DOI: 10.1111/fima.12368

ORIGINAL ARTICLE

Financial Management | WILEY

Ultimate ownership and bank competition

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Funding information
Secretaria d' Universitats I Recerca del Departament d' Empresa I Coneixement de la Generalitat de Catalunya, Ref. 2016 BP00358

Abstract

We document substantial time-series and cross-sectional variation in branch-level deposit account interest rates, maintenance fees, and fee thresholds, and examine whether variation in bank concentration helps explain variation in these prices. Herfindahl–Hirschman Index (HHI) alone is not correlated with any of the outcome variables. A "generalized HHI" (GHHI) capturing both common ownership (the degree to which banks are commonly owned by the same investors) and cross-ownership (the extent to which banks own shares in each other), is strongly correlated with all prices, even when we limit cross-sectional variation in bank ownership to only that predicted by the growth of index funds.

1 | INTRODUCTION

Many fees for banking deposit services and the deposit thresholds to avoid these fees have experienced a secular increase over the past decade (Figure A1). Those fees, their avoidance thresholds, and the interest rates paid on the related accounts also vary substantially in the cross section. For example, even in the low-interest environment of 2013, Certificate of Deposit (CD) rates vary by almost 1 percentage point across U.S. counties (Figure 1C). Do differences in bank competition help explain the variation in prices consumers pay for the privilege of storing their savings? To examine this question, we examine whether variation of various measures of local bank concentration helps predict variation in product prices.

Measuring bank concentration and its consequences has been a primary interest of financial economists for decades, because it is hugely important for many areas of economics. For example, higher bank concentration (1) is related to increased barriers to entry for firms and latent entrepreneurs—particularly for the poor and for minorities—and can negatively affect economic growth, (2) hamper the transmission of monetary policy, (3) slow down the adoption of new technologies, (4) increase inequality and crime, and (5) adversely affect households, who receive lower rates on their savings and pay more for consumer loans. The degree of bank competition can also affect (6) the fragility

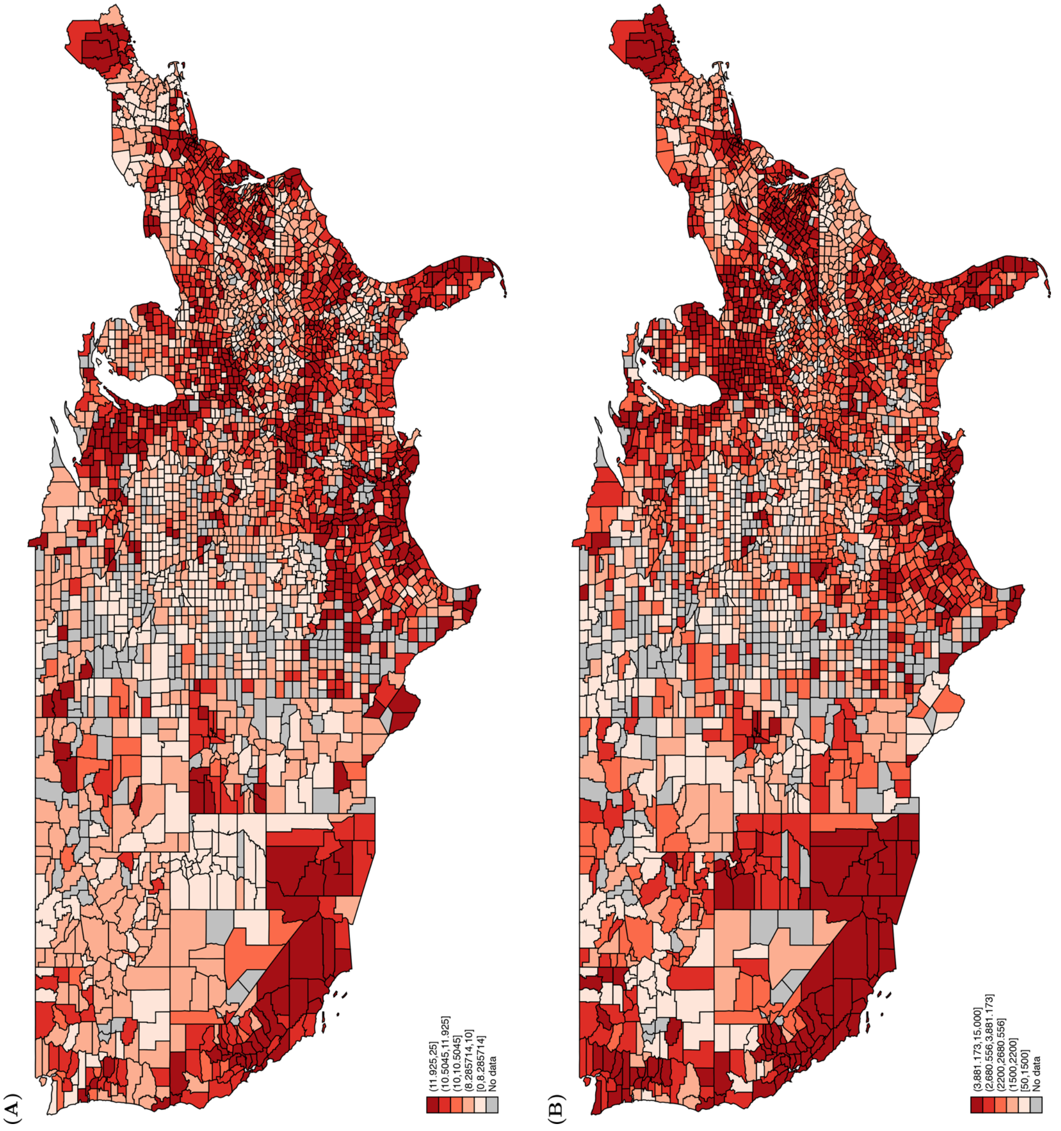


FIGURE 1 2013 Average prices, by county [Color figure can be viewed at wileyonlinelibrary.com]

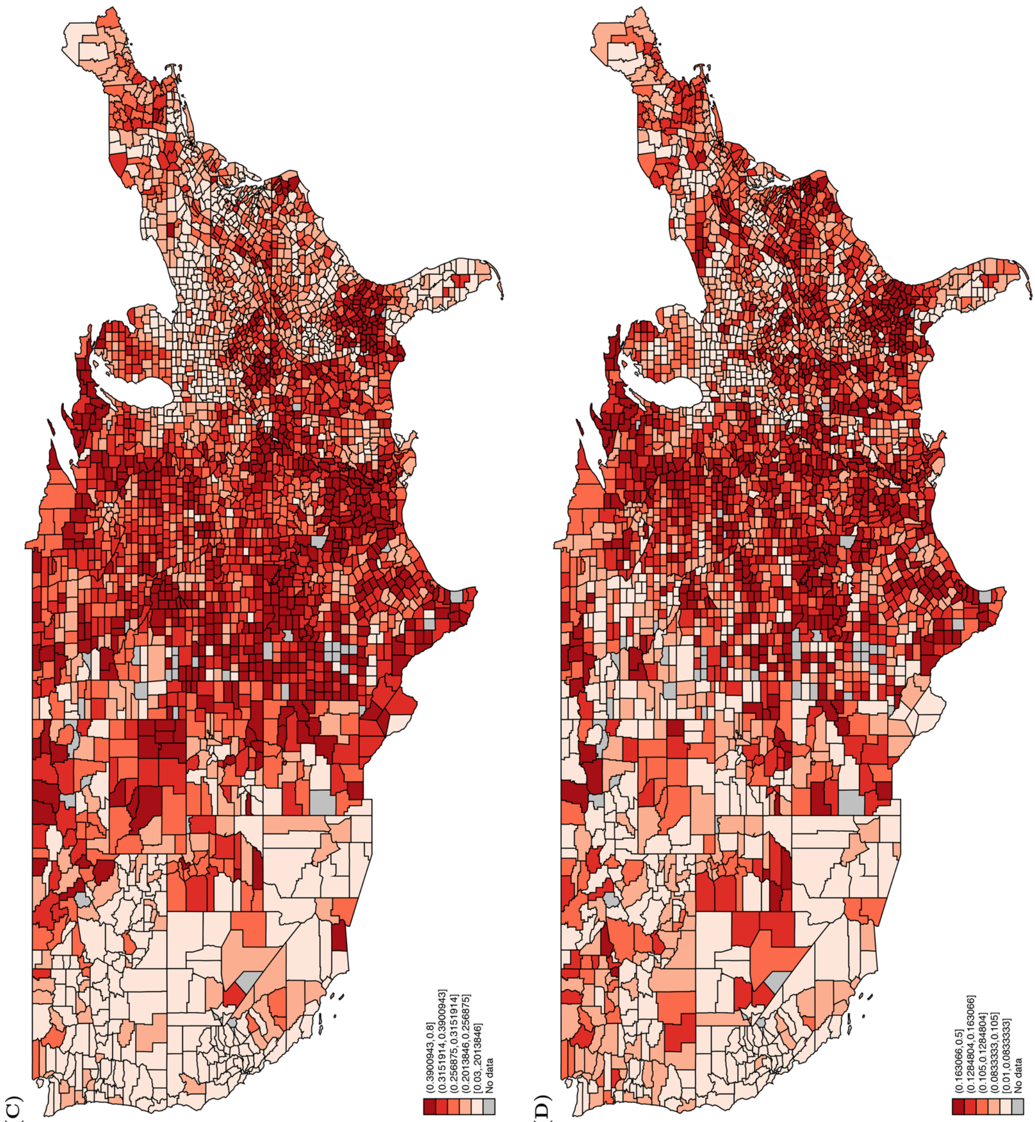


FIGURE 1 Continued

of the financial system, (7) the value of lending relationships, (8) lending standards, (9) the propensity of lenders to foreclose on their borrowers, and (10) the allocation of labor to its most productive use.[1] For all these applications, it is crucial to understand the economic forces governing bank competition and to find effective ways to measure them. However, because of data limitations and the use of conceptually incomplete measures of concentration, our understanding of bank competition remains uncomfortably limited, as the present study helps to illustrate.

This paper contributes to the literature (i) new facts from a uniquely extensive branch-level panel data set on various prices of bank deposit products, (ii) the computation of a more general and conceptually complete, more realistic, and empirically more effective measure of bank concentration: the generalized Herfindahl–Hirschman Index (GHHI) of market concentration, (iii) first evidence that common ownership and cross-ownership increase monopsony power, and (iv) a new source of cross-sectional variation of market-level ownership structures (and hence market concentration as measured by the GHHI): index fund growth.

We find that (i) fees and thresholds have increased markedly over the last decade, and exhibit large cross-sectional variation. In particular, prices of deposit products are higher in California, New York, and New Jersey than in the midwest (e.g., Kansas or Nebraska). This is perhaps surprising, given that there are many more banks in New York, and the Herfindahl–Hirschman Index (HHI) measure of market concentration[2] is *lower*, than in the Midwest (Figure 2A). Indeed, we also find that (ii) changes in the HHI do not correlate with changes in either fees, thresholds, or deposit spreads. There is also much cross-county variation in prices within regions, which is not explained by variation in HHI.

One reason why the HHI fails to reliably explain variation in prices may be that its derivation counterfactually assumes that every bank is owned by individuals that hold no stakes in other banks; HHI ignores the very high and increasing degree of overlapping ownership between banks, illustrated in Table 1. The same four institutional investors are among the top five shareholders of the nation's five largest banks. The fifth important player is Berkshire Hathaway, which ranks among the top five shareholders of three of the top six banks. In addition to such common ownership links, there are cross-ownership links: many banks have asset management divisions that are shareholders of competitor banks. As a consequence, banking is an industry in which an effective concentration measure, as we show empirically, has to *jointly* take into account common ownership and cross-ownership.

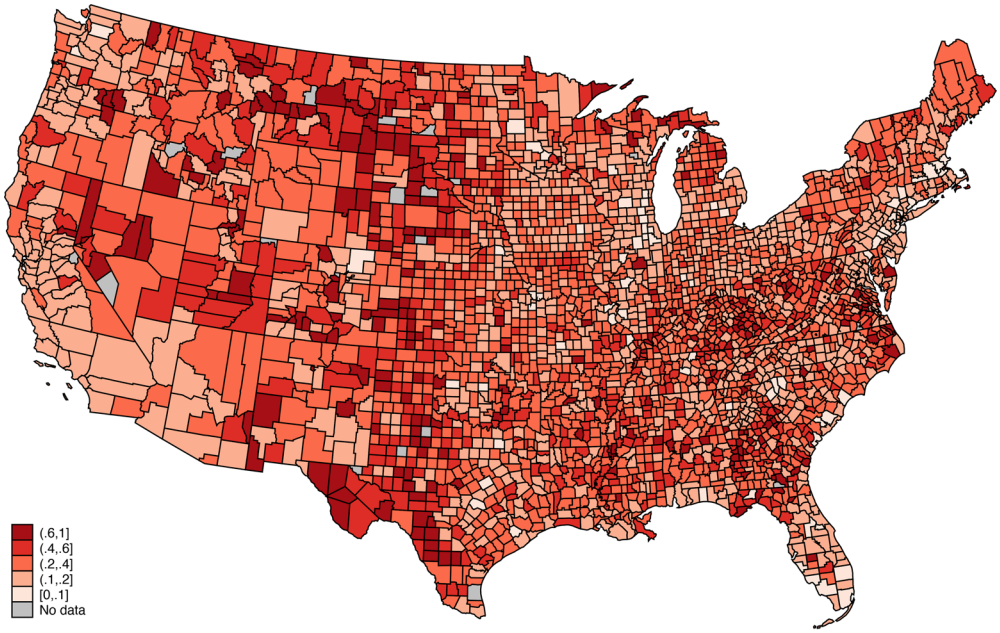
We provide such a measure: the GHHI. The GHHI is a generalization of the "modified HHI" (MHHI) of O'Brien and Salop (2000) that accounts not just for common ownership but also for cross-ownership.[3] The market-level GHHI as of 2013 is more than 2500 points higher than the HHI (Figure 6B) ; we call this difference "GHHI delta." This magnitude compares to regulatory thresholds for merger review of 200 HHI points.

