Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.

Estimating the Competitive Effects of Common Ownership

Jacob Gramlich and Serafin Grundl

2017-029

Please cite this paper as:
Gramlich, Jacob, and Serafin Grundl (2017). "Estimating the Competitive Effects of Common Ownership," Finance and Economics Discussion Series 2017-029. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2017.029r1.

Estimating the Competitive Effects of Common Ownership

Jacob Gramlich and Serafin Grundl †

April 21, 2017

Abstract

If managers maximize the payoffs of their shareholders rather than firm profits, then it may be anticompetitive for a shareholder to own competing firms. This is because a manager's objective function may place weight on profits of competitors who are held by the same shareholder. Recent research found evidence that common ownership by diversified institutional investors is anticompetitive by showing that prices in the airline and banking industries are related to generalized versions of the Herfindahl-Hirschman Index (HHI) that account for common ownership. In this paper we propose an alternative approach to estimating the competitive effects of common ownership that relates prices and quantities directly to the weights that such managers may be placing on the profits of their rivals.

We argue that this approach has several advantages. First, the approach does not inherit the endogeneity problems of HHI regressions, which arise because HHI measures are functions of quantities. Second, because we treat quantities as outcomes we can look for competitive effects of common ownership on both prices and quantities. Third, while concentration measures vary only at the market-time level, the profit weights also vary at the firm level, which allows us to control for a richer set of unobservables.

We apply this approach to data from the banking industry. Our empirical findings are mixed, though they're preliminary as we investigate irregularities in ownership data (Anderson and Brockman (2016)). The sign of the estimated effect is sensitive to the specification. Economically, estimated effects on prices and quantities are fairly small.

* Empirical Findings are Preliminary *

JEL Codes: L40, L20, L10, G34, G21

Keywords: Common Ownership, Bank Competition

† Board of Governors of the Federal Reserve System, jacob.gramlich@frb.gov, serafin.j.grundl@frb.gov.
The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the staff, by the Board of Governors, or by the Federal Reserve Banks. Rebecca Jorgensen, Nadia Wallace, Meher Islam, and Helen Willis provided outstanding research assistance. We thank Dan O'Brien, Martin Schmalz, and Robin Prager for helpful conversations, and Traci Mach and her team for help with the Rate Watch data. First Draft: February, 2017.

1 Introduction

If managers maximize the payoffs of their shareholders rather than firm profits, then it may be anticompetitive for a shareholder to own competing firms. This is because a manager's objective function may place weight on profits of competitors who are held by the same shareholder. This has been recognized in the theoretical IO literature for some time (e.g. Rubinstein, Yaari, et al. (1983); Rotemberg (1984); Reynolds and Snapp (1986); Bresnahan and Salop (1986)), though there has been little empirical work on the topic.

Recently, two seminal empirical papers by Azar, Schmalz, and Tecu (2016) and Azar, Raina, and Schmalz (2016) find that common ownership by diversified institutional investors causes higher prices in the airline and banking industries. Moreover, Antón, Ederer, Giné, and Schmalz (2016) find that managers are rewarded more for the performance of their competitors in industries with more common ownership, which suggests that managers are incentivized to take the profits of their competitors into account.[1]

These findings have received significant attention from economists, legal scholars, policy makers, and the media. For example, Posner, Scott Morton, and Weyl (2016) propose to limit the anti-competitive power of institutional investors by limiting their holdings in an industry to 1% or alternatively to only hold shares of a single firm in the industry. Elhauge (2016) recommends antitrust enforcement actions to reduce common ownership in instances where it can be shown to have anticompetitive effects.[2] In addition to the implications for antitrust and the regulation of the asset management industry, some have pointed out links to the ongoing debates about rising profit shares and wealth inequality.

These far-reaching policy recommendations are based on a small yet growing literature which finds that prices and executive compensation are related to measures of market concentration that take common ownership into account. These concentration measures can be regarded as generalizations of the Herfindahl-Hirschman Index (HHI). The Modified Herfindahl-Hirschman Index ($MHHI$) proposed by O'Brien and Salop (2000) takes into account common ownership of competitors by shareholders, and the Generalized Herfindahl-Hirschman Index ($GHHI$) proposed by Azar, Raina, and Schmalz (2016) additionally accounts for cross-ownership between firms. The HHI,

[1] The findings on management compensation are mixed however, as Kong (2016) finds the opposite of Antón, Ederer, Giné, and Schmalz (2016).

[2] Rock and Rubinfeld (2017) also present a policy view.

$MHHI$, and $GHHI$ all depend on firms' market shares, but the latter two also incorporate weights that managers place on the profits of their rivals. Formally, $HHI = s's$, $MHHI = s'\widetilde{W}_M s$ and $GHHI = s'\widetilde{W}_G s$, where s is a vector of market shares and $\widetilde{W}_M$ and $\widetilde{W}_G$ (generically $\widetilde{W}$) are matrices with weights $\widetilde{w}_{jk}$ that the manager of firm j places on the profits of firm k, relative to the weight on its own profits $\widetilde{w}_{jj} = 1$.[3] If there is no common ownership or cross-ownership, then managers place no weight on the profits of their rivals and $HHI = MHHI = GHHI$. In the presence of common or cross-ownership $MHHI$ and $GHHI$ are larger than HHI, and the difference are captured by the $\widetilde{W}$ matrices. Conceptually, the $MHHI$ and the $GHHI$ can be regarded as generalizations of the HHI because they have the same interpretation in a homogenous good Cournot model.[4]

In this paper we propose an alternative approach to estimating competitive effects of common and cross ownership that does not rely on the $MHHI$ and the $GHHI$. Instead of relating prices to $MHHI$ or $GHHI$, we relate prices and quantities directly to W, which is a row-normalized version of $\widetilde{W}$.[5] For example, suppose the ownership structure of a firm changes such that it places less weight on its own profits and more weight on the profits of its rivals. We then investigate whether this firm raises its price and/or reduces its output. We argue that this approach has several advantages over the approach relying on $MHHI$ and $GHHI$.

First, by relating prices and quantities directly to W, the approach does not inherit the endogeneity problems of HHI regressions. These endogeneity problems arise because s is a function of quantities, which are endogenous (see Schmalensee (1988) and O'Brien and Waehrer (2017) for discussions).

Second, we treat quantities as outcome variables.[6] This is important because if common ownership is anticompetitive, then theory predicts that it leads not only to higher

[3]The calculation of $\widetilde{W}_G$ involves an additional step relative to the calculation of $\widetilde{W}_M$ that takes into account cross-ownership between firms.

[4] Let $\alpha = \eta \sum_j s_j L_j$ be the product of the demand elasticity η and the market-share weighted average of Lerner indices $\sum_j s_j L_j$. If managers maximize firm profits, then $\alpha = HHI$. Analogously, if managers maximize shareholder payoff, and there is some common ownership, then $\alpha = MHHI$ (O'Brien and Salop (2000)). Lastly, if managers maximize shareholder payoff and in addition to common ownership by outside shareholders, there is cross-ownership between firms $\alpha = GHHI$ (Azar, Raina, and Schmalz (2016)).

[5]The weights $\widetilde{w}_{jk}$ in $\widetilde{W}$ are measured relative to the weight firm j places on its own profits $\widetilde{w}_{jj} = 1$. The weights in W are normalized so they sum to one: $w_{jk} = \widetilde{w}_{jk} / \sum_k \widetilde{w}_{jk}$.

[6]Azar (2016) show regressions in which quantity is an outcome variable, but these regressions are difficult to interpret because quantity also enters the calculation of $MHHI$, the main regressor of interest.

prices but also to lower quantities. Similarly, if common ownership is procompetitive, then theory predicts it should lead to lower prices and higher quantities.[7] A finding of prices and quantities moving in the same direction would suggests the presence of other changes in the market, perhaps related to unobserved quality or demand. An added benefit is that our approach can be used when either price or quantity data are missing, while analyses using $MHHI$ and $GHHI$ can not.

Third, while concentration measures vary only at the market-time level, the profit weights vary at the market-time-firm level, which allows us to control for a richer set of unobservables.[8] In particular, we can control for market-time effects that are not captured by $MHHI$ or $GHHI$.

We apply our approach to data from the banking industry using SEC 13F data on shareholdings of institutional investors. Researchers have noted irregularities in these reports (Anderson and Brockman (2016)) that we are investigating, so our empirical findings are preliminary. We find that the sign of the estimated effect on prices and quantities depends on the specification. Economically, the estimated effects are fairly small and even for specifications which suggest that common ownership leads to less aggressive pricing (lower deposit rates), we often find that the effect on quantities is either zero or even positive.

