Growing Oligopolies, Prices, Output, and Productivity

Sharat Ganapati
Georgetown University*
First Version: September 11, 2017
Updated: October 1, 2019

Abstract

American industries have grown more concentrated over the last forty years. In the absence of productivity innovation, this should lead to price hikes and output reductions, decreasing consumer welfare. With US Census data from 1972-2012, I use price data to disentangle revenue from output. Industry-level estimates show that concentration increases are positively correlated to productivity and real output growth, uncorrelated with price changes and overall payroll, and negatively correlated with labor's revenue share. I rationalize these results in a simple model of competition. Productive industries (with growing oligopolists) expand real output and hold down prices, raising consumer welfare, while maintaining or reducing their workforces, lowering labor's share of output.

*An earlier version of this paper circulated under the title "Oligopolies, Prices, and Quantities: Has Industry Concentration Increased Price and Restricted Output?" Contact me at sganapati@gmail.com or sharat.ganapati@georgetown.edu. I am indebted to Peter Schott, Costas Arkolakis, Penny Goldberg, Nina Pavcnik, Steve Berry, and Carl Shapiro for in-depth discussions or comments. Various conversations with Colin Hottman, Brian Greaney, Fabian Eckert, Conor Walsh, Jeff Weaver and with participants at the 2018 NBER Summer Institute were extremely helpful. Thanks to Jelena Leathard at the Georgetown Federal Research Data Center. Any opinions and conclusions expressed herein are those of the author and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed.

Does America have a monopoly problem? Market concentration within narrowly defined industries has risen over last forty years. Various papers have systematically and comprehensively laid out the implications of concentration on profits, productive factors, and markups.[1] However, research has not systematically measured consumer welfare and prices, a first order concern for antitrust authorities (Shapiro, 2010, FTC Hearings 2018).[2] In the simplest economics examples (Tirole, 1988), monopolies charge higher prices and restrict output, maximizing profits and reducing consumer welfare. However, monopolies could be caused by innovation from "superstar" firms or scale economies, leading to falling prices or increased output (Autor et al., 2017; Van Reenen, 2018; Armstrong and Porter, 2007; Tirole, 1988; Kehrig and Vincent, 2018).

Monopolists and oligopolists have incentives to both increase prices and/or decrease output.[3] My main research question is simple: is there an empirical relationship between changes in oligopolies and consumer-relevant market outcomes on an economy-wide basis? I test the relationship of prices, quantities, and market concentration across the vast majority of the US economy using 40 years of Census data. I then link these changes on the consumer side to productivity innovations and labor shares.

I directly quantify how changes in industry concentration in the medium to long-run are correlated to changes in prices and real output by combining price data with revenue data.[4] A 10% increase in the national market share of the four largest firms is correlated with a 1% increase in real output. Finding that higher output, but not price, is linked with higher concentration rates, I turn to the role of productivity. Industries with the most real productivity growth are those with the largest increases in industry concentration. A 10% increase in the market share of the largest four firms is linked to a 2% increase in labor productivity. With both industry concentration and productivity, output growth is not accompanied by payroll growth. Growing monopolists and oligopolists are able to produce more output with fewer, but higher paid workers. A 10% increase in the market share of the largest four firms is correlated with a 1% decrease in the labor's share of revenue.[5]

These correlations are interpreted through the perspective of Sutton-style models, where fixed costs are used to reduce marginal costs (Sutton, 1991). This can lead to decreases in competition and increases in output. If fixed costs come from capital expenditures, as opposed to labor expenses,

[1] See Autor et al. (2017); Barkai (2016); Furman and Orszag (2015); Grullon et al. (2016); Gutiérrez and Philippon (2017); De Loecker and Eeckhout (2017); White and Yang (2017).

[2] Markups are relevant to consumer welfare, but if only paired with marginal and average cost data. See De Loecker and Eeckhout (2017) for detailed markup data.

[3] US merger guidelines state that "A merger enhances market power if it is likely to encourage one or more firms to raise price, reduce output, diminish innovation, or otherwise harm customers as a result of diminished competitive constraints or incentives." (Department of Justice 2010) I hold to this spirit in evaluating medium-run changes to market concentration.

[4] What does it mean for output expansion without falling prices? There are a few simple and consistent stories. Marginal cost reductions may be correlated with increases in demands. For example, an increase in demand enlarges the total market, allowing for new natural monopolies. Additionally, changes in marginal cost could be linked with unobservable quality, inducing demand.

[5] Without considering general equilibrium effects, the net effect of oligopoly growth appears to be Pareto improving. This is distinct from Pareto optimal; there may be further Pareto gains from regulating a natural monopoly and redistributing the gains.

labor shares fall.[6] Furthermore, these models allow for national market concentration increases, holding local market concentration constant (Rossi-Hansberg et al., 2018; Rinz, 2018).

Research investigating consumer surplus generally address three main questions. First, has increasing market concentration reduced consumer surplus? Second, could current consumer surplus be higher? Third, what does the future hold? This paper answers the first question on a systematic, economy-wide basis. The second question often requires detailed modeling of supply and demand and has been done for selected industries, but answers lack economy-wide coverage. In particular, if new technologies create natural monopolies, is there a role for regulation and intervention? Monopolies and superstar firms may pass on the benefits from technical innovation as profits, partially offsetting increases in markups. As market power is related with real productivity improvements, this paper lends credibility to this story, but there may be room for further intervention (Covarrubias et al., 2019). The third (and perhaps most important) question primarily lies in the realm of speculative analysis, paving the way for future work.

The results from this paper tie directly with a large and growing body of literature and public discussion.[7] The rising trend toward monopolization has been linked to the growth of superstar firms, declining labor compensation (Furman and Orszag, 2015; Autor et al., 2017; Azar et al., 2017), and increased profits (Barkai, 2016). This missing link in this literature comes from the focus on upstream factor markets, not on downstream customers. This paper explicitly considers prices and uses this price data to disentangle revenue and real output, allowing consumer welfare comparisons. This approach is complementary with Barkai (2016); Kehrig and Vincent (2018) and Autor et al. (2017), which use similar datasets to fully describe trends in labor shares and productivity within the manufacturing sector.[8] Peltzman (1977) runs a similar analysis on manufacturing from 1947 through 1967. This paper expands analysis to the majority of the private sector, as manufacturing only accounts for 12% economic output. De Loecker and Eeckhout (2017) use data on publicly traded companies to show that markups have increased, but cannot link this to prices. This paper is consistent with higher markups, as that could indicate large fixed costs that reduce marginal production costs. In contrast, Gutiérrez and Philippon (2017) find that declining competition may be responsible for reduced levels of investment.[9]

The finding that productivity and oligopoly are intertwined is related to the discussion of both the business dynamics of the US economy (Decker et al., 2016) and the proliferation of automatization (Acemoglu and Restrepo, 2016, 2017). Industries that become more productive require fewer workers. Industries that become monopolies hire fewer workers. Productivity (and the automatization, computerization, and the robotics that underpin it) enhancements do not appear 'free' and exogenous. Improvements are much more common in industries that move towards higher levels of monopolization. This paper cannot assign causality. Do productivity improvements lead to higher

[6] This is true if capital is a more dynamic input than labor as in Ackerberg et al. (2015).

[7] For example: Porter (2016) and The Economist (2016).

[8] Autor et al. (2017) performs similar analysis on productivity just within the manufacturing sector and finds broadly comparable results. Azar et al. (2017) finds that wages fall with industry concentration (monopsony).

[9] Gutiérrez and Philippon (2017) show that investment is negatively correlated with market share, but do not consider if higher investment led to higher market shares in the first place.

market shares, or do higher market shares lead to productivity investment? If productivity enhancements require large sunk costs, such as employing more expensive workers and building up intellectual property, this may prevent entry of new firms. The decline in labor share may be due to cheap capital (Karabarbounis and Neiman, 2013), but is there a minimum efficient scale to use this capital?[10]

There have been many case studies that focus on the role of industry concentration, prices, outputs, consumer welfare, and innovation. In the 1950s, cross-industry analysis of profit rates and market concentration was formalized by Bain (1951); however, due to measurement and endogeneity issues[11], the literature was supplanted by "New Industrial Organization (IO)." (Bresnahan, 1989; Sutton, 1991). "New IO" did away with cross-industry analysis and placed more structure on individual industries to understand the interaction of market power, profits, and consumer welfare.[12] A recent literature also addresses market concentration from both international trade and macroeconomic perspectives (Mongey, 2016; Head and Spencer, 2017; Hottman et al., 2016).[13]

A new series of papers have aimed at directly understanding the results of the aggregate trend of consolidation on various outcomes. Antón et al. (2016); Azar et al. (2016a,b) explore common ownership of firms within industries. Within wholesale trade, Ganapati (2016) shows that while market concentration and prices may both increase, downstream customers may still benefit as higher operating profits cover substantial fixed costs to improve customer experiences and increase total overall sales. Looking solely at price, Kwoka Jr (2012) finds that there is a small average increase in price following mergers. Blonigen and Pierce (2016) show that mergers do not seem to improve firm productivity. I consider aggregate market power expansion, including both natural and M&A growth.

I describe the data in Section 1, before considering the relationship of changes in market concentration to economic outcomes in Section 2. I consider the role played by productivity in Section 3 before concluding with a simple explanatory model.

1 Data

Data comes from three main data sources. First, the U.S. Census Bureau's Economic Censuses (EC), conducted ever five years from 1997 to 2012, provide national-level market concentration figures by North American Industry Classification System (NAICS) codes. The same surveys from 1972-1992 compiled data by Standard Industry Classification (SIC) codes. Second, the Manufacturing Industry Database, compiled jointly by the National Bureau of Economic Research and the U.S. Census Bureau's Center for Economic Studies (NBER-CES), provides detailed manufacturing

[10] In the medium run explored in this paper, the change in the price of capital is largely constant between industries - and therefore is difficult to in a difference-in-difference framework with time fixed effects.

[11] See Schmalensee (1989) and Peltzman (1977).

[12] See Armstrong and Porter (2007).

[13] Mongey (2016) uses a general equilibrium model to understand the role of market power on monetary policy. Head and Spencer (2017) argue for the return to oligopolistic competition in analysis of international trade. Hottman et al. (2016) show significant departures from monopolistic competition models for the largest firms in retail purchase datasets.

industry statistics, including both input and output price levels. Third, for non manufacturing industries, the U.S. Bureau of Economic Analysis (BEA) provides price index and output volume data from 1977 to 2012. All data, including market shares and prices, refer to domestic producers. While manufactured goods prices may have fallen in aggregate (Feenstra and Weinstein, 2017), I focus on the price of domestically produced goods and follow the international trade literature in assuming there is imperfect substitutability between foreign and domestically produced goods.[14]

The price data used is primarily sourced from the Bureau of Labor Statistics (BLS) Producer Price Indices (PPI), originally called the Wholesale Price Index (WPI) prior to 1978. These time-series measure the average price of US domestic output. Historically, the BLS primarily collected industry-level price data on agricultural commodities, before transitioning to manufacturing data following World War II (Conforti, 2016). As the economy transitioned to services, the BLS started collecting high-quality data on service sectors in the 1980s (Swick et al., 2006; Bureau of Labor Statistics, 2018).[15]

Due to the slow take-up of BLS PPI data collection on service sectors prior to 1985, the BEA supplemented this data with their own estimates and data collection, with data from a variety of sources, including the Department of Transport, the Federal Communications Commission, Securities and Exchange Commissions and various BLS Consumer Price Indices (Yuskavage, 1996; Streitwieser, 2010; Landefeld and Parker, 1997; Locke et al., 2011).[16] I use the BEA's chained measures, as opposed to fixed weights, minimizing prior issues of substitution bias of products within sectors. (Landefeld et al., 1995) These chained measures are derived from a BLS computed Laspeyres index, chosen from a representative weighed survey of domestic producers.[17]

Market shares are more difficult to construct. One must identify competitors/industries, allow for companies to compete in multiple segments, and account for varying substitution margins between firms and markets. To simplify the analysis, industry definitions follow those computed by the US Census across firms within a particular NAICS or SIC code. Industries are defined at the 6-digit NAICS level and at the 3 or 4-digit SIC level (depending on historical data availability).[18] I measure market concentration using the aggregate market shares of the four largest firms in an industry by revenue (following Autor et al. 2017).

This combined dataset has market concentration, revenues, prices indices, employment, and payroll by industry every five years. I then derive real output, labor productivity, average wage and labor's share of revenue from these initial data points. This covers the majority of the U.S. private

[14]Robustness checks from the Online Appendix adds four further data sources, covering international trade, hourly wages, and regulatory barriers. I directly control of import penetration and the growth of China following permanent normalization of trade relations. Imports have the expected effect, lowering prices, output, workers and wages. Additionally the baseline results hold when dropping all manufacturing sectors.

