2} \frac{\mu_H}{(\mu_H - \mu_L)^2} > 0 \quad \text{that is } \uparrow \mu_L \Rightarrow \uparrow \pi^A \Rightarrow \uparrow \pi^B$$

$$\frac{\partial \pi^\alpha}{\partial \mu_L} = \frac{\partial \pi^\beta}{\partial \mu_L} = \frac{NT}{2} \frac{\mu_H(\mu_H + \mu_L)}{(\mu_H - \mu_L)^2} > 0 \quad \text{that is } \uparrow \mu_L \Rightarrow \uparrow \pi^\alpha \Rightarrow \uparrow \pi^\beta$$

This means that when  $\mu_L$  increases the investor with the lower ownership share takes more shares from the other non-passive investor than from the other passive investors.

This results in more *equal* ownership shares between the two investors (*increasing* common ownership) and incentivizes the firm to increase prices because of reduced competition. The profits of both firms and investors rise as prices increase. Lower market competition thus promotes the interests of horizontal shareholders.

### 2.5.2 Undiversified investors

This second extension of the model modifies the previous extension by considering that the share  $1 - \mu_H - \mu_L$  in each firm is not owned by passive investors with small ownership shares but belongs to a large undiversified investor which owns a majority share in one of the two firms.

Firms *A* and *B* thus have the following shareholders' structure:

	FIRM A	FIRM B
INVESTOR $\alpha$	$\mu_H$	$\mu_L$
INVESTOR $\beta$	$\mu_L$	$\mu_H$
INVESTOR $\gamma$	$\mu_F = 1 - \mu_H - \mu_L$	0
INVESTOR $\delta$	0	$\mu_F = 1 - \mu_H - \mu_L$
	100%	100%

The two firms are common owned by the two institutional investors  $\alpha$  and  $\beta$  while the undiversified investors  $\gamma$  and  $\delta$  own a majority share in one of the two firms such that  $\mu_F \in [\frac{1}{2}, 1]$ . This allows for  $0 < \mu_H + \mu_L < \frac{1}{2}$ .

The purpose now is to investigate the impact of horizontal institutional investors' profit maximization process on undiversified shareholders' profits,  $\pi^\gamma$  and  $\pi^\delta$ .

In other words, I would like to know what happens to the profit of an undiversified investor who owns a majority share in a single firm if horizontal shareholders set the price level of the common-owned firms.

According to this scenario, since  $\mu_F > \mu_H > \mu_L$ , I assume that investor  $\alpha$  continues to influence firm A's corporate strategy. This implies, that while accounting for its minority share in firm B, investor  $\alpha$  has control over firm A's price definition process. The same can be said for the institutional investor  $\beta$ 's influence over firm B. Based on these assumptions, investor  $\gamma$  and  $\delta$  act like price takers.

The horizontal investors' maximization problem is equal to (15) and leads to the same equilibrium outcomes analyzed above, while the investors'  $\gamma$  and  $\delta$  profits are

$$\pi^\gamma = \mu_F \pi^A(p_1^A, p_1^B) = \mu_F \pi^B(p_1^A, p_1^B) = \pi^\delta \quad (21)$$

Substituting (17) into (21) and considering that  $\mu_F = 1 - \mu_H - \mu_L$ , I obtain

$$\pi^\gamma = \pi^\delta = -\frac{NT}{2} \frac{(\mu_H + \mu_L - 1)}{\mu_H - \mu_L} \quad (22)$$

Differentiating (22) with respect to  $\mu_H$  and  $\mu_L$  I get

$$\frac{\partial \pi^\gamma}{\partial \mu_H} = \frac{\partial \pi^\delta}{\partial \mu_H} = -\frac{NT}{2} \frac{\mu_L(1-2\mu_L)}{(\mu_H - \mu_L)^2} < 0 \quad (23)$$

$$\frac{\partial \pi^\gamma}{\partial \mu_L} = \frac{\partial \pi^\delta}{\partial \mu_L} = -\frac{NT}{2} \frac{\mu_H(2\mu_H-1)}{(\mu_H-\mu_L)^2} > 0 \quad (24)$$

The signs of the two first derivatives show that, when  $\mu_H$  increases, the fall in prices leads to a decrease in the profits of both firms and to more *unequal* ownership between the two investors. When  $\mu_H$  rises, the investor which owns takes more shares from the other horizontal investor than from the undiversified investor ( $\gamma$  or  $\delta$ ), thus the latter participates in the loss in profit of firm  $A$  and  $B$  with an ownership share which is reduced but not as much as  $\mu_L$ . More *unequal* ownership (and more competition between the two firms) thus leads to a reduction in the profits of both the horizontal shareholders and the non-diversified investor.

Vice versa, if  $\mu_L$  increases. In this case, more common ownership between the two horizontal investors decreases the competition between the two firms, leading to an increase in prices as well as in the profits of the two firms. This means that when  $\mu_L$  increases the investor with the lower ownership share takes more shares from the other horizontal investor than from the undiversified investor  $\gamma$  or  $\delta$  (more *equal* ownership). This means that the latter participates in the rise in profit of firm  $A$  and  $B$  with an ownership share that is reduced but not as much as  $\mu_H$ . More *equal* ownership (and less competition between the two firms) thus leads to an increase in the profits of both the horizontal shareholders and the non-diversified investor.

According to the findings, undiversified investors are better off with more *equal* ownership shares and worse off with more *unequal* ownership shares. This means that greater common ownership does not harm undiversified majority shareholders.

So far, I have considered that the share  $1 - \mu_H - \mu_L$  in each firm is owned by a large undiversified investor which owns a majority share  $\mu_F \in [\frac{1}{2}, 1]$  in one of the two firms.

However, looking at the sign of the partial derivatives, I can notice that the same results hold if I consider  $\mu_F$  a minority share  $0 < \mu_F < \frac{1}{2}$ .

This allows for  $\mu_H \in [0, \frac{1}{2}]$  and  $\mu_L \in [0, \mu_H[$  under the assumptions that  $\frac{1}{2} \leq \mu_H + \mu_L < 1$  and  $\mu_F < \mu_L < \mu_H$ . The sign of the partial derivatives (23) and (24) remains unchanged under this condition.

I can conclude that a shift toward a higher degree of common ownership does not harm undiversified majority and minority shareholders: they benefit from lower competition and increased earnings of the two firms, just like horizontal investors.

These findings are in line with the theoretical analysis in Elhauge (2020). According to some critics, the anticompetitive effects of horizontal shareholding are implausible for a variety of theoretical reasons as they would be prevented by non-horizontal shareholders' interests,

among other things. Elhauge (2020) shows that these arguments are erroneous because the reduction in competition produced by horizontal shareholding benefits non-horizontal owners as well as diversified shareholders, although the formers may advocate a different operational approach. Indeed, horizontal shareholding increases profitability for all affected companies, benefiting both non-horizontal and horizontal shareholders. As a result, non-horizontal shareholders would have no more reason to oppose horizontal shareholding than they would have if their company formed a cartel with competitors. Relatedly, Boller and Scott Morton (2020) state that the undiversified owners will benefit from softer competition and higher profitability determined by the presence of common ownership.

### **3. Research design, empirical proxies, and sample selection**

#### **3.1 Research design**

The theoretical model presented in Section 2, as well as its extensions, consists of two periods and does not provide any insight into the impact of competition over multiple periods, when old customers exit, and new customers enter the market continuously.

In an infinite model of competition with switching costs, Beggs and Klemperer (1992) show that, if firms cannot price discriminate between the two groups, the desire to exploit the old consumer base outweighs that to attract new consumers, leading to equilibrium prices higher than those in absence of switching costs.

The empirical literature on the effect of switching costs on market power support this conclusion (Ioannidou & Ongena, 2010; Barone et al., 2011; Egarius & Weill, 2016; He & Siebert, 2021).

Based on these findings, in this Section, I test the prediction that the positive association between common ownership and market power is more pronounced when firms' customers face switching costs.

In other words, I hypothesize that the anticompetitive effect of common ownership is exacerbated in markets with switching costs. This serves as an empirical test of "Result 1" from the two-period theoretical model presented in Section 2 applied to real-world multi-period competition.

To address this research question, in the baseline specification I estimate the following regression through a fixed effect model using a within-regression estimator

$$\begin{aligned} Markup_{f,t} = & \beta_0 + \beta_1 CommonOwnership_{f,g,t} + \beta_2 SwitchingCosts_{f,t} + \\ & + \beta_3 CommonOwnership_{f,g,t} \times SwitchingCosts_{f,t} + \beta_4 \log(Market\ Cap)_{f,t} + \\ & + \beta_5 BigThreeHoldings_{f,t} + \beta_6 IHHI_{f,t} + \beta_7 \frac{Capex_{f,t}}{Total\ Assets_{f,t}} + \lambda_{fg} + v_t + \varepsilon_{f,t} \end{aligned}$$

Where  $f$  denotes the firm,  $t$  denotes quarters,  $\lambda_{fg}$  are firm-pair fixed effects, and  $v_t$  are quarter fixed effects. Standard errors are robust to heteroskedasticity and clustered at firm level. Firm pair fixed effects allow me to look within each pair of common owned firms,  $f$  and  $g$ , while year dummies account for any variation in the dependent variable that occurs over time and that is not attributed to the explanatory variables included in the model.

Prices would have been the ideal candidate as indicators of changes in the competitive forces on the market. However, due to data unavailability at the product level, I rely on an alternative measure of market power extensively used by prior literature, represented by the markup. Computing markups requires the knowledge of prices and marginal costs, which generally are not observable. Therefore, many methodologies have been developed to infer markups indirectly. Following prior empirical literature on common ownership (e.g., Azar, 2012; Rosati et al., 2020; Koch et al., 2021; Lewellen & Lowry, 2021), I compute markup using the accounting approach as the difference between revenue and cost of goods sold, divided by revenue (e.g., Domowitz et al., 1987; Phillips, 1995; De Loecker et al., 2019).

For firms operating in the banking industry, I use the Net Interest Margin to compute markups because it represents a universal proxy for the spread between the interest rate charged on loans and the one paid on deposits (De Blas & Russ, 2009). In the robustness checks, following Rosati et al. (2020), I use as alternative dependent variables the *Lerner Index* and the *Lerner Index Adjusted* for the cost of capital.

The upcoming two sections will present the common ownership proxy used in the baseline specification as well as the approach for estimating switching costs.

### 3.2 Common ownership variable

In the baseline model, I construct the common ownership measure at firm-quarter level according to the following definition of common ownership “profit weight”:

$$\kappa_{f,g} = \frac{\sum_i \gamma_{fi} \beta_{gi}}{\sum_i \gamma_{fi} \beta_{fi}}$$

where  $\kappa_{f,g}$  represents the weight that firm  $f$  puts on every euro of firm  $g$ 's profits in its maximization problem.

The basic idea is that, when firms have common ownership, the maximization of the company's profit no longer coincides with the maximization of shareholders' returns due to their interests in other firms. In order to address this issue, the theoretical literature proposes that firm  $f$ 's objective function is represented by the linear combination of firm  $f$ 's profits and the profits of all the other firms  $g$  in which common owners hold shares. The “profit weights”, as specified above, are the weights that firm  $f$  puts on each euro of the firms  $g$ 's profits where  $g$  are the other firms common held by the same investors who own  $f$ .

The formula above shows that the common ownership proxy depends on  $\beta_{fi}$  and  $\beta_{gi}$  which reflect the fraction of the total shares outstanding of firm  $f$  and  $g$  owned by shareholder  $i$ . This primitive measure of common ownership also includes  $\gamma_{fi}$ , which is the Pareto weight that a firm places on its shareholders. Given that the researcher cannot observe this weight, much of the literature relies on the proportion control assumption, which assumes  $\gamma_{fi} = \beta_{fi}$ . This measure, introduced by Azar (2012) and adopted by Azar and Vives (2021) as well as by Backus et al. (2021), Rosati et al. (2020), and Boller and Scott Morton (2020) is also a component of the *MHHI* measure of O'Brien and Salop (2000).

Under the proportional control assumption  $\gamma_{fi} = \beta_{fi}$ , I compute this common ownership proxy for each pair of FTSE MIB's constituents using quarterly institutional ownership data from 2011 to 2020.

In the robustness checks, I test if the findings obtained in the baseline model hold using three alternative common ownership measures recently introduced by Azar (2022). The first measure is *DummyCO*, a dummy variable equal to 1 if there is at least one investor who holds more than 1% of the shares in both firms in the pair. The second measure is *Max Of Mins*, which considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$  and then computes the maximum across all the investors. The third alternative proxy is *Sum Of Mins*, which first

considers the minimum share owned by investor  $i$  in firm  $f$  and  $g$  and then sum across all the investors.

### 3.3 Switching costs estimation

I estimate switching costs using the methodology proposed by Shy (2002) who developed a simple theory and a calculation method that connects the firms' observed prices and market shares with the unobserved switching costs. This method allows solving for the switching costs as a function of prices and market shares only.

Shy (2002) proposes a new equilibrium notion, called the undercut-proof equilibrium, according to which the most (least) profitable firm is assumed to be the one with the largest (smallest) market share.

Consequently, the firm with the smallest market share, in order to gain market power, has strong incentives to undercut more profitable firms.

If there are  $F \geq 2$  firms in the market indexed by  $f$  with  $f = 1, \dots, F$ , let denote  $N_f$  firm  $f$ 's market share such that,

$$N_1 > N_2 > \dots > N_F$$

Each firm  $f$ , fearing to be undercut by firm  $F$ , the one with the smallest market share, maximizes its price  $p_f$  so that firm  $F$  will not find it profitable to undercut.

Solving firm  $f$ 's maximization problem (with  $f \in \{1, \dots, F - 1\}$ ), I can obtain the unobservable switching costs faced by brand  $f$  consumers as a function of the observed prices set by firms  $f$  and  $F$ , and firms' market shares:

$$S_f = p_f - \frac{N_F p_F}{N_f + N_F} \quad \text{with } f \in \{1, \dots, F - 1\} \quad (25)$$

On the other hand, the firm with the smallest market share, firm  $F$ , assumes that it is the prey target of firm 1. Therefore, firm  $F$  chooses a price,  $p_F$ , that would make undercutting its price by firm 1 unprofitable. Since  $p_F$  is observed I obtain the switching costs faced by firm  $F$  consumers as

$$S_F = p_F - \frac{N_1 p_1}{N_1 + N_F} \quad (26)$$

In this work, switching costs are directly obtained from Eq. (25) for all firms in the dataset since none of the firms can be considered as the company with the smallest market share within its reference industry.

Following Egarius and Weill (2016), to estimate switching costs I compute quarterly the ratio of total revenues to total income as a proxy of the average price applied by the firms from 30/03/2011 to 31/12/2020.

Industries are identified by the 6-DIGIT NAICS 2017 National Industry Code. Firms are assumed to compete in their national market and market shares are computed annually from 2011 to 2020 as the ratio between the sales of the firm and total industry sales,  $N_f =$

$\frac{Sales_f}{\sum_{f=1}^F Sales_f}$ . For firms in the “Commercial banking” industry, firm’s  $f$  market share is

computed as  $N_f = \frac{Total\ assets_f}{\sum_{f=1}^F Total\ assets_f}$

To determine the market shares of firms in the dataset, I rely on financial data extracted from two sources: Refinitiv Eikon’s financial statements from publicly listed companies, and Bureau van Dijk’s Aida database for privately held Italian companies within each industry.

### 3.4 Other control variables

The regression equation includes among the control variables  $\log(Market\ Cap)$ , the logarithm of the firm’s market capitalization at time  $t$ , as a proxy of the firm’s size, and the ratio between capital expenditure and total assets to account for the effect of capital investment decisions on firm’s profitability.

I also control for *BigThreeHoldings* equal to the sum of the ownership shares ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street for each firm at time  $t$ . In fact, prior literature has sought to link the rise in common ownership and its anticompetitive effects to the recent massive shift of capital to index funds as well as to the increase in the Asset under Management (AuM) in the hands of the top investment managers, the so-called “Big Three” (Fichtner et al., 2017; Seldeslachts et al., 2017; Schmalz, 2018).

On the right side of the equation, I also consider institutional investors’ concentration in firm  $f$  at time  $t$  (*IHHI*). Following Seldeslachts et al. (2017), this measure is calculated as the sum of squared institutional investors’ shares of the total market value of the firm held by institutional investors. Higher values of the index denote a higher investors’ concentration.

### 3.5 Sample selection

The sample used to carry out the empirical analysis consists of the Italian companies included in the FTSE MIB index from 30/06/2009 to 31/12/2020. The end of the first semester of 2019 coincides with the merger between Borsa Italiana and the London Stock Exchange and with the constitution of the FTSE MIB Index itself (previously called S&P/MIB).

The FTSE MIB is the benchmark stock market index for Borsa Italiana, and it includes, with a few exceptions<sup>3</sup>, the 40 largest Italian companies in terms of capitalization, free float, and liquidity. The index's constituents account for more than 80% of total market capitalization and approximately 90% of exchange value.

I select the FTSE MIB Index because it is supposed to reflect the entire Italian economy, it is composed of widely held companies, and many investment funds offer products that are connected to the index's constituents.

The sample includes data about all FTSE MIB constituents except for delisted firms and shares revoked as a result of an OPA or acquisition when the acquirer is not included in the index.

I obtain quarterly ownership information and financial statement data from Refinitiv Eikon. Specifically, I restrict the ownership data to institutional investors' holdings, which include investment managers and brokerage firms<sup>4</sup>.

I use the Bureau van Dijk's Aida database to obtain annual financial statements data of Italian unlisted companies, in order to calculate firms' market share in their national industry. Because data from the Aida database are available starting from 2011, I restrict the sample period to 30/03/2011-31/12/2020. Industries are defined by the 6-digit NAICS National Industry Code. To mitigate the effect of outliers, I winsorize all continuous variables at the 1<sup>st</sup> and 99<sup>th</sup> percentile.

Panel A of Table A1 (see the Appendix) presents the summary statistics of the variables in the analysis while Panel B reports the correlation matrix. On a univariate basis, the four common ownership proxies are positively correlated as well as the alternative dependent variables.

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<sup>3</sup> From October 2013 to December 2013 and from January 2016 to March 2016 the index included 41 firms.

<sup>4</sup> Investment managers include banks and trustees, endowment funds, finance companies, foundations, government agencies, hedge funds, investment advisors, insurance companies, pension funds, private equity, venture capital, sovereign wealth funds, investment management companies, miscellaneous investment managers. Brokerage firms include research firms and independent research firms.

## 4. Results

The regression results are reported in Table (1). Column (1) reports results considering only the common ownership variable and the switching cost variable, while the interaction between them is included in Column (2). Column (3) presents the estimates when also the other control variables are added. I consider Column (3) as the baseline specification.

I find that the coefficient on the variable of interest, the interaction  $\kappa_{fg} \times \textit{SwitchingCosts}$ , is positive and statistically significant both in Column (2) and (3). Consistent with my prediction, this finding suggests that the higher the switching costs, the greater the effect of common ownership on markup. In other words, the positive association between common ownership and market power is more pronounced when the firm's customers face switching costs.

In models with interaction terms, the regression coefficients on the variables that interact reflect conditional relationships. This means that the coefficient on the common ownership variable  $\kappa_{fg}$  represents the effect of  $\kappa_{fg}$  on markup in the absence of switching costs. Similarly, the coefficient on the switching costs variable reflects the effect of switching costs faced by the firm's customers on markup when  $\kappa_{fg}$  is equal to zero, thus in the absence of common ownership.

Columns (1)-(3) show that there is a positive and statistically significant association between common ownership and market power in the absence of switching costs. This evidence is consistent with the prediction of industrial organization theories that common ownership may lead common owned firms to compete less aggressively and internalize the externalities that their actions produce on other firms (e.g., Hansen & Lott, 1996; O'Brien & Salop, 2000; Gilo et al., 2006; Rubin, 2006; Azar et al., 2018). These findings are also in accordance with the recent empirical evidence on the anticompetitive effects of common ownership (e.g., Azar et al., 2016, 2018; Rosati et al., 2020; Koch et al., 2021).

The coefficient on the switching costs variable is positive and significant in all regressions suggesting that, even in the absence of common ownership, firms with customers facing higher switching costs are on average more likely to achieve greater operating margins.

These findings are consistent with prior theoretical and empirical literature showing that greater switching costs enhance market power and then hamper competition (Klemperer, 1987; Klemperer, 1995; Ioannidou & Ongena, 2010; Barone et al., 2011; Egarius & Weill, 2016; He & Siebert, 2021).