The remainder of this paper is structured as follows. Section 2 is a brief discussion of related literature and recent commentary. Section 3 reviews the model by O'Brien and Salop (2000), which is the basis for our approach and the previous approach using $MHHI$ or $GHHI$. Section 4 describes the data. Section 5 introduces our empirical specification and presents the baseline results. Section 6 attempts to exploit the merger between Blackrock and Barclays Global Investors to address potential endogeneity concerns. Section 7 concludes and discusses avenues for future research.

2 Literature Review

The idea that common ownership of competitors may be anti-competitive is not new. The theoretical literature noted this possibility at least as early as the 1980s, and antitrust enforcers at least as early at the 1940s (Rubinstein, Yaari, et al. (1983);

[7] López and Vives (2016), for instance, suggest that information sharing could lead to procompetitive effects of common ownership.

[8] The profit weights actually vary at an even more granular level: that of ordered firm pairs. However, the outcomes we observe - prices and quantities - vary only at the firm level.

Rotemberg (1984); Reynolds and Snapp (1986); Gordon (1990); Hansen and Lott Jr (1996); Gilo (2000); O'Brien and Salop (2001); Gilo, Moshe, and Spiegel (2006); Azar (2011, 2016); López and Vives (2016)).

O'Brien and Salop (2000) build upon Bresnahan and Salop (1986) to formally develop a model with common ownership, and derive the "$MHHI$" or Modified Herfindahl Hirschman Index. Both the HHI and the $MHHI$ can be interpreted as measures of the average markup in a market in the homogeneous good Cournot model, as we discuss further below.

Our work is most closely related to the recent empirical findings by Azar, Schmalz, and Tecu (2016) and Azar, Raina, and Schmalz (2016). To the best of our knowledge, these papers contain the first empirical findings suggesting that common ownership by diversified institutional investors is anticompetitive. Azar, Schmalz, and Tecu (2016) investigates airline routes. Azar, Raina, and Schmalz (2016), the "banking paper," investigates banking markets, and proposes a "$GHHI$" ("Generalized Herfindahl Hirschman Index") that further generalizes the $MHHI$ to account for competitors directly owning shares of each other ("cross ownership").

The findings of Azar, Schmalz, and Tecu (2016) and Azar, Raina, and Schmalz (2016) have challenged the common notion that the theoretical results on anticompetitive effects of common ownership might not be directly applicable to large, institutional asset managers. The skepticism that the theoretical results would apply to these investors is based on a number of considerations. First, asset managers invest their customers' funds, not their own, so they are not the ultimate owners of the shares.[9] Therefore it is not clear that asset managers benefit from lessened competition in the same way that a direct shareholder would. In response, some have pointed out that it is asset managers' fiduciary duty to act in the interest of their customers. Second, some have expressed doubt that large asset managers - which often follow low-cost, passive investment strategies - would expend significant resources to engage actively in corporate control. This raises questions about a potential mechanism by which asset managers could soften competition among their portfolio firms against the interests of undiversified shareholders. Azar, Schmalz, and Tecu (2016) argue that active involvement in corporate control is not necessary to explain anticompetitive effects, because large institutional asset managers could simply be crowding out activist investors who push for more aggressive competition. This crowding-out argument is based on idea

[9] Asset managers earn fees, generally a small percentage of assets under management.

that - in the absence of activist investors - managers prefer a "quiet life" (Hicks (1935); Bertrand and Mullainathan (2003)).[10] Third, some commentators have noted that a large literature in corporate finance suggests that managers often do not act in the interest of their shareholders, even if the shareholders are undiversified and thus interested in profit maximization.

Schmalensee (1988) contains an overview of the literature that relates outcomes variables (such as profit or price) to market structure. This literature began with the seminal study of Bain (1951). Initial studies were cross-sectional and inter-industry, but faced challenges due to factors that vary from industry to industry. Within-industry studies (e.g. Benham (1972)) became more common, though these still faced endogeneity concerns. Unobservables can provide alternative explanations for "intuitive" signs and reasonable explanations for "counter-intuitive" signs, as well. Market-specific costs can lead to both limited entry (higher concentration) and higher prices, or unobserved cost advantages can lead to market dominance (higher concentration) and higher share-weighted margins (Demsetz (1973)). Alternatively, cost advantages can lead to market dominance (higher concentration) and lower prices. These possibilities underscore that market structure is not exogenous but is the outcome of a competitive entry game.

There exists a literature on reconciling predictions of Cournot and Bertrand models of competition (e.g. Davidson and Deneckere (1986)). HHI and its generalizations have a structural interpretation in the homogenous good Cournot model (see footnote 4), but in most industries firms choose prices rather than quantities and product differentiation is important. We believe that some predictions about the relationship between outcome variables - prices and quantities - and the profit weights in W hold under many assumptions about the nature of competition and demand. For example, if the ownership structure of a firm changes such that it places more weight on its own profits, we expect the firm to have more aggressive prices and higher output, regardless of whether the choice variable is price or quantity.

Our paper also relates to work on corporate ownership, corporate governance, and potential mechanisms for a link between common ownership and competition. McCahery, Sautner, and Starks (2016) find that some institutional investors intervene behind the scenes in governance and exit if they are unhappy about governance. They also document that many investors use proxy advisers for voting. Rydqvist, Spizman, and Strebulaev (2014) argue that the transition from direct ownership to indirect stock own-

[10]Note that this mechanism seems to suggests that any ownership by non-activist investors is anti-competitive, regardless of whether these investors own shares of competitors or not.

ership of stocks through institutional investors is driven by tax and retirement policies. Adams and Ferreira (2008) survey the empirical literature on the relationship between ownership and control.

As mentioned above, recent literature on the effect of common ownership on executive compensation has mixed findings. Antón, Ederer, Giné, and Schmalz (2016) and Liang (2016) find that managers are paid more for rival performance if firms are commonly owned, while Kong (2016) finds the opposite. He and Huang (2014) find that commonly owned firms experience higher market share growth, which could suggest that common ownership is pro-competitive rather than anti-competitive. Our view is that studies on compensation and common ownership should also relate compensation directly to the profit weights rather than to concentration measures like the $MHHI$ or the $GHHI$. In a companion paper, we are investigating relating the profits weights w_{jk} to correlations between manager j compensation and firm k performance.[11]

This paper is perhaps most closely related to O'Brien and Waehrer (2017), which was written independently of and concurrently with earlier drafts of this paper. Like this paper, O'Brien and Waehrer (2017) are also pointing out that $MHHI$ is endogenous because it is a function of market shares. The focus of our paper is to conduct an empirical analysis of the competitive effects of common ownership that does not suffer from this problem, while O'Brien and Waehrer (2017) focus on a more detailed discussion of potentials concerns with $MHHI$ regressions.

3 Model

In this section we discuss the model by O'Brien and Salop (2000) in which managers maximize a weighted sum of their shareholders' payoffs:

$$\sum_i \gamma_{ij} \sum_k \beta_{ik} \pi_k \tag{1}$$

Managers are indexed by j and k, and shareholders by i. γ_{ij} is owner i's "control share" of firm j, which is the weight that manager j assigns to owner i's payoff. For each firm j, the control shares add up to one $\sum_i \gamma_{ij} = 1$. β_{ik} is owner i's ownership share

[11]The idea is that (time-varying) correlation between manager j compensation and firm k performance varies at the level of (ordered) firm pairs just like w_{jk}. Therefore we can control for a richer set of unobservables in this setting, than with outcome variables that vary only at the firm level, like price and quantity.

of firm k, which is the percentage of firm k's profits, π_k, which accrue to owner i. For each firm k, the ownership shares add up to one $\sum_i \beta_{ik} = 1$. It natural to assume that γ_{ij} is a non-decreasing function of β_{ij}: as i's ownership of firm j increases, manager j should place weakly more weight on i in its objective function. In this paper we follow the previous literature in assuming that $\gamma_{ij} = \beta_{ij}$, which is called the proportional control assumption. Estimating the competitive effects of common ownership using alternative assumptions about how ownership translates into control is an important area for further research. Generally, γ_{ij} likely depends not only on β_{ij}, but the whole ownership structure of firm j. For example, a ownership share of $\beta_{ij} = 0.49$ might result in almost full control if all other shareholders are small, and in almost no control if the remaining 51% are held by a single shareholder.

As owner i increases their ownership of firm j, two terms in manager j's objective function increase: β_{ij} and γ_{ij}. As the objective function depends on the interaction between between both terms, $\beta_{ij}\gamma_{ij}$, large shareholders can have a disproportionate impact. This can lead to surprising implications of the model - especially if a large number of shares are held by small shareholders, as we discuss in more detail below.