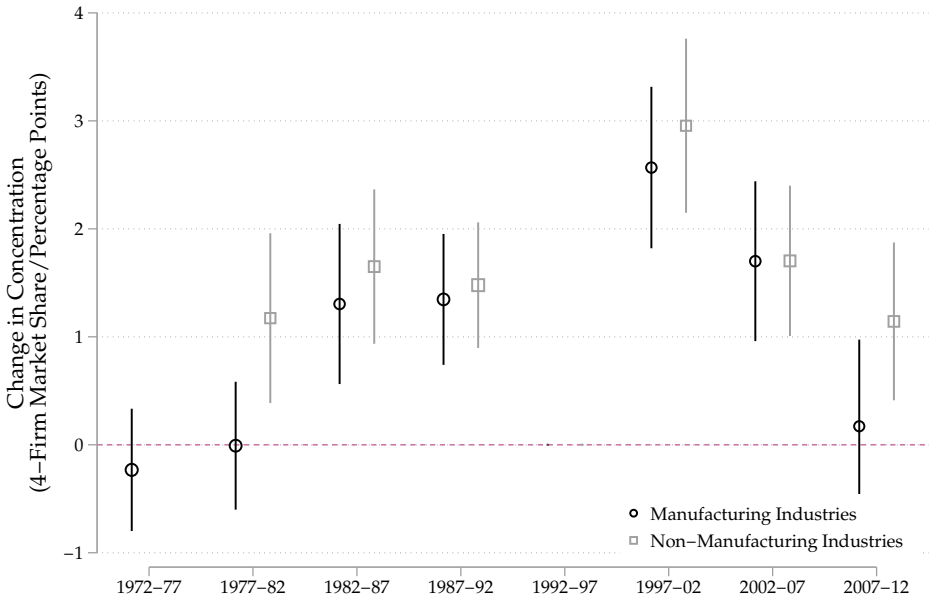
[15]Furthermore, as the BLS uses hedonic prices for a subset of industries, I am able to correct for changes in quality (Moulton et al., 2001).

[16]This ad-hoc and noisy coverage of service sectors prior to 1987 may bias me against finding any results in that time period.

[17]These indices only update weights every 5-years; matching the frequency of our market share statistics (Bureau of Labor Statistics, 2008).

[18]An example 6-digit NAICS category is "327121-Brick and Structural Clay Tile Manufacturing" and a 4-digit SIC category is "3251-Brick and Structural Clay Tile (except slumped brick)."

Figure 1: Average Change in Market Share of 4-Largest Firms over 5-year intervals



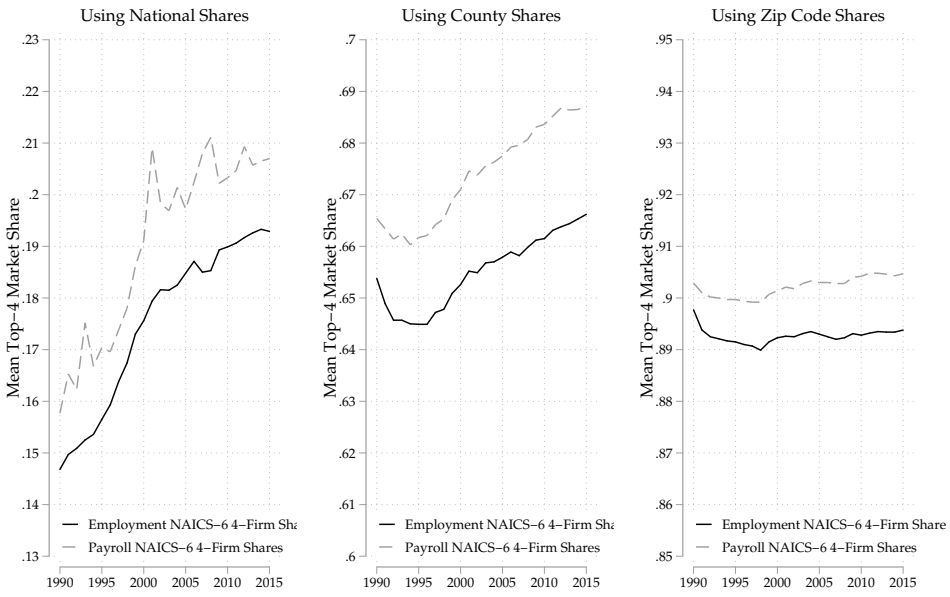
Notes: Results from a regression of change in 4-firm concentration shares by time period. From 1972-1992, average of 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, average of 6-digit NAICS codes for all industries. Data for non-manufacturing firms in 1972 is incomplete. Data from 1992 and 1997 are from non-comparable industrial classification systems.

sector, with over 75% of gross output in 2012. I measure productivity as gross output per worker (following Decker et al. 2016). All data covers only domestic prices and market shares. The Online Appendix presents summary statistics and considers alternative measures for productivity (total factor productivity and hourly gross output) and for market shares (market shares using levels, the Herfindahl-Hirschman index and correcting for manufacturing import shares).

1.1 Concentration Trends

The largest firms have grown disproportionately in size over the last forty years. Figure 1 shows the average market share growth of the largest four firms (4-Firm Share) across industries in five year intervals. For example, between 1997 and 2002, the largest four firms increased their market share by an average of 2.5 percent. Data for 1992-1997 is unavailable due to a change in the U.S. Census Bureau's industry classification system. If changes in this time period are recovered through interpolation, the market share of the largest four firms in the average industry increased nearly 10 percentage points from 1977-2012, reaching nearly 40% by 2012. I refer the reader to Autor et al. (2017) for a fuller description of this trend.

Figure 2: Market Share by Employment and Payroll, 1990-2015



Notes: These three graphs plot changes in the average market share of the top four firms across 6-digit NAICS codes. Data drawn from a balanced panel from 1990 through 2015, with data weighted using employment levels in 1990. The left plots trends ranking firms using the top four firms by within-NAICS code employment and payrolls, using national market definitions. The center plots trends using county-level market definitions. The right plots trends using 5-digit zip code market definitions. The solid trend-line plots market shares computed using payroll. The dotted trend-line plots market share computed using employment. Data aligned from 1990-2005 to 2012 NAICS codings from the Longitudinal Business Database for all firms with either payroll or employment.

1.1.1 Local versus national market power

One issue is that market concentration is only calculated at national levels, even though competition may be local. If markets are regional and national concentration increases are not correlated with local concentration changes, then downstream market power should remain constant. For example, if an New England grocery chain mergers with a Midwest grocery store chain, downstream market power should stay constant.[19]

In the absence of consistent and comprehensive establishment-level revenue data across all sectors, I compute market shares using employment at different regional aggregations by 6-digit NAICS code from 1990-2015 using a unified crosswalk from Fort and Klimek (2016).[20] In Figure 1, I show that market concentration exhibits similar patterns over different market definitions. In 1990, the largest four firms employed 15% of all workers in the average industry nationally, increasing to 19% in 2015. County-based markets show a similar trend, with equivalent market shares rising from 65% to 67%. Data at the 5-digit Zip code level finds that employment market shares have remained roughly constant, hovering around 90%.[21] The truth lies somewhere in the middle, national data shows increasing concentration, while zip code data shows markets that have always been concentrated, with little variation over time. Concentration matters at different levels of aggregation in different industries. Some goods are non-traded, while others are globally traded, I will consider both possibilities while interpreting results.[22]

2 Market Concentration and Outcomes

Baseline regressions are of the following form:

$$\Delta_5 \log(Y_{it}) = f\left[\Delta_5 \log(Concentration_{it})\right] + \gamma_{st} + \epsilon_{it}$$

Observations are indexed by industry i and year t. $Concentration_{it}$ denotes the market concentration of industry i in year t.[23] The operator Δ_5 takes a five year difference and standardizes

[19] This assumes away both upstream market effects and potential production synergies.

[20] Data on traded firms is available through Compustat, but this data exists only at the national/global level. For example the entry for Amazon not only contains sales data for the United States, but also abroad. In addition to containing sales data for online retailing, this data further mingle data for IT computing services (cloud computing). While US Census establishment level data does not completely solve this aggregation issue, it significantly alleviates these concerns and includes on public and private firms. Data prior to 1990 are riddled with numerous errors and are highly variable.

[21] In terms of HHI indices, average ZIP code levels are between 5700 and 6000. Nearly all markets qualify as "Highly Concentrated", being over the 2500 cutoff.

[22] Notably, Rinz (2018) and Rossi-Hansberg et al. (2018) find that local market power is often decreasing, even though national market power is increasing. In the Online Index, I show their results may be due to compositional issues. First, extremely small market definitions can lead to locations with zero firms. Second, an unbalanced panel can lead to mis-measuring market power. The dataset used by Rossi-Hansberg et al. (2018) is not easily available, and the revenue portion of the data set has never been cross-validated with administrative datasets. I follow the approach of Rinz (2018), using US Census administrative data that uses tax data to verify employment and payroll records by establishment.

[23] I use the logarithm of concentration, as opposed to the level or exponent. This is since the data may deflate the level of concentration at the bottom end of the data. Many markets are regional or local, as opposed to national.

the variables. The fixed effect γ_{st} controls for the 2-digit NAICS top-level sector and year.[24] The residual ϵ_{it} reflects any residual unexplained variation and measurement error. Outcome variables Y come from the following interlinked outcomes of economic interest:

$$\begin{aligned}
\Delta_5 \log\left(Price\right) & \\
\Delta_5 \log\left(Real\ Output\right) &= \Delta_5 \log\left(Revenue/Price\right) \\
\Delta_5 \log\left(Labor\ Productivity\right) &= \Delta_5 \log\left(Real\ Output/Employees\right) \\
\Delta_5 \log\left(Average\ Wage\right) &= \Delta_5 \log\left(Wages/Employees\right) \\
\Delta_5 \log\left(Employees\right) &= \Delta_5 \log\left(Quantity/Labor\ Productivity\right) \\
\Delta \log\left(Payroll\right) &= \Delta_5 \log\left(Average\ Wage \times Employees\right) \\
\Delta_5 \log\left(Wage\ Share\right) &= \Delta_5 \log\left(Wages/Revenue\right)
\end{aligned}$$

The five-year time difference reflects medium-run changes and reflects data availability. This controls for aggregate inflation and growth, as well as secular sectoral effects (such as the relative growth of healthcare and the relative decline in manufacturing). The relationships $f\left(\cdot\right)$ are identified off differences in concentration within an industry and across time. This form is convenient as it is (a) parsimonious, (b) uses readily available data, and (c) allows for simple decompositions and extensions.

The primary issue to running regressions that directly test their relationships is that prices and quantities are equilibrium objects. Shifts in both supply and demand can alter both variables (Schmalensee, 1989). Lacking straightforward exogenous shifters of market concentration, these regressions are presented as correlational and are not used to calculate any counterfactual (which likely would need (a) macroeconomic effects and (b) detailed modeling of both the supply and demand sides).

These regressions are motivated by a variety of classic models in the style of Sutton (1991). Market power increases are driven by increases in the implied (endogenous or exogenous) fixed cost of entry. If such fixed costs increase, but do not reflect either product innovation, increased demand, or decreased marginal costs, then there will be a welfare loss. Examples include heightened barriers to entry from anti-competitive incumbent behavior or costly, unproductive regulation. On the other hand if these increased fixed costs reflect sufficient innovation or production efficiency, then welfare will increase.

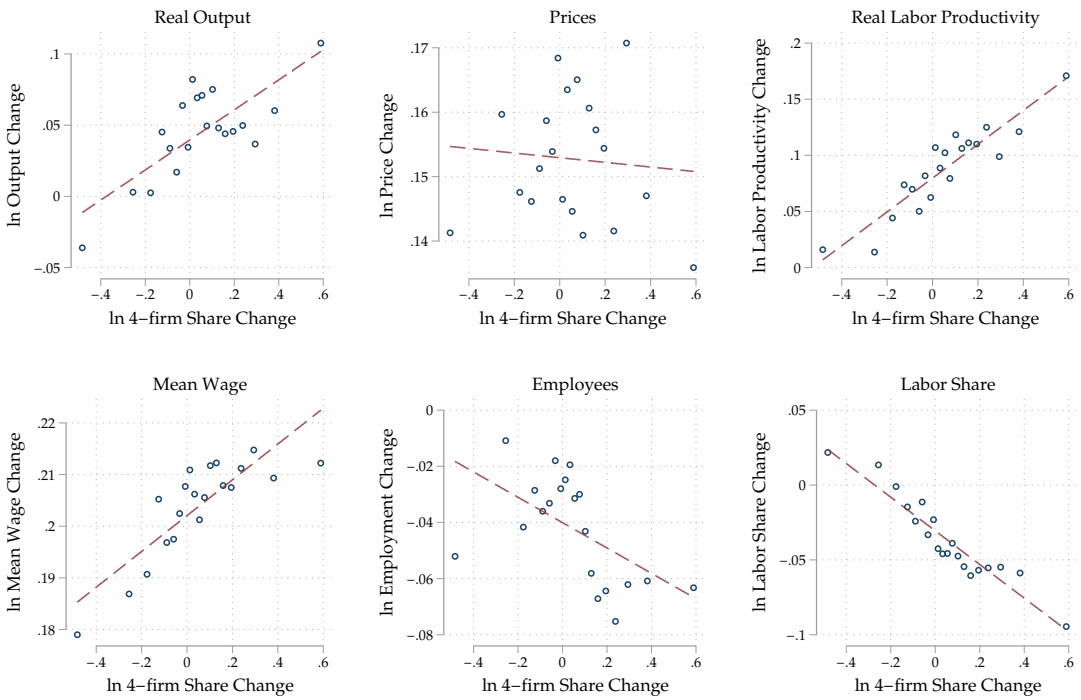
Returning to empirics, the various relationships summarized by the function $f\left(\cdot\right)$ are illustrated in bin-scatter plots in Figure 3.[25] Outcomes can be simply summarized: increases in industry con-

Markets such as retail gasoline and childcare have extremely low market shares. On the other hand, in specialized manufacturing industries that are nationally dominated by one or two firms, a 5% change may simply indicate year-to-year noise. Using using national market shares levels would effectively overweight these latter industries. However, as shown in Section **??**, national market shares are good proxies for more local market shares. Using a logarithms gives these locally monopolistic, but nationally competitive industries more weight. Furthermore, in the Online Appendix, regressions using levels, as opposed to logarithms, gives similar to the baseline results in the main text.