Given the large common ownership concentration (GHHI delta), and given the negative correlation between HHI and GHHI delta, it is, with hindsight, not surprising that omitting GHHI delta in a regression of price on market concentration (HHI) leads to a severe downward bias—and in some specifications even to a "wrong" negative sign in correlations of price on market concentration (HHI). This is indeed he case. Moreover, by contrast to the HHI, GHHI is strongly and reliably correlated with all fees and thresholds. Indeed, GHHI levels are higher in the high-price areas on the coasts, compared to the middle of America (Figure 2B). More importantly, changes over time in market-level

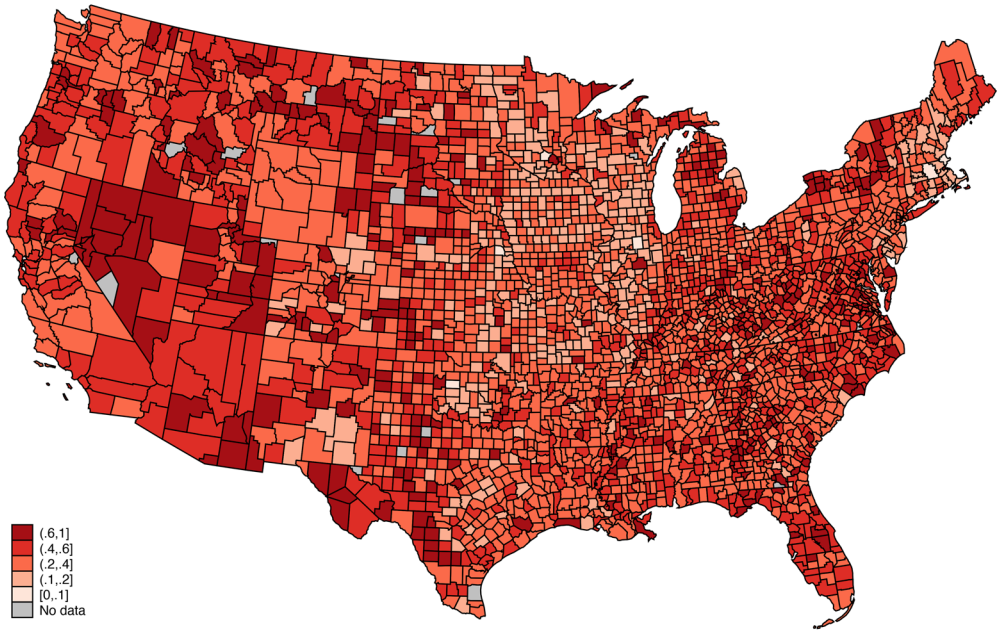
[1] (1) Black and Strahan (2002), Collender and Shaffer (2003), Beck, Demirguc-Kunt, and Maksimovic (2004), Cetorelli (2004), Cetorelli and Strahan (2006), Kerr and Nanda (2009), Canales and Nanda (2012), Chatterji and Seamans (2012), Love and Pería (2015), Saidi and Streitz (2018), (2) Hannan and Berger (1991), Neumark and Sharpe (1992), Drechsler, Savov and Schnabl (2017), and Scharfstein and Sunderam (2014), (3) Allen, Clark, and Houde (2009), (4) Garmaise and Moskowitz (2006) and Beck, Levine, and Levkov (2010), (5) Kahn, Pennacchi, and Sopranzetti (1999) and Kahn, Pennacchi, and Sopranzetti (2005), Célérier and Matray (2014), and others (reviewed below), (6) Beck, Demirgüç-Kunt, and Levine (2006), Beck (2008), Berger, Klapper, and Turk-Ariss (2009), Martinez-Miera and Repullo (2010), Hakenes and Schnabel (2011), Anginer, Demirgüç-Kunt and Zhu (2014), Beck, De Jonghe, and Schepens (2013), and Egan, Hortaçsu, and Matvos (2017), (7) Petersen and Rajan (1995) and Simkovic (2013), (8) Ruckes (2004), (9) Favara and Giannetti (2017) and Gormley, Gupta, and Jha (2018), (10) Bai, Carvalho, and Phillips (2018).

[2] The HHI index is the sum of the squared market shares. As such it goes from zero for a perfectly competitive market to one for a monopoly. Regulators sometimes multiply the index by 10,000.

[3] Brito et al. (2018) also develop an index that generalizes MHHI to allow for simultaneous common ownership and cross-ownership (i.e., partial ownership by competitors). The main difference between our and Brito et al. (2018)'s derivation is that "our" GHHI has the appealing property that the ultimate control shares add up to 100%; see Appendix D. The generalization from MHHI to GHHI is important: there are 656 counties (out of about 3000 counties in the contiguous United States) where the difference between MHHI and GHHI is greater than 100 HHI points, and 231 counties where the difference is greater than 200 HHI points.



(A) HHI



(B) GHHI

FIGURE 2 Banking market concentration, county-level (2013)
[Color figure can be viewed at wileyonlinelibrary.com]
Note: This figure shows the county-level banking sector concentration in 2013, as measured using HHI and GHHI

TABLE 1 Top five owners of the largest six U.S. banks

JP Morgan Chase	*[%]*	*Bank of America*	*[%]*	*Citigroup*	*[%]*
Vanguard	6.28	Berkshire Hathaway*	6.90	BlackRock	6.43
BlackRock	6.28	Vanguard	5.94	Vanguard	5.96
State Street	4.12	BlackRock	5.94	State Street	4.04
Capital Research	3.68	State Street	4.01	Fidelity	3.00
Fidelity	2.10	Fidelity	2.37	Invesco	1.67
Wells Fargo	*[%]*	*PNC Financial*	*[%]*	*U.S. Bancorp*	*[%]*
Berkshire Hathaway	10.46	Wellington	8.34	BlackRock	6.51
Vanguard	5.67	Vanguard	6.30	Berkshire Hathaway	5.94
BlackRock	5.42	BlackRock	5.03	Vanguard	5.59
State Street	3.68	State Street	4.33	Fidelity	4.12
Wellington	2.55	Barrow Hanley	3.71	State Street	3.84
Panel A: Top five owners in 2013q2					
JP Morgan Chase	*[%]*	*Bank of America*	*[%]*	*Citigroup*	*[%]*
Capital Research	6.0	AXA	4.2	State Street	4.4
Barclays	3.9	Barclays	4.0	Fidelity	3.9
AXA	3.7	Capital Research	3.6	AXA	3.7
State Street	2.5	Fidelity	3.2	Barclays	3.7
Fidelity	2.3	State Street	2.4	Wellington	1.8
Wells Fargo	*[%]*	*U.S. Bank*	*[%]*	*PNC Bank*	*[%]*
Barclays	3.4	Putnam Investment	7.4	Fidelity	6.8
Fidelity	3.2	Barclays	3.7	Barclays	3.9
Berkshire Hathaway	3.1	U.S. Bank	3.0	Barrow Hanley	3.7
Citigroup	2.9	JP Morgan Chase	2.8	Wellington	2.9
State Street	2.3	State Street	2.5	State Street	2.3
Panel B: Top five owners in 2002q1					

*Warrants without voting rights.

Note: These tables show the top five shareholders in the second quarter of 2013 and the first quarter of 2002 of the largest six American banks by deposits in the second quarter of 2013. The data source is Thomson institutional ownership data and proxy statements, Capital IQ, and own calculations (for the Berkshire Hathaway warrant stake).

GHHIs correlate with local price changes. Thus, we find that (iii) depository institutions' monopsony power, generated through common ownership and cross-ownership links, has a strong correlation with prices in one of their input markets: the market for deposits. These results do not appear to be driven by the potential endogeneity of market shares.

As a final contribution, (iv) we use variation from the growth of index funds (as opposed to actively chosen portfolios) to examine whether the above correlations are likely to have a causal interpretation within theories of anti-competitive effects of common ownership. Common ownership of banks increases over time due to the growth of (passively managed) index funds. By exploiting this "exogenous" growth in common ownership, this analysis addresses endogeneity issues present in the previous panel regression analysis, including the reverse causality concern that investors with actively chosen portfolios choose their portfolios in response to expected deposit prices, which would naturally lead to a downward-bias in the coefficient on common ownership concentration. To do so, we first directly

TABLE 2 Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	*N*
Maintenance fee: Interest checking	12.126	6.244	0	25	535,360
Maintenance fee: Money market	9.800	4.251	0	20	536,451
Maintenance fee threshold: Interest checking	4291.701	4685.847	0	25,000	493,563
Maintenance fee threshold: Money market	2904.967	2831.349	0	15,000	491,310
Interest rate: 12-Month CD	1.674	1.381	0.042	5.608	951,588
Interest rate: 24-Month CD	1.963	1.343	0.094	6.36	932,394
Interest rate: 36-Month CD	2.201	1.324	0.1	5.758	907,310
Interest rate: Money market	0.656	0.690	0.01	4.325	914,586
Interest rate: Interest checking	0.205	0.264	0.01	2.5	917,577
HHI	0.184	0.115	0.05	1	1,004,842
GHHI	0.325	0.148	0.059	1	1,004,842
Top index fund ownership (Percent)	2.395	1.692	0	13.028	1,005,055
Log Income	10.799	0.255	9.766	11.706	1,002,906
Log Population	12.468	1.655	6.084	16.12	1,002,906

Note: This table provides annual, branch-level summary statistics that describe our outcome and explanatory variables. The first three variables are maintenance fee amounts, the next three are maintenance fee thresholds. The next six variables are interest rates for each of the deposit products examined. The next two variables are county-level HHI and GHHI, our two concentration measures. Finally, the last two variables are two covariates that we employ in our regressions: log of county-level average income and county population.

instrument our GHHI measure using county-level index fund ownership of banks and find that index fund growth-induced variation in the GHHI is strongly correlated with higher fees, thresholds, and deposit spreads. Under the assumption that aggregate index fund growth is not primarily caused by across-county variation in banking market outcomes, this finding indicates that index fund growth causes higher prices for banking products.

To mitigate the endogeneity concern implied by the identifying assumption of the instrumental variable (IV) analysis described above, we complement it with a difference-in-differences (DiD) analysis. Specifically, we show that growth in deposit prices from 2004 to 2013 can be predicted by information from 2003 before about county-level industrial organization of banks, the banks' ownership, and deposit prices. In particular, a higher level of common ownership in 2003 predicts greater growth in common ownership in the same market, which in turn predicts greater price changes over the next decade.

We mitigate potential endogeneity concerns arising from differences across banks by showing that similar results are present when we use only variation from changes over time in within-bank variation across counties in the prices they charge, as well as with controls for bank size.[4] Under the (reasonable) assumption that index fund ownership in a given county in 2003 is not determined by future price changes *beyond what is reflected in the market value of the bank holding companies or any other characteristic of the bank holding company*, these findings imply that greater levels of common ownership cause higher prices for deposit products. The results are marginally stronger when we include region-time fixed effects, which suggests that across-region variation over time in economic conditions is unlikely to drive the observed effects, and, if anything, has a mitigating effect on the baseline results.

[4] Within-bank variation in prices a cross geographies exists primarily for large banks. This variation is visible on bank websites, which use consumers' location as an input to pricing. This feature indicates a decision making on market-level products and prices that is centralized at the corporate level. The within-bank variation in prices is more limited for fees and thresholds, but plentiful for interest rates. As a result, statistical significance of the fee and threshold results is reduced when we use only within-bank variation over time.

Given our findings, the question arises which corporate governance mechanism drives these outcomes. The most important message is that the link between concentrated ownership and higher prices for banking products need not be driven by collusion, that is, price setting coordination by banks. Whereas mutual funds' unrecorded "engagement" meetings with their various portfolio firms could, in principle, be used as such a coordination device, overlapping ownership interests can cause anticompetitive effects even without collusion, with each firm independently maximizing its shareholders' portfolio profits (O'Brien & Salop, 2000). Azar (2012) shows that the O'Brien and Salop (2000) equilibrium can be the outcome of the battle for corporate control, in which potential managers strive to earn the votes of the industry firms' shareholders. Managers who propose broad strategic plans that correctly represent shareholder interests will tend to be selected to run the firms and managers that fail to propose such strategic plans will tend to be selected out.

This selection effect becomes more severe when index funds can outvote smaller undiversified activist investors that would otherwise push firms to compete harder (Aslan & Kumar, 2016). Schmalz (2015) recounts how large index fund providers voted against an activist campaign that arguably would have strengthened product market competition. Without the presence of activists, large, diversified mutual funds could simply let portfolio firm managers live a "quiet life" with high margins and low competition (Bertrand & Mullainathan, 2003). Antón, Ederer, Giné and Schmalz (2018) show that managers' incentives are at least partially aligned with their shareholders anticompetitive interests as top executives get paid less for the own firm's performance when the firm is owned predominantly by investors that also hold large stakes in competitors. In sum, the outcomes we document can be implemented either by active involvement in corporate governance on behalf of mutual fund companies, or, more simply, by asset managers' failure to push firms to compete hard, failure to implement compensation contracts that reward aggressive competition, and discouraging activist campaigns that would otherwise pursue such goals.[5]

The most direct policy implication of our findings is that bank regulators should consider taking ownership structures into account when measuring bank concentration. A failure to do so may lead to "hidden" increases in bank concentration through partial common- and cross-ownership links that can cause adverse effects on bank competition that go undetected when using the HHI.

2 | RELATED LITERATURE

This is the first paper that studies the relationship between a broad set of deposit fees and competition. Considering fees as part of the price vector is important for an accurate measurement of the effective price of deposit banking, especially in times of low interest rates. Studying the relation between competition and fee *thresholds* is important because it uncovers a previously undiscussed mechanism that can amplify inequality.[6]

The literature on the relation between bank concentration and profits is reviewed by Northcott (2004) and Gilbert and Zaretsky (2003). It generally finds that the HHI captures some cross-sectional differences in the level of competition between banks, but with declining robustness over time. Specifically, local market HHIs have been shown to correlate positively with bank profits (Akhigbe & McNulty, 2003; Pilloff & Rhoades, 2002; Rhoades, 1995) and loan rates (Berger et al., 2001; Cyrnak & Hannan, 1999; Hannan, 1991; Hannan & Liang, 1995), and negatively with deposit rates (Heitfield & Prager, 2004; Prager & Hannan, 1998; Sharpe, 1997). CR3, a measure closely related to the HHI, also correlates with higher loan rates (Edwards, 1964) and lower deposit rates (Berger & Hannan, 1989; Calem & Carlino, 1991).

[5] Azar, Schmalz, and Tecu (2018) provide a more comprehensive discussion.

[6] Depositors can avoid account maintenance fees by maintaining a balance in excess of some fee avoidance threshold. Naturally, richer households are in a better position to avoid such fees than less affluent depositors. Hence, if lessened competition was associated with higher thresholds, lessened bank competition would contribute to inequality through this channel.

However, the correlation between the HHI and prices is not very robust over time, to the introduction of controls, or to other changes in the econometric specification. Moore, Siems, and Barr (1998) find that the correlation of the HHI with profits declines over time and is only present in the early years of their sample; similarly, Hannan and Prager (2004) also find that the HHI loses its significant influence on deposit rates over time. Note that the disappearance of the HHI effect can be explained with an increased importance of the omitted variable concern. Controlling for market or bank characteristics is sufficient to render the HHI coefficient insignificant in Flechsig (1965), Berger (1995), and Hannan (1997), and Melzer and Morgan (2014). A redefinition of profitability eliminates the correlation between the HHI and profitability also in Punt and Van Rooij (1999). Also, the literature finds that a correlation between the HHI and prices is more difficult to find in changes, a specification that comes closer to the theoretical idea of the Cournot model.[7] For example, Corvoisier and Gropp (2002) use country-product-level prices and variation in the HHI from bank mergers to examine the concentration–price relationship. They find no robust effect of the HHI changes on prices, and interpret their finding as consistent with efficiency increases from the mergers.

Finally, ours is not the first paper that points out that banks assess fees for services. Greenwood and Scharfstein (2013) present evidence showing that *aggregate nation-wide revenue* from fees has replaced interest revenue from 1997 to 2007.[8] By contrast, we present evidence on *prices* (not revenues) *at the branch level*, and relate changes in prices to changes in competition. Berg, Saunders, and Steffen (2016) show that fees are a significant contributor to the cost of corporate borrowing, whereas we analyze fees as a contributor to the cost of depositing money with a bank, and relate the variation in fees to bank concentration. Similarly, Melzer and Morgan (2014) study competition in the small-dollar loan market, Berg et al. (2016) examine the role of fees in syndicated *loans* between the United States and Europe, but without considering competition as a factor, and Agarwal, Song, and Yao (2017) consider the impact of bank product market competition on fees charged on mortgage products. Moreover, for deposits and loan rates, our data have an order of magnitude more banks (over 9000) and over two orders of magnitude more observations (over 60 million interest rate data points each for 12-month CDs, money market, and interest-bearing checking accounts) than most existing studies.[9]

3 | DATA

In this section, we detail the data sources for our analysis, and then present the first main result of the paper: the variation over time and across geographies of fees, thresholds, and deposit interest rates and spreads.[10]

[7] The Cournot model predicts that markups—not prices—correlate with the HHI. Absent measures of markups, research designs in changes thus more closely approximate the model: assuming constant cost, changes in the HHI should relate to changes in prices as costs are differenced out.