**Table 1: Fixed-effects panel regression of firm’s markup on the interaction between common ownership and switching costs**

Dependent variable	<i>Markup</i>		
	(1)	(2)	(3)
$\kappa_{fg}$	0.00858*** (0.00261)	0.00616** (0.00257)	0.0158*** (0.00265)
<i>Switching Costs</i>	0.0523*** (0.00228)	0.0148*** (0.00526)	0.0139*** (0.00527)
$\kappa_{fg} \times \text{Switching Costs}$		0.103*** (0.0154)	0.102*** (0.0151)
$\text{Log}(\text{MarketCap})$			-0.0125 (0.00935)
<i>Big Three Holdings</i>			-0.0326 (0.0424)
<i>IHHI</i>			0.000210*** (3.75e-05)
<i>Capex/Total Assets</i>			0.217*** (0.0308)
<i>Constant</i>	0.499*** (0.00296)	0.501*** (0.00292)	0.523*** (0.0353)
Observations	22,511	22,511	19,653
R-squared	0.120	0.124	0.139
Number of firm-pairs	1,747	1,747	1,450
Firm-Pair FE	YES	YES	YES
Quarter FE	YES	YES	YES
S.E. Robust	YES	YES	YES

This table reports the results of fixed-effects panel regressions of a firm’s Markup on common ownership interacted with the switching costs measure developed by Shy (2002), and other controls. *Markup* is the difference between revenue and COGS divided by revenue. Common ownership is proxied by  $\kappa_{fg}$ , which is the relative value of each euro of firm  $g$ ’s profits in firm  $f$ ’s maximization problem. *Switching costs* are estimated according to Shy (2002).  $\text{log}(\text{MarketCap})$  is the logarithm of firm’s market capitalization at time  $t$ . *Big Three Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street in a firm  $f$  at time  $t$ . *IHHI* is the institutional investors’ concentration measure calculated as the sum of squared institutional investors’ shares of the total market value of the firm held by institutional investors. *Capex/ Total Assets* the ratio between capital expenditure and total assets. All regressions include firm-pair fixed effects and quarter fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

In contrast with the discussions which often link the anticompetitive effects of common ownership to the rise in the “Big Three” holdings, in my sample I find that changes in the combined ownership shares of the “Big Three” (BlackRock, Vanguard, and State Street) do not significantly affect firms’ markup. This result is in line with a recent finding by Backus et al. (2021) which shows that much of the rise in common ownership predates the rise in the combined holdings of the “Big Three” in an average S&P 500 constituent. They also provide

evidence that indexing behavior rather than the rise of the “Big Three” explains the broader trend in the rise of common ownership and then, the associated economic consequences.

Table (1) shows that the coefficient on the institutional investors’ concentration measure (*IHHI*) is always positive and statistically significant suggesting that when a firm’s ownership is in the hand of a lower number of institutional investors with larger shares, the firm can obtain higher operating profits. This result is in line with previous literature which explains the positive relationship between ownership concentration and firm profitability with the increased interest alignment between managers and shareholders, due to increased monitoring effectiveness over management and lower agency costs (e.g., Berle & Means, 1932; Claessens & Djankov, 1999; McConnell & Servaes, 1990; Shleifer & Vishny, 1986). Indeed, dispersed ownership cannot exercise enough power to oversee managerial performance. Consequently, managers are freer to use firm resources than they would in case of more concentrated ownership (Shleifer & Vishny, 1997). In addition, the recent growth in index funds leads institutional investors to hold multiple blockholdings in different firms which makes institutional investors’ monitoring more effective (Kang et al., 2018).

In order to analyze how market concentration affects the findings obtained above, in Table 2 I split the sample into two subsamples corresponding to the first and the fourth quartiles of the *HHI* measure of market concentration and I perform the regression in Column (3) of Table 1 for each subsample.

Column (1) of Table 2 reports the results from the baseline regression performed above, while Columns (2)-(3) show the results corresponding to each quartile. The other explanatory variables are included but not reported. The coefficient on the common ownership variable is positive and significant in all regressions and increases its economic significance in firms that act in more concentrated markets. This result is in line with the prediction that the anticompetitive effects of common ownership are particularly harmful in highly concentrated markets and require adequate antitrust enforcement (Elhauge, 2016, 2017, 2020; Posner et al., 2017; Scott Morton & Hovenkamp, 2018; Posner, 2021). For firm-year observations belonging to industries with low concentration, the coefficient on the switching costs variable is negative and not statistically significant while becoming positive and significant in the fourth quartile of the *HHI* distribution.

Although the coefficient in the first quartile is not statistically significant, the negative sign could be explained by the fact that in industries with very low concentration, therefore more competitive and not yet saturated, companies could be incentivized to lower prices when

**Table 2: Fixed-effects panel regression in different quartiles of the HHI Index of industry concentration**

Dependent variable	<i>Markup<sub>f</sub></i>		
	Baseline	1° Quartile HHI	4° Quartile HHI
	(1)	(2)	(3)
$\kappa_{fg}$	0.0158*** (0.00265)	0.00303*** (0.00103)	0.0177** (0.00733)
<i>Switching Costs</i>	0.0139*** (0.00527)	-0.00454 (0.00287)	0.0255*** (0.00760)
$\kappa_{fg} \times \textit{Switching Costs}$	0.102*** (0.0151)	0.0489 (0.0388)	0.0725*** (0.0172)
<i>Constant</i>	0.523*** (0.0353)	0.445*** (0.0163)	0.789*** (0.0473)
Observations	19,653	1,326	6,649
R-squared	0.139	0.867	0.272
Number of firm-pairs	1,450	229	457
Firm-Pair FE	YES	YES	YES
Quarter FE	YES	YES	YES
S.E. Robust	YES	YES	YES

This table reports the results of fixed-effects panel regressions of a firm's Markup on common ownership interacted with the switching costs measure developed by Shy (2002), and other controls. Column (1) presents the baseline specification (the same specification in Column (3) of Table 1). In Columns (2)-(3) I report the regression results when the sample is split depending on whether the industry's concentration is low (first quartile of the HHI Index) or high (fourth quartile of the HHI Index). *Markup* is the difference between revenue and COGS divided by revenue. Common ownership is proxied by  $\kappa_{fg}$ , which is the relative value of each euro of firm *g*'s profits in firm *f*'s maximization problem. *Switching costs* are estimated according to Shy (2002).

All regressions include but the table does not report the following controls:  $\log(\textit{MarketCap})$ , the logarithm of the firm's market capitalization at time *t*, *Big Three Holdings*, the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street in a firm *f* at time *t*, *IHHI*, the institutional investors' concentration measure calculated as the sum of squared institutional investors' shares of the total market value of the firm held by institutional investors, and *Capex/ Total Assets*. All regressions include firm-pair fixed effects and quarter fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

switching costs faced by customers increases in order to attract new customers that would be "locked-in" in the future. On the other hand, in highly concentrated industries, with lower competition, the desire to exploit the current base of customers is greater than the desire to attract new customers and this translates into an increase in prices, and thus in markup, as switching costs rise.

Following the discussion presented above, the coefficient on the interaction variable, which is positive and significant considering the entire distribution, remains positive and significant for firm-quarter observations belonging to industries included in the fourth quartile of the *HHI*. Thus, the average effect of common ownership on markup in presence of switching costs is

driven by the observations in the fourth quartile of the *HHI*. In other words, in the presence of switching costs faced by firms' consumers, the effect of common ownership on market power is larger in firms operating in highly concentrated industries than in firms operating in industries with low concentration.

## 5. Robustness checks

In this Section, I perform several robustness checks to confirm the validity of the results obtained in the baseline regression model. First, I examine whether the findings hold using alternative common ownership proxies. Second, I test the validity of the results using alternative dependent variables.

### 5.1 Alternative common ownership measures

At the date, there is no common consensus among researchers on which measure best represents common ownership since there are trade-offs associated with the different proxies (see, Gilje et al., 2017; Azar, 2022)

Consistently, in this Section, I assess the robustness of the baseline results using three alternative common ownership measures recently introduced by Azar (2022).

The first measure, *DummyCO*, is a dummy variable equal to 1 if there is at least one investor who holds more than 1% of the shares in both firms in the pair. This measure has the advantage of conceptual simplicity, but it overlooks a lot of useful information. In fact, the variable takes the value 1 if an investor owns 20% of both firms in the pair but also when she only has 1% in each firm, ignoring the fact that in the first case there is a higher level of common ownership in that pair of firms. Conversely, if an investor owns 0.95% of both firms, this variable has a value of zero.

The second measure is defined as

$$Max\ Of\ Mins_{fg} = \max_{i \in I} \{ \min[S_{if}, S_{ig}] \}$$

Where  $f$  and  $g$  are the firms in the pair,  $I$  is the set of shareholders of both firms and  $s_{if}$  is the percentage of firm  $f$  owned by shareholder  $i$ .

This measure first considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$ , then computes the maximum across all the investors. Even though the *Max Of Mins* eliminates the arbitrariness of defining a threshold and assumes higher values if a shareholder holds larger shares in both companies, it still has drawbacks. For example, if we consider a pair of firms having one shareholder with 3% in each firm and another pair of firms with four common shareholders each owing 3% of both firms, this measure will assume the same value for both pairs of firms. The reason behind this is that the *Max Of Mins* focuses on the shareholder with the greatest block of shares in the pair of firms while ignoring the information coming from all other shareholders.

The third common ownership proxy that includes information on all the common shareholders is defined as

$$Sum\ Of\ Mins_{fg} = \sum_{i \in I} \min[s_{if}, s_{ig}]$$

Where  $f$  and  $g$  are the firms,  $I$  is the set of shareholders of both firms and  $s_{if}$  is the percentage of firm  $f$  owned by shareholder  $i$ . This measure first considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$ , then sums across all the investors. The *Sum Of Mins* accounts for the link generated by all common owners but it does not give any information about the concentration of the ownership. Indeed, it takes the same value if one investor is holding 100% of both firms or one-hundred investors have 1% ownership in each firm.

From this point of view, the common ownership variable  $\kappa_{fg}$  that I used in the baseline specification has in the nominator the product of the shares held by the investor  $i$  in both firms in the pair. The product yields values that are more than proportionally higher for more concentrated ownership shares. Thus, the  $\kappa_{fg}$  measure accounts for ownership concentration, while the *Sum Of Mins* does not.

Table 3 shows the results. Using Column (3) of Table 1 as my baseline specification and varying the common ownership measures, I find that in two out of three cases, the coefficient on the interaction variable between common ownership and switching costs is positive and significantly different from zero, suggesting that the results hold for alternative common ownership measures.

**Table 3: Robustness checks - Alternative common ownership proxies**

Dependent variable	<i>Markup</i>		
	(1)	(2)	(3)
<i>DummyCO</i>	-0.00420 (0.00295)		
<i>DummyCO</i> × <i>Switching Costs</i>	0.0361*** (0.0100)		
<i>Max of Mins</i>		0.107 (0.128)	
<i>Max of Mins</i> × <i>Switching Costs</i>		-0.0155 (0.0180)	
<i>Sum of Mins</i>			-0.00634 (0.0557)
<i>Sum of Mins</i> × <i>Switching Costs</i>			0.239*** (0.0902)
<i>Switching Costs</i>	0.0204** (0.00956)	0.0516*** (0.00225)	0.0312*** (0.00745)
<i>Log(MarketCap)</i>	-0.0130 (0.00959)	-0.0118 (0.00965)	-0.0122 (0.00975)
<i>Big Three Holdings</i>	-0.0226 (0.0419)	-0.0323 (0.0424)	-0.0253 (0.0417)
<i>IHHI</i>	0.000139*** (3.68e-05)	0.000136*** (3.69e-05)	0.000137*** (3.68e-05)
<i>Capex /Total Assets</i>	0.186*** (0.0311)	0.187*** (0.0312)	0.187*** (0.0313)
<i>Constant</i>	0.539*** (0.0364)	0.531*** (0.0365)	0.534*** (0.0365)
Observations	19,653	19,653	19,653
R-squared	0.134	0.133	0.133
Number of firm-pairs	1,450	1,450	1,450
Firm-Pair FE	YES	YES	YES
Quarter FE	YES	YES	YES
S.E. Robust	YES	YES	YES

This table reports the results of fixed-effects panel regressions of a firm's markup on common ownership interacted with the switching costs measure developed by Shy (2002), and other controls. *Markup* is the difference between revenue and COGS divided by revenue. Common ownership is proxied by three alternative measures: *DummyCO*, *Max of Mins*, and *Sum of Mins*. *DummyCO* is a dummy variable equal to 1 if there is at least one investor who holds more than 1% of the shares in both firms in the pair. The second measure is *Max of Mins*, which considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$  and then computes the maximum across all the investors. The third alternative proxy is *Sum of Mins*, which first considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$  and then sums across all the investors. Switching costs are estimated according to Shy (2002).  $\log(\text{MarketCap})$  is the logarithm of a firm's market capitalization at time  $t$ . *Big Three Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street in a firm  $f$  at time  $t$ . *IHHI* is the institutional investors' concentration measure calculated as the sum of squared institutional investors' shares of the total market value of the firm held by institutional investors. *Capex / Total Assets* is the ratio between capital expenditure and total assets. All regressions include firm-pair fixed effects and quarter fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

## 5.2 Alternative dependent variables

In the baseline specification, I use as a dependent variable the difference between revenue and cost of goods sold divided by revenue. Here I test the robustness of the results using two alternative proxies of markup.

Following Rosati et al. (2020), the first alternative dependent variable is represented by the *Lerner Index* calculated as

$$Lerner\ Index = \frac{EBIT}{Operating\ Revenues}$$

While this indicator is commonly recognized as a reliable measure of market power and my definition aligns with the one employed by IMF (2019), it does not fully encompass the cost of capital. To obtain a more realistic measure of markets' competition I can subtract the cost of capital from EBIT (Elzinga & David, 2011) and construct an *Adjusted Lerner Index*

$$Adjusted\ Lerner\ Index = \frac{EBIT - Cost\ of\ Capital}{Operating\ Revenues}$$

The cost of capital is calculated according to the following formula

$$Cost\ of\ Capital = Tangible\ Assets (i - \pi_e)$$

where  $i$  is the nominal interest rate and  $\pi_e$  is the average expected inflation of 2% following Konigs and Vandebussche (2005). I obtain the nominal yields series from the ECB Statistical Data Warehouse.

Using data from Eurostat, I also compute an *Adjusted Lerner Index* using the real historical monthly inflation rate series instead of the average expected inflation rate. The results are reported in Table 4. Consistently with the baseline specification, the coefficient on the interaction between common ownership and switching costs remains positive and statistically significant using three alternative dependent variables.

**Table 4: Robustness checks - Alternative dependent variables**

Dependent variable	<i>Lerner Index</i>	<i>Lerner Index</i> (Adjusted with historical inflation rates)	<i>Lerner Index</i> (Adjusted with the expected inflation rate)
	(1)	(2)	(3)
$\kappa_{fg}$	-0.0501*** (0.0114)	0.00765** (0.00335)	0.00219 (0.00303)
<i>Switching Costs</i>	-0.0403*** (0.00852)	-0.0293*** (0.00400)	-0.0442*** (0.00622)
$\kappa_{fg} \times \text{Switching Costs}$	0.112*** (0.0248)	0.0407*** (0.0101)	0.0141 (0.0125)
<i>Log(MarketCap)</i>	0.0185 (0.0170)	0.138*** (0.0110)	0.0773*** (0.0104)
<i>Big Three Holdings</i>	0.855*** (0.153)	-0.0299 (0.0847)	0.304*** (0.0684)
<i>IHHI</i>	-0.000956*** (0.000149)	3.98e-05 (8.80e-05)	-8.16e-05 (7.86e-05)
<i>Capex/Total Assets</i>	-4.762*** (0.857)	0.364*** (0.0413)	0.173*** (0.0410)
<i>Constant</i>	0.575*** (0.0867)	-0.208*** (0.0407)	-0.0315 (0.0396)
Observations	20,290	14,136	15,161
R-squared	0.055	0.157	0.111
Number of firm-pairs	1,499	1,448	1,463
Firm-Pair FE	YES	YES	YES
Quarter FE	YES	YES	YES
S.E. Robust	YES	YES	YES

This table reports the results of fixed-effects panel regressions of a firm's markup on common ownership interacted with the switching costs measure developed by Shy (2002), and other controls. The firm's *Markup* is proxied by three alternative measures: the *Lerner Index*, the *Lerner Index Adjusted* for the cost of capital using the historical inflation rate, and the *Lerner Index Adjusted* for the cost of capital using the expected inflation rate of 2%. Common ownership is proxied by  $\kappa_{fg}$ , which is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. *Switching costs* are estimated according to Shy (2002). *log(MarketCap)* is the logarithm of a firm's market capitalization at time  $t$ . *Big Three Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street in a firm  $f$  at time  $t$ . *IHHI* is the institutional investors' concentration measure calculated as the sum of squared institutional investors' shares of the total market value of the firm held by institutional investors. *Capex/Total Assets* is the ratio between capital expenditure and total assets. All regressions include firm-pair fixed effects and quarter fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-pair level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

## 6. Conclusion

This study investigates the effect of common ownership on market power and welfare in a competitive environment where a firm's customers face switching costs.

Using a two-period duopoly model of competition in a market with switching costs, I demonstrate that greater common ownership between firms harms consumers because it reduces the intensity of product market competition in the first period, resulting in an equilibrium price higher than that determined in the absence of common ownership. The welfare analysis shows that the socially optimal level of common ownership is influenced by two factors: the relative weight society places on consumption versus returns on savings through investments in institutional investors' funds, and the degree of risk aversion.

The first extension of the model releases the hypothesis that the dominant investor in each firm owns more than 50% of the stocks and allows institutional investors with small ownership shares to join the firm. Even so, I demonstrated that lower market competition favors the interests of horizontal shareholders. The second extension shows that the anticompetitive effects of common ownership do not harm the interest of undiversified shareholders.

Empirically, using the sample of Italian firms Included in the FTSE MIB Index for the period 2011-2020, I find that the positive association between common ownership and market power is more pronounced when a firm's customers face switching costs, and this effect is larger in firms operating in highly concentrated industries.

It remains interesting for future research to examine the empirical relationship between common ownership and price competition in a market with switching costs using an across-industry study. As an alternative, it could be also employed a larger sample of firms operating in specific industries where customers typically face high switching costs, such as banking and airline, and where prior works have shown that common ownership has an impact on prices. In fact, following the literature, this study uses the markup as a proxy of market competition; nevertheless, data on prices or other outcomes of the competitive process would contribute to reinforcing the evidence of the anticompetitive effects of common shareholding in markets with switching costs.

Empirical findings that common ownership is associated with anticompetitive outcomes and is likely harmful to markets, raise questions about possible policy responses in the area of antitrust and capital markets regulation.

Elhauge (2016) offers the first assessment of the concrete legal implications of the empirical findings about the anticompetitive effects of common ownership. In short, he shows that

existing US antitrust law allows enforcement against anticompetitive common ownership. Specifically, stock acquisitions that create common ownership in the same industry are illegal under Clayton Act §7 whenever those horizontal shareholdings are shown to have created actual or likely anticompetitive effects.

In cases where horizontal shareholding leads to anticompetitive consequences, it may also be deemed a violation of the Sherman Act § 1. This is based on the notion that owning shares in companies within the same industry constitutes a form of combination or agreement that restrained competition.

Given their international implications, Elhauge (2017) provides an evaluation of how the antitrust risks associated with common ownership links can be addressed under EU competition law. He shows that, although EU merger control law is narrower than Clayton Act §7, EU law's prohibition of anticompetitive agreements and concerted practices under Article 101 of the Treaty on the Functioning of the European Union (TFEU) is at least as comprehensive as Sherman Act §1's ban on anticompetitive agreements. Moreover, the EU law on collective dominance and excessive pricing under TFEU Article 102 is even broader and offers a straightforward approach to addressing the issue of anticompetitive common ownership. Other countries, such as China, Russia, Taiwan, and Turkey, which, like the EU, have abuse of dominance statutes, can also tackle horizontal shareholding as collective dominance<sup>5</sup> and treat excessive pricing as an abuse of dominance<sup>6</sup>.

Although curbing anticompetitive common ownership through antitrust enforcement appears to be the least expensive solution, both in terms of political and economic costs, Posner (2021) exposes the reasons for thinking that traditional antitrust legal principles will not be adequate to the problem and proposes several possible policy responses including regulation of corporate governance, regulation of compensation of management of portfolio firms, and regulation of capital market structure.

These proposals are considered quite radical, which makes them controversial. Alternately, a more agreeable suggestion could be for policymakers to insist on obtaining and thoroughly examining precise information on beneficial ownership and institutional investor governance activities, such as the degree to which governance rights are practically exercised. Specifically, regulators should also be mindful of the "aggregation" issue", which occurs when some

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<sup>5</sup> China Anti-Monopoly Law Arts. 17 & 19; Russia Competition Law Arts. 4(10), 5; Taiwan Fair Trade Act, Arts. 5 & 5-1; Turkey Competition Art. 6.

<sup>6</sup> China Anti-Monopoly Law Art. 17(1) (banning a firm in dominant market position from "selling at unfairly high prices or buying at unfairly low prices"); Russia Competition Law Art. 6(1) (prohibiting a "monopolistically high price"); OECD, Predatory Foreclosure 247 (2005) (Taiwan); Belco Decision, No. 01-17/150-39 (Turkey Competition Commission 2001) (banning excessive pricing by a dominant firm).

investors report their holdings separately, resulting in an understatement of common ownership concentration. Asset managers who want to participate in an open and fact-based debate could consider making this information available to academic researchers as well.