[24] See the Online Appendix for a crosswalk from SIC to 2-digit NAICS.

[25] This figure is replicated as a local polynomial plot in the Online Appendix Figure 5 and in levels in Appendix

Figure 3: Correlation of Economic Outcomes to Market Concentration



Notes: Results from a bin-scatter regression of 5-year changes change in the combined market share of the four largest firms by time period after controlling for year-sector means. Sectors computed using two-digit sector codes according to Table 4. From 1972-1992, data uses 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, 6-digit NAICS codes for all industries. Data from 1992 and 1997 are from non-comparable industrial classification systems. Bin-scatters use 20 bins, with equal numbers of observations in each bin.

centration are significantly correlated with higher output, higher revenue, higher labor productivity, average wages, and lower labor income shares. Monopolization is not correlated with significant changes in prices, employment, or aggregate payroll. Specifically a 10% increase in the market share of the largest four firms is linked to a 1% increase in output, flat prices, 1.5% increase in labor productivity, 0.4% increase in wages, 0.3% decrease in employment, flat total payroll, and 1% decrease in labor's share of output.

The choice of 4-firm concentration shares and real labor productivity are motivated by data availability. Alternative measures of productivity on a smaller sample of industries, such as using hours worked or total factor productivity yield similar results. Alternative measures of concentration, such as the Herfindahl–Hirschman Index and simplified regressions where $f(X) = \alpha X$ are conducted. See the Online Appendix for details.

Two endogeneity concerns warrant further discussion. First, a negative demand shock could lead to higher concentration and lower prices. In light of the expansion in output, this seems improbable. An ideal dataset would include a true demand instrument, however in the Online Appendix, I control for pre-trends in demand by including lagged output and a one-period change in lagged output. Results are largely unchanged. Second, a productivity shock may drive these results. As shown in the baseline results in Figure 4, productivity is highly correlated with market concentration. Omitting productivity in the baseline results would lead to potentially misleading results. Growth in output may not be due to oligopoly growth; the true underlying factor may be productivity growth.

3 Productivity

The third panel of Figure 5 highlights the strong relationship between productivity and market concentration. To investigate, I rerun a similar specification as before, but now use:

$$\Delta_5 \log(Y_{it}) = f\left[\Delta_5 \log(Labor\ Productivity_{it})\right] + \gamma_{st} + \epsilon_{it}$$

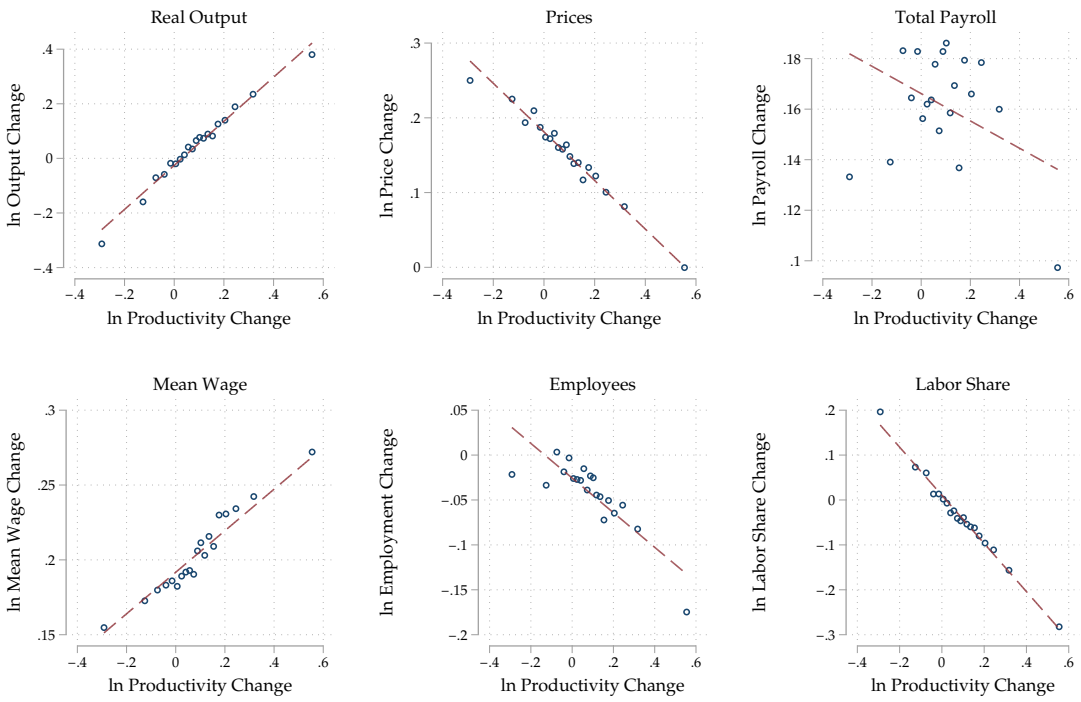
The variables Y represent real output, prices, payroll, mean wages, employees, and labor share. The results are presented as bin-scatter plot in Figure 6.[26] All relationships are similar to those for market concentration, but magnified and precise. Higher labor productivity is correlated with higher output, lower prices, constant payroll, higher wages, fewer employees, lower labor shares. Specifically a 10% increase in the labor productivity is linked to a 8% increase in output, 3% decrease in prices, 1.5% increase in wages, 1.7% decrease in employment, flat total payroll, and 5% decrease in labor's share of output.[27]

Figure 7. Results are similar.

[26]This figure is replicated as a local polynomial plot in the Online Appendix Figure 4. See the Online Appendix for results with alternative measures of productivity on a smaller sample of industries, such as using hours worked or total factor productivity.

[27]This may be partially mechanical, unlike the market concentration results. For example, $Labor\ Productivity = Revenue/Price/Employment$. If prices fall, and revenue and employment remain constant, productivity must rise. However, these are all equilibrium outcomes and it is unlikely that revenue and employment will remain constant.

Figure 4: Correlation of Economic Outcomes to Labor Productivity



Notes: Results from a bin-scatter regression of 5-year changes in labor productivity after controlling for year-sector means. Sectors computed using two-digit sector codes according to Table 4. From 1972-1992, data uses 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, 6-digit NAICS codes for all industries. Data for non-manufacturing firms in 1972 is incomplete. Data from 1992 and 1997 are from non-comparable industrial classification systems. Bin-scatters use 20 bins, with equal numbers of observations in each bin.

Table 1: Market Concentration and Productivity Regressions

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.000669	0.0127	0.0120	0.208
	(0.00462)	(0.00196)	(0.00535)	(0.0197)
Std Δ Ln Productivity	0.166	-0.0653	0.100	
	(0.00698)	(0.00630)	(0.00896)	
r2	0.360	0.614	0.318	0.188
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00444	-0.000669	0.00377	-0.00825
	(0.00146)	(0.00462)	(0.00496)	(0.00210)
Std Δ Ln Productivity	0.0265	-0.0336	-0.00712	-0.107
	(0.00301)	(0.00698)	(0.00756)	(0.00561)
r2	0.590	0.201	0.281	0.547
Observations	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

To better compare these relationship between productivity and market concentration, I run regressions of the form:

$$\Delta_5 \log(X_{it}) = \alpha_1 [\Delta_5 \log(Concentration_{it})] + \alpha_2 [\Delta_5 \log(Labor\ Productivity_{it})] + \gamma_{s,t} + \epsilon_{it}.$$

For comparability, concentration and productivity are standardized by subtracting means and dividing by their standard errors. Results are presented in Table 1. It appears that almost the entirety of the correlation of market concentration and the other observed market outcomes is absorbed by productivity. There is a small positive correlation between prices and market concentration, but as shown in Figure 3, this is completely offset in aggregate as growth in productivity is highly correlated with concentration.[28] However both market concentration and productivity are measured with error, preventing a true disentangling of market power and productivity.[29] Over the last 40 years, productivity growth has been intrinsically tied with the rise of monopolies and oligopolies.

[28] Assuming away measurement error, this means there is a small negative effect of monopoly, a one standard deviation increase in monopoly power offsets 1/5 of the price decrease from a one standard deviation increase in productivity. How should a observer interpret this? The most pessimistic reading is that after controlling for productivity, monopolies do increase prices. But this argument assumes that all other conditions including productivity remain constant. In the light of the close linkage of productivity and concentration, this seems untenable. In the Appendix, looking at only non-manufacturing firms that account for over 80% of the economy, this link between price and industry concentration vanishes.

[29] As shown in the Appendix, measures of regulation seem to be uncorrelated with either productivity or market power.

3.1 Robustness

Even though these relationships are purely correlational, they are extremely robust. I consider a set of alternative specifications. These alternative specification are not to attribute causation, but rather test the strength of the baseline relationships. I focus on two specific forms of heterogeneity, across time and across industries.

In the Online Appendix, I further consider long-run trends, trends in homogenous industries, different methods of computing market share changes, weighted results, the role of factor price inputs, total factor productivity, hourly productivity, import penetration in manufacturing, regulations, and time-series demand controls. The core result, that increases in oligopoly are not directly correlated with price increases and output decreases is well supported in the data across all robustness exercises. The interaction between productivity and market power is extremely robust. More market power is extremely highly correlated with increased productivity - regardless of how market power or productivity are measured.

3.1.1 Industry Heterogeneity

There is significant heterogeneity across industries. Due to the sparsity of the data, I follow (Eckert et al., 2019) and create the following top-level groups: Arts and Hospitality, Health Care, Manufacturing, Trade and Transport (Retail, Wholesale, Shipping), Skilled Tradable Services (Finance and Professional Services), and Other Services (Repairs and Household Services).

Table 2 displays the results. All sectors, with exception of the Hospitality sector, exhibit a positive relationship between productivity and concentration.[30] Most sectors exhibit a positive relationship between concentration and output increases, with Manufacturing and Hospitality showing noisy results. Only one sector shows a correlation between prices and market concentration: the Health Care sector. This echoes systematic research (Cooper et al., 2018), showing that price increases in the hospital sector are systematically due to market concentration. While most sectors see a negative correlation between labor shares and market concentration, this is not true in the Health Care sector, suggesting a very different pattern relative to the rest of the economy.

3.1.2 Timeline Heterogeneity

In Table 3, I replicate out baseline results across time. In particular, our headline finding, that increases in market share are correlated with output and productivity increases are stable from 1987-2012. A one standard deviation increase in market concentration is related to a 2-5% increase in output, no changes in prices, 20-30% increase in productivity, and a 2-5% fall in the labor share of income. Data prior to 1987 is imprecise, reflecting the sparsity and quality of market share data prior to 1987.[31]

[30] Aligning with Aghion et al. (2019), showing that BLS price indices have the largest issues measuring restaurant and hotel entry/exit.

[31] See the Online Appendix discussion of issues with BEA and BLS price index data in services prior to the mid-1980s.