[8] There is also a public debate, largely based on bank-level revenues from fees versus rates; see, for example, *Wall Street Journal*, May 12, 2015, "Overdraft fees continue to weigh on bank customers," *BloombergView*, November 11, 2015, "A checking account is a dangerous thing," *USA Today*, September 29, 2014, "Survey: ATM, checking overdraft fees surge," or *US News & World Report*, "Are bank fees set to rise?" *The New York Times* reports that 8% of 2015 bank profits stem from overdraft fees alone.

[9] Also, a relatively new empirical literature examines the role of common ownership on product markets (see Schmalz, 2018) and as a potential explanation for macroeconomic trends (Azar & Vives, 2018; Azar & Vives, 2019). Within this literature, ours is similar in techniques employed as that of the large motivating finance literature on bank concentration reviewed above. At the same time, a structural approach has come to dominate the industrial organization literature, perhaps because cross-industry comparisons of margins as a function of HHI face severe omitted variable challenges, as emphasized by Schmalensee, Armstrong, Willig and Porter (1989). Recent preliminary working papers by Gramlich and Grundl (2017) and Gramlich and Grundl (2018) and others are motivated by similar challenges of interpretation inherent in this approach. Schmalensee, Armstrong, Willig and Porter (1989) also note, however, that "studies that compare price levels among geographically separated markets in the same industry are immune to the … problems, and one can expect that omitted market-specific variables are less important (and thus less likely to cause large biases) when attention is focused on a single industry." We concur, and conclude with Nevo and Whinston (2010) that "structural analysis is not a substitute for credible inference" and that "credible analysis can come in many guises, both structural and nonstructural." We therefore see value in both approaches.

[10] Motivated by theory (detailed in the next section), we define deposit rate spreads as the difference between the 10-year treasury rate and the respective deposit interest rate, normalized by the 10-year treasury rate. This expression most closely corresponds to the theoretical equivalent for margins, and is also more stable over time than spreads in levels.

3.1 | Data sources

We use three main sources of data: RateWatch, Federal Deposit Insurance Corporation (FDIC) Summary of Deposits (SoD), and Thomson Reuters's SEC 13F filings database. RateWatch provides branch-level data on rates and fees that we use as our outcome variables. FDIC's SoD supplies the branch-level deposits data used to calculate market share. Thomson Reuters's database of SEC 13F filings provides data on institutional ownership of public banks, which we use, along with FDIC data, to construct the GHHI. We also use Thomson Reuters's SEC 13F database to measure index fund ownership over time.

3.1.1 | Data on banking product prices

RateWatch was established to provide their clients—the major U.S. banks—with information on competitors' prices at the branch level. We use their data on fees, fee thresholds, and deposit rates to examine the total price customers pay when depositing savings. We have deposit fees data from over 3000 banks and deposit rates data from over 9600 banks.

Our fees data are extensive. For example, in 2013, we have data on money market maintenance fees for at least one branch in the same county as 99.1% of the U.S. population. Overall, we have over 4.5 million fee amount and fee threshold observations for both money market and interest-bearing checking accounts.

Our interest rates data coverage is even more extensive than the fees data. For 12-month CDs, in 2013, we have interest rates from at least one branch in the same county as 99.9% of the U.S. population. Overall, for each deposit rate that we explore, we have over 60 million observations.

3.1.2 | FDIC SoD

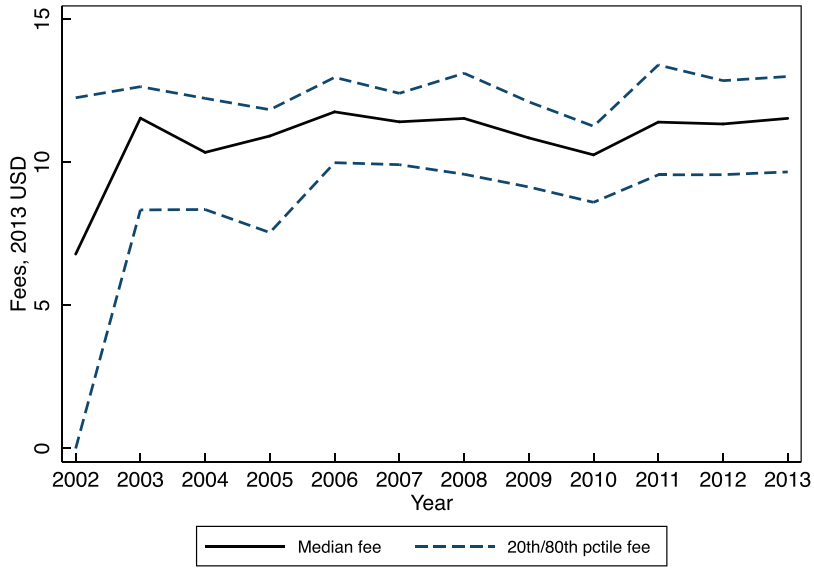
We use FDIC's SoD to calculate market share for banks. SoD is based on an annual survey of deposits completed by all FDIC-insured bank branches. SoD is a standard source for measuring bank product market concentration in the extant literature (e.g., Cetorelli & Strahan, 2006; Drechsler, Savov & Schnabl, 2017).

3.1.3 | Thomson Reuters SEC 13F data

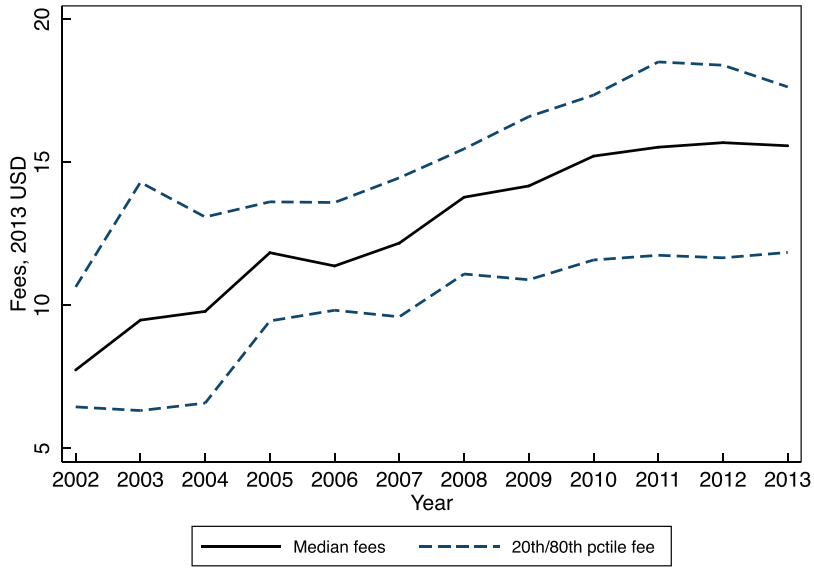
All institutions that "exercise investment discretion over $100 million or more" must file a Form 13F every quarter with the SEC that provides information on their holdings of U.S. firms' equity. We use the Thomson Reuters collection of these data for two purposes. First, we use it to calculate GHHI indices, our generalized measure of market concentration, for local banking markets. Second, we use it to identify five of the largest index fund groups—iShares, Vanguard, SPDR, Invesco, and Fidelity Spartan. We use their growth as an instrument for exogenous changes in the ownership structure of banks.

3.2 | Description of fees, fee thresholds, and rates

We begin with a description of the cross-sectional variation in interest-bearing checking and money market account maintenance fees that banks charge their customers. Figure 1A shows that money market account fees are higher in areas which feature more banks, such as the coastal areas, and in particular the Northeast. These fees range from under $8 to $25. Similarly, Figure 1B shows considerable geographic variation in money market account maintenance fee thresholds in 2013, going as high as $15,000 in some counties and as low as $50 in others. There is similar



(A) Money market accounts



(B) Interest-bearing checking accounts

FIGURE 3 Median, 20th percentile, and 80th percentile maintenance fee amounts, 2002–2013
[Color figure can be viewed at wileyonlinelibrary.com]
Note: This figure shows the annual median, 20th percentile, and 80th percentile of maintenance fee amounts for money market accounts and interest-bearing checking accounts, for 2002–2013, in 2013 USD (adjusted for inflation using CPI)

geographic variation in money market account fees and thresholds holds in other years and in interest-bearing checking accounts as well.

Figures 3A and B present the annual median, 20th, and 80th percentile county average maintenance fees for money market and interest-bearing checking accounts, respectively. These figures confirm that the annual distributions of

fees for the two deposit products have considerable variation across counties. Similarly, Figures 4A and B present the annual 20th, 50th, and 80th percentile county average maintenance fee thresholds for money market and interest-bearing checking accounts.[11] Again, we see that there is considerable variation in thresholds across counties within each year.[12]

For the analyses of fees and fee thresholds, we take the annual mean of survey responses for each outcome variable for each branch and then winsorize the right side of the distribution at the 1% level to reduce the impact of suspected data errors.[13]

In our analysis on interest rates, we use deposit rates for CDs with 12-, 24-, and 36-month terms, money market accounts, and interest-bearing checking accounts. We begin by describing their cross-sectional variation. In Figures 1C and D, we present a map of the average interest rates in each county in 2013 for 12-month CDs and money market accounts, respectively. The variation is substantial, despite the low interest rate environment. Rates are somewhat higher in the central regions of the United States than in coastal regions, with rates ranging from 0.8% for 12-month CDs and 0.5% for money market accounts in some counties to close to 0% for both types of deposit accounts in other counties. There is similar geographic variation in rates for other years in 12-month CDs and money market accounts and in 24- and 36-month CDs and interest-bearing checking accounts as well. In sum, perhaps surprisingly, banks are able to charge higher spreads in the banking markets that feature more natural competitors, such as the east coast and California, than in the markets that feature fewer competitors, such as the midwest.

Figures 5A, B, and C plot quarterly median, 20th percentile, and 80th percentile county-level average interest rates for 12-month CDs, money market accounts, and interest-bearing checking accounts, respectively. We observe cross-sectional dispersion in the interest rates for all three products, although there is less dispersion in the 12-month CD rates. As these figures show, the distribution of interest rates and their spread margins expands and contracts enormously over time as interest rates increase or decrease with the business cycle. This can be problematic, for example, because a bank with relatively low rates during a period of high interest rates would see a smaller drop in rates as the overall level of interest rates decline, relative to a bank with higher initial rates, simply because there is less room for its rates to fall. To avoid this "accordion" econometric problem, we run our analyses for interest rates on the within-year ranking of interest rate spread margins

We prepare the interest rates data for analysis by, first, calculating the difference between the 10-year Treasury Constant Maturity average rate for each month and our deposit interest rates as a fraction of the Treasury rate. Next, like for the fees analyses, we take annual means of the reported interest rate spread margins for each branch in the data. After that, we symmetrically winsorize the data at the 2% level. This helps reduce the impact of outliers on our analyses. Finally, we take the within-year percentiles of these rate spread margins to minimize problems tied to the "accordion" problem discussed above.

3.3 | Banking market concentration

In this paper, we take ownership into account by measuring bank concentration using GHHI, our generalized measure of bank concentration.[14],[15] Figures 2A and B present the geographic dispersion of the HHI and GHHI measures of bank concentration in 2013, respectively. Based on the maps, we observe that considering ownership significantly

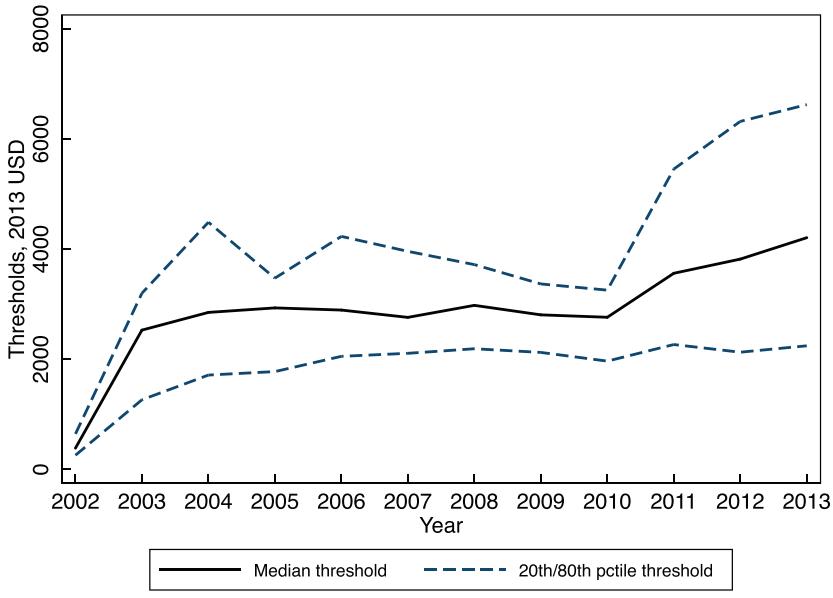
[11] The figures discussed in this paragraph present data in constant 2013 USD, adjusted for inflation using CPI.

[12] The threshold dispersion in 2002 appears smaller than in other years, but, in proportion to the mean maintenance fee thresholds in that year, the variation in 2002 is similar to other years. In addition, there is less data on thresholds in 2002 than later years. We do not use 2002 in our regression analyses.

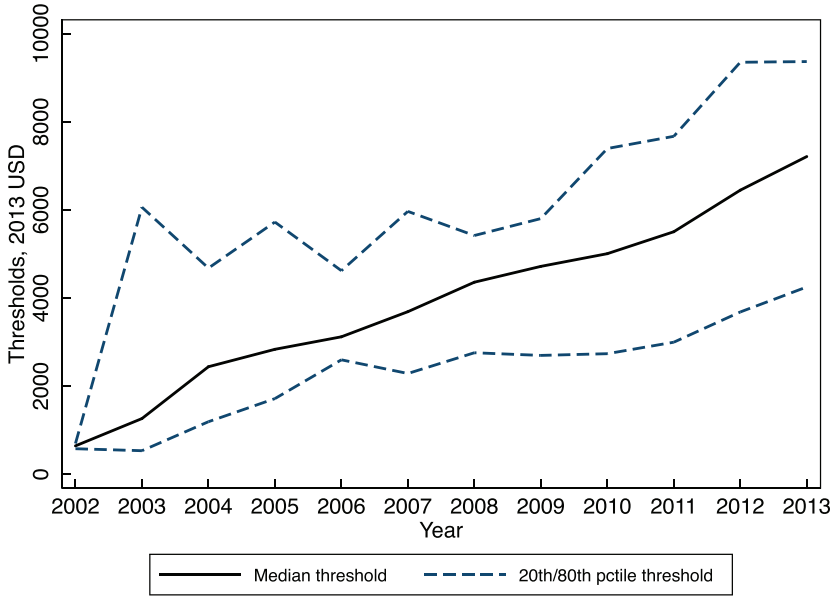
[13] Some reported fees for some branches within some banks appear to be typos. For example, a bank reported charging a $213 maintenance fee for certain accounts in some geographies, whereas most other branches of the same bank charged $13. Such outliers are not part of the data we use. Unrelated, note the aggregation of responses at the annual level within branches is the reason for the smaller sample size reported in our analyses.