## Appendix

Table A1: Panel A – Summary statistics

Variable	Mean	Standard Deviation	Min	Max	25 <sup>th</sup> percentile	Median	75 <sup>th</sup> percentile	N
<i>Markup</i>	0.539	0.242	0.0271	2.054	0.353	0.5557	0.696	30,967
<i>Lerner Index</i>	0.306	1.051	0.00515	31.53	0.0689	0.1800	0.417	50,138
<i>Lerner Index Adjusted Real Adjusted Expected</i>	0.310	0.344	0.000325	3.118	0.0523	0.1621	0.464	35,828
$\kappa_{fg}$	0.338	0.399	2.88e-05	6.981	0.0848	0.1992	0.440	47,619
<i>DummyCO</i>	0.745	0.436	0	1	0	1	1	47,619
<i>Max of Mins</i>	0.0166	0.0160	0.000256	0.593	0.00998	0.0139	0.0190	47,619
<i>Sum of Mins</i>	0.0725	0.0439	0.00948	0.294	0.0450	0.0647	0.0882	47,619
<i>Switching Costs</i>	0.0402	0.200	0.000168	3.543	0.00427	0.0104	0.0243	39,644
<i>log(MarketCap)</i>	3.847	0.441	2.965	4.821	3.514	3.773	4.201	60,367
<i>Big Three Holdings</i>	0.0658	0.0511	0.00463	0.207	0.0271	0.0513	0.0855	72,875
<i>IHHI</i>	94.46	288.0	1.226	2,535	18.34	42.796	89.76	72,928
<i>Capex/Total Assets</i>	0.0430	0.0501	0.000414	0.326	0.00280	0.0330	0.0605	106,848

**Table A1: Panel B – Correlation matrix**

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
	1												
<i>Markup</i>	0,704701	1											
<i>Lerner Index</i>	0,665421	0,965176	1										
<i>Lerner Index Adjusted Real</i>	0,651719	0,96162	0,962463	1									
<i>Lerner Index Adjusted Expected</i>	-0,09368	-0,02814	-0,05134	-0,06138	1								
$\kappa$	0,019543	-0,03402	-0,04082	0,006973	0,083506	1							
<i>DummyCO</i>	0,012866	-0,0099	-0,00848	0,011778	0,187656	0,390686	1						
<i>Max of Mins</i>	-0,01543	-0,03991	-0,06255	-0,00869	0,264275	0,4682	0,633689	1					
<i>Sum of Mins</i>	-0,05216	-0,06994	-0,06799	-0,06832	0,01417	0,017958	0,000608	0,016093	1				
<i>Switching Costs</i>	-0,0818	-0,04145	-0,10146	-0,08033	0,092718	0,004022	0,022471	0,201335	0,011236	1			
<i>log(MarketCap)</i>	0,044404	-0,03656	-0,02603	0,017706	-0,20175	0,26811	0,228603	0,395875	-0,00685	0,223149	1		
<i>Big Three Holdings</i>	0,046295	-0,07956	-0,06445	-0,06199	-0,13263	-0,00188	0,132721	0,002774	-0,00773	-0,09267	0,035215	1	
<i>IHHI</i>	-0,14839	-0,39626	-0,41389	-0,45656	-0,00294	-0,03298	-0,04268	-0,04677	0,017844	0,221	-0,07783	0,010221	1

Panel A provides summary statistics of the key variables used in the analyses. Panel B reports the Pearson correlations for these variables. *Markup* is the difference between revenue and COGS divided by revenue. The *Lerner Index* is computed as the ratio between EBIT and operating revenues. The *Lerner Index Adjusted Real* is computed subtracting the cost of capital from EBIT. The *Lerner Index Adjusted Expected* is equal to the Lerner Index Adjusted Real but uses the historical inflation rate rather than the expected rate for the cost of capital calculation.  $\kappa_{fg}$  is the relative value of each euro of firm  $g$ 's profits in firm  $f$ 's maximization problem. *DummyCO* is a dummy variable equal to 1 if there is at least one investor who holds more than 1% of the shares in both firms in the pair. *Max of Mins*, considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$  and then computes the maximum across all the investors. *Sum of Mins*, first considers the minimum share owned by investor  $i$  in firms  $f$  and  $g$  and then sums across all the investors. *Switching costs* are estimated according to Shy (2002). *log(MarketCap)* is the logarithm of a firm's market capitalization at time  $t$ . *Big Three Holdings* is the sum of the holdings ( $\beta_{fi}$ ) of BlackRock, Vanguard, and State Street in a firm  $f$  at time  $t$ . *IHHI* is the institutional investors' concentration measure calculated as the sum of squared institutional investors' shares of the total market value of the firm held by institutional investors. *Capex/ Total Assets* is the ratio between capital expenditure and total assets.

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## Chapter 4

# Common Ownership and Investment Efficiency: Evidence from the European Context

### Abstract

This paper investigates the relationship between common ownership and investment efficiency, documenting a conditional negative (positive) association between common ownership and investment among firms that are more prone to over-investment (under-investment). Relatedly, firms with higher common ownership with their industry peers are also less likely to deviate from predicted investment levels. I demonstrate causal inference using financial institutions' mergers as an exogenous shock to common ownership.

These results suggest that one mechanism linking common ownership to investment efficiency is the information advantage of common owners, which enhances monitoring effectiveness improving firms' financial reporting quality. Results from additional analysis support the prediction that higher-quality financial reporting exacerbates the positive association between common ownership and investment efficiency. Finally, I show that common owners' information advantage is more valuable when the firm's analyst coverage is lower than the industry median and when the firm's largest owner is not a family owner.

### 1. Introduction

Common ownership arises when a common set of investors hold shares in industry peers. Theory in industrial organization suggests that when shareholders have multiple holdings in competing firms, these firms have less incentive to compete and more incentive to internalize the economic consequences of their actions on commonly owned peer firms (e.g., Hansen & Lott, 1996; Rubin, 2006; Azar, 2017; He, Huang, & Zhao, 2019). Consistently with these predictions, earlier empirical research focused on the effect of common ownership on product market competition (Azar et al., 2016, 2018; Azar, 2017; He & Huang, 2017; Rosati et al.,

2020; Koch et al., 2021). Follow-up studies show how common ownership affects multiple firm outcomes such as knowledge spillovers and innovation (Kini et al., 2019; López & Vives, 2019; Vives, 2020; Li et al., 2023), firms' coordination (Kostovetsky & Manconi, 2020; Xie & Gerakos, 2020; Freeman, 2021; Lewellen & Lowry, 2021), mergers and acquisition activity (Matvos & Ostrovsky, 2008; Harford et al., 2011; Brooks et al., 2018), monitoring effectiveness and corporate governance (Kang et al., 2018; Edmans et al., 2019; He et al., 2019), disclosure policy and financial reporting quality (Park et al., 2019; He et al., 2020; Ramalingegowda et al., 2020).

However, a limited number of studies investigate how common ownership affects corporate finance decisions. Evidence of common ownership in corporate finance is limited to cash management (Semov, 2017), cost of capital (Ni & Yin, 2021), financing of investment opportunities (Chen et al., 2021), and convergence of dividend policy among common owned firms (Di Giuli et al., 2021).

In this paper, I investigate the role of common ownership on a firm's investment efficiency. Specifically, I hypothesize that greater common ownership is associated with a reduction of over-investment, under-investment, or both.

Conceptually, I posit that a firm invests efficiently if it pursues investment projects with a positive Net Present Value (NPV) in the absence of market frictions such as moral hazard or adverse selection. In this scenario, a firm under-invests if it does not undertake potential investment opportunities with an NPV larger than zero in the absence of adverse selection. Over-investment, on the other hand, is defined as investing in initiatives having a negative net present value. Information asymmetries between managers and outside providers of capital generate market frictions, such as moral hazard and adverse selection, which may lead firms away from their optimal investment level, thus altering their investment efficiency.

Prior literature identifies higher-quality financial reporting as a potential tool to alleviate these information asymmetries, thus improving investment efficiency (e.g., Leuz & Verrecchia, 2000; Bushman & Smith, 2001; Healy & Palepu, 2001; Verrecchia, 2001; Biddle & Hilary, 2006; Lambert et al., 2007; Biddle et al., 2009).

Relatedly, a recent and growing accounting literature on common ownership (He et al., 2020; Ramalingegowda et al., 2020) shows that industry-wide information and expertise acquired by common owners enhance their ability in monitoring portfolio firms' financial reporting, thus reducing earnings management incentives and accruals. By improving monitoring efficiency, common ownership thus increases financial reporting quality.

Together, these two strands of literature provide validity for the research hypotheses underlying this paper, identifying in the financial reporting quality the channel through which common ownership may affect investment efficiency. In fact, increased common ownership indicates better industry-wide expertise and lower monitoring expenses, which improves financial reporting quality. Higher-quality financial reporting, on the other hand, reduces the information asymmetries that cause economic frictions, enhancing investment efficiency.

Following the discussion above, I hypothesize that greater common ownership is negatively associated with over-investment, under-investment, or both.

To test this prediction, I use two different approaches. First, I test if greater common ownership is associated with lower investments in firms more likely to over-invest and higher investments in firms more likely to under-invest. To classify firms, I use cash and leverage as firm-specific characteristics that previous literature has shown to affect firms' tendency to over/under-invest (Myers, 1977; Jensen, 1986).

Second, after modeling the firm-specific expected level of investment, I test the relationship between common ownership and the deviation from this expected level through a multinomial logistic regression.

Using a sample of European listed companies from the 1998-2021 period, my analysis yields two key findings. First, I find that higher common ownership is associated with lower over and under-investment. Specifically, common ownership is negatively associated with investments among firms with high cash and low leverage, shown by previous literature to be more likely to over-invest (Myers, 1977; Jensen, 1986) and positively associated with investments among highly leveraged and cash-constrained firms, shown to be more likely to under-invest. This finding suggests that the relationship between common ownership and investment is conditional on whether a firm is more prone to over or under-invest.

Second, when modeled directly at firm level, I find that firms with a higher common ownership level are less likely to depart from their expected level of investment. The results obtained are robust to the use of alternative common ownership proxies.

A potential concern with the two preceding approaches is related to the existence of unobservable variables, not included in the regressions, which can be correlated with both the dependent variable and the common ownership measures, even after the inclusion of a large set of controls and fixed effects. Another concern is that since institutional investors do not randomly invest, there are elements to suppose that the correlation between common ownership and the investment rate does not necessarily have a causal interpretation because "reverse causality" may play a role. Specifically, institutional investors may be attracted by

firms that invest more efficiently, which leads to greater overlapping ownership; alternatively, common ownership may allow firms to obtain higher investment efficiency.

To establish causality, following (He & Huang, 2017), I exploit a quasi-natural experiment of financial institutions' mergers using a Difference-in-Differences (DiD) approach to generate potential exogenous variation in common ownership.

When two institutions merge, their portfolio firms may exogenously become common owned (i.e., treatment firms). Indeed, a firm and one of its industry peers might each be owned separately by one of the two merging institutions, indicating no cross-ownership before the merger. After it, however, both firms are held by the merged institution, creating common ownership. I find that, for both firms classified as under and over-investment, treatment firms experience a significant increase in investment efficiency, relative to control firms (i.e., those that are unlikely to become common owned due to the merger),

When the DiD estimator is used to perform the multinomial logistic regression, I find that treatment firms experience a reduction in the predicted probability of falling into the over-investment group when compared to control firms, while the experiment has no significant influence on the predicted probability of falling into the under-investment group.

I next examine the role of financial reporting quality as a potential mechanism that contributes to the positive relationship between common ownership and investment efficiency.

According to the literature mentioned above, increased common ownership enhances firms' financial reporting quality and higher-quality financial reporting improves investment efficiency. As a result, to validate the effectiveness of this channel, I specifically test whether increased financial reporting quality positively affects the relationship between common ownership and firms' investment efficiency.

I define financial reporting quality as the accuracy with which financial reporting transmits information about the firm's operations, with a particular emphasis on expected cash flows, to investors and other interested parties. This definition is consistent with the FASB's Statement of Financial Account Concepts No.8 (2021) which states that the objective of general-purpose financial reporting is to provide financial information about the reporting entity that is useful to existing and potential investors, lenders, and other creditors i) to make decisions about providing resources to the entity and to ii) to help them assess the prospects for future net cash inflows to an entity.

As a proxy for financial reporting quality (*FRQuality*) I use a measure of accrual quality derived from prior literature (Dechow & Dichev, 2002; McNichols, 2002) and extensively

used in prior works (e.g., Aboody et al., 2005; Francis et al., 2004, 2005; Core et al., 2008; Biddle et al., 2009).

Results from my analysis provide support for the hypothesis that the positive (negative) association between common ownership and investments in firms that are more likely to under (over) invest is more pronounced for firms with higher quality financial reporting.

Finally, to further explore the role of common ownership in increasing investment efficiency, I conduct several additional analyses on the conditions under which common ownership is likely to have a larger impact.

Specifically, I focus on the information advantage of common owners which constitutes the main economic driver underlying the association between common ownership and investment efficiency. In fact, industry-wide knowledge and expertise acquired through multiple holdings in the same industry give common owners an information advantage which is larger when there is more information asymmetry between the managers of the firm and the external providers of capital. Consistent with this argument, using analysts' coverage as a proxy of available public information, I find that the effect of common ownership on a firm's investment efficiency is stronger when the firm has an analyst coverage lower than the median-industry coverage. Relatedly, I also find that common ownership has a greater effect on investment efficiency in firms with no large family owners because family ownership mitigates managerial opportunism and reduces agency costs, making the information advantage of common owners less valuable.

The contributions of this paper are threefold.

First, it primarily contributes to the growing literature investigating the effect of common ownership on corporate finance decisions (Semov, 2017; Chen et al., 2021; Ni & Yin, 2021). Extending this line of research, I provide the first study on the effect of common ownership on investment efficiency, in terms of lower under and over-investment. The results link the increase in investment efficiency to improved monitoring effectiveness and financial reporting quality. In addition, this is the first study to provide evidence about the effect of intra-industry common ownership in Europe using a broad sample of industries.

Second, this paper also contributes to the literature that examines the determinants of investment efficiency from different aspects (Biddle et al., 2009; Chen et al., 2011; Ward et al., 2020) identifying common ownership as a further factor that may affect the achievement of the optimal investment target.

Third, the final contribution of this paper is empirical since it exploits a new dataset including quarterly holdings of European publicly traded firms referring to individuals, corporations,

governments, government agencies, and institutional investors. This dataset, built by collecting data from Refinitiv Eikon, does not suffer from the data quality issues of Thomson's Spectrum database, mostly used by prior research and containing only data from 13F mandatory filings. In addition, my dataset reflects a "money-manager view", this means that it combines one or more filings to connect the holdings to the firm that manages the investments<sup>1</sup>.

The structure of this paper is as follows. Section 2 reviews the literature and describes the hypotheses' development. Section 3 presents research methodologies. Section 4 introduces the data. Section 5 presents the analyses of the main empirical results and robustness tests. Section 6 assesses the endogeneity issue. In Section 7 I test the financial reporting quality channel. Additional analyses on the magnitude of the impact of common ownership on investment efficiency are conducted in Section 8. Section 9 concludes.

## **2. Related literature and research hypotheses**

### **2.1 Comprehensive review of the existing literature on common ownership**

Common ownership emerges when a set of investors own shares in a common panel of firms. The recent increase in common ownership, especially by institutional investors, gave rise to a new strand of literature that examines its economic consequences with a particular focus on the US equity market (see Schmalz (2018, 2021) for an in-depth literature review).

Of particular interest is the case in which common owned firms belong to the same industry and thus are competitors in the same product market.

Industrial organization theories predict that common ownership may induce industry peers to develop an anticompetitive incentive: if firms engage in aggressive competition (i.e., price undercutting, entry into new markets, development of a new product, patent races, etc.) they gain an advantage relative to the other firms in the same industry but their actions hurt the total portfolio value of the common investors represented by the combined profits of all firms (Hansen & Lott, 1996; O'Brien & Salop, 2000; Gilo et al., 2006; Rubin, 2006; Azar, 2017). Thus, common ownership may lead common owned firms to compete less aggressively and

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<sup>1</sup> The European ownership dataset used in this paper was built together with Simone Caldarelli and it is also used in Caldarelli (2023).

internalize the externalities that their actions produce on other firms, thereby increasing common owners' portfolio value.

Consistently with this theoretical intuition, earlier empirical research focuses on the effects of common ownership on product market competition.

Azar et al. (2018) examine whether changes in common ownership concentration in a given airline route over time are associated with changes in ticket prices on the same route. According to their findings, the ticket prices for the average U.S. airline route are between 3% and 7% higher than they would be if the airlines were under separate ownership. However, Kennedy et al. (2017) and Dennis et al. (2020) find no evidence that common ownership raises ticket prices after accounting for the endogeneity of market shares in the measure of market concentration.<sup>2</sup> Studying the U.S. banking sector, Azar et al. (2016) find that the combination of common ownership and cross-ownership leads to higher prices on retail deposit products and lower deposit interest rates. These early findings drew a lot of attention and started a strong debate regarding benefits and costs related to common ownership, as well as the potential need for antitrust remedies (Elhauge, 2016, 2017, 2020; Posner et al., 2017; Patel, 2018; Scott Morton & Hovenkamp, 2018; Posner, 2021).

While Azar et al. (2016, 2018) both look at a single highly regulated industry with high barriers to entry, low variability and discrimination in prices, and high regulatory oversight, Koch et al. (2021) conduct a study across a broad sample of industries and find that greater common institutional ownership is neither related to significantly higher industry profitability and product market prices nor negatively associated with measures of non-price competition.

The empirical evidence on the effect of common ownership on product prices is currently focused on the US market. To the best of my knowledge, Rosati et al. (2020) is the first work to conduct a comprehensive study on the extent of common ownership in the EU and to present an empirical analysis of the effect of common ownership on the profitability of the Beverage sector. Using the BlackRock and BGI merger as a source of exogenous variation in common shareholdings, they perform a Difference-in-Differences analysis and find that firms already owned by BlackRock and/or BGI have on average a Lerner Index that is 0.07 higher than control firms after the merger, suggesting that the merger event increase the profitability of firms already exposed to one or both the counterparties.

If common ownership reduces the incentive to compete, it may also imply a reduction in the incentive to invest. Consistently with this prediction, Gutiérrez and Philippon (2017) conclude

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<sup>2</sup> See Azar et al. (2018b) for the reply.

that industries with a higher level of common ownership show lower investment levels despite high profits.

Alternatively, López and Vives (2019) show that since common ownership leads to the internalization of rivals' profits, it increases R&D investments and output for high enough spillovers, and vice versa for low levels of spillovers. In presence of an intermediate level of spillovers, ownership overlapping reduces output while increasing R&D investment. Using the same framework, Kini et al. (2019) argue that common ownership mitigates the fear of involuntary knowledge spillover to rivals because knowledge created by investments in one firm produces benefits for other firms in the common owners' portfolios. According to this prediction, they find empirical evidence of a positive association between common ownership, innovation, and competition. Vives (2020), using a model substantially based on López and Vives (2019), investigates the impact of overlapping ownership on market power when there are knowledge spillovers across peers, finding lower production costs and higher markups.

Several studies investigate whether common ownership affects some form of coordination among firms. He and Huang (2017), using a comprehensive sample of US firms from different industries, find that cross-held firms experience greater market share growth if compared with non-cross-held firms. They also demonstrate that higher common ownership within the same industry promotes product market collaboration through acquisitions, strategic alliances, and joint ventures while enhancing innovation productivity and operating profitability.

Similarly, Matvos and Ostrovsky (2008) conclude that in case of mergers with negative acquiror announcements returns, institutional investors owning both the acquiror and the target are more likely to vote in favor of the merger because they offset the losses for the acquiror with the gains deriving from the target company. Brooks et al. (2018) find that when two firms are cross-owned by institutional investors, the likelihood for them to merge increases, and the outcomes of the deal are influenced by the cross-ownership status. However, Harford et al. (2011) argue that the size of the holdings is too small to incentivize cross-holders to affect the outcome of a merger.

Lewellen and Lowry (2021), in a more recent study, identify the limitations of different identification approaches used in literature to determine the effects attributed to common ownership and find no evidence that common ownership increases firm coordination and strategic alliances. They also find no evidence that common ownership causes an increase in operating performance or a decrease in investment expenditure.

Other studies show evidence of coordination among common owned firms along other dimensions. For example, Freeman (2021) finds that ownership overlapping between

customer-supplier improves the duration of the relationship along the supply chain making it value-enhancing.

According to Kostovesky and Manconi (2020), greater institutional common ownership between firm pairs results in higher intensity of each other's patent citations, implying that institutional ownership facilitates the transmission of innovation across their portfolio firms.

Relatedly, Xie and Gerakos (2020) find that, in the pharmaceutical industry, institutional horizontal shareholding between the brand-name company and the generic manufacturer involved in a patent litigation increases the probability to conclude a settlement agreement in which the former often pays the latter for to delay the entry in the market.

The following sub-Section introduces the strands of common ownership literature that are directly related to the research questions addressed in this paper.

## **2.2 Related literature on common ownership and investment efficiency**

This work contributes to the growing literature investigating the role of common ownership on corporate finance decisions, as well as to the existing body of works that examine the determinants of investment efficiency.

A limited number of studies investigate how common ownership affects corporate finance decisions. Evidence of common ownership in corporate finance is limited to cash management (Semov, 2017), cost of capital (Ni & Yin, 2021), financing of investment opportunities (Chen et al., 2021), and convergence of dividend policy among common owned firms (Di Giuli et al., 2021).

According to Semov (2017), growing market concentration due to common ownership, measured by the Modified Herfindahl-Hirschman Index, reduces firm cash holdings: this result is mainly driven by constrained firms. Ni and Yin (2021) provide empirical evidence that firms that share common owners have a significantly lower cost of equity capital. They also observe lower overall risk and higher stock liquidity in common owned firms. Chen et al. (2021) find that the presence of institutional common owners facilitates firms to obtain financing when they have investment opportunities: this result holds even more for firms with more reliance on external financing, for those with lower financial reporting quality, and those facing more product market competition.

Di Giuli et al. (2021) demonstrate that common owners present a dividend policy style because the dividend policies of firms newly joined to their portfolio move towards the dividend policies of the firms already present in the portfolio.

Follow-up research shows evidence of common ownership affecting monitoring effectiveness and corporate governance.