Table 2: Sectoral Heterogeneity: 4-Firm Market Share Change Coefficients

	Δ Ln Output	Δ Ln Price	Δ Ln Labor Productivity	Δ Ln Labor Share
Std Δ Ln 4-Firm Share ×				
Resources + Construction	0.281	-0.0305	1.158	-0.212
	(0.0825)	(0.00703)	(0.341)	(0.0679)
Manufacturing	0.0188	0.00349	0.196	-0.0326
	(0.00964)	(0.00346)	(0.0261)	(0.00413)
Trade + Transport	0.0486	-0.00707	0.232	-0.0341
	(0.0115)	(0.00471)	(0.0383)	(0.00729)
Skilled Tradable Services	0.0672	-0.00253	0.327	-0.0554
	(0.0230)	(0.00215)	(0.0735)	(0.0127)
Health Care	0.0218	0.00469	0.0916	-0.00522
	(0.0108)	(0.00173)	(0.0389)	(0.00344)
Arts + Hospitality	-0.0128	-0.00208	0.0799	-0.00183
	(0.0222)	(0.00235)	(0.0765)	(0.0116)
Other Services	0.0342	-0.00175	0.179	-0.0171
	(0.0130)	(0.00139)	(0.0509)	(0.00776)
r2	0.141	0.502	0.194	0.229
Obs	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 3: Intertemporal Heterogeneity: 4-Firm Market Share Change Coefficients by Year

	Δ Ln Output	Δ Ln Price	Δ Ln Labor Productivity	Δ Ln Labor Share
Std Δ Ln 4-Firm Share ×				
1972-1977	0.0161	-0.0232	0.268	-0.0254
	(0.0193)	(0.0122)	(0.0691)	(0.00979)
1977-1982	-0.0169	-0.0162	0.0480	0.00849
	(0.0201)	(0.00999)	(0.0734)	(0.0107)
1982-1987	0.0242	0.0117	0.0661	-0.0185
	(0.0175)	(0.00594)	(0.0434)	(0.00767)
1987-1992	0.0339	-0.00768	0.177	-0.0229
	(0.0105)	(0.00472)	(0.0300)	(0.00394)
1997-2002	0.0425	0.000170	0.240	-0.0350
	(0.0140)	(0.00304)	(0.0396)	(0.00643)
2002-2007	0.0296	0.000929	0.221	-0.0334
	(0.0156)	(0.00305)	(0.0309)	(0.00540)
2007-2012	0.0544	0.00582	0.293	-0.0504
	(0.0178)	(0.00338)	(0.0555)	(0.0104)
r2	0.138	0.503	0.193	0.226
Obs	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

4 Simple Framework

Competition in individual markets can take many forms of competition - a single model cannot capture all aspects faithfully. I rely on the insights of Sutton-style models (Shaked and Sutton, 1987; Sutton, 1991, 2007), where firms first make sunk investments. These sunk investments may be either exogenous (factories reducing marginal cost) or endogenous (advertising and innovation increasing demand), but are completed before firms compete to sell goods and services. This competition can take a variety of forms, it may be on price, quality, or quantity. Throughout these models, there is one prediction that holds constant; as a market grows in size, market concentration should be weakly decreasing (Sutton, 1991). I do not observe this in the data and it helpful to consider why.

In such models, if fundamental parameters governing sunk costs remain constant, larger markets become more appealing to entrants. However, in a world with technology growth and/or changing production costs, this may not be true. Empirically there is a stark relationship between market concentration growth and productivity growth. Through the lens of these models, if firms pay higher sunk costs over time (say through better automation, R&D, or innovation), then we can break the inverse relationship between market size and concentration. Investments, that once provided limited scope for either increasing demand or decreasing marginal costs, are aided by technical change and now may create winner-take-all economies.

Furthermore to be consistent with the labor share results, the bulk of these fixed costs should be paid to capital, rather than labor. This is consistent with conventional modeling of production functions, where capital is a dynamic investment and labor is more flexible. (See Ackerberg et al. (2015) for a variety of approaches.)[32]

While national market and country market shares are increasing, there is some debate if effective market shares are increasing (Rossi-Hansberg et al., 2018). Data at the zip code level shows that 4-firm shares have remained high, averaging 90%. An increase in output, with no change in price, can be also rationalized in a world where the number of firms at the local level is constant. In that case, monopolies represent a more productive national firm simply displacing smaller local rivals.[33]

In the online appendix, I present two extremely simple models that capture this mechanic. One uses Cournot competition and the other uses Nash-in-Prices competition.

5 Discussion

This paper aims to provide another piece of evidence in the ongoing debate over increases in market power. Industry concentration could theoretically lead to higher prices and lowered output in the

[32]In the online appendix, I present two extremely simple models that capture this mechanic. One uses Cournot competition and the other uses Nash-in-Prices competition. In these two textbook models, an increase in output, productivity, and market concentration can only be rationalized with an increase in fixed costs that lead to lower marginal costs. Furthermore if fixed costs are disproportionately paid to non-labor factors, labor share will fall.

[33]Alternatively, a decrease in the slope of demand, will decrease the quantity demanded and leave price constant. For this story, it must be then true that national monopolies are correlated with systematic shifts in reduced consumer price-sensitivity. However, I do find evidence that national monopolies are correlated with increases in productivity (and thus decreases in marginal costs), detracting from this story.

absence of true productivity innovation or reallocation to superstar firms. However, concentration increases do not correlate to price hikes and correspond to increased output. This implies that oligopolies are related to an offsetting and positive force - these oligopolies are likely due to technical innovation or scale economies. My data suggests that increases in market concentration are strongly correlated with innovations in productivity.

These price and quantity regressions are purely within-industry results and lack causality. They may suffer from omitted variable biases. Results are from 5-year difference-in-difference estimates and assume away general equilibrium effects. However, they show clear patterns between prices, quantities, productivity, and market concentration. Many - if not most - industries could be developing new and novel economies of scale. In retail, Walmart (Holmes, 2011) and Amazon (Houde et al., 2017) both exploit economies of scale to lower their marginal cost and increase market shares. While market power may increase, consumers benefit in the short to medium run through price reductions and real choice increases.[34] On the other hand, these effective firms do not expand their workforces, creating more while holding payroll constant.

This is a trend that is consistently noted, especially from 1987-2012, the period coinciding with high quality price data. But there is substantial heterogeneity between industries. For example, the Health Care sector exhibits classic symptoms, where market concentration increases are correlated to price increases. Though notably, market concentration in the Health Care sector is not correlated with a declining labor share, as the benefits of monopoly may accrue to workers.

This modeling framework also highlights directions for possible future work. We need better data on effective market shares. National and highly local market shares are both problematic. Markets are not mutually exclusive, as there is overlap between regions and industries (for example traditional and online retail). Adding complexity, market definitions may be changing over time, due to changes in both consumer preferences and producer technologies. Additionally, while regional consumption and price data exists for some markets, such as consumer packaged retail goods (Handbury and Weinstein, 2014), further work needs to be done to integrate such data across all markets with appropriate market share data. Welfare in many situations can be quickly summarized by both price and output levels, market power alone is rarely a sufficient statistic.

Finally, taking the superstar firm hypothesis seriously does not imply that antitrust authorities should be powerless. Dominant firms may entrench themselves and use their newly dominant market positions to engage in anti-competitive behavior. Natural monopolies can give way to anti-competitive monopolies that act to raise prices and squelch innovation (Coll, 2017). Monopolies may be taking a bigger share of productivity innovations for themselves and only passing a small share of the gains to the consumer. Effective regulators may want to force monopolies to share a greater share of their surplus with the public (Watzinger et al., 2017).[35]

[34] For an international trade context, see Atkin et al. (2015).

[35] The classic example is the 1956 consent decree between the US Department of Justice and the AT&T, leading to the widespread dissemination of lasers, solar cells Unix operating system, while allowing AT&T to continue as a telecommunications monopoly for another 30 years.

References

Acemoglu, Daron and Pascual Restrepo, "The race between machine and man: Implications of technology for growth, factor shares and employment," Technical Report, National Bureau of Economic Research 2016.

_ and _ , "Robots and jobs: Evidence from US labor markets," 2017.

Ackerberg, Daniel A, Kevin Caves, and Garth Frazer, "Identification properties of recent production function estimators," *Econometrica*, 2015, *83* (6), 2411–2451.

Aghion, Philippe, Antonin Bergeaud, Timo Boppart, Peter J. Klenow, and Huiyu Li, "Missing Growth from Creative Destruction," *American Economic Review*, August 2019, *109* (8), 2795–2822.

Antón, Miguel, Florian Ederer, Mireia Giné, and Martin C Schmalz, "Common ownership, competition, and top management incentives," 2016.

Armstrong, Mark and Robert H Porter, *Handbook of industrial organization*, Vol. 3, Elsevier, 2007.

Atkin, David, Benjamin Faber, and Marco Gonzalez-Navarro, "Retail globalization and household welfare: Evidence from mexico," Technical Report, National Bureau of Economic Research 2015.

Autor, David, David Dorn, Lawrence F Katz, Christina Patterson, John Van Reenen et al., "The Fall of the Labor Share and the Rise of Superstar Firms," 2017.

Azar, José, Ioana Marinescu, and Marshall I Steinbaum, "Labor Market Concentration," Technical Report, National Bureau of Economic Research 2017.

_ , Martin C Schmalz, and Isabel Tecu, "Anti-competitive effects of common ownership," 2016.

_ , Sahil Raina, and Martin C Schmalz, "Ultimate ownership and bank competition," 2016.

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

Barkai, Simcha, "Declining labor and capital shares," *Stigler Center for the Study of the Economy and the State New Working Paper Series*, 2016, (2).

Bernard, Andrew B, J Bradford Jensen, and Peter K Schott, "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of US manufacturing plants," *Journal of international Economics*, 2006, *68* (1), 219–237.

Blonigen, Bruce A and Justin R Pierce, "Evidence for the effects of mergers on market power and efficiency," Technical Report, National Bureau of Economic Research 2016.

Boskin, Michael J, Ellen R Dulberger, Robert J Gordon, Zvi Griliches, and Dale W Jorgenson, "The CPI commission: Findings and recommendations," *The American Economic Review*, 1997, *87* (2), 78–83.

Bresnahan, Timothy F, "Empirical studies of industries with market power," *Handbook of industrial organization*, 1989, *2*, 1011–1057.

Bureau of Labor Statistics, "BLS Handbook of Methods, Chapter 14: Producer Prices," 2008.

_ , "Manufacturing Sector: Capital Intensity [MPU9900082]," Technical Report, retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/MPU9900082 August 2018.

Coll, Steve, *The deal of the century: The breakup of AT&T*, Open Road Media, 2017.

Conforti, Lana, "The first 50 years of the Producer Price Index: setting inflation expectations for today," *Monthly Lab. Rev.*, 2016, *139*, 1.

Cooper, Zack, Stuart V Craig, Martin Gaynor, and John Van Reenen, "The price ain't right? Hospital prices and health spending on the privately insured," *The Quarterly Journal of Economics*, 2018, *134* (1), 51–107.

Covarrubias, Matias, Germán Gutiérrez, and Thomas Philippon, "From Good to Bad Concentration? U.S. Industries over the past 30 years," Working Paper 25983, National Bureau of Economic Research June 2019.

Davis, Peter, "Spatial competition in retail markets: movie theaters," *The RAND Journal of Economics*, 2006, *37* (4), 964–982.

De Loecker, Jan and Jan Eeckhout, "The Rise of Market Power and the Macroeconomic Implications," Technical Report, National Bureau of Economic Research 2017.

Decker, Ryan A, John Haltiwanger, Ron S Jarmin, and Javier Miranda, "Where has all the skewness gone? The decline in high-growth (young) firms in the US," *European Economic Review*, 2016, *86*, 4–23.

Eckert, Fabian, Sharat Ganapati, and Conor Walsh, "Skilled Tradable Services: The Transformation of U.S. High-Skill Labor Markets," *SSRN Electronic Journal*, 2019.

Feenstra, Robert C, "US imports, 1972-1994: Data and concordances," Technical Report, National Bureau of Economic Research 1996.

_ , "US exports, 1972-1994: with state exports and other US data," Technical Report, National bureau of economic research 1997.

_ **and David E Weinstein**, "Globalization, markups, and US welfare," *Journal of Political Economy*, 2017, *125* (4), 1040–1074.

Fort, Teresa C and Shawn D Klimek, "The Effect of Industry Classification Changes on US Employment Composition," Technical Report, Mimeo 2016.

Furman, Jason and Peter Orszag, "A firm-level perspective on the role of rents in the rise in inequality," *Presentation at "A Just Society" Centennial Event in Honor of Joseph Stiglitz Columbia University*, 2015.

Ganapati, Sharat, "The Modern Wholesaler: Global Sourcing, Domestic Distribution, and Scale Economies," 2016.

_ and Brian Greaney, "Market concentration over industry, geography and time," *Unpublished Working Paper*, 2017.

Goolsbee, Austan D. and Peter J. Klenow, "Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce," *AEA Papers and Proceedings*, May 2018, *108*, 488–92.

Gordon, Robert J, "The Boskin Commission report: A retrospective one decade later," Technical Report, National Bureau of Economic Research 2006.

Griliches, Zvi, "Hybrid corn: An exploration in the economics of technological change," *Econometrica, Journal of the Econometric Society*, 1957, pp. 501–522.

Grullon, Gustavo, Yelena Larkin, and Roni Michaely, "Are US Industries Becoming More Concentrated?," *Unpublished Working Paper*, 2016.

Gutiérrez, Germán and Thomas Philippon, "Declining Competition and Investment in the U.S.," Working Paper 23583, National Bureau of Economic Research July 2017.

Handbury, Jessie and David E Weinstein, "Goods prices and availability in cities," *The Review of Economic Studies*, 2014, *82* (1), 258–296.

Head, Keith and Barbara J Spencer, "Oligopoly in International Trade: Rise, Fall and Resurgence," Technical Report, National Bureau of Economic Research 2017.

Holmes, Thomas J, "The Diffusion of Wal-Mart and Economies of Density," *Econometrica*, 2011, *79* (1), 253–302.

Hottman, Colin J, Stephen J Redding, and David E Weinstein, "Quantifying the sources of firm heterogeneity," *The Quarterly Journal of Economics*, 2016, *131* (3), 1291–1364.