[14] The economic reasoning for considering ownership when measuring concentration is presented in Section 4.

[15] More specifically, we measure bank-holding company concentration.

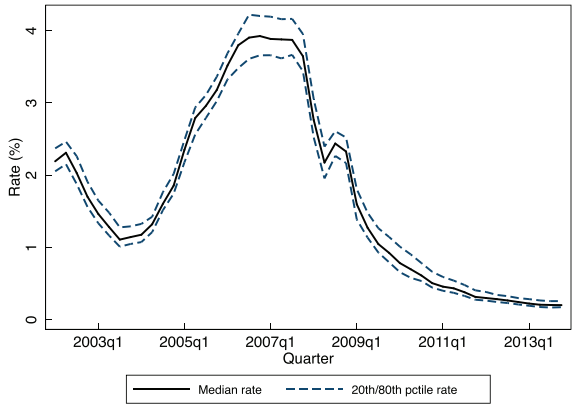


(A) Money market accounts

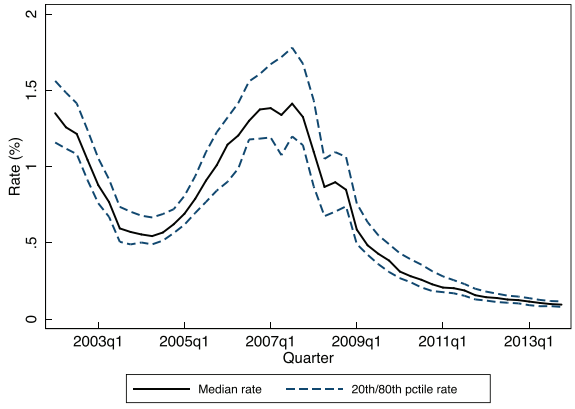


(B) Interest-bearing checking accounts

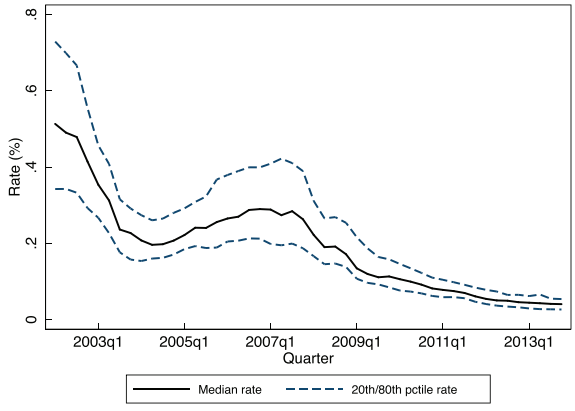
FIGURE 4 Median, 20th percentile, and 80th percentile maintenance fee thresholds, 2002–2013
[Color figure can be viewed at wileyonlinelibrary.com]
Note: This figure shows the annual median, 20th percentile, and 80th percentile of maintenance fee thresholds for money market accounts and interest-bearing checking accounts, for 2002–2013, in 2013 USD (adjusted for inflation using CPI)



(A) 12-month CDs



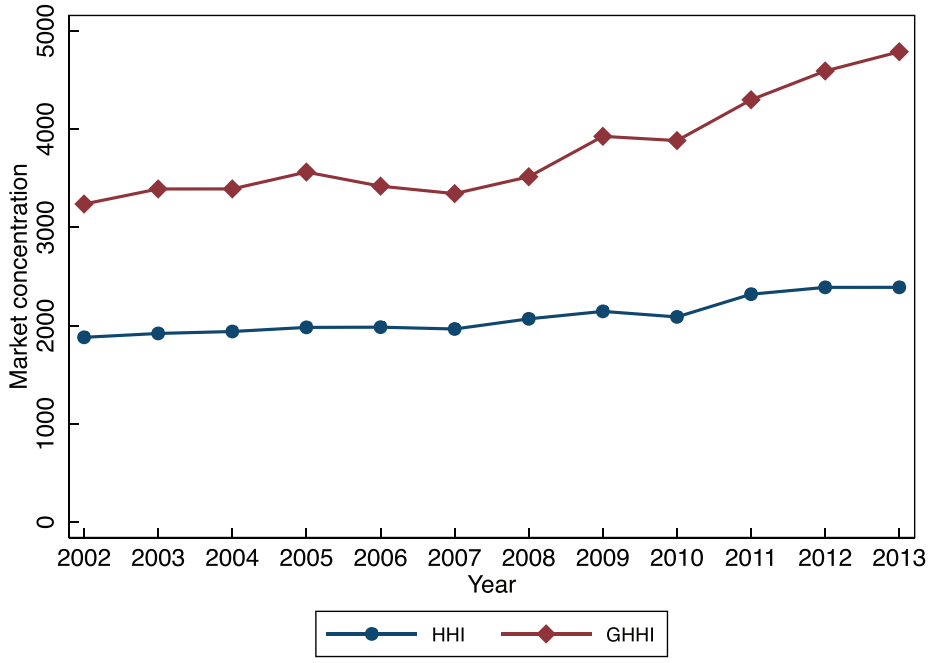
(B) Money market accounts



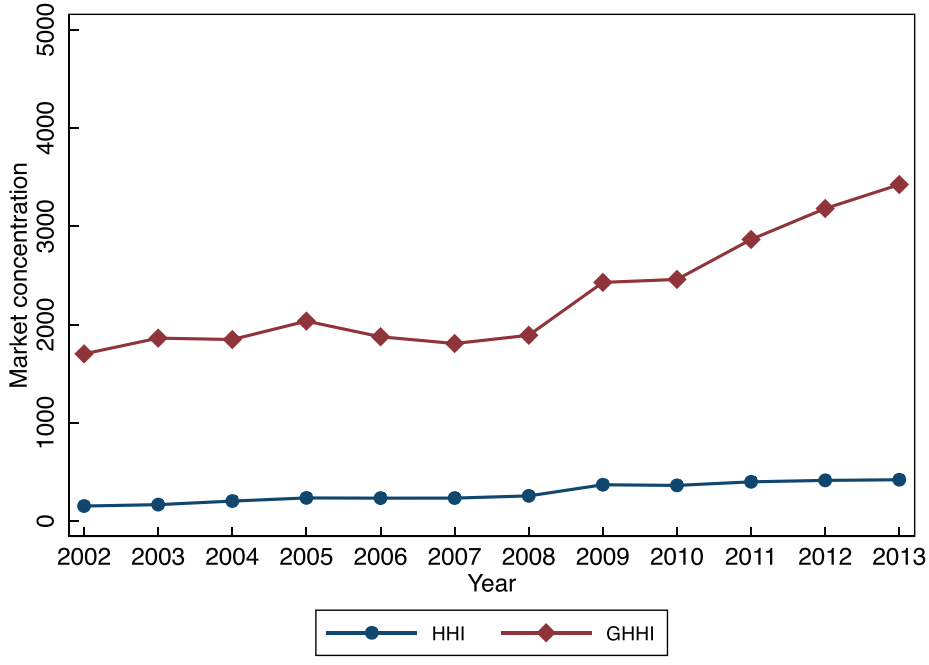
(C) Interest-bearing checking accounts

FIGURE 5 Median, 20th percentile, and 80th percentile interest rates, 2002–2013 [Color figure can be viewed at wileyonlinelibrary.com]

Note: This figure shows the quarterly median, 20th percentile, and 80th percentile of the interest rate for deposit products offered by banks from 2002 through 2013. The bank interest rates in this figure are for 12-month CDs with $10,000 minimum deposit, money market accounts, and interest-bearing checking accounts



(A) County-level bank concentration



(B) National-level bank concentration

FIGURE 6 National and County-Level Bank Concentration, 2002–2013
[Color figure can be viewed at wileyonlinelibrary.com]
Note: This figure shows the annual bank concentration from 2002 through 2013 taking the entire United States as a unified market, and the deposit-weighted average across counties of bank concentration measures. Bank concentration is measured using the HHI and GHHI

increases county-level banking concentration. This impact is especially clear on the coasts, particularly the New York City and DC metropolitan areas and California.

Moreover, in unreported tests, we find that there is a strong negative correlation between the ownership-based component of concentration (GHHI delta) and product market-based component of concentration (HHI). At the county-year level, we find a Pearson correlation coefficient of −0.289, which we find to be highly statistically significant (p-value $< .001$).

Figure 7 shows the cross-sectional distribution and the growth of county-level ownership-based concentration (GHHI delta) from 2002 to 2013. As most of the points are above the 45° line, ownership-based concentration increased in most counties from 2002 to 2013. The figure also shows that there are many counties in 2002 with high ownership-based concentration in 2002 and 2013, implying that ownership adds to county-level banking concentration not just in 2013 but in all years.

4 | HYPOTHESIS DEVELOPMENT AND BASIC RESEARCH DESIGN

4.1 | HHI versus generalized (G)HHI

This paper tests two alternative concentration measures for their effectiveness in capturing differences across markets and over time in the competitiveness of the local banking sector. The standard measure, used by regulators and researchers alike, is the HHI of market concentration, which is simply the sum across firms j of market shares squared,

$$\text{HHI} = \sum_j s_j^2. \tag{1}$$

This measure of market concentration is meaningful if each firm maximizes its own profits, that is, each firm acts in the financial interest of an investor who has no wealth invested in other firms in the industry (or several investors with such undiversified portfolios). Under that assumption, if firms compete à la Cournot,[16] markups $\frac{P-C_j'(x_j)}{P}$ in a given market will be proportional to the market's HHI,

$$\eta \sum_j s_j \frac{P - C_j'(x_j)}{P} = \text{HHI} = \sum_j s_j^2. \tag{2}$$

A corresponding empirical prediction is that markets with high HHI should have higher prices. This prediction assumes that marginal cost is constant across markets. This relatively strong assumption can be weakened by instead correlating changes over time in the HHI with changes in prices. A regression in changes captures the above prediction under the weaker assumption that within a market, marginal costs do not change over time, whereas marginal costs are allowed to differ across markets in ways that are correlated with firm's entry and exit decisions. Adding time fixed effects also allows for changes in marginal costs over time if they are similar across markets. These are the standard regressions the literature has examined.

As reviewed in Section 2, existing work finds mixed results on the correlation between the HHI and prices, especially for regressions in changes. One possible interpretation of a missing link between changes in the HHI and changes in prices is that changes in the HHI are accompanied not only by increases in market power, but also by decreases in marginal costs, that is, efficiency gains. Or perhaps deposit markets simply are not local and do not vary at the county level.

[16] Note however that the HHI as a measure of concentration is also applicable in contexts other than Cournot competition. See for example, Moresi, Salop, and Sarafidis (2008).

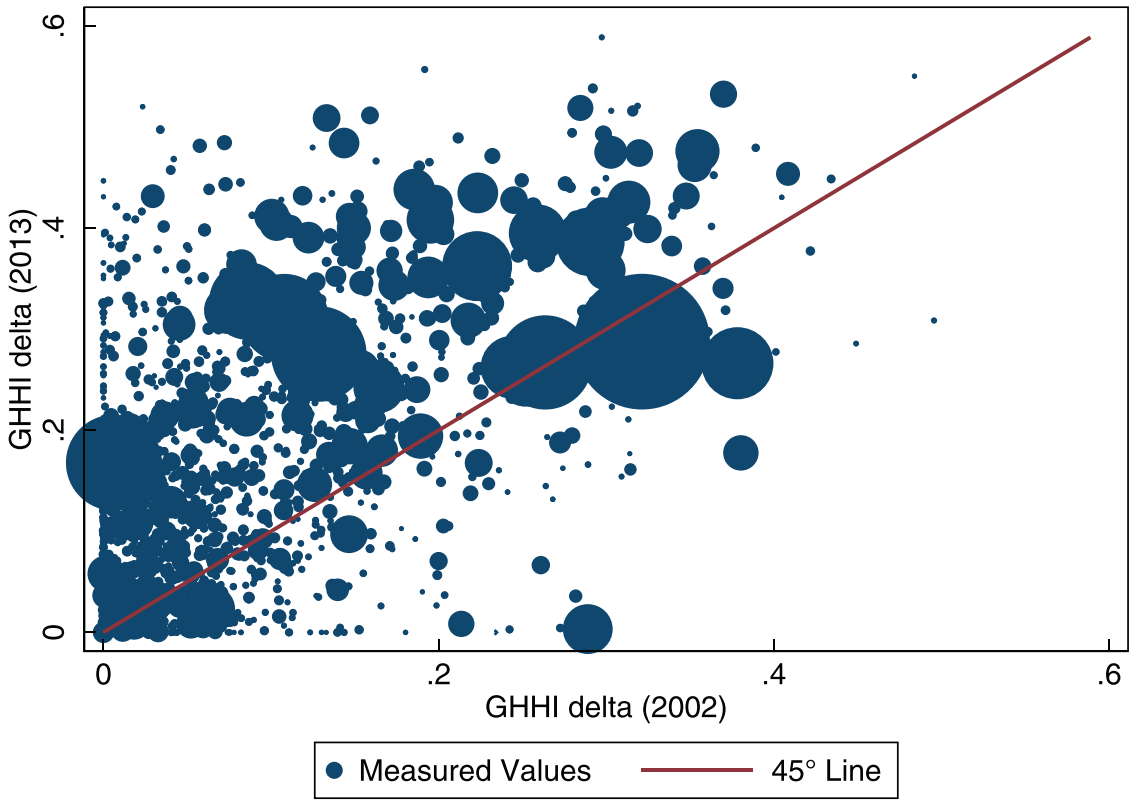


FIGURE 7 GHHI Delta County-Level Scatter, 2002–2013
[Color figure can be viewed at wileyonlinelibrary.com]
Note: This figure is a scatterplot of county-level GHHI deltas in 2013 against county-level GHHI deltas in 2002. The horizontal axis plots the GHHI delta of counties in 2002 and the vertical axis plots the GHHI delta of counties in 2013. The diagonal red line is a 45°, which is where all counties would lie if there was no change in GHHI delta from 2002 to 2013 in any county. Finally, the size of the plotted point signifies the total average amount of deposits in the county, with more deposits signified by a larger plotted point

An alternative interpretation of the tenuous link between prices and the HHI is that the regression model corresponding to Equation (2) does not fully reflect the economic forces shaping bank competition. We show below that making counterfactual assumptions about ownership leads to such a mismeasurement of economic forces, and leads to an omitted variable bias in the empirical implementation that can lead to a false negative in these regressions.

Specifically, one way in which the HHI model is inconsistent with factual reality is that it assumes that each bank is controlled by undiversified investors who do not own stakes in competitors. We have shown that assumption to be factually wrong in Table I Panel A. A generalized version of the HHI, the GHHI, can adjust the HHI model to reflect these realities.

Similar to the HHI, the GHHI can be derived from a Cournot game between competitors. Also, the assumption that the firm acts in its shareholders' interests is maintained, that is, does not change relative to the HHI model. The only difference is that the generalized approach does not restrict the competitors to have only undiversified controlling shareholders; instead, any shareholder structure is allowed. In particular, the GHHI allows for simultaneous common ownership and cross-ownership as well. This is an important generalization of existing concentration measures especially for measuring bank concentration. The reason is that many large banks have large asset management divisions, which are major owners of other banks. We explain this point in more detail below.