The MHHI is defined as follows:

$$\begin{aligned} MHHI &= \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}} \\ &= HHI + \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}} \\ &= HHI + MHHI\Delta \end{aligned} \tag{2}$$

where s_j is the market share of firm j. O'Brien and Salop (2000) show that under Cournot competition with homogenous goods $MHHI$ is the product of the demand elasticity η and the market-share weighted average of Lerner indices: $MHHI = \eta \sum_j s_j L_j$. Azar, Raina, and Schmalz (2016) generalize this model to allow for cross-ownership among firms and propose the $GHHI$. They show that in this case $GHHI = \eta \sum_j s_j L_j$. Lastly, if managers maximize firm profits then $HHI = \eta \sum_j s_j L_j$. Hence, all three of these concentration measures can be interpreted as measures of the average industry markups in the homogenous good Cournot model.

After dividing by $\sum_i \gamma_{ij}\beta_{ij}$, manager j's maximization problem in 1 can be rewritten as follows:

$$
\begin{aligned}
&\pi_j + \sum_{k \neq j} \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}} \pi_k \\
=&\widetilde{w}_{jj}\pi_j + \sum_{k \neq j} \widetilde{w}_{jk}\pi_k
\end{aligned}
\tag{3}
$$

The profit weights $\widetilde{w}_{jk} = \sum_i \gamma_{ij}\beta_{ik} / \sum_i \gamma_{ij}\beta_{ij}$ measure the weight firm j places on the profits of rival k, relative to its own profits $\widetilde{w}_{jj} = 1$. The profit weights $\widetilde{w}_{jk}$ are collected in the matrix $\widetilde{W}$ and the $MHHI$ can be expressed more compactly as $MHHI = s\widetilde{W}s$, where s is a vector of market shares.

For our purposes it will be more convenient to work with weights that add up to one. Divide equation (1) by $\sum_i \sum_k \gamma_{ij}\beta_{ik}$ to obtain

$$
\begin{aligned}
& \textstyle\sum_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \sum_k \gamma_{ij}\beta_{ik}} \pi_k \\
= & \textstyle\sum_k w_{jk}\pi_k
\end{aligned}
\tag{4}
$$

where $\sum_k w_{jk} = 1$. We collect these profit weights in the matrix W. Notice that W is a row normalized version of $\widetilde{W}$ and $w_{jk} = \widetilde{w}_{jk} / \sum_k \widetilde{w}_{jk}$.

In our empirical specification we will study how the prices and quantities of firm j depend on the weight manager j places on its own profits w_{jj} and on the average weight its rivals place on firm j $\overline{w_{kj}} = \sum_{k \neq j} w_{kj} / (n-1)$, where $n-1$ is the number of rivals of firm j.

Model Implications

Before discussing the empirical specification in more detail, we illustrate some surprising implications of the model by discussing some examples. The main takeaway is that the incentives of managers and thereby prices and quantities can be determined by a small number of of large shareholders even if they collectively own much less than the remaining small shareholders.

Example with Symmetric Ownership Structure

Consider two firms with identical constant marginal cost c and assume proportional control $\gamma_{ij} = \beta_{ij}$. Initially, 100% of firm 1 is owned by shareholder 1 who does not hold any shares of firm 2, and 100% of firm 2 is owned by a shareholder 2 who does not own any shares of firm 1. As there is no common ownership, managers place no weight on the profits of their rival and $\widetilde{W}_M = W_M = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. Consequently, $MHHI = HHI = 0.5$[12] and - under the assumption of homogenous good Cournot competition - $\frac{p-c}{p} = 0.5/\eta$, where η is the elasticity of demand.

Now consider a small amount of common ownership: suppose shareholder 3 buys 5% of firm 1 and 5% of firm 2. The managers now place some weight on the profits of their rivals $\widetilde{W}_M = \begin{bmatrix} 1 & .003 \\ .003 & 1 \end{bmatrix}$ and $W_M = \begin{bmatrix} .997 & .003 \\ .003 & .997 \end{bmatrix}$ but a very small amount. To understand this consider the objective function of manager 1 in equation (1), and recall that it depends on the products of control rights and ownership shares:[13] $\sum_i \gamma_{ij} \sum_k \beta_{ik}\pi_k = 0.95\,(0.95\pi_1) + 0.05\,(0.05\pi_1 + 0.05\pi_2) = \pi_1\,(0.95^2 + 0.05^2) + \pi_2 0.05^2$. The reason manager 1 places almost no weight on the profits of its rival, despite 5% common ownership through owner 3, is that the undiversified shareholder of firm 1 is very large compared to the owner with common ownership and the objective function of manager 1 is dominated by the term $\gamma_{11}\beta_{11} = 0.95^2$. If instead the 95% held by owner 1 were held by many small shareholders the manager would place more weight on the profits of firm 2 as we will see later. In this example the $MHHI$ is only increased slightly to 0.5014 and - again assuming homogeneous good Cournot competition - the price level increases somewhat such that $\frac{p-c}{p} = 0.5014/\eta$. The takeaway from this example is that if the undiversified shareholders are large compared to the shareholders with common holdings, common ownership has only a small effect on the incentives of managers and therefore on prices.

Now suppose that we split owners 1 and 2 into two equal sized owners. So now there are four distinct owners, two of whom own 47.5% of firm 1, and two of whom own 47.5% of firm 2. The objective function of manager 1 is now $\sum_i \gamma_{ij} \sum_k \beta_{ik}\pi_k = 2 * 0.475\,(0.475\pi_1) + 0.05\,(0.05\pi_1 + 0.05\pi_2) = \pi_1\,(2 * 0.475^2 + 0.05^2) + \pi_2 0.05^2$. As $2 *$

[12]We measure HHI from 0 to 1 rather than 0 to 10,000.

[13]As we maintain the proportional control assumption $\gamma_{ij} = \beta_{ij}$. However a similar point can be made if γ_{ij} is some other increasing function of β_{ij}.

$0.475^2 < 0.95^2$ the manager now places more weight on the profits of firm 2, even though we have the same amount of common ownership through owner 3 as before ($\widetilde{W}_M = \begin{bmatrix} 1 & .006 \\ .006 & 1 \end{bmatrix}$ and $W_M = \begin{bmatrix} .994 & .006 \\ .006 & .994 \end{bmatrix}$). The $MHHI$ is now increased somewhat more to 0.5028 and the price level increases such that $\frac{p-c}{p} = 0.5028/\eta$.

If we would split owners 1 and 2 into n parts of equal size, the manager would maximize $n \times \left(\frac{0.95}{n}\right)^2 \pi_1 + 0.05^2\pi_1 + 0.05^2\pi_2 = \frac{0.95^2}{n}\pi_1 + 0.05^2\pi_1 + 0.05^2\pi_2$. As n becomes large the shareholders become atomistically small and no longer have any impact on the objective function. So for large n the manager of firm 1 places almost equal weight on the competitor's profits as their own, even though common ownership is not increasing. As $n \to \infty$, $\widetilde{W}_M \to \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$, $W_M \to \begin{bmatrix} .5 & .5 \\ .5 & .5 \end{bmatrix}$, $MHHI \to 1$, and the price goes to the monopoly price. The Lerner index almost doubles compared to the case with $n = 1$, even though we have not changed the extent to which both firms are commonly owned. Hence, if the undiversified shareholders are small, even a moderate amount of common ownership can have a large impact on the incentives of managers and thereby on the price level.

This property of the model is important in practice because the largest shareholders of most listed firms are large asset managers with diversified portfolios, while many of the smaller shareholders are presumably less diversified. Therefore the impact of large diversified asset managers on the objective function of managers is disproportional compared to their ownership share. Thus, the model predicts that prices would decrease if the large diversified asset managers (e.g. Vanguard, Blackrock and State Street) would be broken up into multiple parts that are equally diversified, because the managers would then place more weight on the smaller, less diversified shareholders.

This property of the model also implies that it matters who we consider to be the ultimate owners of firm shares: the diversified asset managers , or their customers. For example, if instead of including Vanguard's ownership share in a firm, we would include the ownership share of each of Vanguard's customers separately, the managers of the firm would place less weight on the shares owned through Vanguard, and the predicted effect of common ownership on prices would be smaller. A considerable part of the anticompetitive effects of common ownership predicted by the model are not driven by the amount of common ownership per se, but by the fact that diversified investors typically hold their shares through very large asset managers, while undiversified investors often hold their shares through smaller asset managers or own the shares directly.

The fact that large shareholders have a disproportionate impact on the manager's objective function has other surprising implications. For example, suppose firms 1 and 2 are fully owned by atomistic, undiversified shareholders. Hence $MHHI = HHI = 0.5$. Now suppose some shareholder buys an arbitrarily small, yet non-atomistic share $\epsilon > 0$ in both firms. As the atomistic shareholders no longer receive any weight in the manager's objective function, this arbitrarily small transaction increases the $MHHI$ to 1 and the price to the monopoly price. If the shares of firms 1 and 2 were initially priced under the assumption of duopoly pricing such a "takeover" through purchasing a small number of shares would be very profitable.