Houde, Jean-François, Peter Newberry, and Katja Seim, "Economies of Density in E-Commerce: A Study of Amazon's Fulfillment Center Network," Technical Report, National Bureau of Economic Research 2017.

Karabarbounis, Loukas and Brent Neiman, "The global decline of the labor share," *The Quarterly Journal of Economics*, 2013, *129* (1), 61–103.

Kehrig, Matthias and Nicolas Vincent, "The Micro-Level Anatomy of the Labor Share Decline," Working Paper 25275, National Bureau of Economic Research November 2018.

Kwoka Jr, John E, "Does Merger Control Work: A Retrospective on US Enforcement Actions and Merger Outcomes," *Antitrust LJ*, 2012, *78*, 619.

Landefeld, J Steven and Robert P Parker, "BEA's chain indexes, time series, and measures of long-term economic growth," *Survey of Current Business*, 1997, *77* (5), 58–68.

_ , _ , and Jack E Triplett, "Preview of the comprehensive revision of the national income and product accounts: BEA's new featured measures of output and prices," *Survey of Current Business*, 1995, *75* (7), 31–38.

Locke, Gary, Rebecca M Blank, J Steven Landefeld, and Rosemary D Marcuss, "Measuring the Nation's Economy: An Industry Perspective," 2011.

Marschak, Jacob and William H Andrews, "Random simultaneous equations and the theory of production," *Econometrica, Journal of the Econometric Society*, 1944, pp. 143–205.

McLaughlin, Patrick A, Oliver Sherouse, Daniel Francis, Michael Gasvoda, Jonathan Nelson, Stephen Strosko, and Tyler Richards, "Regdata 3.0 User's Guide," 2017.

Mongey, Simon, "Market structure and monetary non-neutrality," Technical Report, Working paper 2016.

Moulton, Brent R et al., "The expanding role of hedonic methods in the official statistics of the United States," *BEA Papers*, 2001, *14*.

Nardone, Thomas, "Part-time employment: Reasons, demographics, and trends," *Journal of Labor Research*, 1995, *16* (3), 275–292.

Nelson, Randy A and Mark E Wohar, "Regulation, scale economies, and productivity in steam-electric generation," *International Economic Review*, 1983, pp. 57–79.

Olley, G Steven and Ariel Pakes, "The dynamics of productivity in the telecommunications equipment industry," Technical Report, National Bureau of Economic Research 1992.

Peltzman, Sam, "The gains and losses from industrial concentration," *The Journal of Law and Economics*, 1977, *20* (2), 229–263.

Pierce, Justin R and Peter K Schott, "Concording US harmonized system categories over time," Technical Report, National Bureau of Economic Research 2009.

_ and _ , "The surprisingly swift decline of US manufacturing employment," *The American Economic Review*, 2016, *106* (7), 1632–1662.

Porter, Eduardo, "With Competition in Tatters, the Rip of Inequality Widens," *The New York Times*, 2016.

Reenen, John Van, "Increasing Differences between firms: Market Power and the Macro-Economy," 2018.

Rinz, Kevin, "Labor Market Concentration, Earnings Inequality, and Earnings Mobilitya," Technical Report CARRA-WP-2018-10, US Census Bureau Working Paper 2018.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Nicholas Trachter, "Diverging Trends in National and Local Concentration," Working Paper 25066, National Bureau of Economic Research September 2018.

Schmalensee, Richard, "Inter-industry studies of structure and performance," *Handbook of industrial organization*, 1989, *2*, 951–1009.

Shaked, Avner and John Sutton, "Product differentiation and industrial structure," *The Journal of Industrial Economics*, 1987, pp. 131–146.

Shapiro, Carl, "The 2010 horizontal merger guidelines: From hedgehog to fox in forty years," *Antitrust Law Journal*, 2010, *77* (1), 49–107.

Streitwieser, Mary L, "Measuring the nation's economy: an industry perspective," *Bureau of Economic Analysis*, 2010.

Sutton, John, *Sunk costs and market structure: Price competition, advertising, and the evolution of concentration*, MIT press, 1991.

_ , "Market structure: theory and evidence," *Handbook of industrial organization*, 2007, *3*, 2301–2368.

Swick, Roslyn, Deanna Bathgate, and Michael Horrigan, "Services Producer Price Indices: Past, Present, and Future," 2006.

The Economist, "A lapse in concentration," 2016.

Tirole, Jean, *The theory of industrial organization*, MIT press, 1988.

Watzinger, Martin, Thomas A. Fackler, Markus Nagler, and Monika Schnitzer, "How antitrust enforcement can spur innovation: Bell Labs and the 1956 Consent Decree," *Working Paper*, 2017, *CEPR Discussion Paper No. DP11793.*

White, Lawrence J and Jasper Yang, "What Has Been Happening to Aggregate Concentration in the US Economy in the 21st Century?," 2017.

Yuskavage, Robert E, "Improved estimates of gross product by industry, 1959-94," *Survey of Current Business*, 1996, *76* (8), 133–155.

Appendix (For Online Publication Only)

A Simple Theoretical Models

I present two simple oligopoly models, first with Cournot competition and second with monopolistic competition under Bertrand pricing. Both models produce relationships that (a) provide a simple tractable framework and (b) allow for straightforward comparative statics.

A.1 Cournot Competition

Assume there are N identical firms indexed by i competing by setting quantity, with constant marginal costs:

$$c\left(q_i\right) = cq_i.$$

Assume market demand takes the form:

$$p\left(Q\right) = p\left(\sum_{i=1}^{N} q_i\right) = a - bQ$$

In a Cournot equilibrium, each firm produces output q_i at price p:

$$q_i = \frac{a-c}{b\left(N+1\right)}, \quad p = \frac{a+Nc}{N+1} \tag{1}$$

This produces total market output Q :

$$Q = \sum_{i}^{n} q_i = \frac{\left(a-c\right)N}{b\left(N+1\right)}. \tag{2}$$

The last two equations are those that can be tested directly[36]. As N decreases, p increases and total output Q falls, controlling for supply and demand shifters.

Now let us assume that there is a per-period fixed cost F that allow a firm to produce at marginal cost c. Then the number of firms in equilibrium is:[37]

$$N^* = \frac{a-c}{\sqrt{Fb}} - 1.$$

Suppose, due to some exogenous innovation, a new technology $c' < c$ become available. This simulates the rise of productivity. What is this technology? Is it some freely available new general

[36]Simple log-linear transforms can provide the following testable equations:

$$\begin{aligned} \log Q &= \log\left(a-c\right) + \log\frac{N}{N+1} - \log b \\ \log p &= \log\left(a+Nc\right) - \log\left(N+1\right). \end{aligned}$$

[37]In reality, N^* is an integer, but I abstract away from that for analytic tractability.

purpose technology that may reduce/hold constant fixed cost F or is it a new technology that increases fixed costs? In terms of market power, market power will increase if the fixed cost of the new technology F' satisfies the following condition:

$$\frac{a-c}{a-c'} < \sqrt{\frac{F}{F'}}.$$

Furthermore, there exists a continuum of (F', c'), such that innovation is welfare improving. [38]

Implicitly, the empirical specifications testing for the correlation between productivity (whose theoretical analog is $1/c$) and market concentration (whose theoretical analog is $1/N$) answer this question. In light of the empirical results, this model implies that higher fixed costs have simultaneous led to lower marginal costs and fewer market competitors.

There is a further question, is labor a larger component of the fixed costs or the operating costs (marginal cost)? The classic answer is rooted in the simultaneity issue in estimating production functions in Marschak and Andrews (1944); Griliches (1957). As operationalized by Olley and Pakes (1992), labor is more variable than capital. One interpretation of their framework is that fixed costs are equivalent to capital expenditures and that operating costs subsist of labor and materials.

Under this framework, total fixed costs (TF) paid by all firms are simply the product of the number of firms and each firm's fixed cost:

$$N \cdot F = F\left(\frac{a-c}{\sqrt{Fb}} - 1\right).$$

Labor's share of revenues are:

$$\frac{c}{p} = \frac{c}{\frac{a+Nc}{N+1}}.$$

Furthermore if both $N' < N$ and $Q' > Q$, then $c'/p' < c/p$, thus labor's share of income decreases.

A.2 Discrete Choice

Following Berry (1994), assume there are N identical firms indexed by i that face symmetric competition and compete by setting price, with constant marginal costs as before. Consumer j chooses the firm that maximizes utility U_{ij}:

$$U_{ij} = \beta - \alpha p_i + \epsilon_{ij},$$

where ϵ_{ij} is an i.i.d shock drawn from a standard Gumbel distribution and $\alpha > 0$.

Market share for firm i is:

$$s_i(p) = \frac{\exp(\beta - \alpha p_i)}{\sum_{i=1}^{N} \exp(\beta - \alpha p_i)}.$$

[38] I can run a similar exercise if fixed costs can be used to create a larger market $a' > a$. For example, if Apple pays a fixed cost $F' > F$ to acquire intellectual property to add a better camera to their phone, then $a' > a$. Similarly, there exists a continuum of (F', a'), such that innovation is welfare improving.

Suppose that total market size is a function of the average utility level:

$$Q(p) = A\left(\sum_{i=1}^{N} \exp(\beta - \alpha p_i)\right)^{\epsilon}.$$

Where $3A > 0$ is a choke market size and $\epsilon > 0$ is the elasticity. Firms maximize profits Π_i:

$$\Pi_i = \max_{p_i} s_i(p) \cdot Q(p) \cdot (p - c).$$

Profit maximization by identical firms implies that:

$$p = \frac{1}{\alpha\left(1 + (\epsilon - 1)\frac{1}{N}\right)} + c, \quad Q = A\left(N \exp(\beta - \alpha p_i)\right)^{\epsilon}. \tag{3}$$

As in the Cournot example, as the number of competitors increases, price falls and quantity sold increases, controlling for supply and demand shifters. Most common formulations of supply and demand will provide similar results. These examples also point to mechanisms where competition could fall, but prices fall and quantities increase. For example if a decrease is N is consistent with a high fixed cost technology that reduces marginal cost (mechanization, efficiency) or stimulates demand (advertising), it may break the linkage between market concentration, prices, and quantities.

B Data Appendix

For data from 1972-1992, the US Census does not publish statistics using a unified SIC system (the exception being in the Manufacturing sector, where in 1992 the Census published a retrospective tabulation unifying past SIC codes). There are two regimes, a 1972 system and a redefinition in 1987, with minor modification in between. Similarly, from 1997-2012 the US Census does not publish statistics using a unified NAICS system, with each of the 1997, 2002, 2007 and 2012 EC using a slightly different variation of NAICS codes. As this paper uses this Census data,[39] I do not merge or alter the Census defined markets and base the analysis on consistently defined SIC/NAICS codes.[40] Market shares cannot be computed in real units of output, so they are computed using the revenue share of all the facilities a given firm operates within a SIC/NAICS category within the United States. the U.S. Bureau of Economic Analysis (BEA) provides price index and output volume data from 1977 to 2012.[41]

[39] See Ganapati and Greaney (2017) for analysis using a harmonized NAICS codes as published by Fort and Klimek (2016); results are stable to NAICS codes changes. In general, releasing additional, harmonized market share data from Census and administrative US sources is difficult, as disclosure would likely reveal confidential sales and revenue data for the largest firms.

[40] For example, from 1997-2007, the Census published statistics for NAICS industries "311222 Soybean processing" and "311223 Other oilseed processing" separately. In 2012, the Census combined these two industries into a new industry "311224 Soybean and other oilseed processing". I do not merge market share statistics for these two industries and treat them separately. This has the practical effect of decreasing the number of usable observations and increasing the number of industry fixed effects.

[41] This data is not originally collected by the BEA; rather, the BEA aggregates Census and Bureau of Labor Statistics data to produce aggregated and consistent statistics. Prices are simply official government statistics, based

Price indices and supply side controls for manufacturing data are drawn from the NBER-CES database in 4-digit SIC basis before 1997 and in 6-digit NAICS basis after 1997.[42] Price indices for non-manufacturing data come from BEA tables at the most disaggregate level of aggregation provided. As prices and quantities also reflect overall macroeconomic inflation and growth, the analysis in the next section will include year fixed effects and sectoral trends. All of these measured prices are derived from underlying data collected primary by the Bureau of Labor Statistics for the creation of producer and consumer price indices.

Table 4 shows the coverage of the data used from 1972 through 2012. There is continuous coverage for the manufacturing sector over the entire time period at an high level of detail. Coverage is at the 4-digit SIC and 6-digit NAICS levels. Coverage for non-manufacturing sectors is spottier. For wholesale and retail trade, coverage is from 1977 through 2012. However, this is at a higher level of aggregation than the manufacturing sector. From 1982 through 1992, this is at the 3-4 digit SIC level. From 1997 through 2012, this is at the 4-6 digit NAICS level. This level of aggregation is due to the limited availability of consistent price indices at finer levels of aggregation. Service data exists from 1977 through 2012. For 1977 and 1982, the data only covers personal (as opposed to business services) at the 3-4 digit SIC level. For 1982 and 1993, the data covers both personal and business services at the 3-digit level. From 1997 onwards, the data covers all services at the 4, 5 or 6-digit NAICS level. From 1977 through 1992, some transportation sectors (such as those related to automotive transport) and communication sector (such as mass media) data are included in the Service Economic Censuses at the 3-digit SIC level. From 1997 onwards, these sectors, joined by the Utilities and Finance are included at the 3- or 4-digit NAICS levels.