Allowing for general ownership structures implies that shareholder unanimity may fail. That is, the interests of investors with different portfolios may differ. An assumption has to be made how such conflicts are resolved. We follow O'Brien and Salop (2000) in assuming that each firm maximizes the weighted average of its shareholders economic interests. Denoting shareholder i's share of control rights in firm j as γ_{ij} and her share of cash flow rights in firm k as β_{ik}, firm j's objective function is assumed to be:

$$\max_{x_j} \Pi_j = \sum_{i=1}^{M} \gamma_{ij} \sum_{k=1}^{N} \beta_{ik} \pi_k, \tag{3}$$

where π_k are firm k's profits, β_{ik} is the ultimate financial interest of shareholder i in firm k, and γ_{ij} is the ultimate control share of shareholder i in firm j. Thus, $\sum \beta_{ik}\pi_k$ is shareholder i's portfolio profits.

That is, we assume that firms primarily focus on the economic incentives of those shareholders with the most control rights in the firm. The outcome is that the firm will put weight not only on its own profits but also on the profits of its competitors—to the extent that its most powerful shareholders also have stakes in those competitors. Indeed, the firm's objective function (3) is proportional to:

$$\pi_j + \sum_{k \neq j} \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}} \pi_k. \tag{4}$$

That is, under common ownership, firm j will not compete quite so hard with more commonly owned competitors as it does with competitors that are not part of firm j's largest owners' portfolios, because any increase in own profits would come at the expense of that commonly owned competitor; such a product market strategy would not be in the largest investors' interests. In other words, the assumption is that firms internalize the externalities that come from aggressive product market behavior that they impose on competitors, to an extent that is proportional to the degree to which these competitors are owned by their largest shareholders. Note that the maximization problem in the traditional HHI model is a special case of the one presented here.

If firms represent their (potentially diversified) investors' economic interests and compete à la Cournot, the prediction ensues that markups are proportional to the GHHI index,

$$\eta \sum_j s_j \frac{P - C_j'(x_j)}{P} = GHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{ij}\beta_{ik}}{\sum_i \gamma_{ij}\beta_{ij}}. \tag{5}$$

Note that privately owned firms impact GHHI through their effect on the denominator of the above formula.[17]

As a result, the same regressions as in the traditional literature can be run, with the only change that the HHI index is replaced with its generalized version, the GHHI. In particular, we can examine if changes of ownership and control (e.g., because of Berkshire Hathaway's acquisition of a multibillion dollar stake in Bank of America's cash flows in addition to the top ownership and control of Wells Fargo, or because of index fund growth) are related to price changes. The main empirical question this paper addresses is which one of these alternative indexes, the HHI or the GHHI, is better able to capture variation in prices of banking products.

4.2 | Ultimate ownership

A complication arises in the construction of the GHHI in the banking industry. Banks often have asset management divisions, which own substantial stakes in other banks. As a result, many banks are both competitors and nontrivial owners of other banks. In addition, "pure" asset management firms such as BlackRock or Vanguard typically own large stakes in several banks. Hence, the ownership structure combines cross-ownership and common ownership. Existing modified measures of market concentration, such as the MHHI by O'Brien and Salop (2000), cannot be applied directly to this situation. We use a more general index that solves for ultimate ownership, and can simultaneously account for general patterns in cross-ownership and common ownership.[18] We describe the construction of this general index of market concentration in Appendix A1. When ultimate ownership is the same as direct ownership (as is the case in the study of airline competition, Azar, Schmalz, & Tecu, 2018) the MHHI and the GHHI are the same.

4.3 | Empirical methodology: panel regressions

To examine the question whether the HHI or the GHHI better captures variation in prices of banking products, we start by examining simple correlations between the two concentration measures and banking prices. The panel regressions we run are of the form:

$$R_{ijbt} = \beta \cdot \text{Concentration Index}_{it} + \theta \cdot X_{it} + \xi \cdot Q_{bt} + \nu_j + \zeta_t + \varepsilon_{ijbt}, \tag{6}$$

where R_{ijbt} is an outcome variable (various fees, fee thresholds, and deposit interest rate spreads) assessed by branch j of bank b in county i in period t. Concentration Index_{it} is alternatively the HHI_{it} or GHHI_{it}. As controls X_{it}, we include market characteristics such as log median household income and log population. Q_{bt} is the market capitalization of each bank. ν_j and ζ_t are branch and year fixed effects, respectively. The motivation for market-level controls such as household income and population is to account for differences in the demand for deposit products across markets. Banks' market capitalization is included in regressions as a proxy for differences across banks in the level and changes over time in variable costs. We include branch fixed effects to capture differing levels of service, product offerings, and so forth that might otherwise bias our estimate of β. In our regressions, we estimate the coefficient β not from cross-sectional variation across markets alone, but from changes over time in the cross-sectional differences between markets. We run our panel regressions on all branches in RateWatch from 2003 to 2013 and cluster standard errors at the county level as there may be a shared component in the variation of data across branches in a given county.[19]

[17] This makes sense as HHI, a special case of GHHI, assumes all firms are wholly owned by undiversified investors.

[18] Although cross-ownership in the banking industry is a phenomenon that we address in our construction of GHHI, it does not have much impact on our empirical results.

[19] We do not two-way cluster our standard errors using counties and years because our panel is not long enough to justify clustering errors within years.

4.4 | Empirical hypotheses

The key question we examine in the following section is whether the HHI or the GHHI are more robustly linked to various prices of banking deposit products. Because the only difference between the HHI and the GHHI is taking ownership structures into account, this question can be restated equivalently as whether ownership of banks matters empirically in important ways or not.

There are several reasons why the anticompetitive incentives arising from common- and cross-ownership might not get implemented: for example, agency conflicts between shareholders and management, informational frictions, or fear of antitrust backlash on behalf of the investors. Corresponding to the idea that these frictions overwhelm any anticompetitive incentives from overlapping ownership, our null hypothesis is that partial ownership links are irrelevant for economic outcomes. In that case, the HHI and the GHHI should be equally effective at capturing variation in prices. (Recall that the HHI is the special case of the GHHI in which common ownership links are irrelevant.)

H0: The HHI and the GHHI are equally effective at capturing variation in prices.

On the other hand, if firms (here: banks) indeed act in their most important shareholders' economic interests, that is, if economic incentives matter for economic outcomes, the following alternative hypothesis should find support in the data.

H1: The GHHI is a better predictor of prices of banking products than the HHI.

Formally, an important reason for the prediction that the GHHI is a stronger predictor of prices than the HHI is a classic omitted variable problem. The HHI and the difference between the GHHI and the HHI, called GHHI delta, are negatively correlated. The reason is that deposit markets such as New York City or many areas of California feature a large number of banks (low HHI), but many of them are commonly owned to a large degree (high GHHI delta), whereas banking markets in the midwest often feature only a small number of banks (high HHI), but these banks tend to be independently owned. (HHI-based merger regulation can contribute to generating this pattern.) Whatever the cause for the negative correlation, omitting the GHHI delta from the standard HHI regression (as specified in Equation 6) hence leads to a downward bias of the coefficient on the HHI, $E[\hat{\beta}_{HHI} \mid X] = \beta_{HHI} + (X'X)^{-1}X'(\beta_{\text{GHHI delta}} \cdot \text{GHHI delta})$.

This section only laid out the basic research design using panel regressions. We describe our strategies that examine causality in Sections 6 and 8 for our IV and DiD designs.

5 | PANEL REGRESSION RESULTS

In our panel regressions, we compare the relationship between changes in deposit product prices and changes in the two alternative market concentration measures defined in Section 4: the HHI and the GHHI. As dependent variables, we consider fees, fee thresholds, and the (within-year) percentile ranking of interest rate spread margins.

We measure interest rate spreads as the difference between the 10-year Treasury Constant Maturity rate and each interest rate, expressed as a percent of the 10-year treasury yield.[20] The reason for calculating percentage spreads is that we try to proxy for margins, as given in Equations (2) and (5). Relatedly, the reason we look at percentile rankings is to avoid the "accordion" econometric problem explained in Section 3. In addition, it allows us to, effectively, score or rank banks within year and less sensitive to outliers within each year.

Overall, we find that the relationship between concentration and fee amounts and thresholds is much stronger and more robust when concentration is measured using the GHHI. Similarly, a GHHI-based estimation of the relationship between concentration and CD rate spreads is a lot more effective than an HHI-based estimation. The sensitivity of rate spreads to changes in concentration is insignificant for both the HHI and the GHHI only for checking account accounts, for which banks charge higher fees and thresholds when concentration is higher. However, this nonresult

[20] The results are similar when we use 1-year primary mortgage average rates from Freddie Mac to calculate spread margins. Aside from 10- and 1-year loan rates for normalization, we ran specifications using raw average rates, also with similar results.

could also be due to the "accordion" econometric problem explained above. Generally, we find a positive and, at times, statistically significant relationship between within-year rate spread percentiles and the GHHI, suggesting that banks also adjust rates to concentration (but perhaps not as much as fees).

We now turn to a detailed discussion of the results. In Table 3, Panal A, we regress within-year CD interest rate spread margin percentiles on banking sector concentration for CDs with 12-, 24-, and 36-month maturities. The HHI has a small, positive, and statistically insignificant correlation with interest rate spreads for all three types of CDs, as shown in columns (1), (3), and (5). By contrast, we see in columns (2), (4), and (6) that the GHHI consistently has a four- to eightfold larger correlation with rate spreads that is highly statistically significant for all three types of CDs. In terms of economic magnitudes, a one-standard deviation increase in the GHHI is associated with a 2.9 percentile point higher ranking in 12-month CD rate spreads, a 3.4 percentile point higher ranking in 24-month CD rate spreads, and a 3.5 percentile point higher ranking in 36-month CD rate spreads for the average branch. Note, however, that these are equilibrium correlations rather than causal effects (which we discuss in later sections).

In Table 3, Panel B, we present the results of regressions with the prices of money market accounts as the dependent variables. Columns (1) and (2) present maintenance fee amount regressions against the HHI and the GHHI, respectively. Columns (3) and (4) present maintenance fee threshold regressions. Columns (5) and (6) present interest rate spread margin percentile regressions. In columns (1), (3), and (5), we observe that concentration measured by the HHI has basically no statistically significant correlation with money market account prices: there is a small, marginally statistically significant relationship of the HHI with maintenance fees but all the other prices are not correlated with the HHI at all (if anything, the other prices are negatively correlated with the HHI). On the other hand, in columns (2), (4), and (6), we see that GHHI-based concentration shows a highly statistically significant, positive correlation with fee amounts, fee thresholds, and rate spreads. To get a sense of the economic magnitude of the coefficients, note that a one-standard deviation increase in the GHHI is associated with a $0.21 increase in maintenance fees (a 2.1% increase), a $230 increase in maintenance fee thresholds (a 7.9% increase), and a 1.6 percentile point higher ranking for the average branch's money market account.

Finally, Table 3, Panel C, shows the results of regressing interest-bearing checking account maintenance fee amount, maintenance fee threshold, and interest rate spread on banking sector concentration. First, examining fee amounts (column (1)) and thresholds (column (3)) we find that the HHI has no statistically significant correlation with fee amounts and thresholds. However, when we measure concentration using the GHHI (columns (2) and (4), respectively), we see a large, highly statistically significant, positive correlation of concentration with both dependent variables. For interest rate spreads, we find in column (5), that the HHI has, against the standard HHI model's prediction, a highly statistically significant *negative* relationship with interest rate spread margin percentiles.[21] On the other hand, the GHHI has a positive but statistically insignificant relationship with rate spreads (column (6)). Again, looking at economic magnitudes of these correlations, we find that a one-standard deviation increase in the GHHI is associated with a $0.56 increase in maintenance fees (a 4.6% increase) and a $408 increase in maintenance fee thresholds (a 9.5% increase) for the average branch's interest-bearing checking account.

To summarize, the panel regressions provide supportive evidence for the hypothesis that banking concentration as measured by the GHHI more robustly explains the variation in prices of banking products than the HHI.[22] This is true for maintenance fees, maintenance fee thresholds, and CD and money market account interest rate spreads as outcome variables. There does not seem to be a significant association between the GHHI and interest checking rate spreads. On the other hand, the HHI as a measure of concentration shows inconsistent statistical significance and inconsistent signs of the regression coefficient. Overall, the results reject the null hypothesis that the HHI and the GHHI are equally effective, and support the alternative hypothesis that the GHHI is more effective.

[21] Two potential explanations exist for this "wrong" sign for HHI. First, it could be that regulators monitor and regulate competition on the basis of HHI. Second, as we point out in Section 3, there is a highly significant negative correlation between HHI and GHHI delta which may help explain this "wrong" sign.

[22] The R^2 for HHI versus GHHI regressions does not seem to differ in our tables because the covariates and fixed effects differentially absorb the variation remaining in our banking product prices, masking any difference in explanatory power. In unreported regressions where we first regress prices on covariates and fixed effects only and then regress the residuals from this first-stage regression, we find that the R^2s for residual regressions against the GHHI are higher than for residual regressions against the HHI.

TABLE 3 Panel regressions of deposit prices on HHI and GHHI

	12-Month CD spread (Percentile)		24-Month CD spread (Percentile)		36-Month CD spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
HHI	4.822		5.115		3.526	
	(5.257)		(4.046)		(3.973)	
GHHI		19.44***		22.75***		23.49***
		(3.577)		(3.548)		(3.520)
Log Income	−27.27***	−24.53***	−16.28***	−13.13***	−12.35**	−9.140*
	(3.556)	(3.498)	(4.360)	(4.300)	(5.220)	(5.141)
Log Population	21.73***	20.48***	23.25***	21.85***	21.30***	19.85***
	(4.331)	(4.168)	(5.446)	(5.164)	(6.244)	(5.931)
Log(1+Market Cap)	0.266***	0.235***	0.368***	0.332***	0.414***	0.376***
	(0.0226)	(0.0228)	(0.0238)	(0.0215)	(0.0310)	(0.0274)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	947,052	947,052	927,727	927,727	902,540	902,540
R^2	0.672	0.673	0.659	0.660	0.670	0.672
	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
HHI	0.842*		−118.4		−1.945	
	(0.479)		(746.5)		(3.463)	
GHHI		1.418***		1,554***		10.76***
		(0.354)		(495.9)		(3.495)
Log income	−1.576***	−1.303***	−1, 294**	−1, 016*	−13.30***	−11.83***
	(0.530)	(0.504)	(611.8)	(586.4)	(3.925)	(3.662)
Log population	−0.718	−0.803	2,509***	2,439***	−4.800	−5.357
	(0.610)	(0.600)	(804.9)	(783.1)	(4.586)	(4.423)
Log(1+Market cap)	0.0313***	0.0292***	45.28***	42.88***	0.339***	0.321***
	(0.00360)	(0.00370)	(4.505)	(4.457)	(0.0236)	(0.0233)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	533,815	533,815	488,666	488,666	911,361	911,361
R^2	0.795	0.795	0.529	0.530	0.655	0.655
	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
HHI	1.148		492.8		−7.058***	
	(0.961)		(858.3)		(2.631)	
GHHI		3.797***		2758***		1.590
		(0.712)		(685.2)		(3.475)

(Continues)

TABLE 3 (Continued)

	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
Log income	−6.565***	−5.880***	−2168**	−1656*	−12.64***	−12.52***
	(0.932)	(0.958)	(892.2)	(904.1)	(3.822)	(3.664)
Log population	6.286***	6.116***	9024***	8884***	−23.99***	−24.00***
	(1.553)	(1.470)	(1,365)	(1,363)	(4.493)	(4.559)
Log(1+Market cap)	0.0242***	0.0181***	36.90***	32.53***	0.327***	0.324***
	(0.00711)	(0.00645)	(6.316)	(6.365)	(0.0207)	(0.0185)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	532,634	532,634	490,230	490,230	913,328	913,328
R^2	0.704	0.705	0.582	0.583	0.752	0.752

Panel A: Panel regressions of time deposit spread percentiles on HHI and GHHI, respectively. *Note*: This table shows the effect of market concentration measures on time deposit spread percentiles with 12-, 24-, and 36-month maturities. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel B: Panel regressions of money market account maintenance fees, thresholds, and spreads on HHI and GHHI, respectively. *Note*: This table shows the effect of market concentration measures on money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel C: Panel regressions of interest checking account maintenance fees, thresholds, and spreads on HHI and GHHI, respectively. *Note*: This table shows the effect of market concentration measures on interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

While many potentially omitted variables are differenced out already in the results presented above, reverse causality remains a potential concern. The results so far leave open the possibility that investors predict banks' profit margins, buy more stock in those banks, and thus generate the link between the GHHI and prices we documented above. To examine if that is indeed the main driver of the results, in the following two sections, we use variation in the GHHI from "passive" index funds' ownership alone and thus address the question whether there is a causal link between the GHHI and prices.