Example with Asymmetric Ownership Structure

The model can have even more surprising implications when ownership structures are not symmetric. Suppose that firms 1 and 2 are entirely owned by atomistic, undiversified shareholders except for a single non-atomistic shareholder who owns β_1 in firm 1 and β_2 in firm 2. Hence, the objective function of manager 1 is $\gamma_1 [\beta_1 \pi_1 + \beta_2 \pi_2]$ and the objective function of manager 2 is $\gamma_2 [\beta_1 \pi_1 + \beta_2 \pi_2]$. Hence both managers simply maximize $\beta_1 \pi_1 + \beta_2 \pi_2$.

Suppose that β_2/β_1 is large so both managers approximately maximize π_2. Given this ownership structure, the model predicts that manager 1 chooses a quantity close to zero and manager 2 chooses a quantity close to the monopoly output. Consequently, $s_1 \to 0$, $s_2 \to 1$, $HHI \to MHHI \to 1$. Hence, the model predicts that firm 1 makes zero profits against the will of the vast majority of its shareholders who are undiversified. The reason for this model prediction is that as β_2/β_1 gets large, the financial interest of owner 1 in firm 1 becomes negligible, but because he is the only non-atomistic shareholder of firm 1 he still has full control of firm 1.

Now suppose we observe this ownership structure with large β_2/β_1, but s_1 is not close to zero as predicted by the model. Similar cases are sometimes observed in the banking data. Recall the definition of $MHHI$:

$$\begin{aligned} MHHI &= s_1^2 \frac{\gamma_1 \beta_1}{\gamma_1 \beta_1} + s_1 s_2 \frac{\gamma_1 \beta_2}{\gamma_1 \beta_1} + s_2 s_1 \frac{\gamma_2 \beta_1}{\gamma_2 \beta_2} + s_2^2 \frac{\gamma_2 \beta_2}{\gamma_2 \beta_2} \\ &= HHI + s_1 s_2 \left[\frac{\beta_2}{\beta_1} + \frac{\beta_1}{\beta_2} \right] \end{aligned}$$

Notice that the control shares cancel out because there is a single non-atomistic owner. If β_2/β_1 becomes large but s_1 does not go to zero the $MHHI$ can not only go above 1 but can become arbitrarily large. For example if $\beta_1 = .01, \beta_2 = .05$ and $s_1 = s_2 = .5$, then $\widetilde{W}_M = \begin{bmatrix} 1 & 5 \\ .2 & 1 \end{bmatrix}$ and $W_M = \begin{bmatrix} .17 & .83 \\ .17 & .83 \end{bmatrix}$ and $MHHI = 1.8$. Through the lens of the model such observations are puzzling because in a monopoly the $MHHI$ is 1. Recall, that in the model $MHHI = \eta \sum_j s_j L_j$, where $L_j = \frac{p-c_j}{p}$ and c_j is the marginal cost of firm j. To rationalize very large s_1 despite the large β_2/β_1 we must assume that c_1 is negative and therefore $L_1 > 1$.

In some of our empirical specifications we assume that there is one undiversified shareholder who owns 1% of the firm. Such an assumption helps to avoid "pathological scenarios" as the one described above. This share could represent the holdings of the CEO for example which wouldn't be captured in the data on ownership because the CEO is not an institutional investor with more than \$100 million assets. Posner, Scott Morton, and Weyl (2016) make a similar assumption, though not to address the issue described here but because it likely results in a better approximation to the actual ownership structure.

4 Data

The data we use come from a number of sources. Ownership data comes from SEC 13F filings, pricing data come from RateWatch, and quantity data come from the Summary of Deposits (SOD). We briefly describe these data sets here, and include an appendix describing the construction of the ownership data.

Ownership data come from SEC 13F investment filings.[14] The SEC requires any institutional investor with over \$100 million in assets under management to file a schedule 13F form every quarter. Filers include stand-alone asset managers, banks, insurance companies, pension funds, and university endowments. We augment this data with data from the Center for Research in Security Prices (CRSP), which contains information about stock prices and the number of shares outstanding.[15] We combine these data sets to calculate the percentage share that a particular institutional investor owns of a bank.

[14] Thomson Reuters *Institutional Holdings*, Wharton Research Data Services (WRDS), www.whartonwrds.com/our-datasets.

[15] CRSP1925 US Stock Database, Wharton Research Data Services (WRDS) wrds-web.wharton.upenn.edu/wrds/about/databaselist.cfm.

Because 13F filers submit holdings of all publicly traded companies, these data exist for many industries. However, we focus on banks from 2000 to 2015. As shown in Table 1, the number of publicly traded banks has decreased somewhat from about 530 to about 440 following consolidations in the wake of the financial crisis. The market capitalization of publicly traded banks grew steadily from $1.4 trillion in 2000 to $2.1 trillion in 2007, fell to less than $1 trillion during the crisis, and recently rebounded to more than $2 trillion . The percentage of publicly traded banks that is held by 13F filers grew from 49.5% in 2000 to 67.3% in 2007 and has dropped somewhat since. The percentage of bank market cap help by the asset management arms of other banks has declined somewhat since the early 2000s. .

Finally, the percent of public bank market cap held by the largest institutional investors - Vanguard, State Street, BlackRock (which purchased Barclays' Asset Manager in 2009) - has increased in the past decade and a half. The one exception to this pattern is Fidelity, whose share of bank market cap has remained fairly steady over the sample period. Researchers have noted irregularities in the 13F data , most notably that the shares for BlackRock in 2014 and 2015 seem implausibly low (see Anderson and Brockman (2016) for more detail). We are investigating the data in an attempt to address these problems.

Table 1: Investment Data

	Banks	Market Cap ($T)	Filers	By 13f Filer	By Banks	By Vanguard	By State Street	By BlackRock	By Barclays	By Fidelity
2000	525	1.4	1423	49.5 %	7.6 %	1.2 %	1.9 %	0.1 %	2.8 %	2.8 %
2001	514	1.6	1520	52.6 %	8.5 %	1.4 %	2.8 %	0.0 %	3.1 %	3.2 %
2002	527	1.5	1523	55.1 %	8.5 %	1.6 %	2.9 %	0.0 %	3.4 %	3.3 %
2003	530	1.5	1612	57.5 %	8.4 %	1.7 %	3.2 %	0.0 %	3.8 %	3.5 %
2004	541	1.8	1721	58.1 %	8.1 %	1.9 %	3.3 %	0.0 %	3.9 %	3.1 %
2005	543	1.8	1844	57.4 %	7.4 %	2.1 %	3.1 %	0.1 %	4.3 %	2.6 %
2006	532	1.9	1909	58.9 %	7.0 %	2.4 %	3.0 %	0.1 %	4.1 %	2.5 %
2007	538	2.1	2062	61.2 %	6.6 %	2.7 %	3.1 %	0.9 %	4.3 %	2.4 %
2008	530	1.2	2161	65.8 %	6.9 %	3.0 %	3.8 %	0.8 %	4.2 %	2.7 %
2009	514	0.9	2078	67.3 %	6.0 %	3.3 %	3.9 %	0.9 %	4.3 %	3.6 %
2010	508	1.2	2131	60.5 %	5.1 %	3.4 %	3.6 %	1.1 %	0.0 %	2.9 %
2011	485	1.4	2227	65.3 %	5.2 %	3.5 %	3.8 %	4.9 %	0.0 %	2.3 %
2012	470	1.3	2245	63.9 %	5.7 %	3.9 %	3.7 %	4.9 %	0.1 %	2.2 %
2013	464	1.8	2422	66.7 %	5.8 %	4.3 %	4.0 %	5.5 %	0.1 %	2.5 %
2014	470	2.2	2588	56.5 %	2.2 %	4.5 %	3.9 %	1.4 %	0.1 %	2.4 %
2015	444	2.3	2543	58.0 %	4.7 %	5.0 %	3.9 %	1.7 %	0.1 %	2.5 %

The pricing data come from RateWatch.[16] RateWatch conducts weekly surveys of branches for rates and fees for various financial products since 2003. We focus on rates

[16]RateWatch Deposit, Loan, and Fee Data. https://www.rate-watch.com.

for certificates of deposit (CD). We have rates on CDs with maturities of 3, 6, 12, and 24 months. RateWatch does not survey every branch in the country; they have identified what we call rate-setter and rate-taker branches. Rate-setters are branches which set the rates for all branches in some region (which in some instances can be as large as country-wide). RateWatch also provides a mapping of rate-takers to rate-setters, so one can impute rates for takers. In the pricing regressions, the unit of observation is the bank-county-quarter, since quarters are the frequency at which the 13F ownership data varies. Within a quarter, banks may have multiple branches with multiple weeks of reported prices: we use the last reported week for each branch, and take the median branch price. Summary statistics of our regression data - including the pricing data - are in Table 2. As expected, longer maturity CDs pay higher rates, and all CDs exhibit fairly low average rates given the sample period which saw rather low interest rates.