For the manufacturing sector under both SIC and NAICS codes, I add import and export data using concordances from Feenstra (1996, 1997); Pierce and Schott (2009) to better understand the role of import competition. To further consider this role, I directly use the timing of the normalization of trade with china (PNTR) from Pierce and Schott (2016) to look at a exogenous supply shock. To better decompose the difference between the number of hours worked and the number of employees, I add in number of worker hours by industry from the Bureau of Labor Statistics. Lastly for regulation, I use the RegData 3.0 database that quantifies the number of federal regulations pertaining to a NAICS sector by year. The database runs a machine learning algorithm on the entire corpus of federal regulation appearing the the Federal Register from 1970-2016. I consider the change in the number of "Industry Relevant Regulations" at the 6-digit NAICS level.

on weighed prices, observed and collected by the Bureau of Labor Statistics. This is in contrast with the exact price indices in macroeconomic, international trade, and industrial organization models that can directly measure welfare under sets of modeling assumptions.

[42]The NBER-CES data is currently only updated through 2011. I use values from 2011 NBER-CES database to correspond to the 2012 EC. Result are robust to the omission of 2012 data.

B.1 Discussion of Price Index Data

The price index data for both manufacturing and non-manufacturing data is largely originally sourced from the Bureau of Labor Statistics' Producer Price Indices (PPI). These indices measure changes in producer prices over time using a Laspeyres index, reindexing the purchasing weights (with each industry) ever five years. The Laspeyres index uses weights from an initial year and tends to overstate price increases, as buyer tend to substitute away from high priced items. In the context of this project, this will have a minimal effect as long as the degree of substitution within an industry is similar across industries, after controlling for year-sector fixed effects. (Boskin et al., 1997; Gordon, 2006)

There has been an related debate over the consumer price index and the measurement of new product entry, as well as consumer substitution patterns. Much of this debate has to do with the role of the price of physical goods that are sold online, a sector of the economy that has exhibited substantial growth (Goolsbee and Klenow, 2018). This project is a bit different, while some of the products are used by final consumers, many of the services are intermediate inputs. It is still unclear what role e-commerce plays in the pricing of these intermediate goods. Furthermore, new work is needed to document if the set of products within an industry increases or decreases with market concentration.

A related critique with the BLS PPI data has to do with the use of hedonic adjustments to account for both new products and quality changes. Aghion et al. (2019) find that creative destruction, which occurs when new products are better than old ones, will systematically lead to a upward bias in prices (thus understating real growth). However, the BLS has begun responding positively to this critique, introducing quality adjustments for a variety of high tech and services industries, getting better underlying quantity data to correct weights, as well as cross validating this data. It is unclear if these issues are systematically related to trends in market concentration and/or productivity. Results is either direction will systematically bias results and further access to price micro-data may shed light on these issues.

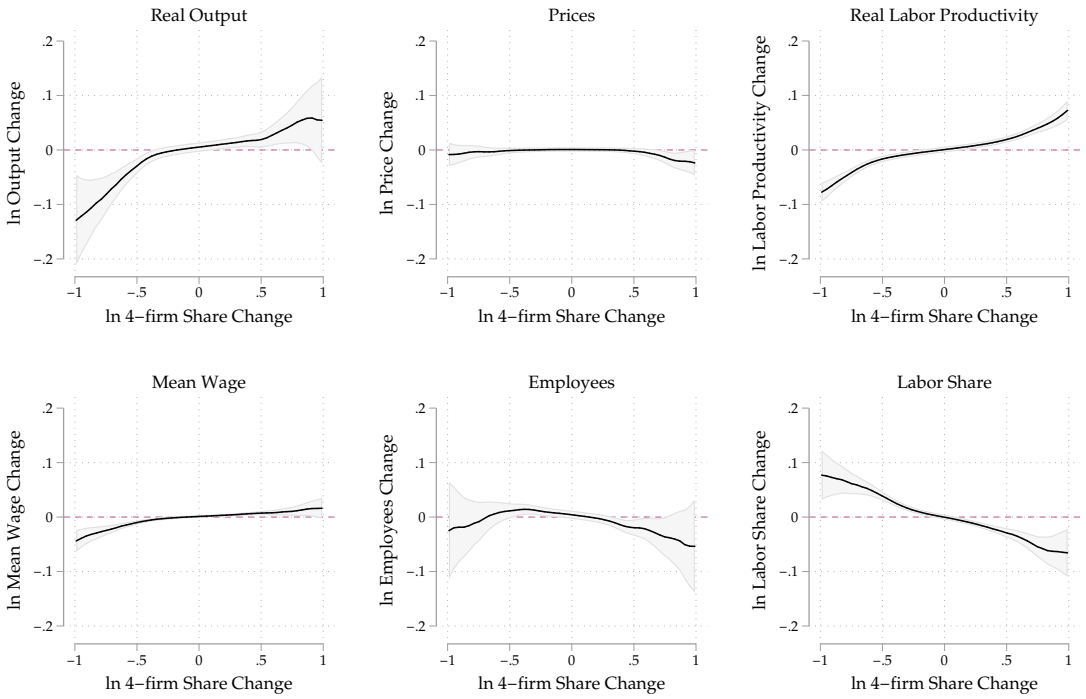
C Replication with Local Polynomial Regressions and Levels

Figures 5 and 6 replicate Figures 3 and 4 using of non-parametric regressions instead of bin-scatter plots. Figure 7 replicates Figure 5 using the levels of 4-firm changes instead of logarithms.

Table 4: Industry Coverage for both Price Indices and Concentration Statistics

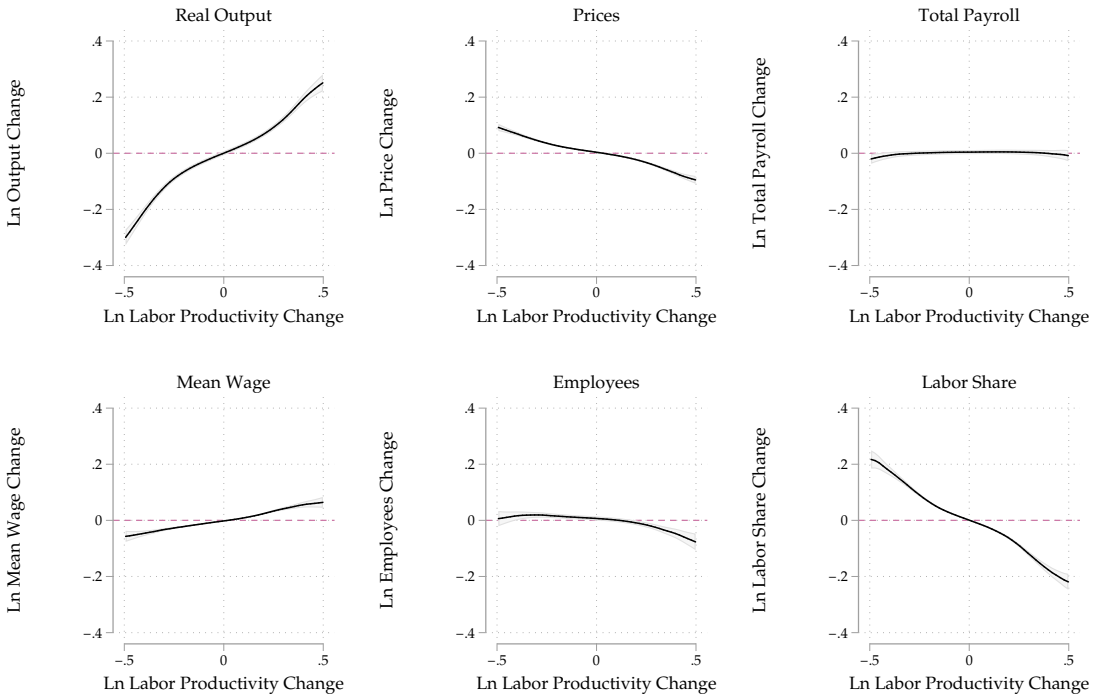
	1972	**1977**	**1982**	**1987**	**1992**	**1997**	**2002**	**2007**	**2012**	2-Digit	Top Level Sector
Classification			SIC				NAICS			Sector	
Agriculture and related										11	
Mining										21	Resources +
Utilities						Part	Part	Part	Part	22	Construction
Construction										23	
Manufacturing	X	X	X	X	X	X	X	X	X	31-33	Manufacturing
Wholesale trade	Part	X	X	X	X	X	X	X	X	42	Trade +
Retail Trade	Part	X	X	X	X	X	X	X	X	44-45	Transport
Transportation						Part	Part	Part	Part	48-49	
Information		Part	Part	Part	Part	X	X	X	X	51	
Finance, Insurance and Real Estate						X	X	X	X	52	Skilled Tradable Services
Real Estate		Part	Part	Part	Part	Part	Part	Part	Part	53	
Professional Services		Part	Part	Part	Part	X	X	X	X	54	
Enterprise Management										55	
Administrative and Waste		Part	Part	Part	Part	X	X	X	X	58	Other Services
Educational Services										61	
Health Care and Assistance			Part	Part	Part	Part	Part	Part	Part	62	Health Care
Arts, Entertainment, and Recreation		Part	Part	X	X	X	X	X	X	71	Arts + Hospitality
Accommodation and Food Services		Part	Part	X	X	X	X	X	X	72	
Other Services		Part	Part	Part	Part	Part	Part	Part	Part	81	Other Services

Figure 5: Correlation of Economic Outcomes to Market Concentration



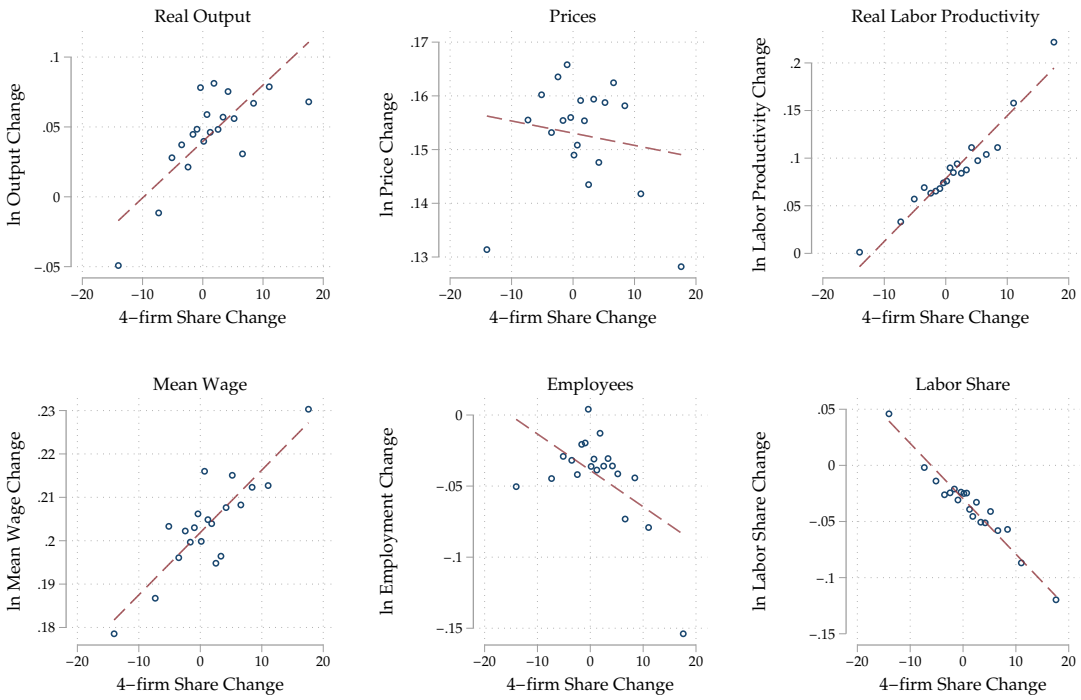
Notes: Results from a non-parametric regression of 5-year changes change in the combined market share of the four largest firms by time period using standardized residuals after demeaning for year-sector means. Sectors computed using two-digit sector codes according to Table 4. For example, the first panel roughly implies that a 1 standard deviation increase in market concentration is correlated with to 0.1 standard deviation increase in real output. From 1972-1992, data uses 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, 6-digit NAICS codes for all industries. Data from 1992 and 1997 are from non-comparable industrial classification systems.

Figure 6: Correlation of Economic Outcomes to Labor Productivity



Notes: Results from a non-parametric regression of standardized 5-year changes in labor productivity using residuals after controlling for year-sector means. Sectors computed using two-digit sector codes according to Table 4. For example, the first panel roughly implies that a 1 standard deviation increase in productivity is correlated with to 0.8 standard deviation increase in real output. From 1972-1992, data uses 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, 6-digit NAICS codes for all industries. Data for non-manufacturing firms in 1972 is incomplete. Data from 1992 and 1997 are from non-comparable industrial classification systems.