The existence of commonalities among industry peers in terms of business environment, geographic locations, products, financial reporting management, etc. allows owners with multiple holdings in the same industry to develop industry-wide expertise. This mechanism implies that information and governance experience acquired by monitoring one portfolio firm can be applied also to other industry-peer they have in their portfolio, thus reducing information acquisition and processing costs of monitoring peer firms. Kang et al. (2018) show that institutions' monitoring effectiveness is related to the number of their blockholdings: the number of blocks is positively associated with CEO-turnover performance sensitivity, abnormal returns around forced CEO turnover, 13D filings, and change in firm value.

Additionally, He and Huang (2019) argue that common owners are more incentivized to exert active monitoring over management since they play a role in alleviating the inefficiency associated with corporate governance externalities. They find that institutional owners' active role in corporate governance and monitoring over management is exploited through a greater likelihood that such institutions vote against management on shareholders-sponsored governance proposals.

Common ownership can also strengthen governance through the exit mechanism as it gives investors more flexibility upon which asset to sell in the event of a liquidity shock, thus increasing price informativeness (Edmans et al., 2019).

Lin (2022) shows that firms' creditors, who are often the most informed monitors, account for the benefit of common owners' governance and tend to view common owners as allied monitors, reducing their monitoring effort and establishing less restrictive covenants on firms with higher common ownership.

Relatedly, another set of studies shows that, by improving monitoring efficiency, common ownership increases firms' financial reporting quality. Ramalingegowda et al. (2020) argue that industry-wide information and expertise acquired by common owners enable them to better monitor their portfolio firms' financial reporting and to discipline earning management. Furthermore, since firms' financial reports are used by industry peers to identify profitable investment opportunities, accounting misstatements by one firm may distort its peers' investment decisions. It follows that earning management can also be mitigated because

common investors internalize the negative externalities that financial misreporting produces on peer firms' investments. He and Huang (2020) document a negative association between common ownership and accruals identifying, in addition to the "financial reporting monitoring" channel described above, the so-called "product market monitoring channel" according to which common ownership, by lowering competition and reducing existing excess capacity, may reduce investment-related accruals through curtailments.

This paper also relates to prior research which has looked at the factors influencing investment efficiency from three different aspects. The first aspect reflects an accounting perspective and connects investment efficiency with firms' financial reporting quality (Biddle & Hilary, 2006; McNichols & Stubben, 2008; Biddle et al., 2009; Beatty et al., 2010; Chen et al., 2011), mandatory adoption of IFRS accounting principles (Chen et al., 2013), firm's accounting conservatism (Lara et al., 2016) and selection of auditors (Elaoud & Jarboui, 2017). The second aspect associates investment efficiency with the impacts of government, in particular concerning governmental intervention (Chen et al. 2011), government officials' corporate site visits (Wang et al., 2019; Yu et al., 2020), government integrity (Du et al., 2018) and state-owned enterprises (O'Toole et al., 2016). The third aspect investigates the effect of corporate governance, including executive compensation (Eisdorfer et al., 2013), CEOs' managerial ability (Gan, 2019), board diversity (Ullah et al., 2020), institutional ownership structure (Cao et al., 2020; Ward et al., 2020), and corporate social responsibility (Benlemlih & Bitar, 2018) on investment efficiency.

Following the monitoring role of common owners, this study contributes to both strands of literature introduced in this Section providing new insights and unprecedented evidence into the relationship between common ownership and investment efficiency by focusing on the information acquisition channel of financial reporting.

## **2.3 Research hypotheses**

In this paper, I investigate the role of common ownership on firms' investment efficiency.

Conceptually, I posit that a firm invests efficiently if it undertakes investment projects with a positive Net Present Value (NPV) in the absence of market frictions such as moral hazard or adverse selection. Under this scenario, a firm under-invest if it does not enter available investment opportunities with NPV greater than zero in the absence of adverse selection. Conversely, over-investment consists in investing in projects with a negative NPV.

According to the neo-classical theory, corporate investment policy is related only to marginal  $q$ , that is the value of capital relative to its replacement cost (Yoshikawa, 1980; Hayashi, 1982; Abel, 1983). The optimality condition requires the equality of marginal  $q$  to the marginal effective cost of investment, once explicitly considered the adjustment costs of installing new capital.

However, prior literature recognizes the possibility for firms to deviate from this optimality condition because information asymmetries between managers and outside providers of capital generate market frictions, such as moral hazard and adverse selection, which may alter firms' investment efficiency. Recently, Jiang and Yuan (2018) and Ward et al. (2020) further identify CEOs' excessive risk-taking and shrinking behaviors as two managerial actions which could generate respectively firm over and under-investment.

Models of moral hazard predict that when there are conflicts between principal-agent interests, firms' managers may not act in the best interest of the shareholders and over-invest in initiatives with negative NPV if firms have adequate resources (Berle & Means, 1932; Jensen & Meckling, 1976). In fact, the possibility to over or under-invest in case of moral hazard is conditional on the availability of capital. Managers also tend to grow companies beyond their optimal size (Jensen, 1986; Blanchard et al., 1994), capital providers may be aware of this tendency and reduce the capital supply in advance, which may lead to ex-post under-investment.

It is also well-recognized that adverse selection is an important barrier that prevents the firm from obtaining financing (e.g., Myers & Majluf, 1984; Fama & French, 2002; Frank & Goyal, 2003; Chang et al., 2006, 2009), especially in the context of financing investment opportunities (Smith & Watts, 1992; Gaver & Gaver, 1993).

According to adverse selection models, if managers are more informed about a firm's prospects than investors, they will attempt to sell overpriced stocks (i.e., a lemon's problem). If they succeed, they may decide to over-invest the gains (e.g., Baker et al., 2003). Rational investors, on the other hand, may respond by limiting capital in advance, which may result in ex-post under-investment.

The discussion above shows how market frictions generated by information asymmetries may affect the firms' investment efficiency. Since long-term firms' market value is harmed by both over and under-investment (e.g., Titman et al., 2004; Cai & Zhang, 2011), shareholders are strongly incentivized to monitor managers' investment policy decisions and to promote firms' investment efficiency (e.g., Ward et al., 2020).

Prior literature identifies higher-quality financial reporting as a potential tool to alleviate information asymmetries, thus improving investment efficiency (Leuz & Verrecchia, 2000; Bushman & Smith, 2001; Healy & Palepu, 2001; Verrecchia, 2001; Biddle & Hilary, 2006; Lambert et al., 2007; Biddle et al., 2009). For example, it is well known that financial reporting represents an important source of information for investors (e.g., Bushman & Indjejikian, 1993; Holmstrom & Tirole, 1993; Kanodia & Lee, 1998) and it is also used to monitor managerial investment activities (Bushman & Smith, 2001; Lambert, 2001), this allows to reduce moral hazard and improve investment efficiency.

Higher-quality financial reporting is also associated with a reduction of adverse selection costs which enables the company to obtain external capital at a lower cost and reduces the likelihood of having excess cash as a result of stock mispricing (Myers & Majluf, 1984; Chang et al., 2009).

The recent and growing accounting literature on common ownership cited above (He et al., 2020; Ramalingegowda et al., 2020) finds that, by enhancing monitoring efficiency, common ownership improves financial reporting quality in terms of reduction of earnings management incentives and accruals.

The research hypotheses underlying this work rely on the connection between these two strands of literature, identifying the financial reporting quality as the channel through which common ownership may affect firms' investment efficiency.

Indeed, increased common ownership indicates better industry-wide expertise and lower monitoring expenses, which improves financial reporting quality. Higher-quality financial reporting, on the other hand, reduces the information asymmetries that cause economic frictions, enhancing investment efficiency.

Based on the discussion above, I hypothesize that greater common ownership improves firms' investment efficiency in terms of a reduction of over-investment, under-investment, or both.

I further suppose that the positive association between common ownership and investment efficiency is more pronounced in firms with higher financial reporting quality.

Specifically, I state my baseline hypothesis as follows:

**Hypothesis 1.** Common ownership is negatively associated with over and under-investment.

Moreover, the above-mentioned points lead to the formulation of the following hypothesis:

**Hypothesis 2.** The negative association between common ownership and over/under-investment is more pronounced in firms with higher financial reporting quality.

### 3. Research design

To test whether higher common ownership is associated with higher under-investment, lower over-investment, or both (H1) I use two different approaches.

First, I examine the relationship between common ownership and the firm's investments based on the firm's propensity to over or under-invest. Specifically, I test if greater common ownership is associated with lower investments in firms more likely to over-invest and higher investments in firms more likely to under-invest.

Second, after modeling the firm-specific expected level of investment, I test the relationship between common ownership and the deviation from this expected level, which constitutes the second proxy for over/under-investment.

#### 3.1 Conditional relation between common ownership and investment

First, I test if greater common ownership is associated with lower (higher) investments in firms that are more likely to over (under) invest. I estimate the following regression through a fixed effects model using a within-regression estimator

$$Investment_{i,t} = \alpha + \beta_1 CO_{i,t-1} + \beta_2 CO_{i,t-1} \times OverFirm_t + \beta_3 OverFirm_t + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t} \quad (1)$$

The dependent variable *Investment* is calculated as the sum of capital expenditure and acquisition of business less cash receipts from the sale of Property, Plant, and Equipment multiplied by 100 and divided by lagged total assets. This computation allows to consider of a comprehensive measure of corporate investment and reflects an accounting framework (Richardson, 2006) to estimate total investment as the difference between total investment and

assets sales<sup>3</sup>. *CO* is one of the common ownership proxies that will be introduced in the next Section. *Overfirm* is a proxy for over/under-investment. Following Biddle (2009), to classify firms, I use cash and leverage as firm-specific characteristics that previous literature has shown to affect firms' tendency to over/under-invest (Myers, 1977; Jensen, 1986).

In particular, firms with low cash are more likely to be qualified as financially constrained. On the other hand, firms with high cash available are more likely to inefficiently use the excess cash and thus to over-invest (Jensen, 1986; Blanchard et al., 1994; Opler et al., 1999).

The firm's leverage is used as another proxy for the firm's liquidity. High-levered firms find it more difficult to access credit and obtain new debt and are forced to under-invest (Myers, 1977). Following this reasoning, cash-constrained, and high-levered firms are considered to be more prone to under-investment. Vice versa, for unlevered firms with high cash balances. To build the partitioning variable I first multiply the leverage variable by minus 1 so that it is increasing, like cash, with the likelihood of over-investing. Then I rank firms into deciles based on the value of their cash-to-assets ratio and their level of leverage and I rescale them from 0 to 1. To minimize the measurement error linked to the construction of the individual variables, I create the final partitioning variable as the average of the ranked values of cash and leverage. Firms in the top decile, those for which the variable assumes values near 1, are unlevered firms with high cash balances and thus more prone to over-invest.

Looking at Eq. (1),  $\beta_1$  depicts the relationship between common ownership and investment when the variable *Overfirm* is near zero. This suggests that this coefficient measures the association between common ownership and investment for firms with the highest level of debt and the lowest level of cash which are more likely to under-invest.

Vice versa,  $\beta_1 + \beta_2$  depicts the relationship between common ownership and investment for firms in the top decile where the variable *Overfirm* has values close to one.

According to H1, greater common ownership is negatively associated with under-investment. To test this prediction, I want that the  $\beta_1$  is greater than zero ( $H1: \beta_1 > 0$ ): when under-investment is more likely, greater common ownership increases the firm's investment level thereby enhancing investment efficiency.

The first research question also predicts that greater common ownership is negatively associated with over-investment. To test this hypothesis, I use the joint effect of  $\beta_1 + \beta_2$  and I want this sum to be less than zero ( $H2: \beta_1 + \beta_2 < 0$ ): when over-investment is more likely, greater common ownership reduces firm's investment level improving investment efficiency.

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<sup>3</sup> The inclusion of R&D expense in the construction of this variable was not possible due to lack of data.

To validate my hypothesis, since I want  $\beta_1 > 0$  and  $\beta_1 + \beta_2 < 0$ , it follows that the coefficient on the interaction term  $\beta_2$  must be negative.

Following prior literature (e.g., Dechow & Dichev, 2002; Francis et al., 2005; Biddle & Hilary, 2006; Biddle et al., 2009; He et al., 2020), I introduce in the regression a vector of controls for firm's characteristics that may affect investments such as size, leverage, cash, the ratio of CFO to sales and tangibility, computed as the ratio between Property Plant and Equipment and total assets<sup>4</sup>.

I also control for the firm's frequency of negative earnings realizations through a dummy variable (*Loss*) that is equal to 1 if the firm in year  $t$  reports negative earnings before extraordinary items.

Among the controls also include the volatility of cash flows which affects a firm's investment levels and serves as a proxy for the cost of acquiring external capital (Minton & Schrand, 1999). The effect of a firm's market power on its investment decisions is considered in the regression through the variable *Excess PCM* following Peress (2010) and Kubick et al. (2015). The price-cost margin is computed as the ratio between operating income and sales. The excess price-cost margin is the difference between a firm's price-cost margin and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. The industry *PCM* is the weighted average of the price-cost margins of the firms included in the industry with the weights represented by their market shares (firm's sales over total industry sales).

Further, I control for institutional ownership through the variable *BlockInstOwn*. Among all the investors in a firm, I first identify the institutional ones and then the blockholders among them (those with an ownership share greater than 1%). Then I compute the sum of institutional blockholders' ownership shares in the firm for the quarter and I averaged across the four quarters of a fiscal year to obtain the variable *BlockInstOwn*.

In the regression, I include firm-fixed effects to mitigate the concern for time-invariant omitted variables that are correlated with both *Investment* and common ownership. I also include year dummies to account for any variation in the dependent variable that occurs over time and that is not attributed to the explanatory variables included in the model.

I cluster standard errors at firm level to account for heteroskedasticity and cross-sectional correlation in the error terms.

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<sup>4</sup> I omit R&D expense from this set due to lack of data. I exclude Leverage and Cash from the controls since these variables are used to compute *Overfirm*. Untabulated results show that including these variables does not affect the conclusions.

### 3.2 Deviation from the expected level of investment

The previous Section examines whether greater common ownership is associated with lower (higher) investments in firms that are more likely to over (under) invest.

In this Section I present the second approach to address the first research question: I investigate if greater common ownership reduces the likelihood of a firm to deviate from its expected level of investment.

That is, whereas the first approach analyzes if common ownership reduces the differences between actual and predicted investments by conditioning on whether a firm is more likely to under/over-invest, in this Section I directly model if greater common ownership is associated with a lower likelihood that a firm over or under-invests.

I estimate the following regression

$$Investment_{i,t} = \beta_0 + \beta_1 SalesGrowth_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where the variable *Investment* is calculated in the same way as in the previous model and *SalesGrowth* represents the percentage change in sales from year  $t - 2$  to  $t - 1$ .

This model relies on the neoclassical framework (Hayashi, 1982) according to which when markets are perfect, the marginal  $Q$  is solely able to explain corporate investment. Since marginal  $Q$  is notoriously hard to measure, I use *SalesGrowth* as a proxy of investment opportunities. Nonetheless, this choice is justified if we consider that an increase in sales is a symptom of an increase in demand for a company's products in the future (Morck et al., 1990). To satisfy the growing demand may be required new production facilities and investment is required to achieve this expansion (Houcine, 2013).

In Eq. (2), firm-year residuals, which represent deviations from expected investments, are saved and their magnitude is used as a firm-specific proxy for investment inefficiency.

Specifically, I rank firm-year residuals into quartiles: firm-year observations in the first quartile, the most negative residuals, are classified as under-investing while firm-year observations in the fourth quartile are classified as over-investing. The observations in the middle quartiles are considered the benchmark group.

Based on this classification I form a categorical variable called *Investment State* which takes the value of 1 for firm-year observations in the first quartile, the value of 2 if the residual is in the middle two quartiles and the value of three if it is in the fourth quartile.

*Investment State* is used as a dependent variable in the following multinomial logistic regression where the middle quartiles are considered as the reference category

$$Investment\ State_{i,t} = \alpha + \beta_1 CO_{i,t-1} + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t} \quad (3)$$

The set of control variables is the same used in Eq. (1) but in this case, I also include leverage and cash, excluded from Eq. (1) since they are used to build the variable *Overfirm*. Standard errors are corrected for heteroskedasticity and clustered at firm and year level. Year fixed effects are used to control for factors changing each year that are common to all firms for a given year such as effects due to business cycles.

The multinomial logit model predicts simultaneously but separately the likelihood that a firm will be in the extreme quartiles (under or over-investment) rather than in the middle quartiles as a function of common ownership.

My research hypothesis predicts that greater common ownership reduces the likelihood that a firm will be in the over/under-investment quartile rather than in the benchmark group: this is equivalent to saying that greater common ownership increases the likelihood that a firm will invest more efficiently.

Looking at Eq. (3) this means that I want the coefficient on the common ownership variable ( $\beta_1$ ) to be less than zero both for over and under-investment. Remember that in a multinomial logit the parameter estimate is relative to the reference/benchmark group, and it is expressed in log-odds unit. It follows that the parameter estimate  $\beta_1$  represents the change in the relative log-odds of being in the over/under-investment quartile rather than in the benchmark group given a one-unit increase in the common ownership variable (or in the presence of common ownership if common ownership is a dummy), holding the other variables in the model constant.

## 4. Data

### 4.1 Sample selection

Data consist of European listed firms with a market cap greater than € 100.000 during the period 1998-2021<sup>5</sup>. To be included in the sample a firm-year must have positive total assets and non-missing industry classification information; the firm must also belong to an industry with at least 15 firms.

I also exclude firms in the financial services (NAICS codes from 521 to 525) and utilities (NAICS 221) from the sample because these are regulated industries and their investment policies have different natures and reflect other strategic decisions.

I retrieve quarterly ownership data, analysts' coverage information, and financial statements information from Refinitiv Eikon. The Bureau van Dijk Orbis Database is used to extract information regarding the status ("family owner" or not) of a firm's Global Ultimate Owner (GUO).

The ownership data include quarterly holdings data of individual investors, corporations, governments and government agencies, and institutional investors<sup>6</sup>. Refinitiv obtains ownership information from stock exchange filings, trade announcements, company websites, company annual statements, and financial newspapers.

My dataset has significant advantages over Thomson's Spectrum database which is used by most other papers on common ownership. In fact, it has been frequently noted that Thomson's Spectrum database suffers from gaps in coverage and errors relative to the source of documents. The information provided is limited to the ownership disclosure reported in the 13F filings, which contain quarterly U.S. equity holdings by institutional investment managers with more than €100 million in Assets under Management (AuM). Moreover, Thomson's Spectrum database follows the so-called "as filed view", which means that it shows the holdings corresponding to the owner that filed the 13F.

The ownership data used in this paper are not limited to institutional holdings and do not suffer from the limitations of Thomson's Spectrum database. Furthermore, similar to the dataset

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<sup>5</sup> The dataset includes public companies with stocks listed in 19 countries: France, Switzerland, Netherlands, Denmark, Germany, United Kingdom, Russia, Sweden, Italy, Finland, Spain, Ireland, Republic of Belgium, Austria, Norway, Portugal, Greece, Luxembourg, Poland.

<sup>6</sup> The types of investors considered as "institutional" are the following: investment advisors, Sovereign Wealth Funds, Pension Funds, Banks and Trusts, Insurance Companies, Private Equity Funds, Hedge Funds, Foundations, Venture Capital Funds, Pension Funds, Endowment Fund, Institutions, Funds, Closed-End Funds, Exchange-Traded Funds.

employed by Banal-Estañol et al. (2021, 2022), my ownership dataset adopts a “money-manager view”, this means that it combines one or more filings to connect the holdings to the firm that manages the investments.

Although my ownership database does not suffer from Thomson’s Spectrum database data quality data issues, I modify it following Azar et al. (2018) by aggregating the holdings of the top 10 institutional investors per AuM<sup>7</sup> at the fund-family level. The rationale behind this choice is rooted in the reality that the primary driver of fund families' incentives is the value of their total Assets under Management. Additionally, the centralized decision-making power at the fund-family level is highlighted by the tendency of institutional investors to exercise governance decisions and shareholders’ voting rights of all individual funds jointly at the family level (Appel et al., 2016; Fichtner et al., 2017).

As regards accounting data, for those firms which file and publish annual financial statements within May year  $t + 1$ , Refinitiv Eikon considers the closing value as the value at year  $t$  end date, while for those firms which file and publish their financial statements between May and December of year  $t + 1$ , then the closing values are considered as year  $t + 1$  end date.

Data about financial institutions’ mergers are based on hand-matching of the ownership data and Refinitiv Security Data Company (SDC) Mergers and Acquisitions database. To alleviate the effect of outliers, I winsorize all continuous variables at the 1<sup>st</sup> and 99<sup>th</sup> percentile. The above sample selection process results in a final sample of 4.595 firms listed in Europe from 1998 to 2021.

## 4.2 Measuring common ownership

To construct the common ownership variables, I use quarterly holdings from Refinitiv Eikon Database from 1998 to 2021. I start in 1998 because ownership data are available from this year.

The key measure of common ownership is represented by the so-called “profit weight” defined as

$$\kappa_{fg} = \frac{\sum_i \gamma_{fi} \beta_{gi}}{\sum_i \gamma_{fi} \beta_{fi}}$$

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<sup>7</sup> The Top 10 institutional investors per AuM as of 31/12/2020 are: Blackrock, State Street, Vanguard, Fidelity, Morgan Stanley, UBS Group, JP Morgan, Allianz, Goldman Sachs, Amundi, AXA Group.

where  $\kappa_{fg}$  represents the weight that firm  $f$  puts on every euro of its industry peers'  $g$  profits in its maximization problem. Industry peers for the calculation of  $\kappa_{fg}$  are defined as firms belonging to the same 5-digit NAICS.