6 | IVs RESULTS USING INDEX FUND OWNERSHIP

Thus far, we have documented new facts about variation in fees, fee thresholds, and interest rates across markets and over time, and have shown the variation in fees and fee thresholds to correlate far more strongly and reliably with the GHHI than with the HHI. The GHHI also correlates strongly with CD and money market account rates; the HHI does

not. The difference between the HHI and the GHHI is common ownership concentration. This section addresses the question of whether the association between concentration and prices is driven solely by the endogenous investment choices of active fund managers. We use variation in prices correlated with changes in ownership of passive investors such as index funds to dispel concerns about the causal effect of concentration on banking product prices.

6.1 | Using index fund ownership for variation in common ownership and market concentration (GHHI)

To address the question of whether "passive" ownership of banks is related to higher prices of banking products at the branch level, we use variation in index fund ownership of banks. The idea for this research design is as follows. First, index funds' ownership changes are not driven by fund managers predicting temporary changes in margins in some banking markets versus others. As a result, reverse causality stemming from active fund managers' investment strategies that could be related to branch-level prices should not be a concern for the results we obtain using this strategy.[23]

Index fund ownership can cause cross-sectional differences in the GHHI as follows. Some banks are part of stock indices. Index funds' ownership of these banks grows when the overall fund size grows. Index funds grow when people invest their savings in index funds or when the value of their aggregate holdings goes up. Neither depends on the performance or pricing decisions of an individual bank, let alone bank branch. Hence, to a first order, index fund growth is exogenous to pricing decisions. But how does this cause cross-sectional shocks? Not all banks are part of an index—indeed, there are many privately owned, not publicly traded, banks in our sample. Those banks' ownership structure does not change when index funds grow. And some geographical areas have more banks that are part of an index than others to start with. Index fund growth thus affects the ownership structure of banks, and thus the GHHI, differentially in markets in which all players are publicly traded banks that are part of an index than in markets mainly comprised of privately owned banks or of publicly traded banks that are not part of major stock indices. Employing variation in the GHHI arising from changes in index fund ownership of banks in each market is the basic idea of our IV regression analysis.

6.2 | Implementation

The IV regression analysis we implement is based on the specification presented in Equation (6). The difference is that we instrument the variation in the GHHI using index fund ownership of banks in each market, which we measure as:

$$\text{Index Fund Ownership}_{it} = \sum_j s_{ijt} \times \text{Pct. Owned by Top Index Funds}_{jt}, \tag{7}$$

where s_{ijt} is the share of deposits in county i owned by bank j in period t and Pct. Owned by Top Index Funds$_{jt}$ is the percent of bank j owned by top index funds in period t. We define top index funds as five index fund groups and ETFs: iShares (currently part of BlackRock, previously managed by Barclays Global Investors), Vanguard's index funds, SPDR (managed by State Street Global Advisers), Invesco's PowerShares, and Fidelity's Spartan index funds.

[23] The reason that despite index funds' "passive" portfolio choice, they nevertheless can have a substantial impact on firm policies is that funds typically make their voting rights available to their fund family's central proxy voting office. These offices also engage with their portfolio firms with the aim of increasing the value of their portfolio firms. (Fund families' revenues are typically a fraction of assets under management. Assets under management grow when the firms in the portfolio become more valuable. Firms become more valuable when their profits increase.) In that sense, there is no difference between the anticompetitive threats from common ownership of index funds or from common ownership of Berkshire Hathaway, Warren Buffett's investment firm. See Azar, Schmalz, and Tecu (2018) for a more comprehensive discussion.

We use variation in the county-level index fund ownership measure described above to generate "exogenous" variation in the GHHI. The first stage of our IV regression is as follows:

$$GHHI_{ijbt} = \gamma \cdot \text{Index Fund Ownership}_{it} + \Theta \cdot X_{it} + \xi \cdot Q_{bt} + \eta_j + \phi_t + \psi_{ijbt}, \quad (8)$$

where controls X_{it} and Q_{bt} are defined as in Equation (6), η_j is a branch fixed effect, and ϕ_t is a year fixed effect. The second stage of our IV regression is identical to Equation (6) with variation in our GHHI concentration index instrumented by index fund ownership from our first stage. We implement our IV analysis on a sample of all bank branches in RateWatch from 2003 to 2013, clustering errors at the county level.

6.3 | Results

We implement our IV regression on prices for all three types of deposit products explored in Section 5: interest rate spread margin percentiles for 12-, 24-, and 36-month CDs and maintenance fee amounts, maintenance fee thresholds, and interest rate spread margin percentiles for money market accounts and interest-bearing checking accounts. We present results for regressions where we examine the direct correlation between prices and index fund ownership and the correlation between prices and the GHHI instrumented by index fund ownership. The results indicate that increases in concentration due to index fund ownership are indeed robustly linked to higher prices of all of these banking products.

Before presenting IV regression results, we should note that the first stage of the IV analyses for all explored depository prices show a large and highly statistically significant positive relationship between the GHHI and Index Fund Ownership, with *t*-statistics around 20 in all cases. The results of all the first-stage regressions can be found in the panels of Table A1.

For CD interest rate spreads, we find clear evidence that increases in common ownership due to index fund ownership are linked to higher interest rate spreads. In Table 4, Panel B, we present this evidence. Columns (1), (3), and (5) show that index fund ownership is positively, strongly, and highly statistically significantly correlated with rate spread margin percentiles for 12-, 24-, and 36-month CD rate spreads. In columns (2), (4), and (6), we present results for the second stage of our IV regression and find that the GHHI instrumented by index fund ownership has a positive and highly statistically significant effect on the within-year percentiles of rate spread margins for CDs of all three maturities.

Interpreting the GHHI results causally, we estimate that a one-standard deviation increase in the GHHI due to changes in common ownership causes a 5.7 percentile point higher ranking in 12-month CD rate spreads, an 8.0 percentile point higher ranking in 24-month CD rate spreads, and an 8.5 percentile point higher ranking in 36-month CD rate spreads. These results imply that common ownership has economically large effects as we see that concentration changes due common ownership substantially alter the relative location of branches within the CD rate spread distribution.

The IV regression results of Table 4, Panel B, show that common ownership due to index fund ownership has a positive and highly significant effect on prices for money market accounts. In particular, columns (1), (3), and (5) show that index fund ownership is positively and highly statistically significantly correlated with fee amounts, fee thresholds, and within-year rate spread margin percentiles. The IV results confirm these findings. In columns (2) and (4), we see that the GHHI instrumented by index fund ownership has a positive and highly statistically significant effect on maintenance fee amounts and thresholds of money market accounts. Column (6) shows that rate spread margin percentiles are positively affected by the GHHI instrumented by index fund ownership as well and the effect is highly statistically significant. Interpreting the IV results causally, we estimate that a one-standard deviation increase in the GHHI causes an increase of $0.31 in fees (a 3.2% increase), an increase of $490 in thresholds (a 16.9% increase), and a 2.4 percentile point higher ranking in rate spreads for money market accounts. From 2003 to 2013, fees and thresholds for money

TABLE 4 Panel regressions of deposit prices on index fund ownership and panel IV regressions instrumenting GHHI with index fund ownership

	12-Month CD spread (Percentile)		24-Month CD spread (Percentile)		36-Month CD spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
Index fund ownership	1.830***		2.567***		2.761***	
	(0.204)		(0.239)		(0.237)	
GHHI		38.77***		54.15***		57.72***
		(4.196)		(4.884)		(5.031)
Log Income	−24.22***	−22.54***	−11.53***	−9.191**	−7.706	−5.113
	(3.174)	(3.624)	(3.888)	(4.437)	(4.821)	(5.123)
Log Population	17.00***	19.35***	16.93***	20.18***	15.10***	18.45***
	(4.021)	(4.255)	(4.970)	(5.224)	(5.685)	(5.867)
Log(1+Market Cap)	0.228***	0.202***	0.312***	0.276***	0.354***	0.316***
	(0.0226)	(0.0226)	(0.0223)	(0.0213)	(0.0283)	(0.0262)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	947,052	947,052	927,727	927,727	902,540	902,540
R^2	0.674	0.672	0.662	0.658	0.672	0.667
	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
Index Fund Ownership	0.111***		178.5***		0.765***	
	(0.0303)		(42.03)		(0.236)	
GHHI		2.101***		3,313***		16.20***
		(0.555)		(771.7)		(4.814)
Log Income	−1.345**	−1.178**	−953.5	−699.6	−12.36***	−11.65***
	(0.524)	(0.496)	(604.7)	(606.0)	(3.573)	(3.511)
Log Population	−0.905	−0.829	2,271***	2,355***	−7.090	−6.076
	(0.626)	(0.596)	(782.0)	(764.0)	(4.521)	(4.274)
Log(1+Market Cap)	0.0295***	0.0281***	42.40***	40.17***	0.317***	0.306***
	(0.00371)	(0.00380)	(4.539)	(4.502)	(0.0237)	(0.0243)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	533,815	533,815	488,666	488,666	911,361	911,361
R^2	0.795	0.795	0.530	0.529	0.655	0.655
	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
Index Fund Ownership	0.480***		258.2***		0.359	
	(0.0644)		(67.51)		(0.223)	

(Continues)

TABLE 4 (Continued)

	Maintenance fee		Maintenance fee threshold		Spread (Percentile)	
	(1)	(2)	(3)	(4)	(5)	(6)
GHHI		8.972***		4,858***		7.592
		(1.186)		(1,270)		(4.738)
Log Income	−5.653***	−4.970***	−1, 672*	−1,272	−13.50***	−13.18***
	(0.952)	(1.015)	(923.0)	(1,025)	(3.669)	(3.695)
Log Population	5.565***	5.952***	8,618***	8,793***	−26.58***	−26.13***
	(1.486)	(1.427)	(1,386)	(1,396)	(4.821)	(4.695)
Log(1+Market Cap)	0.0160**	0.00965	32.55***	29.16***	0.303***	0.298***
	(0.00692)	(0.00651)	(6.204)	(6.053)	(0.0196)	(0.0193)
Year FE	✓	✓	✓	✓	✓	✓
Branch FE	✓	✓	✓	✓	✓	✓
Observations	532,634	532,634	490,230	490,230	913,328	913,328
R^2	0.705	0.703	0.583	0.582	0.753	0.753

Panel A: Panel regressions of time deposit spread percentiles on index fund ownership and panel IV regressions instrumenting GHHI with index fund ownership. *Note*: This table shows the effect of index fund ownership, and the effect of the GHHI instrumented with index fund ownership, on time deposit spread percentiles with 12-, 24-, and 36-month maturities. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
Panel B: Panel regressions of money market account maintenance fees, thresholds, and spreads on index fund ownership and panel IV regressions instrumenting GHHI with index fund ownership. *Note*: This table shows the effect of index fund ownership, and the effect of the GHHI instrumented with index fund ownership, on money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.
Panel C: Panel regressions of interest checking account maintenance fees, thresholds, and spreads on index fund ownership and panel IV regressions instrumenting GHHI with index fund ownership. *Note*: This table shows the effect of index fund ownership, and the effect of the GHHI instrumented with index fund ownership, on interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

market accounts grew by $3.15 and $1960, respectively. The effect of a one-standard deviation increase in the GHHI is comparable to 10% of the overall growth of fees and 25% of the overall growth of thresholds in that period, which suggests that these GHHI effects have relatively large economic magnitude. The percentile change in rate spreads is also substantial, suggesting that the GHHI effects for interest rates are similarly important.

We find that the GHHI has a positive and highly significant effect on fees and thresholds for interest-bearing checking accounts but not on the interest rate spreads for the accounts. Table 4, Panel C, presents the results for interest-bearing checking account prices. Columns (1) and (3) show that index fund ownership is positively and highly statistically significantly correlated with fee amounts and thresholds for interest checking. Column (5) shows that rate spread margin percentiles are positively, but statistically insignificantly, correlated with index fund ownership. IV results

bear out these reduced-form findings. Columns (2) and (4) show positive, highly statistically significant effects of the instrumented GHHI on maintenance fee amounts and thresholds for interest checking accounts. Column (6) shows a positive, but statistically insignificant, effect of the instrumented GHHI on money market rate spread margin percentiles. We estimate that a one-standard deviation increase in the GHHI due to changes in common ownership leads to an increase of $1.33 in fees (an 11% increase) and an increase of $719 in thresholds (a 16.8% increase). From 2003 to 2013, fees and thresholds for interest-bearing checking accounts grew by $6.64 and $4100, respectively. Again, this suggests that the GHHI effects we observe on fees are economically large: the effect of a one-standard deviation increase in the GHHI is comparable to 20% of the growth in fees and 17% of the growth in thresholds for interest-bearing accounts in that period.

In comparing OLS results presented in Section 5 and IV regression results presented here, we see that the IV coefficients are generally much larger in magnitude. This phenomenon presents in other papers in this literature, as well (e.g., Azar, Schmalz, & Tecu, 2018; Backus, Conlon, & Sinkinson, 2018). However, there may exist a negative bias in panel (OLS) regressions where firm ownership is endogenous. This is because, if active investors pick firms and become large shareholders in a firm, that firm will have greater pricing power, which would drive down overall GHHI delta and introduce a negative bias in panel (OLS) regressions. By instrumenting GHHI delta by index fund ownership in this section, we reduce this source of endogeneity.

6.4 | Remaining identification challenges

The panel IV identification strategy is of course not perfect. Its merits are that using index fund ownership variation eliminates the reverse causality concern that active fund managers' holdings decisions are endogenous to branch-level variation in prices as we simply do not use that variation here. However, a challenge is that market-level variation in concentration stemming from changes in "passive" ownership does not only come from the aggregate growth of index funds, but could also stem from the inclusion and exclusion of banks in indices, as well as from entry and exit of banks with different levels of index ownership concentration into and out of a particular banking market. To illustrate why that is a concern, consider that the inclusion of a bank in an index could be endogenous to market-level outcomes. This observation does not challenge the primary motivation, which is showing that the variation in ownership from index fund growth is related to prices, but it puts limits on a causal interpretation of the results. In sum, the strategy employed in this section removes endogeneity concerns present in the panel regression design, but not all of them. We therefore offer DiD analyses in the following section that avoids this concern.