Figure 7: Correlation of Economic Outcomes to Market Concentration (Levels)



Notes: Results from a bin-scatter regression of 5-year changes change in the combined market share of the four largest firms by time period using residuals after demeaning for year-sector means. Sectors computed using two-digit sector codes according to Table 4. From 1972-1992, data uses 4-digit SIC codes for manufacturing industries and lowest levels of aggregation for non-manufacturing industries (A mixture of 3 and 4 digit SIC codes). From 1997 onwards, 6-digit NAICS codes for all industries. Data from 1992 and 1997 are from non-comparable industrial classification systems.

D Results Robustness Appendix

D.1 Weighted Results

To consider the economy-wide effect, I consider two forms of weighted results. One, weighting by the share of gross output and the other by the share of employment. Both of these weighting measures are imperfect, however they are internally consistent; one for the final consumption basket and the other for labor input factors. See See Table 6 for a replication of the baseline tables weighting by BEA gross output shares and Table 7 weighting by total industry employment. In the baseline, a one standard deviation increase in the concentration rise is correlated with a 3% increase in output. When results are weighted by gross output, the same concentration correlates to a 4% increase in output. When results are weighted by employment, the same concentration correlates to a 3% increase in output

D.2 Long-Run Relationships

This paper considers short run relationships due to the nature of the underlying data; industry classifications change from year to year, making it difficult to consider long run changes. To partially mitigate this issue, I consider 15-year trends in non-manufacturing (1977-1992 and 1997-2012) and 40-year trends in manufacturing. The break in non-manufacturing is due to changes in industry classification systems. See Tables 8 and 9 for a the 15-year non-manufacturing and 40-year manufacturing trends respectively. In the non-manufacturing sectors, a one standard deviation increase in market power echoes the baseline results, reflecting a 8% increase in output, no price effect, 25% increase in productivity and a 7% decrease in labor's share of output. As before, controlling for productivity mitigates these effects and highlights the role played by the strong relationship between productivity and market concentration.

In manufacturing, I am left with just 76 out of 471 NAICS industries with a useable experimental bridge from SIC to NAICS industry codes (covering 1992-1997). This is a small and highly selected sample of industries accounting for just 13% of manufacturing sales (using 2012 sales). Within this small set, I only obtain imprecise results correlating market share changes to prices, output, or productivity. However, when I control for productivity, I see that increases in market concentration are related to weak increases in prices and decreases in output. These results are all relatively weak, likely attenuated by the long time-spans and likelihood of data mis-specification.

D.3 Manufacturing vs Non-Manufacturing

Manufacturing makes up only around 10% of US GDP. However, Census data on manufacturing is widely available at fine levels of detail and make up nearly half of all observations. As a robustness check, I drop all manufacturing industries from the baseline data set. Results are largely the same. Increases in market concentration are positively correlated with output, revenue, and productivity. I do not find significant changes in wages, employment, or payroll, but confirm the negative correlation

between output and labor's share of revenue. As in the baseline, when controlling for productivity, I find the relationship between market concentration and output/revenue insignificant.

See Table 11 for a replication of the baseline tables, subset to only non-manufacturing firms. Manufacturing data may be contaminated by import data (see table 16 for a comparison) and is therefore hard to directly compare. As before, an increase in the 4-firm concentration share is positively related to increases in output and productivity, while being negatively related to labor's share of revenue. As before, controlling for productivity mutes concentration's relationship to output and labor shares.

D.4 Homogenous Manufacturing Industries

These relationships rely on accurate price and output indices. Homogenous manufacturing industries may have more accurately measured price and output data. As before, I subset the data to just include the 76 homogenous manufacturing industries with consistent data (again accounting for 13% of 2012 manufacturing sales). These are the same industries used to consider long run changes in the manufacturing data. See Table 10 for a replication of the baseline tables. I do not find any correlation of market concentration to output or prices. However, I do find a strong relationships with productivity and labor's share of revenue. A one standard deviation in market concentration leads to 14% higher productivity and a 2% decrease in labor's share of revenue. When controlling for productivity, there is a small positive correlation between price changes and market concentration growth, but this is completely offset by the negative relationship between price changes and productivity growth.

D.5 Levels vs Logarithms

The logarithm of market shares compresses differences under large level changes. An alternative specification would consider level changes in the market shares. Thus a change from 10% to 20% would be roughly equivalent to the change from 30% to 40%.

See Table 13 for a replication of the baseline tables, using the level of 4-firm market concentration (as opposed to the logarithm of the 4-firm market concentration).

D.6 Herfindahl-Hirschman Index

This analysis considers four-firm market shares, as this data is widely available. However a four-firm market share is a crude instrument. Under certain forms of competition (Cournot), a classic Herfindahl-Hirschman Index (HHI) index is a more reliable indicator of market power. Substituting an HHI index for the four-firm market shares, where available within manufacturing, finds results broadly consistent with the baseline estimates. See Table 13 for a replication of the baseline tables, using the Herfindahl-Hirschman index (HHI) computed using the 50 largest firms.

D.7 Factor Price Inputs

Baseline estimates consider output, prices, and revenues without considering the role of input factor prices, such as for materials or capital goods. There may be co-movement in upstream markets, biasing results. For a subset of industries, I directly consider the prices of material and capital inputs. While these factors are quantitatively important, the positive relationship between changes in output, productivity, and concentration remains. See Table 14 for a replication of the baseline tables, controlling for input price indices in both materials and capital.

D.8 Total Factor Productivity

The baseline estimation considered labor productivity, as opposed to total factor productivity. As production becomes more capital intensive (Bureau of Labor Statistics, 2018), the baseline estimates could suffer from mis-measurement. Total factor productivity estimates would allow for better estimates. For a sample of manufacturing industries, substituting total factor productivity for labor productivity results in nearly identical results. See Table 15 for a replication of the baseline tables using total factor productivity instead of labor productivity.

D.9 Hourly Labor Productivity

The baseline results measured labor productivity by considering the total number of workers. However there are long term trends in full-time versus part-time workers (Nardone, 1995). To account for this, in a subset of industries, I consider labor productivity by considering the number of hours worked. See Table 16 for a replication of the baseline tables using hourly employee productivity instead of labor productivity.

D.10 Import Penetration in Manufacturing

Manufactured goods imports have significantly increased over the sample period (Bernard et al., 2006). While the price indices consider only domestically manufactured goods, imports change the market power available to the largest domestic producers. If this trend is monotonic across time, yearly fixed effects will account for imports, but if there are differential trends across industries, market power will be mis-measured. In response I directly control for import penetration in manufacturing. The positive relationship between changes in output, productivity, and concentration remains.

See Table 17 for a replication of the baseline tables controlling for import shares and exogenous changes in PNTR status. Import share is computed as $\frac{imports}{domestic+imports}$. PNTR status comes from Pierce and Schott (2016). It is important to note here that the output prices and market concentrations are for domestic production only.

D.11 Regulation

Regulation is one possible source of scale economies (See (Nelson and Wohar, 1983) for a classic example). To control for regulation, I use data from "Regdata" database that considers US Federal industry-level regulation measures derived from textual analysis of federal laws (McLaughlin et al., 2017). While I find that regulation is quantitatively important, the positive relationship between changes in output, productivity, and concentration remains. See Table 18 for a replication of the baseline tables controlling observed federal regulations.

D.12 Demand Controls

As mentioned earlier, the baseline results lack a true demand instrument. I control for pre-trends in demand by including lagged output and a one-period change in lagged output. The positive relationship between changes in output, productivity, and concentration remains. See Table 19 for a replication of the baseline tables controlling for both lagged production and lagged production growth rates.

Table 5: Baseline Results

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0337	-0.000859	0.0329	0.208
	(0.00604)	(0.00171)	(0.00608)	(0.0197)
r2	0.135	0.501	0.247	0.188
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00995	-0.00765	0.00229	-0.0306
	(0.00156)	(0.00449)	(0.00480)	(0.00348)
r2	0.549	0.189	0.281	0.219
Observations	4719	4719	4719	4719

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.000669	0.0127	0.0120	0.208
	(0.00462)	(0.00196)	(0.00535)	(0.0197)
Std Δ Ln Productivity	0.166	-0.0653	0.100	
	(0.00698)	(0.00630)	(0.00896)	
r2	0.360	0.614	0.318	0.188
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00444	-0.000669	0.00377	-0.00825
	(0.00146)	(0.00462)	(0.00496)	(0.00210)
Std Δ Ln Productivity	0.0265	-0.0336	-0.00712	-0.107
	(0.00301)	(0.00698)	(0.00756)	(0.00561)
r2	0.590	0.201	0.281	0.547
Observations	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 6: Weighted - Gross Output Shares

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0414	-0.00101	0.0404	0.296
	(0.00931)	(0.00110)	(0.00949)	(0.0319)
r2	0.160	0.450	0.230	0.194
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00751	-0.0176	-0.0101	-0.0505
	(0.00351)	(0.00827)	(0.00947)	(0.00728)
r2	0.212	0.160	0.229	0.284
Observations	1372	1372	1372	1372

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.00326	0.00352	0.000254	0.296
	(0.00970)	(0.00130)	(0.00973)	(0.0319)
Std Δ Ln Productivity	0.151	-0.0153	0.135	
	(0.0242)	(0.00345)	(0.0234)	
r2	0.388	0.480	0.405	0.194
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	-0.00262	-0.00326	-0.00588	-0.00613
	(0.00335)	(0.00970)	(0.0115)	(0.00395)
Std Δ Ln Productivity	0.0342	-0.0485	-0.0143	-0.150
	(0.00659)	(0.0242)	(0.0222)	(0.00747)
r2	0.319	0.191	0.231	0.779
Observations	1372	1372	1372	1372

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 7: Weighted - Employment Shares

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0277	0.00172	0.0294	0.108
	(0.00864)	(0.00356)	(0.00778)	(0.0336)
r2	0.206	0.588	0.369	0.254
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00513	0.00619	0.0113	-0.0181
	(0.00213)	(0.00650)	(0.00718)	(0.00473)
r2	0.660	0.297	0.386	0.277
Observations	4719	4719	4719	4719

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0116	0.0105	0.0221	0.108
	(0.00658)	(0.00266)	(0.00726)	(0.0336)
Std Δ Ln Productivity	0.150	-0.0818	0.0677	
	(0.0120)	(0.0106)	(0.0124)	
r2	0.438	0.730	0.412	0.254
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00253	0.0116	0.0141	-0.00802
	(0.00202)	(0.00658)	(0.00737)	(0.00265)
Std Δ Ln Productivity	0.0241	-0.0497	-0.0255	-0.0932
	(0.00475)	(0.0120)	(0.0125)	(0.00951)
r2	0.690	0.328	0.393	0.579
Observations	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 8: 15-year relationship - Non-manufacturing Industries

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0707	-0.0142	0.0566	0.257
	(0.0291)	(0.00822)	(0.0284)	(0.0436)
r2	0.156	0.471	0.188	0.258
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0220	-0.0233	-0.00131	-0.0579
	(0.00627)	(0.0228)	(0.0233)	(0.0164)
r2	0.488	0.137	0.227	0.119
Obs	557	557	557	557

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.0106	0.0107	0.0000594	0.257
	(0.0256)	(0.00858)	(0.0260)	(0.0436)
Std Δ Ln Productivity	0.316	-0.0965	0.220	
	(0.0372)	(0.0132)	(0.0369)	
r2	0.342	0.589	0.285	0.258
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00515	-0.0106	-0.00547	-0.00553
	(0.00628)	(0.0256)	(0.0255)	(0.00945)
Std Δ Ln Productivity	0.0656	-0.0494	0.0162	-0.203
	(0.0105)	(0.0372)	(0.0376)	(0.0151)
r2	0.564	0.143	0.228	0.568
Obs	557	557	557	557

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 9: 40-year relationship - Manufacturing Industries

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.218	0.0946	-0.124	0.0284
	(0.141)	(0.101)	(0.0884)	(0.141)
r2	0.0435	0.0151	0.0319	0.000805
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0123	-0.245	-0.232	-0.109
	(0.0193)	(0.0883)	(0.0868)	(0.0370)
r2	0.00634	0.149	0.124	0.114
Obs	76	76	76	76

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.242	0.115	-0.128	0.0284
	(0.0867)	(0.0341)	(0.0876)	(0.141)
Std Δ Ln Productivity	0.844	-0.703	0.141	
	(0.0911)	(0.0491)	(0.0652)	
r2	0.694	0.848	0.0733	0.000805
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0105	-0.242	-0.232	-0.104
	(0.0162)	(0.0867)	(0.0869)	(0.0268)
Std Δ Ln Productivity	0.0628	-0.0943	-0.0314	-0.172
	(0.0151)	(0.0911)	(0.0830)	(0.0364)
r2	0.171	0.171	0.126	0.399
Obs	76	76	76	76

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 10: Homogenous Industries - Manufacturing Industries

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.000393	-0.00130	-0.000908	0.137
	(0.0135)	(0.00477)	(0.0144)	(0.0435)
r2	0.102	0.539	0.358	0.123
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00447	-0.0275	-0.0230	-0.0221
	(0.00242)	(0.0125)	(0.0132)	(0.00753)
r2	0.770	0.119	0.356	0.209
Obs	532	532	532	532