Table 2: Summary Statistics of Regression Data

	Mean	Std	Min	Max	Obs
CD Rate Paid - 3 mo	1.10	1.17	0.00	6.78	911217
CD Rate Paid - 6 mo	1.37	1.35	0.00	7.29	982646
CD Rate Paid - 12 mo	1.61	1.43	0.00	7.52	977128
CD Rate Paid - 24 mo	2.51	1.39	0.00	7.51	850673
Deposit Share	0.11	0.15	0.00	1.00	1656807
Weight on Own Profits	0.80	0.32	0.00	1.00	1658615
Average Weight Received From Rivals	0.20	0.35	0.00	2.69	1658615

Quantity data come from the SOD.[17] The SOD is an annual census of insured depository institutions that is taken as of June 30 of each year, and tracks deposit information at the branch level. There are currently just under 100,000 branches in the country, which are distributed among roughly 2,000 banking markets (often approximately the size of counties).[18] We use counties as banking markets to parallel previous empirical work. In the future we plan to use Federal Reserve banking markets rather than counties. Table 2 shows that the average deposit market share for a competitor is 0.11, which corresponds to being one of 9 equal sized competitors in the market.

Our main variable of interest is the weight that banks place on their own profits. In Table 2 one can see that the average weight that firms place upon themselves is 80%, with the other 20% distributed over their competitors. Notice, that the majority of banks is privately held and these banks maximize their profits, i.e. they place a weight

[17] This data is collected by the FDIC (https://www.fdic.gov/regulations/resources/call/sod.html).

[18] We cap the deposits of branches at $1 billion to avoid attributing centrally-booked deposits to the local banking market.

of 100% on themselves.[19]

Table 3 shows how the weight banks place on themselves, w_{jj}, evolves over time as common ownership by institutional investors has grown. The weight banks place on themselves has drifted downward from approximately 85% to 77%. Again, this includes bank-market pairs of private banks, which always place 100% weight on themselves. Restricting these numbers to public banks (not shown) shows the own-weight drifting from approximately 50% down to 40% from 2000 to 2015. This calculation of the w_{jj} follows Azar, Raina, and Schmalz (2016) in assuming that the holdings of bank asset managers result in cross ownership rather than common ownership and does not assume that there is a undiversified shareholder with 1%.

Table 3: Average Weight Placed on Own Profits over Time

	Mean	p50	Std	Min	Max	Obs
2000	0.85	1.00	0.27	0.00	1.00	24958
2001	0.82	1.00	0.29	0.00	1.00	25160
2002	0.81	1.00	0.31	0.00	1.00	25224
2003	0.80	1.00	0.31	0.00	1.00	25507
2004	0.80	1.00	0.32	0.00	1.00	25783
2005	0.80	1.00	0.32	0.00	1.00	26104
2006	0.79	1.00	0.32	0.00	1.00	26782
2007	0.79	1.00	0.32	0.00	1.00	27301
2008	0.80	1.00	0.32	0.00	1.00	27868
2009	0.78	1.00	0.33	0.00	1.00	27858
2010	0.78	1.00	0.33	0.00	1.00	27676
2011	0.79	1.00	0.33	0.01	1.00	27610
2012	0.78	1.00	0.34	0.00	1.00	27423
2013	0.77	1.00	0.34	0.01	1.00	27212
2014	0.77	1.00	0.34	0.01	1.00	26561
Total	0.79	1.00	0.32	0.00	1.00	399027

Below we chart w_{jj}, for all banks (green) and for the four largest banks in the country (red) over the sample period.[20] w_{jj} is averaged across bank-market pairs within the time period.

[19]The 80% mean is taken over bank-market-quarter level observations, which mechanically counts public banks more often because they appear in more markets than private banks do. There are approximately 5,000 private banks compared with about 500 public banks, but there are approximately equal numbers of bank-market pairs for public and private banks.

[20]The four largest banks today are Citi, JPMC, Bank of America, and Wells Fargo. These were also the four largest banks in 2000.

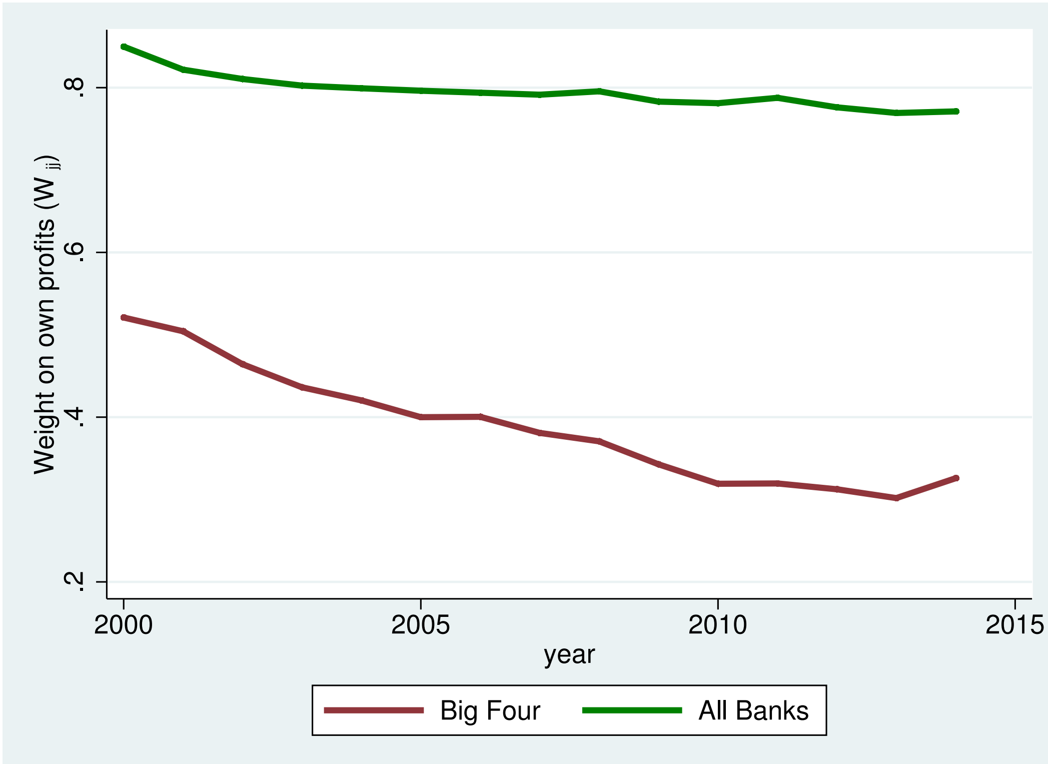

Figure 1: Average Weight Placed on Own Profits . The Big Four are Citi, JPMC, Bank of America, and Wells Fargo.

5 Results

5.1 Specification

We estimate the following specifications:

$$p_{jmt} = \theta_1 ownweight_{jmt} + \theta_2 receivedweight_{jmt} + \xi_{jm} + \xi_{mt} + \varepsilon_{jmt} \quad (5)$$

$$q_{jmt} = \theta_3 ownweight_{jmt} + \theta_4 receivedweight_{jmt} + \xi_{jm} + \xi_{mt} + \varepsilon_{jmt} \quad (6)$$

Here, p_{jmt} and q_{jmt} are the price and the quantity of firm j in market k at time t. The variable $ownweight_{jmt}$ is the weight that firm j places on its own profits w_{jj} in market m at time t and $receivedweight_{jmt}$ is the average weight received by rivals $\overline{w_{kj}} = \sum_{k \neq j} w_{kj} / (n-1)$, where $n-1$ is the number of rivals of firm j. We also include firm-market fixed effects ξ_{jm} and market-time fixed effects ξ_{mt}. The null hypothesis is that managers maximize firm profits and therefore common ownership does not affect competition: $\theta_1, \theta_2, \theta_3, \theta_4 = 0$. In our application the prices are CD rates that banks pay to their customers. Hence, a finding of $\theta_1, \theta_3 > 0$ is consistent with anticompetitive effects of common ownership.

The variation that is used in profit-weight regressions differs from that used in $MHHI$ regressions. $MHHI$ is a function of the profit weights that only varies at the market level because it sums across firms. This aggregation removes firm-level variation in profit weights that we exploit in our profit-weight regressions. In extreme cases there can be variation in profit weights that does not lead to any variation in $MHHI$. For example, suppose there is a market with three firms. Initially, firms A and B have common shareholders but none in common with C. Later the ownership structure changes such that B and C have common owners but none in common with A. This scenario could leave the $MHHI$ unchanged, but the model predicts that firms A and B have high prices and low quantities initially, but firms B and C subsequently. Note that using this firm-level variation allows us to include market-time fixed effects.