Before we turn to the DiD analyses, let us examine the likely importance of the concern with the IV. To do so, we compare the baseline IV results with specifications in which the instrument is lagged by 1 year. The idea is that predicting the future is harder for longer-term predictions. Hence, the reverse causality concern should be attenuated when lagging the instrument. That is, the coefficients should be smaller on a lagged instrument if reverse causality due to index inclusions is the key driver behind our results. Contrary to that prediction, we find that, in general, coefficients are *higher* when the instrument is lagged. We conclude that reverse causality is less likely to be the driver of the baseline results (but, again, not impossible).

To summarize, across all the deposit products discussed, we find evidence of a robust relationship between increased common ownership and higher prices. We now offer DiD analyses that use different sources of variation from the IV and thus mitigate the endogeneity concerns pointed out above.

7 | PANEL AND IV REGRESSIONS WITH EQUAL MARKET SHARES

The previous sections provided evidence from panel and IV regressions to inform the question whether common ownership is likely to cause higher prices in some U.S. banking markets. The focus of the IV was to investigate the likely

effect of potentially endogenous ownership on the estimates. However, the measure of ultimate ownership we use features not only ownership but also market shares, which could be endogenous as well (whereas the simplest economically meaningful story would be that market shares are lower when common ownership is higher and thus prices are higher).

This section investigates the role of potentially endogenous market shares on the GHHI-estimates from the panel regressions and IV regressions presented above. Specifically in Table 5, we tabulate panel regressions similar to those presented in Section 5, whereas the true market share for each bank is replaced by a counterfactual market share, calculated as the equal-weighted average market share for each bank in the product market in each period.

We find that, with the exception of money market account prices, the coefficients for this modified GHHI are generally similar to those for the GHHI that uses true market shares. More specifically, money market prices seem to be uncorrelated with the modified GHHI. In the same tables, we also present results of IV regressions where we instrument actual GHHI with GHHI calculated using these equal market shares. Again, excepting money market account prices (which seem uncorrelated with the instrumented GHHI measure), we find that coefficients for the instrumented GHHI in these regressions are similar to those for actual GHHI in our panel regressions.

We conclude that the previously presented panel and IV results are unlikely to be solely driven by endogenous market shares.

8 | DiD RESULTS

In this section, we present our DiD analyses. These analyses help mitigate reverse causality concerns that are not fully addressed by the IV regressions presented in Section 6. We show that one can predict price changes for deposit products a decade into the future, using only cross-sectional information about banks' market shares, ownership, and current price levels. Specifically, index ownership of a county's banks in 2003 predicts how much index ownership in a county increases until 2013, which predicts how much deposit prices change from 2004 to 2013.

8.1 | Implementation

Our DiD analysis takes as given the cross-section of counties and their characteristics in 2003. This information is useful to predict the cross-section of deposit price changes over the next decade. In other words, we compare the difference in the change in deposit product prices from 2004 and 2013 between bank branches in treatment and control counties, where treatment is determined by index fund ownership terciles in 2003. The regression specification for these analyses is:

$$\Delta R_{ijb2004-2013} = \beta \cdot \mathbb{1}\left(\text{Index Fund Ownership Tercile}_{i2003} = 1\right) + \gamma \cdot R_{ijb2004} + \Theta \cdot X_{i2004} + \xi \cdot Q_{b2004} + \varepsilon_{ijb},$$
$$\forall\, i \text{ s.t. Index Fund Ownership Tercile}_{i2003} \in \{1, 3\}, \tag{9}$$

where $\Delta R_{ijb2004-2013}$ is the change in an outcome variable for branch j of bank b in county i between 2004 and 2013, Index Fund Ownership Tercile$_{i2003}$ is an indicator for the tercile to which county i belongs, based on index fund ownership in 2003, $R_{ijb2004}$ is the outcome variable value for branch j of bank b in county i in 2004, X_{i2004} is a vector of market-level controls (median county income, county population) in 2004, and Q_{b2004} is 2004 market capitalization for bank b. The 2004 market-level controls are included to control for the potential effect of local demand for deposit products on subsequent product price growth and index fund ownership growth. The obvious remaining concern is that treatment may not be exogenous even conditional on these controls because (i) the size of the bank holding company corresponding to branch j may be related to changes in cost of capital or other variable costs between 2003 and

TABLE 5 Panel and IV regressions of deposit prices on GHHI, equal market shares

	12-month CD			24-month CD			36-month CD		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GHHI, eq mkt shares	10.44***			15.81***			14.25***		
	(3.735)			(3.941)			(4.097)		
GHHI		19.35***	12.53***		22.72***	18.99***		23.30***	17.18***
		(3.590)	(4.362)		(3.598)	(4.586)		(3.578)	(4.771)
Log Income	−28.04***	−25.73***	−26.67***	−16.45***	−13.90***	−14.40***	−13.20**	−10.53**	−11.35**
	(3.556)	(3.472)	(3.582)	(4.361)	(4.306)	(4.306)	(5.197)	(5.129)	(5.067)
Log Population	22.07***	20.64***	21.05***	23.14***	21.42***	21.63***	21.47***	19.73***	20.10***
	(4.394)	(4.187)	(4.150)	(5.555)	(5.225)	(5.156)	(6.315)	(5.951)	(5.881)
Log Bank Mkt Cap	0.262***	0.234***	0.245***	0.353***	0.323***	0.329***	0.401***	0.369***	0.378***
	(0.0226)	(0.0226)	(0.0238)	(0.0241)	(0.0214)	(0.0243)	(0.0311)	(0.0272)	(0.0307)
Branch FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regression	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Obs.	945,936	945,936	945,936	927,639	927,639	927,639	901,345	901,345	901,345
R^2	0.672	0.673	0.0136	0.658	0.660	0.0158	0.670	0.671	0.0180
	Maintenance fees			**Fee thresholds**			**Spread percentiles**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GHHI, eq mkt shares	0.420			−930.5			−1.081		
	(0.534)			(707.4)			(3.657)		
GHHI		1.668***	0.539		1559.0***	−1208.4		10.52***	−1.305
		(0.366)	(0.674)		(484.4)	(952.5)		(3.449)	(4.429)
Log Income	−1.616***	−1.322***	−1.528***	−1236.6**	−933.9	−1429.2**	−14.27***	−12.78***	−14.42***
	(0.499)	(0.460)	(0.532)	(609.6)	(579.6)	(708.3)	(3.978)	(3.701)	(4.096)
Log Population	−0.00886	−0.0831	−0.0416	2697.0***	2650.0***	2781.5***	−5.148	−5.686	−5.051
	(0.592)	(0.564)	(0.575)	(812.1)	(796.3)	(845.9)	(4.630)	(4.472)	(4.654)
Log Bank Mkt Cap	0.0308***	0.0283***	0.0300***	42.58***	39.93***	44.19***	0.331***	0.314***	0.333***
	(0.00389)	(0.00392)	(0.00419)	(4.584)	(4.465)	(5.311)	(0.0236)	(0.0231)	(0.0253)
Branch FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regression	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Obs.	533,815	533,815	533,815	488,666	488,666	488,666	911,065	911,065	911,065
R^2	0.792	0.792	0.00633	0.525	0.525	0.00752	0.653	0.654	0.00696
	Maintenance fees			**Fee thresholds**			**Spread percentiles**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GHHI, eq mkt shares	1.772*			7352.6***			−3.272		

(Continues)

TABLE 5 (Continued)

	Maintenance fees			Fee thresholds			Spread percentiles		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	(1.071)			(1071.7)			(3.177)		
GHHI		3.962***	2.284*		2952.3***	9616.8***		0.315	−3.948
		(0.685)	(1.343)		(658.1)	(1383.1)		(3.549)	(3.859)
Log Income	−6.753***	−6.103***	−6.396***	−2212.1**	−1850.7**	−641.9	−15.66***	−15.51***	−16.08***
	(0.889)	(0.900)	(0.896)	(874.7)	(885.3)	(1032.6)	(4.011)	(3.859)	(4.122)
Log Population	7.181***	7.008***	7.061***	9005.7***	8681.9***	8392.2***	−24.53***	−24.47***	−24.20***
	(1.542)	(1.431)	(1.451)	(1322.8)	(1305.4)	(1424.8)	(4.767)	(4.823)	(4.703)
Log Bank Mkt Cap	0.0233***	0.0174***	0.0201***	37.06***	34.38***	23.73***	0.305***	0.303***	0.310***
	(0.00700)	(0.00617)	(0.00761)	(6.285)	(6.052)	(6.378)	(0.0214)	(0.0190)	(0.0231)
Branch FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regression	OLS	OLS	2SLS	OLS	OLS	2SLS	OLS	OLS	2SLS
Obs.	532,634	532,634	532,634	490,230	490,230	490,230	913,219	913,219	913,219
R^2	0.720	0.721	0.0115	0.587	0.586	−0.000508	0.746	0.746	0.0110

Panel A: Panel and IV regressions of time deposit spread percentiles on GHHI, considering equal market shares. *Note*: This table shows the effect of market concentration measures on time deposit spread percentiles with 12-, 24-, and 36-month maturities. The first column for each deposit product uses GHHI assuming equal market share for each bank in a product market as the concentration measure. The second column for each deposit product uses GHHI as defined in Equation (5). The third column instruments GHHI instrumented by GHHI assuming equal market shares. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel B: Panel regressions of money market account maintenance fees, thresholds, and spreads GHHI, considering equal market shares. *Note*: This table shows the effect of market concentration measures on money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. The first column for each product price uses GHHI assuming equal market share for each bank in a product market as the concentration measure. The second column uses GHHI as defined in Equation (5). The third column instruments GHHI instrumented by GHHI assuming equal market shares. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel C: Panel regressions of interest checking account maintenance fees, thresholds, and spreads GHHI, considering equal market shares. *Note*: This table shows the effect of market concentration measures on interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. The first column for each product price uses GHHI assuming equal market share for each bank in a product market as the concentration measure. The second column uses GHHI as defined in Equation (5). The third column instruments GHHI instrumented by GHHI assuming equal market shares. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch from the period 2003 to 2013. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

2013, and/or (ii) larger banks may be smarter in market selection and be invested in higher-growth markets in 2003, combined with the fact that larger banks are more likely to be included in index funds. To control for this potential mechanism, we include Q_{b2004}, the banks' market capitalization in 2004, as well. Of course, this strategy does not *rule out* all potential endogeneity concerns, but it mitigates the most obvious ones.

Note that we only include branches in top and bottom tercile counties in this analysis, with top tercile counties forming our treatment group and bottom tercile counties forming our control group. Bank branches in counties for which we do not possess index fund ownership data are included as control branches. Our standard errors for these regressions are clustered at the county level and we run the regressions on all bank branches in RateWatch for which we have data in 2004 and 2013.

Compared to the IV regressions in Section 6, these DiD analyses are far less exposed to the aforementioned concerns of reverse causality. The reverse causality concern is that inclusion of a bank in an index is endogenous to the profit margins in the markets in which it chooses to operate. In our DiD analyses, we "instrument" ultimate ownership changes through index fund ownership from up to a decade ago. For the reverse causality concern to be valid for the DiD "instrument" (and our identifying assumption to be invalid), index ownership must depend on performance of banking markets and banks' entry into and exit out of markets up to a decade in the future, *over and above what is reflected in the market value of the bank* and conditional on the other controls.

Finally, in these DiD analyses, we do not employ a concentration measure that we constructed. The terciles of index fund ownership that define our treatment and control groups are based on aggregations of ownership across banks in each county in 2003. Therefore, the findings in this section also help alleviate any concerns that our panel and IV findings arise from our GHHI measure being defined to exaggerate relationships between prices and ultimate ownership. In other words, they also offer a less structural test of the effect of ultimate ownership on prices.

8.2 | Results

We implement the regression specified in Equation (9) for all the outcome variables explored previously: within-year interest rate spread margin percentiles for 12-, 24-, and 36-month CDs and maintenance fee amounts, maintenance fee thresholds, and within-year interest rate spread margin percentiles for money market and interest-bearing checking accounts. Overall, the results indicate that banking product prices increase significantly more from 2004 to 2013 for our treated bank branches than for control group branches. In fact, the difference in growth for fee amounts and thresholds between the treatment and control branches is comparable to the overall growth of these prices in the same period documented in Appendix A2.

Before presenting the treatment effect of being in a high index fund ownership county on price growth, we note the clear positive relationship between high ultimate ownership in 2003 and ultimate ownership growth in 2004–2013. As we observe in the first row of Table 6, a bank branch in a top tercile county, where terciles are based on index fund ownership in 2003, sees 586 points greater growth in the GHHI over the 2004–2013 period than a bank branch in a bottom tercile county. In other words, higher index fund ownership in 2003 indeed predicts increases in common ownership over the next decade. This difference is highly statistically significant. Furthermore, relative to the overall growth in the GHHI over the same period of about 1200 HHI points, this difference in ultimate ownership growth rates is economically large.

Table 7, Panel A, shows that bank branches in top tercile counties have much higher growth in interest rate spread margin percentiles for CDs than bottom tercile counties. In Table 7, Panel A, column (1), we see that 12-month CD spreads percentile ranking growth is more than 3.5 percentile points higher for top tercile counties. Column (2) shows that the percentile ranking of 24-month spreads rises by 5.5 percentile points more for top tercile counties and column (3) shows that the percentile ranking of 36-month spreads rises by nearly 5.2 percentile points more for top tercile counties. Furthermore, these differences are highly statistically significant.

TABLE 6 Regressions of change in GHHI between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003

	Δ GHHI
	(1)
Top Tercile Index Fund Ownership in 2003	0.0586***
	(0.0192)
Log Income	0.00968
	(0.0266)
Log Population	0.0226***
	(0.00546)
Log(1+Market Cap)	9.17e−05
	(0.000165)
Constant	−0.329
	(0.259)
Observations	50,684
R^2	0.198

Note: This table shows the effect of an indicator variable fo-r whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in GHHI. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. While throughout the paper the HHI and GHHI are expressed on a scale of 0 to 10,000, we use a scale of 0 to 1 for the regressions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 7, Panel B, presents evidence that money market prices increase more for branches in top tercile counties than for branches in bottom tercile counties. Column (1) shows that the growth in maintenance fees is $1.16 higher for branches in top tercile counties and column (2) shows that maintenance fee threshold growth is over $900 higher for these branches. The differences between top and bottom tercile county branches are highly and moderately statistically significant for the fees and thresholds, respectively. And, given that average fees and thresholds for money market account maintenance increased by approximately $0.80 and $1200 from 2004 to 2013, respectively, the differences in growth between the top and bottom terciles are economically quite large. Column (3) shows that rate spread growth is 3.4 percentile points higher in top tercile counties. That difference is highly statistically significant as well.

In Table 7, Panel C, we observe that overall interest-bearing checking account price growth is greater for branches in top tercile counties. In column (1), we see that interest-bearing checking account maintenance fees grow $1.41 more in top tercile county branches. Column (2) shows that maintenance fee thresholds grow by nearly $2600 more in top tercile county branches. Both these interest-bearing checking account price growth differences are highly statistically significant. They are also economically meaningful as the overall growth of fees and thresholds for interest-bearing checking accounts in that same time period was approximately $5 and $4000, respectively. Column (3) shows that there is no statistically significant difference between top and bottom tercile county branches in terms of growth of interest rate spread margin percentiles (although, ignoring statistical significance, top tercile counties seem to have 1.5 percentile point higher growth in that period).