The basic idea is that, when firms have common ownership, the maximization of the company's profit no longer coincides with the maximization of shareholders' returns due to their interests in other firms. To address this issue, the theoretical literature proposes that a firm's  $f$  objective function is represented by the linear combination of firm  $f$ 's profits and the profits of all the other firms  $g$  in which common owners hold shares. The "profit weights", as defined above, are the weights that firm  $f$  puts on every euro of its industry peers'  $g$  profits in its objective function.

This common ownership proxy depends on  $\beta_{fi}$  and  $\beta_{gi}$  which reflect the fraction of the total shares outstanding of firm  $f$  and  $g$  owned by shareholder  $i$ . This primitive measure of common ownership also includes  $\gamma_{fi}$ , which is the Pareto weight that a firm places on its shareholders. Given that the researcher cannot observe this weight, much of the literature relies on the proportion control assumption, which assumes  $\gamma_{fi} = \beta_{fi}$ .

This measure, introduced by Azar (2012) and adopted by Azar and Vives (2021) as well as by Rosati et al. (2020), Boller & Scott Morton (2020), and Backus et al. (2021), is also a component of the MHHI measure of O'Brien and Salop (2000).

Under the proportional control assumption  $\gamma_{fi} = \beta_{fi}$ , I compute this common ownership proxy quarterly for each pair of firms belonging to the same 5-digit NAICS industry, creating for each quarter a  $n \times n$  matrix for each industry where  $n$  is the number of firms. Then, I calculate the average of each row in the matrix, that is the average  $\kappa$  that firm  $f$  poses on its industry peers in each quarter. In the end, I averaged among the four quarters in a given year. This measure represents the first common ownership proxy.

In robustness checks, I also use five alternative cross-ownership variables following He and Huang (2017). To construct these measures, I define blockholding as an ownership share exceeding 1% of the firm's outstanding shares. In contrast with He and Huang (2017), I reduce the ownership threshold from 5% to 1%, following Banal-Estañol et al. (2021, 2022) and Lin (2022), in order to avoid losing too many observations and because an investor with 1% ownership still has the incentive and bargaining power to influence strategic decisions (Jiang et al., 2010).

I define a cross-blockholder as an investor that holds an ownership share greater than 1% (a blockholding) in more than one firm in the same 3-digit NAICS industry in the same quarter.

The first alternative measure of common ownership is *CrossDummy*, a dummy variable equal to 1 if the firm is cross-held by at least one blockholder in any of the four quarters in a fiscal year and zero otherwise. The second one is *NumConnected* which represents the number of same-industry peers that share any common blockholder with the firm in a given quarter. The third alternative measure used in the robustness checks is which is the number of unique blockholders that cross-hold the firm in a given quarter. The fourth measure, *AvgNum* is computed in two steps: first, I calculate the number of same industry peers, excluded the firm into consideration, blockheld by each cross-holding investor in a given quarter, and then I calculate the average among such cross-holding investors for the quarter. The last measure is *TotalCrossOwn* which is the sum of the ownership shares of each cross-blockholding institution in a given firm for the quarter.

Except for the first measure, *CrossDummy*, I first calculate each cross-ownership measure quarterly, and then I average the results over the four quarters of a fiscal year to obtain the annual measures.

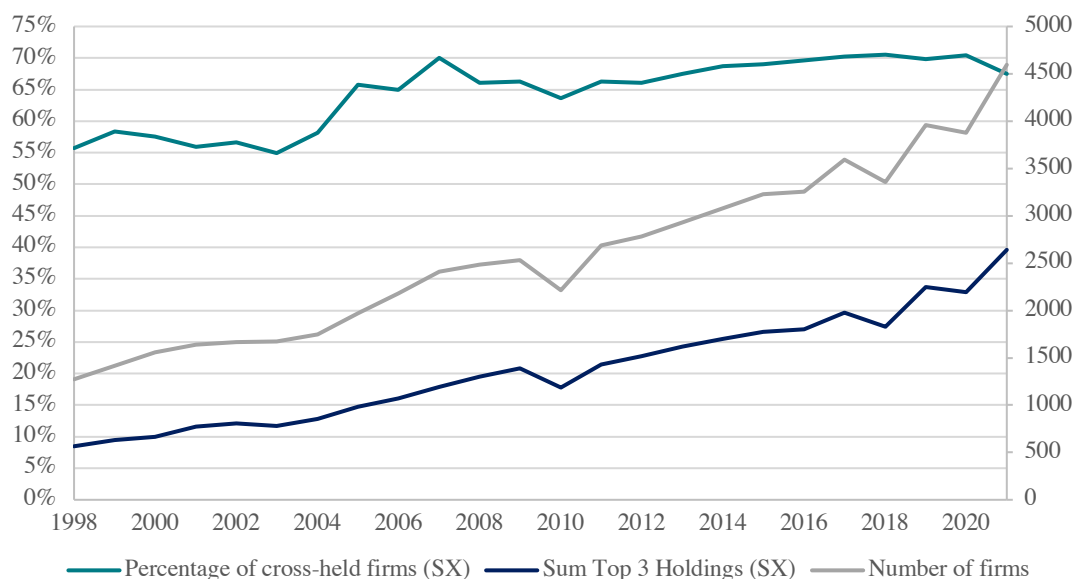
To correct for the skewness in these variables and limit the influence of large values, in the regressions I use the natural logarithm of one plus *NumConnected*, *NumCross* and *AvgNum*.

### 4.3 Summary statistics

Fig.1 shows the pattern of common ownership from 1998 to 2021. A blockholder is defined as an investor who owns at least 1% of the firm. A firm is defined cross-held if at least one investor blockheld the firm and another firm in the same three-digit NAICS industry.

The grey line represents the total number of European public firms considered in the analysis per year. The green line shows how the fraction of European listed firms cross-held in any fiscal year had increased from around 56% to 68% between 1998 and 2021, indicating that common ownership across industry competitors is becoming increasingly widespread in Europe. The blue line plots the sum of the holdings of the top three investors averaged among all firms. From 1998 to 2021, the “Top Three Holdings” grew significantly from roughly 9% to 40%, indicating an increasing concentration in the ownership structure which may also entail a concentration of corporate control. In fact, the rise of institutional investors' Assets under Management at the expense of direct stock ownership by individual households is one of the factors impacting corporate ownership concentration. This phenomenon not only had a

**Figure 1: Common ownership pattern in Europe**



This figure plots the pattern of common ownership among European listed companies from 1998 to 2021. A blockholder is defined as an investor who owns at least 1% of the firm. A firm is defined as cross-held if at least one investor blockheld the firm and another firm in the same 3-digit NAICS industry. The green line shows the fraction of European public companies cross-held in any fiscal year. The grey line represents the total number of European public firms considered in the analysis per year. The blue line plots the sum of the holdings of the top three investors averaged among all firms for each year.

significant impact on the U.S. equity market but also on other jurisdictions where dispersed ownership was considered the norm (Fichtner et al., 2017; Fichtner, 2020).

Table A1 in the Appendix shows the distribution of cross-held firms among different 3-digit NAICS industries during the most recent fiscal year of analysis, 2021. Each industry has a considerable proportion of cross-held firms, with a higher concentration in Food and Beverage stores (NAICS 445), Publishing industries except internet (NAICS 511), and Paper Manufacturing (NAICS 322). On the other hand, the Textile Mills industry (NAICS 313) does not have any cross-held firms whereas cross-held firms are less likely to be found in Crop Production (NAICS 111), Performing Arts, Spectator Sports, and Related Industries (NAICS 711), and in the Accommodation industry (NAICS 721).

Panel A of Table A2 (see the Appendix) provides summary statistics for the variables used in this study. The mean (median) value of *Investment* across all firm-years is equal to 9.22% (5.33%) of prior year's assets. The mean (median) firm in the sample has a financial reporting quality proxy equal to -0.43 (-0.09). Each firm on average poses a weight equal to 0.015 on its industry peers' profits in its maximization problem. The mean value of *CrossDummy* is equal to 0.36 suggesting that 36% of the firms included in the sample are cross-owned by at least

one investor. The average number of same industry peers that share at least a common blockholder is 1.24 (*LnNumConnected* has a mean value of 0.81). The mean value of the variable *LnNumCross* is 0.50, indicating that the average number of unique investors that cross-hold a firm is equal to 0.65. Average *LnAvgNum* is 0.57, indicating that a firm has on average 0.77 same industry peers (excluded itself) with cross-owners. In percentage terms, the average cross-blockholding (*TotalCrossOwn*) is 6.85%.

Following prior literature, at the bottom of Panel A of Table A2 I provide summary statistics for a set of control variables included in the analysis. The average firm in our sample, for example, has a PP&E equal to 20.7% of assets, total debt equal to 20.6% of assets, and applies an *Excess Price Cost Margin* of 6% relative to its industry peers. The mean value of the variable *BlockInstOwn* indicates that, on average, the ownership share held by the total number of institutional blockholders is equal to 8.6% of the outstanding shares.

Panel B of Table A2 reports the correlation matrix for the variables.

The common ownership proxies are positively related with a correlation range across the five measures from 0.08 to 0.94. The variable *Investment* is negatively correlated with all the common ownership proxies on a univariate basis (except for *TotalCross*) with the correlations ranging from -0.006 and -0.04. However, as illustrated below, the relationship between investment and common ownership depends on the firm's tendency to over or under-invest.

## 5. Main empirical results

### 5.1 Conditional tests

Table 1 shows the results from the estimation of Eq. (1). Column (1) reports the results using  $\kappa$  as a proxy of common ownership while in Columns (2)-(6), as robustness checks, I use as common ownership proxies the measures introduced in He and Huang (2017), widely used in the recent literature on common ownership (e.g., He et al., 2020; Ramalingegowda et al., 2020; Chen et al., 2021; Jang et al., 2022). Overall, I find evidence that common ownership is positively associated with investment among firms that are more prone to under-invest. This means that the coefficient on the common ownership variable is positive and significant in five out of six specifications with *t*-statistics ranging from 1.73 to 3.37.

**Table 1: Conditional relation between investment and common ownership**

Dependent variable	<i>Investment</i>					
	$\kappa$	<i>CrossDummy</i>	<i>LnNumConnected</i>	<i>LnNumCross</i>	<i>LnAvgNum</i>	<i>TotalCrossOwn</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>CO</i>	5.104* (2.927)	-0.618 (1.230)	1.396*** (0.430)	2.241*** (0.664)	1.786*** (0.667)	0.0723* (0.0418)
<i>CO</i> × <i>Overfirm</i>	-7.910* (4.502)	1.145 (2.155)	-1.426* (0.732)	-2.748** (1.150)	-2.099* (1.124)	-0.0999* (0.0525)
<i>Overfirm</i>	-14.82*** (1.685)	-17.36*** (2.355)	-13.91*** (2.039)	-13.07*** (2.071)	-13.91*** (2.100)	-13.70*** (1.907)
<i>BlockInstOwn</i>	-0.0423*** (0.0153)	-0.0249* (0.0134)	-0.0369*** (0.0135)	-0.0403*** (0.0143)	-0.0275** (0.0127)	-0.0308 (0.0192)
<i>Excess PCM</i>	3.426** (1.740)	4.120** (1.705)	3.994** (1.696)	4.067** (1.701)	0.608 (1.140)	-1.262 (1.630)
<i>Size</i>	-0.00014*** (2.44e-05)	-0.00013*** (2.32e-05)	-0.00015*** (2.42e-05)	-0.00014*** (2.34e-05)	-0.00014*** (2.70e-05)	-0.000145*** (3.88e-05)
<i>CFOsale</i>	1.479 (2.120)	2.216 (2.346)	2.186 (2.331)	2.194 (2.332)	0.0134** (0.00553)	0.00176 (0.0185)
<i>Loss</i>	-3.775*** (0.525)	-3.803*** (0.461)	-3.674*** (0.459)	-3.658*** (0.460)	-3.529*** (0.395)	-2.416*** (0.669)
<i>Tangibility</i>	1.478 (2.168)	0.342 (1.945)	0.545 (1.965)	0.544 (1.957)	-0.339 (2.080)	3.202 (2.555)
$\sigma(CFO)$	-25.83*** (8.150)	-22.21*** (6.897)	-23.07*** (7.017)	-23.00*** (7.031)	-17.88*** (6.745)	-4.080 (5.430)
Constant	23.24*** (1.529)	24.06*** (1.765)	21.75*** (1.608)	21.28*** (1.625)	22.17*** (1.679)	23.61*** (1.664)
Observations	8,195	10,116	10,116	10,116	10,116	10,116
R-squared	0.071	0.071	0.074	0.073	0.068	0.070
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
S.E. Firm Cluster	YES	YES	YES	YES	YES	YES

This table reports the results of panel regressions predicting *Investment* using a within-regression estimator (or fixed effects estimator). *Investment* is the sum of capital expenditure and acquisition expenditure less cash receipts from the sale of property, plant, and equipment multiplied by 100 and scaled by lagged total assets. Columns (1)-(6) report results using as a proxy of common ownership respectively  $\kappa$ , *CrossDummy*, *LnNumConnected*, *LnNumCross*, *LnAvgNum*, *TotalCrossOwn*.  $\kappa$  is the average profit weight that firm *f* puts on every dollar of its industry peers' profits in its maximization problem. *CrossDummy* is a dummy variable equal to 1 if the firm is cross-held by at least one blockholder in any of the four quarters in a fiscal year and zero otherwise. *LnNumConnected* is measured as the natural logarithm of one plus the average number of same-industry peers that share any common blockholder with the firm across the four quarters of a fiscal year. *LnNumCross* is the natural logarithm of one plus the average number of unique blockholders that cross-own a firm across the four quarters of a fiscal year. *LnAvgNum* is measured as the natural logarithm of one plus the average number of same-industry peers blockheld by all the cross-holding investors across the four quarters of a fiscal year. *TotalCrossOwn* is the average percentage holdings by all the cross-blockholders across the four quarters of a fiscal year. *Overfirm* is a ranked variable based on the average of ranked (deciles) measures of cash and leverage (multiplied by minus one). *BlockInstOwn* is the average percentage of shares held by institutional blockholders across the four quarters in a fiscal year. *Excess PCM* is the difference between a firm's price-cost margin (Operating Income over Sales), and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. *Size* is represented by the firm's total assets. *CFOsale* the ratio of *CFO* to sales. *Loss* is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. *Tangibility* is the ratio of PP&E to total assets.  $\sigma(CFO)$  is the standard deviation of *CFO* from years *t-4* to *t* deflated by average total assets. All regressions include firm fixed effects and year fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

In terms of economic significance, a one standard deviation increase in  $\kappa$  is associated with an increase in *Investment* by approximately 0.23% among those firms which are more likely to under-invest. Since the mean value of *Investment* is 9.22% this effect represents an increase of 2.5%.

The interaction between common ownership and *Overfirm* is negative and significant in five out of six specifications (the *t*-statistics range is between -1.76 and -2.39). The overall effect of common ownership on investment among those firms which are more likely to under-invest is given by  $\beta_1 + \beta_2$ . The sum of the two coefficients is always negative and statistically significant except for the specification in Column (2), where I use *CrossDummy* as a proxy of common ownership. In terms of economic significance, increasing  $\kappa$  by one standard deviation decreases investment by approximately 0.12% among firms that are over-investing. This result implies an increase in *Investment* of about 1.3%. Overall, the findings in Table 1 provide support for the first research hypothesis.

Consistent with prior works, I find that firms with higher market power, positive net income before extraordinary items, higher tangibility of assets, lower volatility of operating cash flows, and lower size have a higher investment rate (Biddle & Hilary, 2006; Biddle et al., 2009; Baek et al., 2020). Hereinafter I consider the specification in Column (1) of Table (1) as my baseline specification.

## 5.2 Unconditional tests

The previous Section examines empirically whether greater common ownership is associated with lower (higher) investments in firms that are more likely to over (under) invest.

In this Section, I estimate a multinomial logistic regression to test if greater common ownership is associated with a lower likelihood that a firm over or under-invests.

From a practical point of view, this approach tests the likelihood that a firm might be in extreme quartiles of the investment residuals, as a function of common ownership, rather than in the benchmark group. This specification considers, together but separately, the likelihood that a firm falls in *Investment state* = 1 (under-investment) and *Investment state* = 4 (over-investment) rather than in *Investment state* = 2 (the benchmark group which represents the efficient investment).

Table 2 reports the results of the estimation using the different proxies of common ownership.

**Table 2: Panel A – under-investment versus normal investment**

Dependent variable	<i>Investment State</i>					
	$\kappa$	<i>CrossDummy</i>	<i>LnNumConnected</i>	<i>LnNumCross</i>	<i>LnAvgNum</i>	<i>TotalCrossOwn</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>CO</i>	-1.336** (0.592)	-0.336*** (0.0757)	-0.136*** (0.0238)	-0.223*** (0.0428)	-0.167*** (0.0341)	-0.0109*** (0.00179)
<i>BlockInstOwn</i>	0.00269* (0.00148)	0.00407*** (0.00145)	0.00594*** (0.00153)	0.00826*** (0.00183)	0.00394*** (0.00142)	0.0113*** (0.00204)
<i>Excess PCM</i>	0.457** (0.184)	0.478*** (0.178)	0.489*** (0.180)	0.506*** (0.179)	0.481*** (0.180)	0.556*** (0.181)
<i>Size</i>	4.31e-06*** (1.53e-06)	4.57e-06*** (1.44e-06)	5.21e-06*** (1.43e-06)	4.88e-06*** (1.42e-06)	5.13e-06*** (1.45e-06)	4.97e-06*** (1.42e-06)
<i>Leverage</i>	1.474*** (0.204)	1.178*** (0.178)	1.169*** (0.178)	1.181*** (0.178)	1.179*** (0.178)	1.211*** (0.179)
<i>Cash</i>	-0.401 (0.343)	-0.738** (0.319)	-0.684** (0.317)	-0.733** (0.318)	-0.711** (0.318)	-0.747** (0.317)
<i>CFOSale</i>	-0.269 (0.395)	-0.114 (0.287)	-0.0576 (0.245)	-0.0862 (0.263)	-0.0688 (0.252)	-0.0645 (0.254)
<i>Loss</i>	0.609*** (0.117)	0.652*** (0.104)	0.645*** (0.105)	0.641*** (0.105)	0.652*** (0.104)	0.653*** (0.104)
<i>Tangibility</i>	-3.216*** (0.254)	-3.044*** (0.223)	-3.133*** (0.223)	-3.087*** (0.223)	-3.113*** (0.223)	-3.093*** (0.225)
$\sigma(CFO)$	2.469*** (0.798)	2.833*** (0.749)	2.727*** (0.735)	2.695*** (0.736)	2.776*** (0.741)	2.665*** (0.738)
Constant	-0.790*** (0.235)	-0.549** (0.220)	-0.651*** (0.215)	-0.641*** (0.215)	-0.639*** (0.216)	-0.698*** (0.214)
Observations	8,426	10,073	10,073	10,073	10,073	10,073
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm/Year cluster						
Pseudo R <sup>2</sup>	0.0699	0.0668	0.0677	0.0673	0.0674	0.0675

**Table 3: Panel B – over-investment versus normal investment**

Dependent variable	<i>Investment State</i>					
	$\kappa$	<i>CrossDummy</i>	<i>LnNumConnected</i>	<i>LnNumCross</i>	<i>LnAvgNum</i>	<i>TotalCrossOwn</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>CO</i>	-0.878* (0.532)	-0.229*** (0.0674)	-0.0985*** (0.0228)	-0.157*** (0.0404)	-0.144*** (0.0326)	-0.00404** (0.00170)
<i>BlockInstOwn</i>	0.00322** (0.00134)	0.00296** (0.00131)	0.00438*** (0.00139)	0.00603*** (0.00173)	0.00331*** (0.00128)	0.00486** (0.00198)
<i>Excess PCM</i>	0.113 (0.200)	0.387** (0.192)	0.390** (0.197)	0.409** (0.195)	0.382* (0.197)	0.422** (0.198)
<i>Size</i>	-4.66e-05*** (5.16e-06)	-5.14e-05*** (5.21e-06)	-5.01e-05*** (5.12e-06)	-5.01e-05*** (5.15e-06)	-4.98e-05*** (5.11e-06)	-5.20e-05*** (5.25e-06)
<i>Leverage</i>	-0.132 (0.201)	0.0239 (0.174)	0.00881 (0.175)	0.0227 (0.174)	0.00492 (0.175)	0.0520 (0.174)
<i>Cash</i>	1.682*** (0.286)	1.559*** (0.262)	1.586*** (0.263)	1.560*** (0.263)	1.573*** (0.263)	1.549*** (0.263)
<i>CFOSale</i>	1.466*** (0.516)	1.266** (0.554)	1.324** (0.573)	1.288** (0.562)	1.328** (0.573)	1.281** (0.566)
<i>Loss</i>	-0.529***	-0.420***	-0.422***	-0.425***	-0.422***	-0.410***

	(0.157)	(0.127)	(0.128)	(0.127)	(0.128)	(0.127)
<i>Tangibility</i>	0.876***	0.888***	0.819***	0.860***	0.825***	0.882***
	(0.151)	(0.141)	(0.145)	(0.142)	(0.145)	(0.142)
$\sigma(CFO)$	-0.132	0.309	0.224	0.214	0.239	0.264
	(0.969)	(0.815)	(0.816)	(0.812)	(0.820)	(0.808)
Constant	-0.460***	-0.287*	-0.351**	-0.354**	-0.326**	-0.413***
	(0.168)	(0.158)	(0.153)	(0.153)	(0.154)	(0.152)
Observations	8,426	10,073	10,073	10,073	10,073	10,073
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm/Year cluster						
Pseudo R <sup>2</sup>	0.0699	0.0668	0.0677	0.0673	0.0674	0.0675

This table reports the results of multinomial logit pooled regressions. Panel A presents the results regarding under-investment. Panel B presents the results regarding over-investment. The dependent variable, *Investment State*, is a categorical variable that takes the value of 1, 2, or 3 if firm-year residuals from Eq. (2) belong respectively to the first quartile, to the middle two quartiles, or to the fourth quartile. Columns (1)-(6) report results using as a proxy of common ownership respectively  $\kappa$ , *CrossDummy*, *LnNumConnected*, *LnNumCross*, *LnAvgNum*, *TotalCrossOwn*.  $\kappa$  is the average profit weight that firm *f* puts on every dollar of its industry peers' profits in its maximization problem. *CrossDummy* is a dummy variable equal to 1 if the firm is cross-held by at least one blockholder in any of the four quarters in a fiscal year and zero otherwise. *LnNumConnected* is measured as the natural logarithm of one plus the average number of same-industry peers that share any common blockholder with the firm across the four quarters of a fiscal year. *LnNumCross* is the natural logarithm of one plus the average number of unique blockholders that cross-own a firm across the four quarters of a fiscal year. *LnAvgNum* is measured as the natural logarithm of one plus the average number of same-industry peers blockheld by all the cross-holding investors across the four quarters of a fiscal year. *TotalCrossOwn* is the average percentage holdings by all the cross-blockholders across the four quarters of a fiscal year. *Overfirm* is a ranked variable based on the average of ranked (deciles) measures of cash and leverage (multiplied by minus one). *BlockInstOwn* is the average percentage of shares held by institutional blockholders across the four quarters in a fiscal year. *Excess PCM* is the difference between a firm's price-cost margin (Operating Income over Sales), and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. *Size* is represented by the firm's total assets. *Leverage* is the ratio of total debt to total assets. *Cash* is the ratio of cash and short-term investments to total assets. *CFOsale* the ratio of *CFO* to sales. *Loss* is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. *Tangibility* is the ratio of PP&E to total assets.  $\sigma(CFO)$  is the standard deviation of *CFO* from years *t-4* to *t* deflated by average total assets. All regressions include year fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm and year level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A presents the results related to under-investment. The coefficient of the common ownership variable has the predicted sign (negative) and it is significant in all specifications (with *t*-statistics ranging from -2.25 to -6.08). Looking at Column (1), this means that a 1 unit increase in  $\kappa$  decreases the relative log-odd of being in the under-investment group rather than in the benchmark group by 1.336.