5.2 Calculating Profit Weights

The 13F data only contains information on the holdings by institutional investors with more than \$100 million in assets. As shown in Table 1 13F holders own between 1/2 and 2/3 of the public banks. To calculate the profit weights, however, requires the entire ownership structure. We assume that the remaining shareholders are atomistic and not diversified. As discussed in section 3 such shareholders have no impact on the objective function of the manager if there is at least one non-atomistic shareholder. We believe that this assumption is a reasonable approximation because most shareholders who are not required to file a 13F form are presumably small compared to the 13F filers.

However, as discussed in section 3, if large parts of a firm are held by small undiversified shareholders then even a small amount of common ownership can have a large impact on the profit weights. This is relevant if the 13F filers own only a relatively small share of some publicly traded banks. To address this issue we calculate the profit weights under the assumption that for every bank there is one (unobserved) undiversified shareholder who holds 1% in some specifications. This 1% undiversified shareholder could represent the management of the bank, for example.

Azar, Raina, and Schmalz (2016) argue that in the banking industry there is cross ownership in addition to common ownership, because many of the 13F filers are banks. These reported holdings predominantly represent the holdings of the asset management divisions of the banks. If the asset management divisions use their control rights in the interest of the bank they belong to then such holdings should be treated as cross ownership. It could however also be argued that it is the fiduciary duty of the asset management division to act in the best interest of their customers and therefore they must use their control rights in the interest of their customers.[21] This argument suggests that the holdings of the asset management divisions should be treated in the same manner as the holding by independent asset managers. Therefore, they do not result in cross ownership, but might result in common ownership. In some specifications we assume that holdings by bank-owned asset managers result in cross ownership and in others we treat them like independent asset managers.

Table 4 summarizes the different ways in which we calculate the W matrix. W_1 follows Azar, Raina, and Schmalz (2016) who do not assume a 1% undiversified shareholder and assume that the holdings of bank-owned asset managers result in cross ownership.

Table 4: **Calculating Profit Weights**. This table summarizes the different assumptions under which we calculate the profit weights.

	1% Undiversified Shareholder	Treatment of Bank-Owned Asset Managers
W_1	No	Cross Ownership
W_2	No	Common Ownership
W_3	Yes	Cross Ownership
W_4	Yes	Common Ownership

5.3 Results

We report three tables with price regressions (Equation (5), Tables 5, 6 and 7) and three tables with quantity regressions (Equation (6), Tables 8, 9 and 10). All specifications include county-quarter and bank-quarter fixed effects. We show specifications that

[21]Notice that we treat the holdings of independent asset managers act as if they act in the best interest of their customers, despite the fact that they typically earn fees that are a small percentage of assets under management and therefore benefit less from reduced competition among their portfolio firms than if they would own the stocks.

include only $ownweight_{jmt}$ and specifications that include $receivedweight_{jmt}$ as well.[22]

The overarching conclusions are that signs and significance levels are mixed, and magnitudes are small. We will make specific comments on each table one by one.

In Table 5 , in which we use W_1 , we see that considering different CD maturities can lead to different signs for θ_1 and θ_2. The dependent variable is price percentile within the nation for a particular quarter. The magnitude of the coefficients is small. For example as $ownweight_{jmt}$ goes from zero to one, the 3 Month CD rate moves by at most 2 percentage points in the national price distribution.

In Table 6 , we consider alternative ways of calculating W. Again, the dependent variable in all specifications is price percentile. We focus on the 3-month CD. Specifications (1) and (2) use W_1 (these specifications are repeated from Table 6), Specifications (3) and (4) use W_2, (5) and (6) use W_3, and (7) and (8) use W_4 . We see that the new specifications, (3)-(8), have even less statistical significance and smaller coefficients than the repeated specifications, (1) and (2). Again all of the magnitudes are small. For example as $ownweight_{jmt}$ moves from zero to one, the 3 Month CD Rate moves by less than one percentage point in the national price distribution.

In Table 7 , in which we again use W_1, we consider alternative transformations of the price variable. The dependent variable is the 3 Month CD Rate for columns (1) and (2), log(3 Month CD Rate) for columns (3) and (4), and the percentile in the national 3 Month CD rate distribution for the quarter in columns (5) and (6). While the estimate of θ_1 is negative in columns (1) and (2) it is positive in columns (3) to (6). Again all of the magnitudes are small. For example as $ownweight_{jmt}$ moves from zero to one, the 3 Month CD Rate moves by less than one percentage point in the national price distribution.

In Tables 8 - 10, the dependent variables are functions of deposits (quantities). Results here are also mixed. Table 10, using shares of market deposits, shows a more consistently anti-competitive effect than with linear (Table 8) or logged (Table 9) deposit variables. But even focusing on Table 10, we again see that the economic magnitudes of the coefficients are small. Going from placing no weight to full weight on yourself increases your deposit market share by less than 1%, and having all competitors similarly shift their entire weight toward you increases your market share by only 4-6%.

An important caveat of the deposit regressions is that it might be preferable to use organic deposit growth as the dependent variable, rather than a measure of the level of

[22]We have experimented with many other specifications. The reported specifications are meant to illustrate which changes in the specification tend to alter the results and which don't.

deposits. Organic deposit growth is a measure of newly attracted depositors and is not affected by mergers or branch acquisitions. We plan to investigate this in future drafts.

6 Blackrock-Barclays Global Investors Merger

The results in this section are preliminary because some reported numbers seem unusual, particularly for the holdings of Blackrock. We are currently working on combining the data with other data sources to fix these issues, and these changes could affect the estimates in this section.

Azar, Schmalz, and Tecu (2016) exploit the merger between Blackrock and Barclays Global Investors (BGI) to address the possibility that common ownership is endogenous in their study of airline competition.[23] We follow this approach to construct an instrument for $ownweight_{jmt}$.[24] The idea is to use pre-merger data to calculate pro-forma Ws for a hypothetical merger. These pro-forma Ws can then be used to predict how $ownweight_{jmt}$ will change as a result of the asset manager merger. As the asset manager merger is likely not driven by considerations about product market competition in the banking industry this provides plausibly exogenous variation in $ownweight_{jmt}$.

Intuitively, the merger provides variation in W, because the the two merging parties differ in their portfolio composition, and the merger results therefore in an increase of common ownership. For example suppose Blackrock owns a large share of Wells Fargo but no shares of JP Morgan, whereas BGI owns no shares of Wells Fargo but a large share of JP Morgan. Hence, there is no common ownership of Wells Fargo and JP Morgan by either Blackrock or Barclays prior to the merger, but there would be common ownership by the merged institution after the merger.

However, not all the variation in W created by the merger is driven by differences in portfolio composition between Blackrock and Barclays. Importantly, the merger would create variation in W even if Blackrock and Barclays had identical portfolios prior to the merger. To understand this recall that larger owners have a disproportionately large impact on the manager's objective functions of manager in the model of O'Brien and Salop (2000), because of the interaction between control rights and financial interests,

[23] Azar, Raina, and Schmalz (2016), who study banks, do not exploit this merger, but try to address the endogeneity problem differently.

[24] In future drafts we will also instrument for $receivedweight_{jmt}$. We will also run bank merger diff-in-diff regressions, which unlike the IV regression presented here uses price and quantity data pre- and post- bank merger. One advantage of the IV regression over the diff-in-diff specification is that it is directly comparable to the baseline regression presented in the previous section.

Table 5: **CDs - Different Maturities:** This table varies the maturity of the CD under consideration. The dependent variable is the percentile of the CD rate in the national distribution for the quarter. We use W_1 to calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$.

	3 Months		6 Months		12 Months		24 Months	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weight on Own Profits (1)	0.00737*	0.00837**	-0.00646*	-0.00569*	-0.0160***	-0.0148***	0.00588	0.00508
	(0.00304)	(0.00304)	(0.00275)	(0.00275)	(0.00271)	(0.00271)	(0.00320)	(0.00320)
Average Weight Received From Rivals (1)		0.215***		0.156***		0.234***		-0.178***
		(0.0201)		(0.0182)		(0.0181)		(0.0213)
Quarter Fixed Effects	No	No	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	819543	819543	876543	876543	871658	871658	750660	750660

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: **3 Month CDs - Different W:** This table varies how we calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$. Columns (1) and (2) use W_1, columns (3) and (4) use W_2, columns (5) and (6) use W_3 and columns (7) and (8) use W_4. The dependent variable is the percentile of the CD rate in the national distribution for the quarter.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weight on Own Profits (1)	0.00737*	0.00837**						
	(0.00304)	(0.00304)						
Average Weight Received From Rivals (1)		0.215***						
		(0.0201)						
Weight on Own Profits (2)			0.00423	0.00530				
			(0.00307)	(0.00307)				
Average Weight Received From Rivals (2)				0.173***				
				(0.0206)				
Weight on Own Profits (3)					0.000747	0.00393		
					(0.00315)	(0.00317)		
Average Weight Received From Rivals (3)						0.199***		
						(0.0220)		
Weight on Own Profits (4)							-0.00151	0.00109
							(0.00317)	(0.00319)
Average Weight Received From Rivals (4)								0.154***
								(0.0225)
Quarter Fixed Effects	No	No	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	819543	819543	819543	819543	819543	819543	819543	819543

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: **3 Month CDs - Different Rate Transformations:** The dependent variable is the 3 Month CD Rate for columns (1) and (2), log(3 Month CD Rate) for columns (3) and (4), and the percentile in the national 3 Month CD rate distribution for the quarter in columns (5) and (6). We use W_1 to calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$.