In Table 8, we present DiD findings that address questions associated with differences across banks. The general theme is that differences in these characteristics may be driving the cross-sectional variation in both deposit prices charged by banks' branches and banks' choice of markets in which they operate. The findings we present in Table 8 incorporate bank fixed effects into our DiD analyses precisely to absorb the effect of bank characteristics that might be driving our results. What we find is that, across all deposit products, the treatment effect is strong and statistically significant for interest rate spreads. For money market and interest-bearing checking accounts, the effect on

TABLE 7 Regressions of change in deposit prices between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003

	Δ 12-Month CD spread (Percentile)	Δ 24-Month CD spread (Percentile)	Δ 36-Month CD spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	3.597***	5.594***	5.172***
	(1.066)	(0.848)	(1.058)
Log Income_{2004}	8.182***	9.651***	7.721***
	(1.854)	(1.800)	(1.903)
Log Population_{2004}	3.204***	3.932***	4.606***
	(0.510)	(0.412)	(0.462)
Log(1+Market Cap_{2004})	0.726***	0.782***	0.773***
	(0.0366)	(0.0362)	(0.0324)
Spread_{2004}	−0.659***	−0.803***	−0.774***
	(0.0148)	(0.0166)	(0.0188)
Constant	−101.9***	−121.2***	−110.3***
	(17.07)	(17.14)	(17.95)
Observations	50,684	49,429	47,930
R^2	0.412	0.529	0.531
	Δ Maintenance fee	Δ Maintenance fee threshold	Δ Spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	1.158***	909.4**	3.377***
	(0.301)	(360.0)	(0.965)
Log Income_{2004}	−0.993	−178.3	1.774
	(0.708)	(408.1)	(1.683)
Log Population_{2004}	0.0149	−4.710	1.372***
	(0.0861)	(92.42)	(0.258)
Log(1+Market Cap_{2004})	−0.0448***	−59.67***	0.162***
	(0.00853)	(9.879)	(0.0288)
$\text{Maintenance Fee}_{2004}$	−0.417***		
	(0.0290)		
Maintenance Fee Threshold_{2004}		−0.422***	
		(0.0407)	
Spread_{2004}			−0.538***
			(0.0133)
Constant	14.05*	3,391	−12.62
	(7.412)	(3,805)	(17.00)
Observations	16,818	13,414	46,763
R^2	0.275	0.174	0.277

(Continues)

TABLE 7 (Continued)

	Δ Maintenance fee	Δ Maintenance fee threshold	Δ Spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	1.410***	2,585***	1.477
	(0.417)	(645.8)	(1.000)
Log $Income_{2004}$	1.557	480.2	0.971
	(1.380)	(929.1)	(1.858)
Log $Population_{2004}$	0.636***	−215.3	2.265***
	(0.149)	(149.0)	(0.353)
Log($Market\ Cap_{2004}$)	0.172***	64.88***	0.385***
	(0.0138)	(14.21)	(0.0451)
Maintenance Fee_{2004}	−0.652***		
	(0.0245)		
Maintenance Fee $Threshold_{2004}$		−0.446***	
		(0.0388)	
$Spread_{2004}$			−0.523***
			(0.0135)
Constant	−16.53	−399.1	−15.88
	(14.53)	(9,615)	(18.33)
Observations	16,105	10,678	48,004
R^2	0.350	0.100	0.254

Panel A: Regressions of change in time deposit spread percentiles between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in time deposit spread percentiles with 12-, 24-, and 36-month maturities. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel B: Regressions of change in money market fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel C: Regressions of change in interest checking fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

TABLE 8 Regressions of change in deposit prices between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects

	Δ 12-Month CD spread (Percentile)	Δ 24-Month CD spread (Percentile)	Δ 36-Month CD spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	2.158***	2.317***	2.281***
	(0.426)	(0.437)	(0.352)
Log Income_{2004}	0.580	0.608	0.0209
	(0.386)	(0.416)	(0.331)
$\text{Log Population}_{2004}$	−0.131	0.000697	0.193***
	(0.0815)	(0.0962)	(0.0563)
Spread_{2004}	−0.923***	−0.943***	−0.952***
	(0.00888)	(0.00813)	(0.00743)
Bank FE	✓	✓	✓
Observations	50,684	49,429	47,930
R^2	0.970	0.978	0.980
	Δ Maintenance fee	**Δ Maintenance fee threshold**	**Δ Spread (Percentile)**
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	0.238	385.0	0.919**
	(0.178)	(377.9)	(0.461)
Log Income_{2004}	−0.0632	−49.07	1.131**
	(0.0485)	(74.39)	(0.461)
$\text{Log Population}_{2004}$	−0.00816	−14.32	0.309***
	(0.0107)	(20.81)	(0.0734)
$\text{Maintenance Fee}_{2004}$	−0.947***		
	(0.0254)		
$\text{Maintenance Fee Threshold}_{2004}$		−0.994***	
		(0.00305)	
Spread_{2004}			−0.867***
			(0.0127)
Bank FE	✓	✓	✓
Observations	16,818	13,414	46,763
R^2	0.988	0.976	0.949
	Δ Maintenance fee	**Δ Maintenance fee threshold**	**Δ Spread (Percentile)**
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	0.110	406.7***	1.247***
	(0.0938)	(149.4)	(0.481)

(Continues)

TABLE 8 (Continued)

	Δ Maintenance fee	Δ Maintenance fee threshold	Δ Spread (Percentile)
	(1)	(2)	(3)
Log $Income_{2004}$	−0.00920	−270.9	1.128
	(0.0506)	(378.1)	(0.876)
Log $Population_{2004}$	−0.0257**	−197.5**	−0.313*
	(0.0130)	(83.25)	(0.185)
$Maintenance\ Fee_{2004}$	−0.989***		
	(0.00341)		
Maintenance Fee $Threshold_{2004}$		−0.763***	
		(0.0533)	
$Spread_{2004}$			−0.888***
			(0.0173)
Bank FE	✓	✓	✓
Observations	16,105	10,678	48,004
R^2	0.995	0.911	0.915

Panel A: Regressions of change in time deposit spread percentiles between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in time deposit spread percentiles with 12-, 24-, and 36-month maturities. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level and bank-level fixed effects absorb all variation in trends across banks. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel B: Regressions of change in money market fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level and bank-level fixed effects absorb all variation in trends across banks. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel C: Regressions of change in interest checking fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level and bank-level fixed effects absorb all variation in trends across banks. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

spreads actually seems to strengthen (Table 8, Panels B and C, respectively). For fees and thresholds, the treatment effect, while in the correct direction, is weaker. This is likely because of a general lack of within-bank variation in our fees data sets.[24] Nevertheless, these within-bank DiD findings ease concerns about bank-related endogeneity driving our results.

[24] For instance, in 2004 and 2013, the RateWatch money market fees data set includes data from branches of approximately 1000 and 1500 banks, respectively. However, in those years, less than 50 banks (around 3% in each year) have cross-sectional variation in fees. With so little cross-sectional variation, it is unsurprising that we have difficulty identifying statistically significant relationships for fees and thresholds.

TABLE 9 Regressions of change in deposit prices between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects and census division-year fixed effects

	Δ 12-Month CD spread (Percentile)	Δ 24-Month CD spread (Percentile)	Δ 36-Month CD spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	1.938***	1.916***	1.927***
	(0.388)	(0.387)	(0.342)
Log Income	0.386	0.440	−0.102
	(0.351)	(0.372)	(0.316)
Log Population	−0.119	0.0210	0.118*
	(0.0758)	(0.0826)	(0.0608)
Spread	−0.922***	−0.939***	−0.937***
	(0.00944)	(0.00940)	(0.00928)
Bank FE	✓	✓	✓
Census Division FE	✓	✓	✓
Observations	49,585	48,452	47,066
R^2	0.970	0.978	0.980
	Δ Maintenance fee	**Δ Maintenance fee threshold**	**Δ Spread (Percentile)**
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	0.220	350.1	1.332***
	(0.148)	(305.0)	(0.443)
Log Income	−0.0315	−8.189	0.603
	(0.0434)	(59.41)	(0.450)
Log Population	−0.00577	−14.30	0.156**
	(0.00975)	(18.50)	(0.0675)
Maintenance fee	−0.944***		
	(0.0284)		
Maintenance fee threshold		−1.000***	
		(0.00277)	
Spread			−0.859***
			(0.0124)
Bank FE	✓	✓	✓
Census division FE	✓	✓	✓
Observations	16,733	13,371	45,822
R^2	0.988	0.978	0.949

(Continues)

TABLE 9 (Continued)

	Δ Maintenance fee	Δ Maintenance fee threshold	Δ Spread (Percentile)
	(1)	(2)	(3)
Top Tercile Index Fund Ownership in 2003	0.124	237.1*	1.632***
	(0.106)	(140.1)	(0.457)
Log Income	−0.0472	−63.11	1.010
	(0.0406)	(387.6)	(0.816)
Log Population	−0.0222*	−90.92*	−0.268*
	(0.0122)	(52.47)	(0.138)
Maintenance fee	−1.007***		
	(0.00710)		
Maintenance fee threshold		−0.811***	
		(0.0508)	
Spread			−0.882***
			(0.0167)
Bank FE	✓	✓	✓
Census division FE	✓	✓	✓
Observations	16,019	10,616	47,042
R^2	0.995	0.918	0.919

Panel A: Regressions of change in time deposit spread percentiles between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects and census division-year fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in time deposit spread percentiles with 12-, 24-, and 36-month maturities. Percentiles are calculated for each year based on spreads defined as the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. Bank-level fixed effects absorb variation in trends across banks. Census division fixed effects absorb variation in trends across regions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel B: Regressions of change in money market fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects and census division-year fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in money market account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. Bank-level fixed effects absorb variation in trends across banks. Census division fixed effects absorb variation in trends across regions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Panel C: Regressions of change in interest checking fees, thresholds, and spreads between 2004 and 2013 on whether the county is in the top or bottom tercile of index fund ownership in 2003 with bank fixed effects and census division-year fixed effects. *Note*: This table shows the effect of an indicator variable for whether a market's index fund ownership is in the top or the bottom tercile of the distribution of index fund ownership in 2003 on the change over the period 2004–2013 in interest checking account maintenance fees, maintenance fee thresholds, and interest rate spread percentiles. Spread percentiles are calculated as the within-year percentile rank of the difference between the 10-year Treasury Constant Maturity rate and the deposit rate, expressed as a percent of the Treasury rate. The sample includes all bank branches in RateWatch. Standard errors are clustered at the county level. Bank-level fixed effects absorb variation in trends across banks. Census division fixed effects absorb variation in trends across regions. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

In Table 9, we show results that address concerns related to differing trends across regions. In particular, the concern is that differences in how different regions evolve over time may drive changes in the deposit prices charged by branches in those regions as well as banks' choice of markets in which they operate. In this table, we present results for DiD analyses that incorporate census division-year fixed effects (in addition to bank fixed effects) to absorb any such variation in trends across regions that may drive our results. Table 9, Panel A, shows that the effect of being in a top tercile county in 2003 does not weaken due to the addition of census division-year fixed effects for interest spread percentiles for any of the CDs. Column (3) of Table 9, Panel B, and column (3) of Table 9, Panel C, show that, for money market and interest-bearing checking accounts, the treatment effect is actually stronger for interest rate spread percentiles when we absorb differential trends across regions with the added fixed effects. For fees and thresholds, the treatment effect does not change much with the region-year fixed effects (although the effect on the interest-bearing checking account maintenance fee thresholds is less statistically significant and smaller in magnitude). Overall, the DiD regressions with census division-year and bank fixed effects, compared to our bank fixed effects DiD regressions, suggest that different trends across regions have actually hidden some of the GHHI effect on prices in the previous analyses.

9 | CONCLUSION

There are two main empirical takeaways from this paper. First, we provide evidence that prices of deposit products are at an all-time high and vary substantially in the cross section. Variation in bank competition that is due to variation in partial common ownership links helps explain the variation in prices. The inclusion of fees and thresholds as outcome variables in addition to interest rates—a major innovation of our study—is important: because fees and thresholds seem to be as responsive as interest rates to changes in competition, an exclusive focus of researchers and regulators on interest rates can result in an incomplete picture of the competitive outcomes in the banking industry.

Second, the paper provides a more complete picture of the economic forces shaping bank competition, with direct implications for policy. We show that who owns the banks matters for how the banks compete. Specifically, we calculate a new generalized concentration index, the GHHI, which can capture the effect of general ownership structures. Empirically, the GHHI is a more effective and robust predictor of market outcomes than the HHI, the measure traditionally used by researchers and regulators. In addition, we provide analyses that suggest a causal link from the GHHI to prices by using index funds' ownership of banks as a source of variation in bank ownership patterns across geographical markets.

These findings suggest that competition authorities should consider complementing their HHI-based analyses with some measure of common ownership concentration—GHHI being but one candidate. Indeed, a vigorous and welcome debate is in full swing about the development and use of appropriate, theoretically motivated and empirically effective measures of common ownership.

In addition, a literature in legal studies controversially discusses further potential policy proposals based on empirical findings such as the ones presented in this paper. We wish to offer no proposed solution to this debate, but only a frame of reference. In particular, much care has to be taken to appropriately weighing the benefits and costs of the current structure of the asset management industry. These benefits can be substantial. Specifically, the benefit to asset owners of large-scale diversified asset management are (i) cheap diversification as well as (ii) improved corporate governance as a result of active involvement by the largest asset managers. These activities serve individual investors' interests in ways the investors could not achieve as independent agents. Indeed, the mutual funds' coordination of corporate governance activities may constitute a partial solution to the free-rider problem that arguably plagued corporate governance in previous decades, when more individuals held stocks directly and there were not many large shareholders that engaged in monitoring activities. However, the benefits to shareholders from diversification and good governance may come at a cost to consumers: efficient capital markets with perfect diversification and "good governance" imply deadweight losses in input and output markets. Examining this trade-off is a quantitative question we leave for future research.

ACKNOWLEDGMENTS

We thank Amiyatosh Purnanandam for providing data. For useful comments and suggestions, we thank Manuel Adelino (discussant), Michael Barr, Tobias Berg (discussant), Judy Chevalier (discussant), Thomas Eisenbach, Ying Fan (discussant), Todd Gormley, Elena Loutskina, Charles Murry (discussant), Stefan Nagel, Amiyatosh Purnanandam, Uday Rajan, Jean-Charles Rochet, Sascha Steffen, Denis Sosyura, Per Strömberg (discussant), Toni Whited, conference participants at EARIE (Lisbon), EEA (Lisbon), ESSFM (Gerzensee), European Banking Center Network Conference (Tilburg), IIOC, NBER Summer Institute Industrial Organization, NYU/NY Fed Conference on Financial Intermediation, and seminar audiences at the Bank of England, Duke University (Fuqua), Lancaster University, Northeastern University, University of California San Diego (Rady), University of Michigan (Finance and Economics), Université de Montréal, University of Oklahoma (Price), University of Virginia (Darden), Universität Zürich, Vanderbilt University (Owen), and ZEW (Mannheim). Benjamin Lipsius and Saumil Shah provided excellent research assistance. Azar gratefully acknowledges the financial support of Secretaria d' Universitats I Recerca del Departament d' Empresa I Coneixement de la Generalitat de Catalunya. Ref. 2016 BP00358.

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How to cite this article: Azar J, Raina S, Schmalz M. Ultimate ownership and bank competition. *Financial Management*. 2021;1–43. https://doi.org/10.1111/fima.12368