Panel B presents the results related to over-investment. These findings are similar to those in Panel A. The coefficient of the common ownership variable has the predicted sign (negative) and it is significant in all specifications (with *t*-statistics ranging from -1.65 to -4.41). Looking at Column (1), a 1 unit increase in  $\kappa$  decreases the relative log-odd of being in the over-investment group rather than in the benchmark group by 0.878. Overall, these findings confirm my research hypotheses.

## 6. Identification

I exploit a quasi-natural experiment of financial institutions' mergers using a Difference-in-Differences (DiD) approach to deal with two potential endogeneity concerns that may affect the results obtained with the preceding analyses.

Even after the inclusion of a large set of control variables and fixed effects, the first endogeneity concern is related to the existence of variables omitted from the regression that are correlated with both the dependent and common ownership variable and which could bias the results. Another concern is that, since institutional investors do not randomly invest, there are elements to suppose that the correlation between common ownership and the investment rate does not necessarily have a causal interpretation because “reverse causality” may play a role. Specifically, institutional investors may be attracted by firms that invest more efficiently, which leads to greater overlapping ownership; alternatively, common ownership may allow firms to obtain higher investment efficiency. In this Section, following He and Huang (2017), I address the potential endogeneity problems using a DiD approach based on a quasi-natural experiment of financial institutions' mergers that cause a presumably exogenous change in the level of firms' common ownership.

### 6.1 The experiment

This experiment, adopted for the first time in Huang (2016)<sup>8</sup>, is based on the fact that financial institutions' mergers are motivated by reasons that do not depend on the fundamentals of the stocks they hold.

For example, in the USA a wave of mergers in the financial sector occurred following the Gramm-Leach-Bliley Act of 1999 which allowed the consolidation of commercial banks, investment banks, securities companies, and insurance companies.

Furthermore, the previous literature suggests that business strategies such as extending the offering of financial products or establishing economies of scale are used to motivate mergers between asset management firms (Jayaraman et al., 2002).

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<sup>8</sup> Other papers in the common ownership literature that follow this identification approach are He et al. (2019), Park et al. (2019), He et al. (2020), Baek et al. (2020), Ramalingegowda et al. (2020), Chen et al. (2021), Lewellen & Lowry, (2021), Lin (2022), Jang et al. (2022).

When two financial institutions merge, the buyer acquires the target's portfolio and generally holds the newly acquired shares for an extended period because of transaction costs and liquidity costs (e.g., Holthausen et al., 1990; Keim & Madhavan, 1996).

Therefore, if one of the two merging parties holds shares in a firm that operates in an industry and the other merging party hold shares in another firm that operates in the same industry there is no common ownership. Common ownership arises once the merger occurs since the two firms are now held by the new merged institution. Of course, the merged institution could sell the newly acquired shares after the merger for different reasons such as portfolio rebalancing, portfolio diversification, new industry's specific information, etc. However, in absence of a systematic shock that forces the new entity to cancel these cross-shareholdings, I would expect, on average, an increase in the extent of common ownership for the affected firms around the merger date.

One significant feature of this identification technique is that various firms are affected by different shocks at exogenously different periods.

The identification strategy with multiple shocks can alleviate a typical problem encountered in research using a single shock: the presence of potentially omitted variables coinciding with the shock that directly affect the outcome of interest.

Because such mergers between financial institutions are exogenous to the common-owned firms, this experiment constitutes a setting in which changes in common ownership across firms are exogenous to firms' investment decisions.

## **6.2 Identifying treatment and control firms**

I create a sample of financial institution mergers using the SDC's Mergers and Acquisitions database from Refinitiv Eikon. The mergers are identified following the criteria given by He and Huang (2017) with several changes.

I require that the merger is between two financial institutions with primary SIC codes between 6000 and 6999 and announced during the period between 2001 and 2018<sup>9</sup>.

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<sup>9</sup> I require a six-year window around the completion of the merger, for this reason the sample is restricted to the period 2001-2018.

I also require that the merger is completed within one year after the initial announcement. I further impose the requirement that the acquiror and target's nations are included in the United States or Europe.

For each target firm and each acquiror firm involved in these deals, I manually match the firms' names with those provided in the holdings' disclosure by Refinitiv Eikon. Mergers in which the acquiror or the target firm does not have any holdings in any of the firms included in the sample are excluded. This process provides a sample of 64 financial institution mergers, 2 of which meet the criteria for the selection of the treatment firms using the 1% threshold to define blockholdings. By changing the threshold for the identification of blockholdings from 1% to 0.5% the number of mergers reaches 4 while in the absence of any threshold I obtain 8 mergers useful for the experiment<sup>10</sup>.

I identify treatment and control firms following the procedure described by He and Huang (2017). Treatment firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement, while the other merging party does not blockhold the firm but at least one industry rival from the same 3-digit NAICS during the same quarter. Firms that are blockhold by both the merging institutions during the quarter before the announcement are deleted.

Firms meeting the selection criteria are included in the treatment sample because they are likely to experience an increase in the common ownership links with same-industry peers after the merger event. This process yields 45 treated firms using a 1% threshold to define blockholdings, 94 treated firms with a threshold equal to 0.5%, and 1.446 treatments in the absence of any threshold.

Control firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement with no same-industry rivals blockheld by the other merging party during the same quarter. This means that control firms' common ownership would not change simply as a result of the merger and that treatments and control firms involved in the same merger must come from different industries.

The control sample consists of 2.396 firms using a 1% threshold to define blockholdings, 3.454 control firms with a threshold equal to 0.5%, and 8.756 controls in the absence of any threshold. In the empirical analysis, I use the 1% threshold to define blockholdings.

The selection procedure described above uses the merger announcement date to identify treatment and control firms, thus it only relies on ex-ante information, alleviating concerns

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<sup>10</sup> See Table A3 in the Appendix for the list of financial institutions mergers.

that the actual cross-holding status of the firm post-merger or its trading decision may be influenced by private information about the firm.

I decide to focus on a six-year window around the event year, thus the pre-merger period is defined as the three years before the merger while the post-merger period as the three years after the merger plus the year in which the merger is completed. The choice of the event window minimizes the noise irrelevant to the events but at the same time allows to capture significant changes in the investment variable in response to exogenous changes in the common ownership because it spans enough for common owners to exert influence on the firm.

To build the DiD sample I remove the observations that are neither in the treatment nor the control group. I also drop the observations not included in the six-year window around the event year.

### 6.3 DiD estimation

#### 6.3.1 DiD approach: conditional tests

I address the potential endogeneity concern that may affect the results obtained in Section 5.1 using a multivariate DiD approach to compare the change in investment efficiency for treatment firms with that for control firms. Specifically, I run the following regression

$$Investment_{i,j,t} = \alpha + \beta_1 Treat \times Post + \beta_2 Post + \beta_3 Treat + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t} \quad (4)$$

Where  $i$  is the firm,  $j$  indexes the financial institution merger and  $t$  indexes the year (before or after the financial institution merger). The variable *Investment* is defined as in Eq. (1) as the sum of capital expenditure and acquisition of business less cash receipts from the sale of Property, Plant, and Equipment multiplied by 100 and divided by lagged total assets. I use the 1% threshold to define blockholdings.

*Treat* is a dummy variable that equals 1 if the firm is a treatment and 0 if it is a control. *Post* is a dummy equal to one for the post-merger period and zero for the pre-merger period.

I estimate Eq. (4) separately for firms included in the first quartile and in the fourth quartile of the variable *Overfirm*, thus respectively for the firms that are more likely to under and over-

invest. All other variables included in the regression are the same as in Eq. (1). I cluster standard errors by financial institution merger and I also include merger fixed effects.

Column (1) of Table 3 presents the DiD results for the subsample of firms that are more likely to under-invest, while Column (2) shows the estimates for firms more prone to over-invest.

The coefficient's estimate on the interaction term of the treatment dummy and the post-merger dummy ( $Treat \times Post$ ) is positive and statistically significant in Column (1) while negative and significantly different from zero in Column (2). This means that treatment firms included in the under (over) investment subsample when common ownership increases as a result of a financial institution merger, experience a significant increase (decrease) in the investment rate when compared to control firms.

Overall, these results suggest that treatment firms, relative to control firms, significantly increase their investment efficiency after the financial institution merger.

Since I use the ex-ante information to construct the DiD sample, I then verify the premise of the quasi-natural experiment according to treatment firms on average experience an increase in common ownership relative to control firms due to the financial institution mergers.

In Table 4 I verify this assumption by carrying out a multivariate DiD analysis on the common ownership variable  $\kappa$ . All other controls are the same as in Table 3.

Columns (1)-(2) report the results using the whole sample while Columns (4)-(5) present the results for firm-year observations included in the first and fourth quartile of the variable *Overfirm* (under/over-investing). As expected, treatment firms indeed experience a significant relative increase in common ownership after the financial institution merger.

The success of a DiD approach relies on a key identifying assumption, namely the parallel trends assumption which states that in the absence of the treatment, the difference between the treatment and the control group is constant over time thus leading to a DiD estimate equal to zero. I verify this assumption separately for the subsample of firms in the first and in the fourth quartile of the *Overfirm* (under and over-investment firms) performing a standard *t*-test for differences in means of the variable *Investment* between the treatment and the control group during the three years pre-merger period.

The results, reported in Table 5, show no significant difference between the mean of the *Investment* variable between treatment and control firms during the three years prior to the merger event, implying that the parallel trend assumption is likely to hold in this setting.

**Table 4: Difference-in-Differences approach: under-investment and over-investment**

Dependent variable	<i>Investment</i>	
	Under-investment (1)	Over-investment (2)
<i>Treat</i> × <i>Post</i>	13.49** (2.572)	-2.180* (0.893)
<i>Treat</i>	-11.04*** (0.773)	1.574* (0.636)
<i>Post</i>	-1.616 (0.644)	2.230* (0.861)
<i>BlockInstOwn</i>	0.0321 (0.0314)	0.0195 (0.0145)
<i>Excess PCM</i>	-6.865*** (0.124)	-0.916 (3.369)
<i>Size</i>	-5.59e-05 (2.09e-05)	-7.58e-06*** (1.10e-06)
<i>CFOsale</i>	-15.22* (3.804)	1.200 (1.071)
<i>Loss</i>	-7.776** (1.345)	-0.798 (0.644)
<i>Tangibility</i>	-8.095** (0.909)	-0.989 (0.863)
$\sigma(CFO)$	-146.7* (34.70)	-0.0292 (0.593)
Constant	16.32*** (0.647)	2.467 (1.074)
Observations	210	384
R-squared	0.118	0.050
Merger FE	YES	YES
S.E. Merger cluster	YES	YES

This table reports the results of the Difference-in-Differences (DiD) test around financial institutions mergers. *Treat* is a dummy variable that equals 1 if the firm is a treatment and 0 if it is a control. *Post* is a dummy equal to one for the post-merger period and zero for the pre-merger period. I use the 1% threshold to define blockholdings. The pre-merger period is defined as the three years before the merger while the post-merger period as the three years after the merger plus the year in which the merger is completed. Treatment firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement, while the other merging party does not blockhold the firm but at least one industry rival from the same 3-digit NAICS during the same quarter. Control firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement with no same-industry rivals blockheld by the other merging party during the same quarter. Column (1) presents the DiD results for the subsample of firms that are more likely to under-invest while Column (2) shows the estimates for firms more prone to over-invest. All other variables are the same as in Column (1) Table 1. All regressions include merger fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at the financial institution merger level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table 5: DiD test of the effect of institution mergers on common ownership**

Dependent variable	$\kappa$			
	(1)	(2)	Under-investing (3)	Over-investing (4)
<i>Treat</i>	-0.0190*** (0.00486)	-0.0216*** (0.00610)	-0.0424*** (0.0122)	-0.0307*** (0.00681)
<i>Post</i>	-0.00398 (0.00279)	-0.00623** (0.00307)	0.00546 (0.0109)	-0.00791** (0.00402)
<i>Treat</i> $\times$ <i>Post</i>	0.0151*** (0.00517)	0.0166*** (0.00634)	0.0379** (0.0167)	0.0301*** (0.00727)
<i>BlockInstOwn</i>		0.000225*** (3.38e-05)	0.000264** (0.000133)	0.000227*** (4.28e-05)
<i>Excess PCM</i>		0.0145*** (0.00331)	0.0120** (0.00529)	0.0113** (0.00511)
<i>Size</i>		2.72e-07*** (2.60e-08)	2.62e-07** (1.22e-07)	6.98e-07*** (9.29e-08)
<i>CFOsale</i>		-9.03e-06*** (1.61e-06)	-0.0486*** (0.00864)	-8.15e-06*** (2.45e-06)
<i>Loss</i>		-0.00984*** (0.00257)	-0.00708 (0.0108)	-0.0131*** (0.00292)
<i>Tangibility</i>		0.00613 (0.00483)	0.0428*** (0.00967)	-0.0211*** (0.00615)
$\sigma(CFO)$		-0.129*** (0.0185)	-0.232 (0.158)	-0.146*** (0.0294)
Constant	0.0812*** (0.00803)	0.0543*** (0.00716)	0.0556*** (0.0200)	0.0715*** (0.00993)
Observations	6,450	4,889	702	1,258
R-squared	0.049	0.104	0.147	0.121
MERGER FE	YES	YES	YES	YES
S.E. Firm- merger/Year cluster	YES	YES	YES	YES

This table reports the results of the Difference-in-Differences (DiD) test on the effect of institutional mergers on common ownership. The dependent variable is represented by  $\kappa$ , which is the average profit weight that firm  $f$  puts on every dollar of its industry peers' profits in its maximization problem. Columns (1)-(2) report the results using the whole sample while Columns (4)-(5) present the results for firm-year observations included in the first and fourth quartile of the variable *Overfirm* (under/over-investing). *Treat* is a dummy variable that equals 1 if the firm is a treatment and 0 if it is a control. *Post* is a dummy equal to one for the post-merger period and zero for the pre-merger period. I use the 1% threshold to define blockholdings. The pre-merger period is defined as the three years before the merger while the post-merger period as the three years after the merger plus the year in which the merger is completed. Treatment firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement, while the other merging party does not blockhold the firm but at least one industry rival from the same 3-digit NAICS during the same quarter. Control firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement with no same-industry rivals blockheld by the other merging party during the same quarter. All other controls are the same as in Table 3. All regressions include merger fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm-merger and year level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table 6: Test to verify the parallel trend assumption**

<i>Investment</i>	Treatment		Control		<i>p</i> -value of difference	
	Mean		Mean		<i>t</i> -test	
	Under-investment (1)	Over-investment (2)	Under-investment (3)	Over-investment (4)	(1)-(3)	(2)-(4)
Year -3 to year -1	1.22	9.15	11.24	7.11	0.364	0.696

This table reports the mean of the *Investment* variable during the three years pre-merger period for treatment and control firms. The mean is calculated separately for the subsample of firms included in the first quartile and in the fourth quartile of the variable *Overfirm*, thus respectively for the firms that are more likely to under and over-invest. The table also reports *p*-values associated with test statistics for differences in means (standard *t*-test) across groups.

### 6.3.2 DiD approach: deviation from expected investment

I perform a DiD analysis employing a multinomial logistic regression to compare the change in the likelihood to deviate from expected investment for treatment relative to control firms. Specifically, I estimate the following regression

$$Investment\ State_{i,j,t} = \alpha + \beta_1 Treat \times Post + \beta_2 Post + \beta_3 Treat + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t} \quad (5)$$

Where *i* is the firm, *j* indexes the financial institution merger, and *t* indexes the year. *Investment State* is a categorical variable defined as in Eq. (3): it takes the value 1 for firm-year observations classified as under-investing, the value of two for the benchmark group and the value of 3 for firm-year observations classified as over-investing.

*Treat* is a dummy variable that equals 1 if the firm is a treatment and 0 if it is a control. *Post* is a dummy equal to one for the post-merger period and zero for the pre-merger period. All other variables are the same as in Eq. (3). Standard errors are robust to heteroskedasticity and clustered at firm level.

Table 6 reports the results of the DiD analysis performed using Eq. (5). Column (1) and Column (2) present respectively the results regarding under and over-investment.

**Table 7: Difference-in-Differences approach: deviation from expected investment**

Dependent variable	<i>Investment State</i>	
	Under-investment (1)	Over-investment (2)
<i>Treat</i> × <i>Post</i>	-0.787 (0.753)	-1.724** (0.707)
<i>Treat</i>	0.932 (0.676)	1.238* (0.663)
<i>Post</i>	-0.0735 (0.172)	0.0410 (0.136)
<i>BlockInstOwn</i>	0.000812 (0.00423)	0.00162 (0.00341)
<i>Excess PCM</i>	-0.339 (0.667)	-0.123 (0.584)
<i>Size</i>	3.71e-06 (3.87e-06)	-7.70e-05*** (1.71e-05)
<i>Leverage</i>	1.805*** (0.640)	-0.337 (0.800)
<i>Cash</i>	-1.071 (1.413)	0.504 (0.763)
<i>CFOsale</i>	-1.901 (1.366)	2.268*** (0.670)
<i>Loss</i>	0.366 (0.287)	-0.923*** (0.346)
<i>Tangibility</i>	-3.179*** (0.875)	0.297 (0.396)
$\sigma(CFO)$	3.539 (2.768)	-1.576 (2.270)
Constant	-0.534 (0.375)	-0.777*** (0.301)
Observations	2,050	2,050
S.E. Firm cluster	YES	YES
Pseudo R <sup>2</sup>	0.0678	0.0678

This table reports the results of the Difference-in-Differences (DiD) test on how exogenous shocks on common ownership (due to financial institutions mergers) affect the likelihood to deviate from expected investment for treatment relative to control firms. Column (1) and Column (2) present respectively the results regarding under and over-investment. *Treat* is a dummy variable that equals 1 if the firm is a treatment and 0 if it is a control. *Post* is a dummy equal to one for the post-merger period and zero for the pre-merger period. I use the 1% threshold to define blockholdings. The pre-merger period is defined as the three years before the merger while the post-merger period as the three years after the merger plus the year in which the merger is completed. Treatment firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement, while the other merging party does not blockhold the firm but at least one industry rival from the same 3-digit NAICS during the same quarter. Control firms are those in which one of the merging institutions owns a blockholding during the quarter prior to the merger announcement with no same-industry rivals blockheld by the other merging party during the same quarter. All other variables are the same as in Column (1) of Table 2. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

To better understand the results, I report in Table A4 (see the Appendix) the predicted probability for a firm to be in each outcome, *Investment State* equal to 1 2 or 3, under each combination of *Treat*  $\times$  *Post*. Since I have three possible outcomes, I obtain three different columns. For example, the first two rows of Column (1) say that for the control group (*Treat* = 0) the predicted probability of falling into *Investment State* = 1, that is under-investment, is 21.4% for the pre-merger period and 20.1% for the post-merger period, i.e. a decrease of  $(0.214-0.201 = -0.013)$  1.3 percentage points.