	3 Month CD Rate		log(3 Month CD Rate)		3 Month CD Rate Percentile	
	(1)	(2)	(3)	(4)	(5)	(6)
Weight on Own Profits (1)	-0.0757***	-0.0757***	0.222***	0.228***	0.00737*	0.00837**
	(0.00542)	(0.00542)	(0.00754)	(0.00754)	(0.00304)	(0.00304)
Average Weight Received From Rivals (1)		0.00714		1.323***		0.215***
		(0.0359)		(0.0500)		(0.0201)
Quarter Fixed Effects	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	819543	819543	819151	819151	819543	819543

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: **Deposits -Different W:** This table varies how we calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$. Columns (1) and (2) use W_1, columns (3) and (4) use W_2, columns (5) and (6) use W_3 and columns (7) and (8) use W_4. The dependent variable is the amount of deposits in dollar.

	Deposits							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weight on Own Profits (1)	-115683.4***	-121634.8***						
	(12794.8)	(12840.3)						
Average Weight Received From Rivals (1)		-452448.7***						
		(82202.6)						
Weight on Own Profits (2)			-120397.4***	-127636.2***				
			(12986.2)	(13050.7)				
Average Weight Received From Rivals (2)				-478627.5***				
				(85776.3)				
Weight on Own Profits (3)					-176026.4***	-196286.2***		
					(13322.2)	(13574.7)		
Average Weight Received From Rivals (3)						-720387.4***		
						(92720.8)		
Weight on Own Profits (4)							-177015.8***	-197523.8***
							(13436.5)	(13702.0)
Average Weight Received From Rivals (4)								-724186.5***
								(94832.6)
Quarter Fixed Effects	No	No	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1566442	1566442	1566442	1566442	1566442	1566442	1566442	1566442

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: **log(Deposits) - Different W:** This table varies how we calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$. Columns (1) and (2) use W_1, columns (3) and (4) use W_2, columns (5) and (6) use W_3 and columns (7) and (8) use W_4. The dependent variable is log(deposits in dollar).

	log(Deposits)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weight on Own Profits (1)	-0.0347***	-0.0246***						
	(0.00477)	(0.00478)						
Average Weight Received From Rivals (1)		0.770***						
		(0.0306)						
Weight on Own Profits (2)			-0.0170***	-0.00641				
			(0.00484)	(0.00486)				
Average Weight Received From Rivals (2)				0.698***				
				(0.0320)				
Weight on Own Profits (3)					-0.0566***	-0.0355***		
					(0.00497)	(0.00506)		
Average Weight Received From Rivals (3)						0.751***		
						(0.0345)		
Weight on Own Profits (4)							-0.0360***	-0.0172***
							(0.00501)	(0.00511)
Average Weight Received From Rivals (4)								0.665***
								(0.0353)
Quarter Fixed Effects	No	No	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1559168	1559168	1559168	1559168	1559168	1559168	1559168	1559168

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: **Deposit Share - Different W:** This table varies how we calculate $ownweight_{jmt}$ and $receivedweight_{jmt}$. Columns (1) and (2) use W_1, columns (3) and (4) use W_2, columns (5) and (6) use W_3 and columns (7) and (8) use W_4. The dependent variable is the deposit market share of a bank in a county.

	Deposit Share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weight on Own Profits (1)	0.00284***	0.00364***						
	(0.000336)	(0.000337)						
Average Weight Received From Rivals (1)		0.0608***						
		(0.00216)						
Weight on Own Profits (2)			0.00418***	0.00490***				
			(0.000341)	(0.000343)				
Average Weight Received From Rivals (2)				0.0471***				
				(0.00225)				
Weight on Own Profits (3)					0.000901*	0.00257***		
					(0.000350)	(0.000356)		
Average Weight Received From Rivals (3)						0.0595***		
						(0.00243)		
Weight on Own Profits (4)							0.00257***	0.00388***
							(0.000353)	(0.000360)
Average Weight Received From Rivals (4)								0.0461***
								(0.00249)
Quarter Fixed Effects	No	No	No	No	No	No	No	No
Bank-County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1566442	1566442	1566442	1566442	1566442	1566442	1566442	1566442

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

as explained in section 3. Two asset managers with identical portfolio composition have the same preferences. However, if they merge their combined impact on the objective functions of managers increases.

Tables 11 and 12 show estimates for deposits and 12 Month CD rates. In the first stage (Tables 13 and 14 in Appendix B) we regress $ownweight_{jmt}$ for the time periods t after the merger on the predicted impact of the merger $ownweight^{pro-forma}_{jmt'} - ownweight_{jmt'}$ for some t' before the merger and a set of fixed effects. In the second stage we regress prices and quantities for the periods t after the merger on $\hat{ownweight}_{jmt}$ and a set of fixed effects. As $ownweight^{pro-forma}_{jmt'} - ownweight_{jmt'}$ does not vary across different post-merger periods we cannot include bank-county fixed effects in this IV regression. Instead we only include bank fixed effects. To make comparisons easier we also show specifications without instrumenting for $ownweight_{jmt}$ that use only data from periods t after the merger. The reported estimates use W_1 to calculate the profit weights.

Table 11 shows the quantity estimates. As for the baseline estimates we consider deposits measured in dollars (columns (1) and (2)), log(deposits) (columns (3) and (4)) and the deposit share (columns (5) and (6)). The estimates in columns (1), (3) and (5) do not instrument for $ownweight_{jmt}$ but use only data starting in $Q1/2010$ after the merger, while the estimates in columns (2), (4) and (6) use the pro-forma change $ownweight^{pro-forma}_{jmt} - ownweight_{jmt}$ for $t = Q2/2009$, as an instrument for $ownweight_{jmt}$. The estimates in all six columns indicate that an increase in $ownweight_{jmt}$ leads to a reduction in deposits and market shares, which is not consistent with an anticompetitive effect of common ownership. The estimates for the deposit share can be most easily interpreted. The IV estimates in column (6) suggest that the deposit share of a bank decreases by 1.2 percentage points if the weight on own profits increases by 10 percentage points.

Table 12 shows the estimates for 12 Month CD rates. As for the baseline estimates we consider 12 Month CD Rate (columns (1) and (2)), log(12 Month CD Rate) (columns (3) and (4)), and the percentile in the national distribution for 12 Month CD Rates for a given year (columns (5) and (6)). The estimates in columns (1), (3) and (5) do not instrument for $ownweight_{jmt}$ but use only data starting in $Q1/2010$ after the merger, while the estimates in columns (2), (4) and (6) use the pro-forma change $ownweight^{pro-forma}_{jmt} - ownweight_{jmt}$ for $t = Q2/2009$, as an instrument for $ownweight_{jmt}$. The estimates in all six columns indicate that an increase in $ownweight_{jmt}$ leads to a reduction in CD rates, which is not consistent with an anticompetitive effect of common ownership. The percentile estimates can be most easily interpreted. The IV estimates in column (6) suggest that the 12 Month CD rate decreases by 0.38 percentage points in the national distribution if the weight on own profits increases by 10 percentage points.

7 Conclusion

We propose an alternative method for estimating the effects of common ownership on competition. . We argue that this approach has several advantages compared with approaches that rely on market concentration measures. First, the approach does not inherit the endogeneity problems of HHI regressions, which arise because HHI measures are functions of quantities. Second, because we treat quantities as outcomes we can look for competitive effects of common ownership on both prices and quantities. Third, while concentration measures vary only at the market-time level, the profit weights also vary at the firm level, which allows us to control for a richer set of unobservables. Our findings are preliminary until we better understand how to best handle reporting irregularities in the common ownership data .

Table 11: **Quantity IV Estimates:** The first stage estimates can be found in Table 13 in the Appendix.

	Deposits		log(Deposits)		Deposit Share	
	(1)	(2)	(3)	(4)	(5)	(6)
	No IV	IV	No IV	IV	No IV	IV
Weight on Own Profits (1)	-993442.7***	-1304925.7***	-1.491***	-0.438***	-0.0933***	-0.119***
	(44942.6)	(305502.0)	(0.0149)	(0.0909)	(0.00127)	(0.00833)
Quarter Fixed Effects	No	No	No	No	No	No
Bank-County Fixed Effects	No	No	No	No	No	No
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	535944	460593	532964	459037	535944	460593

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: **12 Month CD Rate IV Estimates:** The first stage estimates can be found in Table 14 in the Appendix.

	12 Month CD Rate		log(12 Month CD Rate)		12 Month CD Rate Percentile	
	(1)	(2)	(3)	(4)	(5)	(6)
	No IV	IV	No IV	IV	No IV	IV
Weight on Own Profits (1)	-0.0357***	-0.0408**	-0.0108*	-0.0990**	-0.0192***	-0.0384***
	(0.00199)	(0.0130)	(0.00509)	(0.0336)	(0.00164)	(0.0104)
Quarter Fixed Effects	No	No	No	No	No	No
Bank-County Fixed Effects	No	No	No	No	No	No
County-Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	411307	359970	411303	359966	411307	359970

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

References

Adams, R., and D. Ferreira (2008): "One share-one vote: The empirical evidence," *Review of Finance*, 12(1), 51–91.

Anderson, A. M., and P. Brockman (2016): "Form 13F (Mis) Filings," .

Antón, M., F. Ederer, M. Giné, and M. C. Schmalz (2016): "Common ownership, competition, and top management incentives," .

Azar, J. (2011): "A new look at oligopoly: Implicit collusion through portfolio diversification," .

Azar, J. (2016): "Portfolio Diversification, Market Power, and the Theory of the Firm," *Browser Download This Paper*.

Azar, J., S. Raina, and M. C. Schmalz (2016): "Ultimate Ownership and Bank Competition," *Available at SSRN 2710252*.

Azar, J., M. C. Schmalz, and I. Tecu (2016): "Anti-competitive effects of common ownership," .

Bain, J. S. (1951): "Relation of profit rate to industry concentration: American manufacturing, 1936–1940," *The Quarterly Journal of Economics*, 65(3), 293–324.

Benham, L. (1972): "The effect of advertising on the price of eyeglasses," *The Journal of Law and Economics*, 15(2), 337–352.

Bertrand, M., and S. Mullainathan (2003): "Enjoying the quiet life? Corporate governance and managerial preferences," *Journal of political Economy*, 111(5), 1043–1075.

Bresnahan, T. F., and S. C. Salop (1986): "Quantifying the competitive effects of production joint ventures," *International Journal of Industrial Organization*, 4(2), 155–175.

Davidson, C., and R. Deneckere (1986): "Long-run competition in capacity, short-run competition in price, and the Cournot model," *The Rand Journal of Economics*, pp. 404–415.

Demsetz, H. (1973): "Industry structure, market rivalry, and public policy," *The Journal of Law and Economics*, 16(1), 1–9.

Elhauge, E. (2016): "Horizontal Shareholding," *Harvard Law Review, Available at SSRN: https://ssrn.com/abstract=2632024*.

Gilo, D. (2000): "The anticompetitive effect of passive investment," *Michigan Law Review*, 99(1), 1–47.

Gilo, D., Y. Moshe, and Y. Spiegel (2006): "Partial cross ownership and tacit collusion," *RAND Journal of Economics*, pp. 81–99.

Gordon, R. H. (1990): "Do publicly traded corporations act in the public interest?," Discussion paper, National Bureau of Economic Research.

Hansen, R. G., and J. R. Lott Jr (1996): "Externalities and corporate objectives in a world with diversified shareholder/consumers," *Journal of Financial and Quantitative Analysis*, pp. 43–68.

He, J., and J. Huang (2014): "Product market competition in a world of cross ownership: Evidence from institutional blockholdings," .

Hicks, J. R. (1935): "Annual survey of economic theory: the theory of monopoly," *Econometrica: Journal of the Econometric Society*, pp. 1–20.

Kong, H. J. K. (2016): "Executive Compensation under Common Ownership," .

Liang, L. M. (2016): "Common Ownership and Executive Compensation," .

López, Á. L., and X. Vives (2016): "Cross-ownership, R&D Spillovers, and Antitrust Policy," .

McCahery, J. A., Z. Sautner, and L. T. Starks (2016): "Behind the scenes: The corporate governance preferences of institutional investors," *The Journal of Finance*.

O'Brien, D. P., and S. C. Salop (2000): "Competitive effects of partial ownership: Financial interest and corporate control," *Antitrust Law Journal*, 67(3), 559–614.

——— (2001): "The competitive effects of passive minority equity interests: reply," *Antitrust Law Journal*, 69(2), 611–625.

O'Brien, D. P., and K. Waehrer (2017): "The Competitive Effects of Common Ownership: We Know Less than We Think," *Available at SSRN: https://ssrn.com/abstract=2922677*.

Posner, E. A., F. M. Scott Morton, and E. G. Weyl (2016): "A Proposal to Limit the Anti-Competitive Power of Institutional Investors," .

Reynolds, R. J., and B. R. Snapp (1986): "The competitive effects of partial equity interests and joint ventures," *International Journal of Industrial Organization*, 4(2), 141–153.

Rock, E. B., and D. L. Rubinfeld (2017): "Defusing the Antitrust Threat to Institutional Investor Involvement in Corporate Governance," .

Rotemberg, J. (1984): "Financial transaction costs and industrial performance," *Sloan Working Papers*.

Rubinstein, A., M. E. Yaari, et al. (1983): "The Competitive Stock Market as Cartel Maker: Some Examples," Discussion paper, Suntory and Toyota International Centres for Economics and Related Disciplines, LSE.

Rydqvist, K., J. Spizman, and I. Strebulaev (2014): "Government policy and ownership of equity securities," *Journal of Financial Economics*, 111(1), 70–85.

Schmalensee, R. (1988): "Industrial economics: an overview," *The Economic Journal*, 98(392), 643–681.

A Appendix - Ownership Data

Ownership data come from SEC 13F investment filings. The SEC requires any institutional investor with over $100 million in assets under management to file a schedule 13F form every quarter. Filers include the following: banks, insurance companies, parents of mutual funds, pension funds, and university endowments. Filers report the dollar value of holdings in all publicly traded companies, so the data exist for many industries researchers may want to investigate.

The 13F data set is provided by the Wharton Research Data Services (WRDS) using data collected from Thomson Reuters mutual fund and investment company common stock holding database. The level of the data set is at the stock CUSIP number, filing date of the asset manager and asset manager. Security prices and shares outstanding are provided by the asset managers.. Amendments to the 13F data are possible within a reporting period, resulting in multiple observations per reporting period. In such instances we keep the last report date of each asset manager within a reporting period.

An institution may issue multiple securities. This does not occur often, however it does occur in large banks such as Bank of America, Citigroup, and Wells Fargo. In institutions with multiple CUSIPs we sum the shares outstanding across securities. If there is a single CUSIP to an institution, percentage shares owned are calculated using shares outstanding. If there are multiple CUSIPs to an institution, percentage shares owned are calculated using the market capitalization.

We adjust percentage shares owned if an asset manager's value is greater than 25% for a single quarter, replacing the value with the subsequent quarter. We do not adjust the percentage share owned if the asset managers' ownership share was 25% over multiple reporting periods. Indeed, if shares owned by all 13F filers in any given bank in a single quarter is greater than 100%, we normalized the percentage shares with values from the previous quarter.

The PERMCO variable links to a Federal Reserve Bank of New York crosswalk that also contains the regulatory identification numbers (ID_RSSD) from the National Information Center. The ID_RSSD variables subsequently link to price and quantity data.

B Additional Tables

Table 13: **Quantity IV Estimates (First Stage):** This is the first stage for the IV estimates in Table 11.

	Deposits (1)	log(Deposits) (2)	Deposit Share (3)
Weight on Own Profits (Pro-Forma - Actual Q2/2009)	8.544***	8.536***	8.544***
	(0.0801)	(0.0802)	(0.0801)
Quarter Fixed Effects	No	No	No
Bank-County Fixed Effects	No	No	No
County-Quarter Fixed Effects	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
N	460593	459037	460593

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: **12 Month CD Rate IV Estimates (First Stage):** These are the first stage estimates for the IV estimates in Table 12.

	12 Month CD Rate (1)	log(12 Month CD Rate) (2)	12 Month CD Rate Percentile (3)
Weight on Own Profits (Pro-Forma - Actual Q2/2009)	8.928***	8.928***	8.928***
	(0.0940)	(0.0940)	(0.0940)
Quarter Fixed Effects	No	No	No
Bank-County Fixed Effects	No	No	No
County-Quarter Fixed Effects	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
N	359970	359966	359970

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$