The following two rows of Column (1) show the predicted probabilities of falling into outcome 1 for the treatment group, respectively in the pre and post-merger period. The results included in Columns (2) and (3) can be interpreted in the same way. You can notice that the probabilities across the outcome categories sum to one: for example, the probability for the control group in the pre-merger period to fall into each outcome (the margin in the first row in each column) must sum to one.

In Table A5 I report the average marginal effect of *Post*, which is the difference I manually calculate above. The coefficient on the first row of Table A5 is the difference between the expected probability for the firms in the control group to fall into *Investment State* = 1 in the post-merger period and in the pre-merger period (the difference I manually calculated above). The second row refers to the same difference in expected probabilities but referred to the treatment group, that is what I am interested in. The way to read this is that the average additive (marginal) effect of *Post* on falling into the under-investment group when *Treat* = 1 is a reduction of 3.9 percentage points.

On the other hand, the average additive effect of *Post* on falling into the over-investment group for treated firms is a reduction of 25.7 percentage points. Overall, I find that the merger event significantly reduces the expected probability for treatment firms to be included in the over-investment group compared to the pre-merger period. On the other hand, the reduction in the expected probability for treatment firms to fall into the under-investment group is not statistically different from zero.

Table 7 shows Difference-in-Differences in probability metrics. The coefficient in Column (1) shows the average Difference-in-Differences between the predicted probabilities referred to the *Investment State* = 1 included in Table A4  $(-0.039 - (-0.0013)) = -0.026$ . Indeed, this coefficient represents the difference between the predicted probability of being in the first outcome category for treatment firms in the post-merger period compared to the pre-merger period less the predicted probability of being in the first outcome category for control firms in the post-merger period compared to the pre-merger period.

**Table 8: Average Difference-in-Differences in probability metric**

Average DiD in probability metric	Investment State = 1 (1)	Investment State = 2 (2)	Investment State = 3 (3)
	Post = 1 (base outcome Post = 0)		
Treat = 1 vs Treat = 0	-0.026 (0.129)	0.294** (0.120)	-0.268* (0.142)
Observations	2,050	2,050	2,050

This table reports the Difference-in-Differences in probability metric for the model estimated in Table 6 using Eq. (5). Columns (1), (2) and (3) show respectively the average Difference-in-Differences between the predicted probabilities included in Table A4 (see the Appendix) referred to the first, second and third outcome (*Investment State* equal to 1 2 or 3). Each coefficient represents difference between the predicted probability of being in that outcome category for treatment firms in the post-merger period compared to the pre-merger period less the predicted probability of being in that outcome category for control firms in the post-merger period compared to the pre-merger period.

The Difference-in-Differences coefficient referred to the over-investment category is negative and statistically significant, while the DiD coefficient for the under-investment category is not significantly different from zero. This means that the average marginal effect of *Post* on falling into the over-investment group when *Treat* = 1 is a reduction of 26.8, percentage points compared to the additive effect of *Post* when *Treat* = 0.

Overall, the DiD estimates suggest that treatment firms, relative to control firms, experience a reduction in the predicted probability of falling into the over-investment group when common ownership increases as a result of a financial institution merger. Conversely, it can be noticed that the DiD coefficient referred to the benchmark group (*Investment State* = 2), is positive and statistically significant. This means that the merger event increases the predicted probability for treatment firms to fall into this outcome category, relative to control firms.

According to prior research, the buyer usually holds the newly acquired shares for an extended period after the merger because of transaction costs and liquidity costs (e.g., Holthausen et al., 1990; Keim & Madhavan, 1996). Starting from this perspective, firms' over-investment status can be more easily mitigated by common owners in the short run by increasing monitoring and reducing agency costs caused by the management's tendency to undertake projects with negative NPV for personal interest. On the other hand, identifying profitable investment opportunities and obtaining financing from capital suppliers to reduce firms' under-investment status takes more time; this could be a reason why, during the three years after the merger, the

exogenous shock in common ownership does not appear to significantly affect the expected probability that treatment firms, relative to control firms, fall into the under-investment group, while this effect emerges in the analysis conducted in Section 5.2.

## 7. Testing the financial reporting quality channel

In this Section, I examine the role of financial reporting quality as a potential mechanism that contributes to the positive relationship between common ownership and investment efficiency. According to recent and growing accounting literature, common ownership, by increasing monitoring effectiveness, improves financial reporting quality (Ramalingegowda et al., 2020; He et al., 2020). On the other hand, prior works identify higher-quality financial reporting as a potential tool to mitigate the information asymmetries that give rise to market frictions, thus enhancing investment efficiency (Leuz & Verrecchia, 2000; Bushman & Smith, 2001; Healy & Palepu, 2001; Verrecchia, 2001; Biddle & Hilary, 2006; Lambert et al., 2007; Biddle et al., 2009)

As a result, to validate the effectiveness of this channel, I specifically test whether the positive relationship between common ownership and investment efficiency is more pronounced for firms with higher financial reporting quality (H2).

To do this, I estimate the following regression through a fixed-effects model by using the within-regression estimator:

$$\begin{aligned}
 Investment_{i,t} = & \alpha + \beta_1 CO_{i,t-1} + \beta_2 CO_{i,t-1} \times OverFirm_t + \beta_3 OverFirm_t + \beta_4 FRQuality_{t-1} + \\
 & + \beta_5 FRQuality_{t-1} \times OverFirm_t + \beta_6 CO_{i,t-1} \times FRQuality_{t-1} + \beta_7 CO_{i,t-1} \times OverFirm_t \times \\
 & FRQuality_{t-1} + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t}
 \end{aligned} \tag{6}$$

As a proxy for financial reporting quality (*FRQuality*), I use a measure of accrual quality derived from prior literature (Dechow & Dichev, 2002; McNichols, 2002) and extensively used in prior works (Aboody et al., 2005; Francis et al., 2004, 2005; Core et al., 2008; Biddle et al., 2009). This measure is based on the idea that one of the functions of accruals is to shift the recognition of a firm's cash flows so that the adjusted measures, that is earnings, better reflect the firm's performance. Accruals thus require estimates and assumptions about the occurrence of future cash flows. If these estimates are wrong, future accruals and earnings

should be corrected. The estimation error and the resulting corrections reduce the benefit of accruals. Consequently, the greater the accruals estimation error the lower the quality of accruals and earnings.

Dechow and Dichev (2002) propose a model in which working capital accruals quality is estimated through a regression of changes in working capital on last year, present, and one-year ahead cash flows from operations. This model captures the extent to which working capital accruals map into operating cash flow realizations. The residuals from this regression identify accruals that are not related to cash flow realizations thus the standard deviation of these residuals constitutes a good proxy for accruals quality, with higher standard deviation denoting lower accruals quality.

McNichols (2002) discusses different issues related to the empirical implementation of this model and proposed an estimation method in which the Dechow and Dichev (2002) model is augmented with the fundamental variables from the modified Jones (1991) model, namely change in revenue and PP&E, two variables that, according to the author, contribute to the formation of expectations regarding current accruals above and beyond operating cash flows. Following the approach proposed by McNichols (2002), I estimate accruals quality by performing the following regression through OLS

$$\Delta WC_{i,t} = \beta_0 + \beta_1 CFO_{i,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,t+1} + \beta_4 \Delta Revenue_{i,t} + \beta_5 PP\&E_{i,t} + \varepsilon_{i,t}$$

Firm-year residuals from the equation above are saved and their standard deviation calculated over years  $t - 4$  through  $t$  provides the accrual quality measure ( $AQ_t$ ). A higher standard deviation of firm-year residuals indicates lower accruals quality; hence, I multiply this measure by minus one so that it is increasing in financial reporting quality.

In Eq. (6) I use  $\kappa$  as a proxy of common ownership while all other variables are the same as in Eq. (1). I also include firm and year fixed effects. Standard errors are clustered at firm level. I hypothesize that financial reporting quality constitutes a channel through which common ownership affect's firm's investment efficiency. According to this prediction, the greater the quality of financial reporting, the greater the effect of common ownership on a firm's investment efficiency (H2). This means that for firms that are more likely to under-invest, greater financial reporting quality increases the positive association between common ownership and the investment rate. Looking at Eq. (6), this means that I want  $\beta_6$  to be greater than zero.

On the other hand, for firms that are more likely to over-invest, greater financial reporting quality increases the negative effects of common ownership on the investment rate. I test this prediction by examining if  $\beta_6 + \beta_7 < 0$ . Since I want  $\beta_6 > 0$  and  $\beta_6 + \beta_7 < 0$  this implies that  $\beta_7$  should be negative.

Table 8 reports the regression results from the estimation of Eq. (6). In terms of the interaction between common ownership and financial reporting quality, I find that the estimated coefficient has the predicted positive sign and is statistically significant (with  $t$  statistics equal to 2.05) implying that higher financial reporting quality increases the positive effect of common ownership on the investment rate in firms that are more likely to under-invest.

I also find evidence that the coefficient of the triple interaction variable  $\beta_7$  is negative and statistically significant (with  $t$  statistics equal to -1.85). The sum of the coefficients of the interaction between common ownership and financial reporting quality and the triple interaction is negative and statistically significant suggesting that the negative effect of common ownership on the investment rate among firms that are more likely to over-invest is increasing in the financial reporting quality.

Overall, Table 8 provides support to the hypothesis that financial reporting quality is a channel through which common ownership affects a firm's investment efficiency (H2). The results suggest the positive (negative) association between common ownership and investments in firms that are more likely to under (over) invest is more pronounced for firms with higher financial reporting quality.

## **8. Additional analyses**

In this Section, I conduct additional analyses on the conditions under which common ownership is likely to have a larger impact on a firm's investment efficiency. Specifically, I focus on the information advantage of common owners, which constitutes the main economic driver underlying the association between common ownership and investment efficiency since it directly affects firms' financial reporting quality (Kang et al., 2018; He et al., 2020; Ramalingegowda et al., 2020).

**Table 9: Testing the financial reporting quality channel**

Dependent variable	<i>Investment</i>
$\kappa$	8.146*** (1.548)
$\kappa \times \text{Overfirm}$	-12.46*** (3.357)
$\kappa \times \text{FRquality}$	18.73** (9.111)
$\kappa \times \text{Overfirm} \times \text{FRquality}$	-28.50* (15.35)
<i>Overfirm</i>	-16.82*** (1.829)
<i>FRquality</i>	0.946* (0.525)
<i>FRquality</i> $\times$ <i>Overfirm</i>	-1.276 (0.996)
<i>BlockInstOwn</i>	-0.0390** (0.0164)
<i>Excess PCM</i>	6.812*** (1.366)
<i>Size</i>	-0.000139*** (2.77e-05)
<i>CFOsale</i>	6.723*** (2.523)
<i>Loss</i>	-3.234*** (0.547)
<i>Tangibility</i>	1.385 (2.496)
$\sigma\text{CFO}$	-27.25*** (9.010)
Constant	19.70*** (1.502)
Observations	7,460
R-squared	0.073
Firm FE	YES
Year FE	YES
S.E. Firm cluster	YES

This table reports the results of the panel regression testing the financial reporting quality channel through a fixed-effects estimator. *Investment* is the sum of capital expenditure and acquisition expenditure less cash receipts from the sale of property, plant, and equipment multiplied by 100 and scaled by lagged total assets.  $\kappa$  is the average profit weight that firm *f* puts on every dollar of its industry peers' profits in its maximization problem. *Overfirm* is a ranked variable based on the average of ranked (deciles) measures of cash and leverage (multiplied by minus one). *FRquality* is a measure of accruals quality proposed by Dechow and Dichev (2002) and modified by Francis et al. (2005). *BlockInstOwn* is the average percentage of shares held by institutional blockholders across the four quarters in a fiscal year. *Excess PCM* is the difference between a firm's price-cost margin (Operating Income over Sales), and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. *Size* is represented by the firm's total assets. *CFOsale* the ratio of *CFO* to sales. *Loss* is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. *Tangibility* is the ratio of PP&E to total assets.  $\sigma(\text{CFO})$  is the standard deviation of *CFO* from years *t-4* to *t* deflated by average total assets. All regressions include firm fixed effects and year fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

Investors with multiple holdings have enhanced capabilities and incentives to monitor corporate managers. In particular, industry expertise is one of the channels for acquiring monitoring effectiveness: since industry peers present commonalities under a variety of aspects, industry-specific knowledge gained by common owners from monitoring one portfolio firm reduces common owners' information acquisition and processing costs when monitoring other peer firms they own. This suggests that having multiple holdings in the same industry gives common owners an information advantage and enhances their efficiency in monitoring firms' financial reporting. Reduced information asymmetry mitigates earnings management (He et al., 2020; Ramalingegowda et al., 2020) and discourages managers' financial reporting discretion which mostly affects the firm-specific component of the reported performance (Hui et al., 2016).

The information advantage of common owners over single investors consists in observing private signals from two or more firms in the same industry, rather than a single one, which allows them to better understand if corporate actions reflect industry-wide or firm-specific economic forces.

I expect that this information advantage is more valuable when the firm suffers from more information asymmetry between managers and external providers of capital.

Analysts' coverage within an industry can be considered a proxy for the amount of publicly available information. Indeed, financial analysts are considered industry specialists because financial institutions commonly organize them by industry and sector. This position allows them to have access to a broad set of industry statistics and data as well as to macroeconomic expertise. Such a broader perspective allows them to piece together the "mosaic" information they needed to assess their coverage (Hutton et al., 2012; Hui & Yeung, 2013). For this reason, if a firm has an analyst coverage lower than the median-industry coverage it could be interpreted as a symptom of less public information on average, which increases the informational advantage of common owners. Furthermore, analysts may also act as external monitors, substituting the monitoring effect of common owners and reducing earnings management (Yu, 2008).

If the main economic driver underlying the effect of common ownership on investment efficiency is attributable to the information advantage of common owners, I expect that the positive (negative) association between common ownership and under (over) investment is more pronounced when public information about a firm's fundamentals is scarce.

To test this prediction, I perform the following regression:

$$\begin{aligned}
Investment_{i,t} = & \alpha + \beta_1 CO_{i,t-1} + \beta_2 CO_{i,t-1} \times OverFirm_t + \beta_3 OverFirm_t + \\
& + \beta_4 LargeAnalysts_{t-1} \\
& + \beta_5 LargeAnalysts_{t-1} \times OverFirm_t + \beta_6 CO_{i,t-1} \times LargeAnalysts_{t-1} \\
& + \beta_7 CO_{i,t-1} \times OverFirm_t \times LargeAnalysts_{t-1} \\
& + \sum \gamma_j Control_{j,i,t-1} + \varepsilon_{i,t}
\end{aligned} \tag{7}$$

*LargeAnalysts* is a dummy variable equal to one if the number of analysts following a firm *i* in time *t* is above the median of the number of analysts following the industry in the same period and zero otherwise. Industry is defined by the 5-DIGIT NAICS industry code, common ownership is proxied by  $\kappa$ , and all other control variables are the same as in Eq. (1).

Column (1) of Table (9) reports the regression results, which indicate that for those firms that are more likely to under-invest, the presence of an analyst coverage greater than the median of the industry reduces (almost offsets) the positive effect of common ownership on the investment rate (the coefficient on the interaction variable  $\kappa \times LargeAnalysts$  is negative and statistically significant).

Further, I also find that the sum of the coefficient on the triple interaction and the coefficient on  $\kappa \times LargeAnalysts$  is positive and statistically significant, this means that among firms that are more likely to over-invest, an analyst coverage above the industry median almost offsets the negative relationship between common ownership and the investment rate (the sum of the coefficients  $\beta_1, \beta_2, \beta_6$ , and  $\beta_7$  is close to zero).

Overall, I find that the effect of common ownership on the rate is stronger for firms with below-median industry analyst coverage.

Consistently with the argument presented above, I also test if our main relation is stronger when the largest owner is not a larger family owner. Following prior literature (Demsetz & Lehn, 1985; Anderson & Reeb, 2003), I expect that family ownership mitigates managerial opportunism and reduces agency costs thus making the information advantage of common owners less valuable. Indeed, monitoring requires knowledge of the firm's technology and family owners, due to their long tenure, may provide superior oversight. Furthermore, a common characteristic of family firms is that family members often hold the CEO position or other top management positions which reduces the information asymmetries between managers and shareholders.

To test the above prediction, I split my sample into subsamples depending on whether the global ultimate owner (GUO) is qualified as a "family owner" or not and I perform the regression in Eq. (1) separately for each subsample. Columns (2)-(3) of Table 9 report the results, which confirm my prediction that among firms with a large family owner, common

**Table 10: Additional analysis: analysts' coverage and family firms**

Dependent variable	<i>Investment</i>		
	Analysts' coverage (1)	Non-family firms (2)	Family firms (3)
$\kappa$	6.683** (3.135)	5.467* (3.020)	1.270 (2.104)
$\kappa \times Overfirm$	-12.27** (4.834)	-8.466* (4.646)	-2.149 (3.378)
$\kappa \times LargeAnalysts$	-5.520* (3.081)		
$\kappa \times Overfirm \times LargeAnalysts$	9.227* (5.073)		
<i>Overfirm</i>	2.521*** (0.298)	-15.68*** (1.859)	-11.66** (5.273)
<i>LargeAnalysts</i>	0.170 (0.152)		
<i>LargeAnalysts</i> $\times$ <i>Overfirm</i>	-0.237 (0.292)		
<i>BlockInstOwn</i>	-0.00340** (0.00167)	-0.0478*** (0.0154)	-0.118 (0.0774)
<i>Excess PCM</i>	0.251 (0.170)	4.033** (2.011)	3.310 (4.902)
<i>Size</i>	-5.72e-06*** (1.89e-06)	-0.000127*** (2.21e-05)	-0.000544*** (0.000167)
<i>CFOsale</i>	0.0156 (0.168)	1.069 (2.034)	9.351** (3.619)
<i>Loss</i>	-0.262*** (0.0535)	-3.951*** (0.576)	-1.071 (1.981)
<i>Tangibility</i>	1.116*** (0.234)	0.859 (2.399)	6.725 (8.047)
$\sigma CFO$	-2.940*** (0.684)	-28.40*** (8.110)	-50.02* (25.89)
Constant	0.120 (0.214)	24.30*** (1.639)	20.12*** (6.942)
Observations	7,819	6,905	799
R-squared	0.099	0.077	0.095
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
S.E. Firm cluster	YES	YES	YES

This table reports the results of the panel regressions testing the impact of common ownership on investment efficiency conditional on whether the firm has analyst coverage higher than the industry median (Column (1)) or has a GUO classified as a family owner (Columns (2)-(3)). *Investment* is the sum of capital expenditure and acquisition expenditure less cash receipts from the sale of property, plant and equipment multiplied by 100 and scaled by lagged total assets.  $\kappa$  is the average profit weight that firm  $f$  puts on every dollar of its industry peers' profits in its maximization problem. *Overfirm* is a ranked variable based on the average of ranked (deciles) measures of cash and leverage (multiplied by minus one). *LargeAnalysts* is a dummy variable equal to one if the firm has above-median industry coverage. *BlockInstOwn* is the average percentage of shares held by institutional blockholders across the four quarters in a fiscal year. *Excess PCM* is the difference between a firm's price-cost margin (Operating Income over Sales), and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. *Size* is represented by the firm's total assets. *CFOsale* the ratio of *CFO* to sales. *Loss* is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. *Tangibility* is the ratio of PP&E to total assets.  $\sigma(CFO)$  is the standard deviation of *CFO* from years  $t-4$  to  $t$  deflated by average total assets. All regressions include firm fixed effects and year fixed effects. Standard errors, reported in parentheses, are robust to heteroskedasticity and clustered at firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

ownership does not affect firms' investment efficiency. These results are also in line with the notion that large family owners are powerful and tend to take short-term-oriented actions to preserve control benefits, limiting the decision-making power of minority shareholders (Huang et al., 2019).

## **9. Conclusion**

This study investigates the relationship between common ownership and investment efficiency. Specifically, I test the hypothesis that higher common ownership can be associated with either lower over or under-investment by exploiting a newly built ownership dataset including quarterly institutional and non-institutional holdings in European listed firms from a broad set of industries.

The results are consistent with the research hypothesis when tested in two different ways. First, higher common ownership is associated with lower investment among firms that are more likely to over-invest, i.e., those with high cash balances and low leverage. On the other hand, higher common ownership is associated with higher investments among highly leveraged firms with low levels of cash, i.e., those with a greater propensity to under-invest.

In addition, firms with higher common ownership with their industry peers are less likely to deviate from their predicted level of investment.

To establish causality, I use financial institutions' mergers as exogenous shocks to common ownership and find that treatment firms which experience a merger-driven increase in common ownership exhibit a greater increase in investment efficiency relative to control firms. In line with the well-accepted notion that the common owners' information advantage reduces the costs associated with monitoring, thus improving firms' financial reporting quality, I find support for the hypothesis that the positive (negative) association between common ownership and investments in firms that are more likely to under (over) invest is more pronounced for firms with higher-quality financial reporting.

Further, I find that the effect of common ownership on investment efficiency is stronger when the firm has a lower analysts' coverage than the industry median and when the firm's largest owner is not a family owner. All these conditions tend to enhance the role of common ownership in reducing information asymmetries between managers and capital suppliers.

The findings of this work suggest that the presence of common owners is beneficial not only for the firms' operating activities, including corporate governance and disclosure, but also for promoting firms' long-term market value creation, which is harmed by both over and under-investment.

The beneficial role of common ownership also comes up from other recent papers which have found statistical or anecdotal evidence that common ownership produces social benefits aside from its facilitation of diversification by internalizing positive externalities across firms while promoting disclosure and coordination (Kini et al., 2019; Park et al., 2019; Kostovesky & Manconi, 2020; Antón et al., 2021; Freeman, 2021). Nevertheless, these articles overlook the normative implications of the conclusions.

If these recent works hold up, it is unclear whether common ownership should be celebrated for creating efficiencies or punished for undermining market competition. It, therefore, raises the question of how policymakers should deal with the "bright side" and the "dark side" of common ownership.

However, there is less to these matters than meets the eye both in terms of antitrust and regulation. Defendants in antitrust trials frequently claim that business efficiency justifies conduct that would appear to be anticompetitive otherwise. The reasoning underlying the improved coordination or innovation-spillovers argument, indeed, is similar to that according to which common owners, acting on behalf of their clients, facilitate easy diversification. In appropriate circumstances, defendants may argue that common ownership (as well as mergers and other forms of collaboration) may be legal if such efficiencies occur.

The same point can be made in terms of regulations designed to limit common ownership or control by common owners of portfolio firms. In this case, regulators should be careful to distinguish between within-industry common ownership and diversification that involves common ownership (only) across industries.

At least a portion of the beneficial behavior will still be preserved under a regulation that restricts within-industry common ownership and requires investors to concentrate their holdings in one firm per industry. For example, a common owner could exert pressure to limit greenhouse gases for the benefit of the firms she owns outside the industry of the polluter, while she will not have any incentive to lessen competition because she owns only one firm per industry. On the other hand, a regulation that restricts the common owner's ability to diversify among industry competitors will also prevent her from capturing the externalities.

Antitrust laws and regulations when addressing common ownership, as so often happens, are thus required to come up with a more complex framework that encourages competition while creating safe harbors for greater efficiency and socially beneficial cooperation among firms.

## Appendix

**Table A1: Common ownership across 3 DIGIT NAICS industries**

3D NAICS	N° firms	N° of cross-held firms	% of cross-held firms	N° common investors	% of common investors	N° single investors	% of single investors
111	25	6	24,0%	67	11,2%	529	88,8%
211	111	84	75,7%	849	14,3%	5091	85,7%
212	187	131	70,1%	1244	16,6%	6230	83,4%
213	42	33	78,6%	239	24,7%	730	75,3%
236	130	86	66,2%	826	28,1%	2112	71,9%
237	92	56	60,9%	694	27,0%	1875	73,0%
238	40	20	50,0%	187	13,4%	1213	86,6%
311	119	80	67,2%	1038	25,9%	2968	74,1%
312	64	37	57,8%	1226	38,4%	1968	61,6%
313	23	0	0,0%	21	7,4%	264	92,6%
315	40	23	57,5%	495	30,6%	1122	69,4%
316	16	10	62,5%	522	44,2%	660	55,8%
321	29	11	37,9%	130	19,5%	537	80,5%
322	46	37	80,4%	715	37,6%	1185	62,4%
324	21	14	66,7%	714	51,7%	668	48,3%
325	310	242	78,1%	2085	31,2%	4602	68,8%
326	50	30	60,0%	635	35,6%	1148	64,4%
327	53	31	58,5%	656	34,3%	1256	65,7%
331	68	38	55,9%	709	42,1%	974	57,9%
332	83	50	60,2%	720	31,8%	1542	68,2%
333	240	187	77,9%	1743	34,2%	3357	65,8%
334	360	281	78,1%	1859	18,2%	8348	81,8%
335	98	69	70,4%	888	26,2%	2500	73,8%
336	139	107	77,0%	1413	39,5%	2161	60,5%
337	20	12	60,0%	132	14,8%	762	85,2%
339	110	78	70,9%	979	34,2%	1884	65,8%
423	99	57	57,6%	735	32,7%	1514	67,3%
424	69	37	53,6%	569	23,2%	1884	76,8%
441	19	11	57,9%	103	13,3%	674	86,7%
443	23	12	52,2%	107	20,0%	428	80,0%
444	16	12	75,0%	226	26,2%	636	73,8%
445	24	22	91,7%	722	45,2%	877	54,8%
446	17	11	64,7%	204	30,0%	476	70,0%
448	34	19	55,9%	724	41,9%	1002	58,1%
451	17	10	58,8%	153	23,5%	498	76,5%
454	45	29	64,4%	282	25,5%	823	74,5%
481	20	14	70,0%	245	17,4%	1164	82,6%
483	43	33	76,7%	440	21,8%	1582	78,2%
488	32	24	75,0%	418	39,1%	651	60,9%
511	455	359	78,9%	1571	19,6%	6429	80,4%
512	48	24	50,0%	341	25,1%	1018	74,9%
515	21	11	52,4%	285	35,3%	522	64,7%
517	88	53	60,2%	1065	47,2%	1193	52,8%
518	34	24	70,6%	157	14,8%	906	85,2%
519	76	48	63,2%	620	18,9%	2667	81,1%
524	74	57	77,0%	1303	43,7%	1681	56,3%

531	447	272	60,9%	1513	19,5%	6234	80,5%
532	28	14	50,0%	194	18,7%	842	81,3%
561	107	83	77,6%	835	25,6%	2426	74,4%
562	29	12	41,4%	222	28,5%	558	71,5%
611	18	7	38,9%	27	6,8%	368	93,2%
621	32	17	53,1%	408	34,7%	767	65,3%
622	16	7	43,8%	61	15,9%	323	84,1%
711	27	10	37,0%	49	8,0%	563	92,0%
713	36	21	58,3%	326	29,5%	779	70,5%
721	32	12	37,5%	230	26,0%	653	74,0%
722	42	28	66,7%	436	19,7%	1780	80,3%
# of firms	4595						
Average			34,7%		15,3%		41,7%

This table shows the distribution of cross-held firms and the number of common owners across different 3-digit NAICS industries in 2021.

**Table A2: Panel A – Summary statistics**

Variable	Mean	Standard Deviation	25 <sup>th</sup> percentile	Median	75 <sup>th</sup> percentile	N
<i>Investment</i>	9.230	13.36	2.361	5.333	10.44	16,189
$\kappa$	0.0159	0.0452	8.19e-07	0.000538	0.00840	61,942
<i>CrossDummy</i>	0.364	0.481	0	0	1	121,296
<i>LnNumConnected</i>	0.811	1.290	0	0	1.447	121,296
<i>LnNumCross</i>	0.503	0.787	0	0	0.916	121,296
<i>LnAvgNum</i>	0.571	0.888	0	0	1.078	121,296
<i>TotalCrossOwn</i>	6.854	14.21	0	0	6.109	121,296
<i>BlockInstOwn</i>	8.671	16.12	0	0	10.22	121,296
<i>Excess PCM</i>	0.0604	0.387	-0.0585	-0.00910	0.0614	71,781
<i>Size</i>	4,378	19,763	17.94	112.8	772.6	112,123
<i>Leverage</i>	0.206	0.208	0.0212	0.157	0.323	108,421
<i>Cash</i>	0.167	0.205	0.0336	0.0903	0.212	102,825
<i>CFOsale</i>	4.540	4,053	-0.000699	0.0679	0.161	95,190
<i>Loss</i>	0.185	0.388	0	0	0	187,500
<i>Tangibility</i>	0.208	0.232	0.0219	0.117	0.324	98,202
$\sigma(CFO)$	0.0761	0.943	0.0147	0.0347	0.0728	102,563
<i>FRquality</i>	-0.437	1.962	-0.258	-0.0936	-0.0423	65,721
<i>LargeAnalysts</i>	0.319	0.466	0	0	1	117,443

**Table A3: Panel B – Correlation matrix**

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
<i>Investment</i>	1																	
$\kappa$	-0,034	1,000																
<i>CrossDummy</i>	-0,006	0,088	1,000															
<i>LnNumConnected</i>	-0,028	0,161	0,617	1,000														
<i>LnNumCross</i>	-0,016	0,276	0,639	0,829	1,000													
<i>LnAvgNum</i>	-0,040	0,121	0,624	0,947	0,667	1,000												
<i>TotalCrossOwn</i>	0,017	0,263	0,380	0,589	0,792	0,414	1,000											
<i>BlockInstOwn</i>	0,026	0,129	0,324	0,431	0,675	0,258	0,739	1,000										
<i>Excess PCM</i>	0,025	0,078	-0,003	-0,004	0,013	-0,009	0,010	-0,110	1,000									
<i>Size</i>	-0,094	0,175	0,065	0,099	0,037	-0,145	-0,065	-0,110	0,033	1,000								
<i>Leverage</i>	0,082	0,033	-0,063	-0,107	-0,092	-0,088	-0,094	-0,073	0,020	0,096	1,000							
<i>Cash</i>	-0,057	-0,080	0,007	0,042	-0,025	0,046	-0,044	-0,086	0,072	-0,123	-0,340	1,000						
<i>CFOsale</i>	0,085	0,055	0,018	0,072	0,042	0,074	0,056	0,012	0,129	0,069	0,013	0,097	1,000					
<i>Loss</i>	-0,021	-0,027	-0,047	-0,057	-0,062	-0,050	-0,023	-0,017	-0,103	0,007	0,141	-0,019	-0,034	1,000				
<i>Tangibility</i>	0,093	-0,007	-0,101	-0,232	-0,172	-0,211	-0,134	-0,118	0,030	-0,060	0,239	-0,235	0,137	0,016	1,000			
$(\sigma)CFO$	0,007	-0,102	-0,084	-0,044	-0,082	-0,040	-0,036	-0,058	-0,021	-0,163	-0,073	0,210	0,061	0,068	-0,078	1,000		
<i>FRquality</i>	-0,025	0,033	0,060	0,062	0,082	0,053	0,050	0,050	0,017	0,041	-0,080	-0,049	-0,051	-0,100	-0,008	-0,224	1,000	
<i>LargeAnalysts</i>	-0,017	0,105	0,237	0,311	0,322	0,283	0,188	0,167	0,027	0,134	-0,006	-0,028	0,064	-0,067	-0,086	-0,098	0,080	1,000

Panel A provides summary statistics of the key variables used in the analyses. Panel B reports the Pearson correlations for these variables. *Investment* is the sum of capital expenditure and acquisition expenditure less cash receipts from the sale of property, plant and equipment multiplied by 100 and scaled by lagged total assets.  $\kappa$  is the average profit weight that firm *f* puts on every dollar of its industry peers' profits in its maximization problem. *CrossDummy* is dummy variable equal to 1 if the firm is cross-held by at least one blockholder in any of the four quarters in a fiscal year and zero otherwise. *LnNumConnected* is measured as the natural logarithm of one plus the average number of same-industry peers that share any common blockholder with the firm across the four quarters of a fiscal year. *LnNumCross* is the natural logarithm of one plus the average number of unique blockholders that cross-own a firm across the four quarters of a fiscal year. *LnAvgNum* is measured as the natural logarithm of one plus the average number of same-industry peers blockheld by all the cross-holding investors across the four quarters of a fiscal year. *TotalCrossOwn* is the average percentage holdings by all the cross-blockholders across the four quarters of a fiscal year. *BlockInstOwn* is the average percentage of shares held by institutional blockholders across the four quarters in a fiscal year. *Excess PCM* is the difference between firm's price-cost margin (Operating Income over Sales), and the price-cost margin of the industry defined by the 3-DIGIT NAICS industry code. *Size* is represented by the firm's total assets. *Leverage* is the ratio of total debt to total assets. *Cash* is the ratio of cash and short-term investments to total assets. *CFOsale* the ratio of *CFO* to sales. *Loss* is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. *Tangibility* is the ratio of PP&E to total assets.  $\sigma(CFO)$  is the standard deviation of *CFO* from years *t-4* to *t* deflated by average total assets. *FRquality* is a measure of accruals quality proposed by Dechow and Dichev (2002) and modified by Francis et al. (2005). *LargeAnalysts* is a dummy variable equal to one if the firm has above-median industry coverage.

**Table A4: Panel A - List of financial institutions mergers**

<b>Acquiror Name</b>	<b>Target Name</b>	<b>Announcement date</b>	<b>Effective date</b>	<b>Number Of Days</b>
United International Enterprises Ltd	International Plantations & Finance	24/04/2002	28/06/2002	65
Panther Securities P L C	Eurocity Properties PLC	08/11/2002	05/02/2003	89
Banc One Investment Advisors/Detroit_NLE	Security Capital Research & Management, Inc.	16/09/2003	26/11/2003	71
Bank of America Corp	Fleet Boston Financial_NLE	27/10/2003	01/04/2004	157
AXA Group	Finaxa SA	19/04/2005	16/12/2005	241
IFG Trust (Jersey) Ltd.	Bank of Scotland Trust Company (International) Ltd	28/12/2005	28/12/2005	0
Mattioli Woods PLC	Suffolk Life Trustee Company Limited	30/01/2006	30/01/2006	0
Blackrock	Merrill Lynch Investment Managers_NLE	15/02/2006	29/09/2006	226
Snefonn AS	Havfonn AS	21/03/2006	21/03/2006	0
La Gaiana SpA	Gabetti Property Solutions SpA	16/10/2006	27/04/2007	193
MorganStanley_aggregate	FrontPoint Partners LLC_NLE	31/10/2006	04/12/2006	34
Bank of New York (Sibling)	Mellon Bank, N.A._NLE	03/12/2006	02/07/2007	211
Baugur Group hf	Immo Croissance SICAV-FIS	27/06/2007	07/02/2008	225
AXA Group	Nationale Suisse Assurances_NLE	23/07/2007	28/09/2007	67
Lehman Brothers Holdings Inc	David J. Greene and Company, LLC_NLE	23/04/2008	30/09/2008	160
Bank of America Corp	Merrill Lynch & Company, Inc._NLE	14/09/2008	01/01/2009	109
Barclays Bank PLC	Lehman Brothers Inc._NLE	16/09/2008	22/09/2008	6
HBK Invest AS	BSB Invest AS_NLE	02/01/2009	02/01/2009	0
Skagenkaien Eiendom AS	Biovekst AS	01/02/2009	01/02/2009	0
Blackrock	Barclays Global Investors Japan Ltd._NLE	11/06/2009	01/12/2009	173
Astaire Group Ltd	Ruegg & Co Ltd	23/07/2009	23/07/2009	0
Blackrock	Barclays Global Investors Ltd	16/09/2009	01/12/2009	76
Bure Equity AB	Skanditek Industriforvaltning AB	14/10/2009	27/01/2010	105
Evli Pankki Oyj	Erik Penser Fonder AB_NLE	20/10/2009	03/02/2010	106
Aviva Investors Global Services Limited	River Road Asset Management, LLC	05/01/2010	04/03/2010	58
Affiliated Managers Group Inc	Artemis Investment Management LLP	01/02/2010	15/03/2010	42
Goldman Sachs	Level Global Investors, L.P._NLE	06/04/2010	06/04/2010	0
Man Group PLC	GLG Partners Inc. Asset Management	17/05/2010	14/10/2010	150
GLI Finance, Ltd.	Investment Company Ltd	26/10/2010	01/02/2011	98

AcomeA SGR S.p.A.	Leonardo SGR S.p.A._NLE	31/01/2011	30/06/2011	150
Bryn Mawr Trust Company	Private Wealth Management	21/02/2011	27/05/2011	95
Yorkshire Building Society	Norwich & Peterborough Building Society	18/03/2011	03/11/2011	230
Ziegler Capital Management, LLC	Lotsoff Capital Management_NLE	28/04/2011	10/06/2011	43
KBC Asset Management N.V.	KBC Towarzystwo Funduszy Inwestycyjnych S.A.	17/01/2012	20/06/2012	155
Talanx AG	Towarzystwo Ubezpieczeni Reasekuracji Warta SA	20/01/2012	01/07/2012	163
James Hambro & Partners LLP	Calkin Pattinson & Co. Ltd._NLE	16/08/2012	16/08/2012	0
Cassa Depositi e Prestiti, S.p.A.	Fintecna S.p.A.	24/10/2012	09/11/2012	16
Lone Star Funds	TLG IMMOBILIEN AG	12/12/2012	12/12/2012	0
Peoples Financial Services Corp.	Penseco Financial Services Corp._NLE	28/06/2013	02/12/2013	157
Miton Group Ltd	PSigma Asset Management Holdings Limited_NLE	02/07/2013	03/07/2013	1
Ader Investment Management LLC_NLE	Springowl Associates LLC	23/10/2013	23/10/2013	0
Vienna Insurance Group AG Wiener	AXA Group	23/12/2013	06/06/2014	165
Versicherung Gruppe Affiliated Managers Group Inc	River Road Asset Management, LLC	28/03/2014	30/06/2014	94
Ingenious Asset Management Limited_NLE	Thurleigh Investment Managers LLP_NLE	03/04/2014	14/08/2014	133
Man Group PLC	Numeric Investors LLC	19/06/2014	05/09/2014	78
The Blackstone Group	Lombard International Assurance, S.A.	11/07/2014	31/10/2014	112
Hunters Group Ltd.	Hunters Property Group Ltd	31/07/2014	31/07/2014	0
Aviva PLC	Friends Life Group Ltd	21/11/2014	10/04/2015	140
Ziegler Capital Management, LLC	Fiduciary Asset Management, LLC_NLE	29/05/2015	29/05/2015	0
KCI SA	Gremi Media SA	02/10/2015	10/05/2016	221
Allianz	Rogge Global Partners Limited_NLE	08/02/2016	01/06/2016	114
Boston Financial Management LLC	Emerson Investment Management LLC_NLE	02/05/2016	02/05/2016	0
Advisory Research, Inc.	Cupps Capital Management, LLC_NLE	18/08/2016	19/08/2016	1
NN Group N.V.	Delta Lloyd NV	05/10/2016	01/06/2017	239
Aspiriant, LLC	Stanford Investment Group Inc._NLE	12/12/2016	01/02/2017	51
Liontrust Asset Management PLC	Alliance Trust Investments Limited_NLE	14/12/2016	03/04/2017	110
Eiffel Investment Group S.A.S.	Alto Invest	02/03/2017	02/03/2017	0
IP Group PLC	Touchstone Innovations Ltd	23/05/2017	08/12/2017	199
RMB Capital Management, LLC	Jacobus Wealth Management, Inc._NLE	26/10/2017	31/12/2017	66
SEI Investments Company	Huntington Steele LLC_NLE	02/04/2018	02/04/2018	0

Schonfeld Strategic Advisors LLC	Folger Hill Asset Management LLC_NLE	10/04/2018	10/04/2018	0
Seven Investment Management LLP	Tcam Asset Management Limited_NLE	17/05/2018	01/08/2018	76
Reyl & Cie S.A.	Ohman Bank SA	20/09/2018	31/03/2019	192
Pareto Securities AS	Aktieinvest FK AB	18/10/2018	09/01/2019	83

**Table A5: Panel B - Mergers that identify treatment and control firms**

Acquiror Name	Target Name	Announcement date	Effective date	N° Of Days	Threshold
AXA Group	Finaxa SA	19/04/2005	16/12/2005	241	1 %
Blackrock	Barclays Global Investors	11/06/2009	01/12/2009	173	0 %
AcomeA SGR S.p.A.	Japan Ltd._NLE Leonardo SGR S.p.A._NLE	31/01/2011	30/06/2011	150	0 %
KBC Asset Management N.V.	KBC Towarzystwo Funduszy Inwestycyjnych S.A.	17/01/2012	20/06/2012	155	0.5 %
Vienna Insurance Group AG Wiener Versicherung Gruppe	AXA Group	23/12/2013	06/06/2014	165	1 %
Aviva PLC	Friends Life Group Ltd	21/11/2014	10/04/2015	140	1 %
Liontrust Asset Management PLC	Alliance Trust Investments Limited_NLE	14/12/2016	03/04/2017	110	0 %
Seven Investment Management LLP	Tcam Asset Management Limited_NLE	17/05/2018	01/08/2018	76	0 %

This table provides the entire list of financial institutions' mergers that meet the requirements (Panel A) and the list of mergers that identify treatment and control firms under different thresholds used to define blockholdings (Panel B). For each merger, I report the acquiror name, the target name, the announcement date, the effective date, and the number of days between the announcement and the completion of the merger.

**Table A6: Predicted probabilities**

Margins		<i>Investment State=1</i>	<i>Investment State=2</i>	<i>Investment State=3</i>
		(1)	(2)	(3)
Treat	Post			
0	0	0.214*** (0.026)	0.529*** (0.025)	0.258*** (0.022)
0	1	0.201*** (0.021)	0.531*** (0.021)	0.268*** (0.020)
1	0	0.283** (0.119)	0.276*** (0.103)	0.441*** (0.137)
1	1	0.244*** (0.051)	0.573*** (0.046)	0.184*** (0.041)
Observations		2,050	2,050	2,050

This table reports the predicted probabilities of the model estimated in Table 6 using Eq. (5). Columns (1), (2), and (3) report respectively the predicted probability for a firm to being in each outcome, *Investment State* equal to 1 2 or 3, under each combination of *Treat*×*Post*.

**Table A7: Average marginal effects**

Average Marginal Effects of Post (dy/dx)		
Post =1 (Base outcome Post=0)		
Investment State	Treat	
1	0	-0.013 (0.027)
1	1	-0.039 (0.129)
2	0	0.002 (0.028)
2	1	0.297** (0.116)
3	0	0.011 (0.025)
3	1	-0.257* (0.140)
Observations		2,050

This table reports the average marginal effect of *Post* in the model estimated in Table 6 using Eq. (5). Specifically, the table reports the average derivatives for each of the three outcomes with respect to *Post* at each level of *Treat*. Technically, because *Post* is a dummy variable these are not derivatives but finite differences in probabilities.

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