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.0261	0.0125	-0.0136	0.137
	(0.0125)	(0.00495)	(0.0143)	(0.0435)
Std Δ Ln Productivity	0.193	-0.101	0.0927	
	(0.0124)	(0.0211)	(0.0268)	
r2	0.463	0.712	0.419	0.123
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00294	-0.0261	-0.0231	-0.00955
	(0.00239)	(0.0125)	(0.0133)	(0.00485)
Std Δ Ln Productivity	0.0112	-0.0103	0.000838	-0.0919
	(0.00436)	(0.0124)	(0.0147)	(0.0195)
r2	0.777	0.120	0.356	0.475
Obs	532	532	532	532

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 11: Only Non-Manufacturing Firms

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0517	-0.00397	0.0477	0.238
	(0.00953)	(0.00233)	(0.00931)	(0.0303)
r2	0.159	0.450	0.225	0.218
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0123	-0.000948	0.0113	-0.0364
	(0.00264)	(0.00626)	(0.00672)	(0.00614)
r2	0.335	0.174	0.260	0.197
Observations	1980	1980	1980	1980

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0104	0.00779	0.0182	0.238
	(0.00672)	(0.00238)	(0.00712)	(0.0303)
Std Δ Ln Productivity	0.173	-0.0493	0.124	
	(0.0127)	(0.00601)	(0.0124)	
r2	0.385	0.561	0.345	0.218
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00256	0.0104	0.0130	-0.00523
	(0.00240)	(0.00672)	(0.00718)	(0.00306)
Std Δ Ln Productivity	0.0407	-0.0476	-0.00696	-0.131
	(0.00560)	(0.0127)	(0.0136)	(0.00769)
r2	0.433	0.196	0.260	0.637
Observations	1980	1980	1980	1980

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 12: 4-Firm Market Shares - In Levels

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Δ 4-Firm Share	0.00521	-0.000190	0.00502	0.0361
	(0.00108)	(0.000300)	(0.00108)	(0.00307)
r2	0.139	0.501	0.249	0.215
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Δ 4-Firm Share	0.00155	-0.00197	-0.000424	-0.00545
	(0.000251)	(0.000745)	(0.000797)	(0.000550)
r2	0.551	0.191	0.281	0.242
Observations	4719	4719	4719	4719

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Δ 4-Firm Share	-0.000820	0.00224	0.00142	0.0361
	(0.000791)	(0.000320)	(0.000944)	(0.00307)
Std Δ Ln Productivity	0.167	-0.0673	0.0999	
	(0.00704)	(0.00639)	(0.00900)	
r2	0.360	0.617	0.318	0.215
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Δ 4-Firm Share	0.000606	-0.000820	-0.000214	-0.00163
	(0.000248)	(0.000791)	(0.000828)	(0.000359)
Std Δ Ln Productivity	0.0262	-0.0320	-0.00581	-0.106
	(0.00306)	(0.00704)	(0.00763)	(0.00568)
r2	0.590	0.201	0.281	0.549
Observations	4719	4719	4719	4719

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 13: Using 50-Firm Herfindahl-Hirschman index (HHI) Concentration Measures

(a) 50-Firm HHI

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 50-Firm HHI	0.00980	0.00613	0.0159	0.152
	(0.0116)	(0.00544)	(0.0127)	(0.0345)
r2	0.0377	0.154	0.0852	0.0635
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 50-Firm HHI	0.00881	-0.0205	-0.0117	-0.0276
	(0.00298)	(0.0107)	(0.0118)	(0.00534)
r2	0.0422	0.0168	0.0195	0.206
Observations	1150	1150	1150	1150

(b) 50-Firm HHI & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 50-Firm HHI	-0.0172	0.0177	0.000476	0.152
	(0.0107)	(0.00412)	(0.0129)	(0.0345)
Std Δ Ln Productivity	0.178	-0.0761	0.102	
	(0.0125)	(0.0157)	(0.0212)	
r2	0.257	0.329	0.144	0.0635
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 50-Firm HHI	0.00581	-0.0172	-0.0114	-0.0119
	(0.00307)	(0.0107)	(0.0120)	(0.00436)
Std Δ Ln Productivity	0.0197	-0.0215	-0.00175	-0.103
	(0.00380)	(0.0125)	(0.0141)	(0.0138)
r2	0.0941	0.0210	0.0196	0.451
Observations	1150	1150	1150	1150

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 14: Controlling for Factor Input Prices

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0356	0.000771	0.0364	0.232
	(0.00734)	(0.00153)	(0.00733)	(0.0229)
S.log(Material Price)	0.0139	0.731	0.744	-1.592
	(0.0917)	(0.0732)	(0.117)	(0.342)
S.log(Capital Price)	-0.0203	0.0695	0.0492	-0.889
	(0.120)	(0.0558)	(0.106)	(0.597)
r2	0.119	0.641	0.265	0.197

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0123	-0.0106	0.00172	-0.0347
	(0.00184)	(0.00540)	(0.00564)	(0.00398)
S.log(Material Price)	0.0410	0.331	0.372	-0.373
	(0.0153)	(0.0923)	(0.0946)	(0.0437)
S.log(Capital Price)	0.0502	0.157	0.207	0.158
	(0.0365)	(0.115)	(0.104)	(0.0709)
r2	0.556	0.171	0.258	0.247
Observations	3905	3905	3905	3905

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.00191	0.0126	0.0107	0.232
	(0.00560)	(0.00190)	(0.00609)	(0.0229)
Std Δ Ln Productivity	0.162	-0.0508	0.111	
	(0.00860)	(0.00574)	(0.00917)	
S.log(Material Price)	0.272	0.650	0.921	-1.592
	(0.0914)	(0.0585)	(0.132)	(0.342)
S.log(Capital Price)	0.124	0.0243	0.148	-0.889
	(0.107)	(0.0405)	(0.110)	(0.597)
r2	0.318	0.705	0.343	0.197

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00559	-0.00191	0.00368	-0.00698
	(0.00167)	(0.00560)	(0.00586)	(0.00220)
Std Δ Ln Productivity	0.0288	-0.0373	-0.00846	-0.119
	(0.00361)	(0.00860)	(0.00924)	(0.00548)
S.log(Material Price)	0.0868	0.272	0.358	-0.563
	(0.0167)	(0.0914)	(0.0972)	(0.0527)
S.log(Capital Price)	0.0758	0.124	0.199	0.0515
	(0.0277)	(0.107)	(0.104)	(0.0470)
r2	0.599	0.183	0.259	0.614
Observations	3905	3905	3905	3905

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 15: Controlling for Total Factor Productivity (Manufacturing Only)

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0337	-0.000859	0.0329	0.0830
	(0.00604)	(0.00171)	(0.00608)	(0.0395)
r2	0.135	0.501	0.247	0.0401
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0101	-0.0203	-0.0103	-0.0326
	(0.00212)	(0.00873)	(0.00937)	(0.00410)
r2	0.677	0.0787	0.252	0.189
Observations	2739	2739	2739	2739

(b) 4-Firm Market Shares & Total Factor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.00605	0.00921	0.0153	0.0830
	(0.00836)	(0.00336)	(0.00987)	(0.0395)
Std Δ Ln TFP	0.153	-0.0686	0.0848	
	(0.0433)	(0.00982)	(0.0347)	
r2	0.327	0.623	0.308	0.0401
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00993	-0.0244	-0.0144	-0.0297
	(0.00212)	(0.00863)	(0.00925)	(0.00375)
Std Δ Ln TFP	0.00142	0.0487	0.0502	-0.0346
	(0.00263)	(0.0257)	(0.0279)	(0.00772)
r2	0.677	0.112	0.278	0.234
Observations	2739	2739	2739	2739

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 16: Use Hourly Measures of Productivity

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0337***	-0.000859	0.0329***	0.195***
	(0.00604)	(0.00171)	(0.00608)	(0.0285)
r2	0.135	0.501	0.247	0.0918
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00791**	-0.0153	-0.00739	-0.0317***
	(0.00300)	(0.00799)	(0.00784)	(0.00369)
SectorYearFE	X	X	X	X
N	3039	3039	3039	3039
r2	0.496	0.114	0.259	0.216

(b) 4-Firm Market Shares & Hourly Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.00431	0.0165***	0.0122	0.195***
	(0.00772)	(0.00280)	(0.00879)	(0.0285)
Std Δ Ln Productivity	0.131***	-0.0685***	0.0620***	
	(0.00706)	(0.00782)	(0.0102)	
r2	0.273	0.630	0.287	0.0918
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	-0.00226	-0.00431	-0.00657	-0.0188***
	(0.00264)	(0.00772)	(0.00792)	(0.00305)
Std Δ Ln Productivity	0.0521***	-0.0563***	-0.00419	-0.0662***
	(0.00502)	(0.00706)	(0.00805)	(0.00541)
SectorYearFE	X	X	X	X
N	3039	3039	3039	3039
r2	0.594	0.152	0.259	0.368

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4.Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data

Table 17: Controlling for Import Penetration (Manufacturing Only)

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.00398	0.00833	0.00434	0.200
	(0.0171)	(0.00716)	(0.0180)	(0.0531)
S.log(Import Penetration)	-3.074	-0.326	-3.400	-2.269
	(0.473)	(0.247)	(0.495)	(1.154)
PNTR Status x Post 1999	-0.238	-0.0946	-0.332	0.538
	(0.0827)	(0.0335)	(0.0913)	(0.195)
r2	0.242	0.152	0.302	0.0726

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0116	-0.0437	-0.0322	-0.0365
	(0.00433)	(0.0139)	(0.0150)	(0.00829)
S.log(Import Penetration)	-0.205	-2.622	-2.827	0.573
	(0.0724)	(0.409)	(0.416)	(0.163)
PNTR Status x Post 1999	0.0569	-0.345	-0.288	0.0443
	(0.0156)	(0.0755)	(0.0760)	(0.0361)
r2	0.0642	0.260	0.259	0.201
Observations	1002	1002	1002	1002

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.0390	0.0236	-0.0154	0.200
	(0.0142)	(0.00639)	(0.0179)	(0.0531)
Std Δ Ln Productivity	0.175	-0.0763	0.0991	
	(0.00999)	(0.0189)	(0.0209)	
S.log(Import Penetration)	-2.675	-0.500	-3.175	-2.269
	(0.406)	(0.212)	(0.497)	(1.154)
PNTR Status x Post 1999	-0.332	-0.0536	-0.385	0.538
	(0.0749)	(0.0329)	(0.0889)	(0.195)
r2	0.478	0.330	0.363	0.0726

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00861	-0.0390	-0.0304	-0.0149
	(0.00437)	(0.0142)	(0.0155)	(0.00651)
Std Δ Ln Productivity	0.0149	-0.0237	-0.00884	-0.108
	(0.00430)	(0.00999)	(0.0108)	(0.0164)
S.log(Import Penetration)	-0.171	-2.675	-2.847	0.328
	(0.0670)	(0.406)	(0.412)	(0.217)
PNTR Status x Post 1999	0.0489	-0.332	-0.283	0.102
	(0.0146)	(0.0749)	(0.0756)	(0.0329)
r2	0.0960	0.266	0.260	0.465
Observations	1002	1002	1002	1002

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data, Pierce and Schott (2016, 2009); Feenstra (1996)

Table 18: Controlling for Measures of Federal Industry Regulation

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0425	0.00244	0.0449	0.266
	(0.00945)	(0.00206)	(0.00953)	(0.0319)
S.log(Regulations)	0.0983	0.0269	0.125	0.136
	(0.0397)	(0.0181)	(0.0407)	(0.135)
r2	0.140	0.192	0.196	0.193
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0127	-0.0106	0.00213	-0.0428
	(0.00265)	(0.00686)	(0.00735)	(0.00574)
S.log(Regulations)	0.0134	0.0711	0.0846	-0.0406
	(0.00908)	(0.0304)	(0.0308)	(0.0247)
r2	0.154	0.225	0.251	0.258
Observations	2201	2201	2201	2201

(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.000313	0.0149	0.0152	0.266
	(0.00705)	(0.00327)	(0.00831)	(0.0319)
Std Δ Ln Productivity	0.158	-0.0469	0.111	
	(0.0104)	(0.0104)	(0.0141)	
S.log(Regulations)	0.0767	0.0333	0.110	0.136
	(0.0304)	(0.0175)	(0.0355)	(0.135)
r2	0.341	0.305	0.283	0.193
	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00466	0.000313	0.00497	-0.0103
	(0.00246)	(0.00705)	(0.00774)	(0.00352)
Std Δ Ln Productivity	0.0301	-0.0408	-0.0107	-0.122
	(0.00503)	(0.0104)	(0.0113)	(0.00917)
S.log(Regulations)	0.00934	0.0767	0.0860	-0.0239
	(0.00865)	(0.0304)	(0.0307)	(0.0170)
r2	0.238	0.240	0.252	0.598
Observations	2201	2201	2201	2201

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data, Mercatus Center

Table 19: Controlling for Lagged Demand and Pre-trends

(a) 4-Firm Market Shares

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	0.0375	0.00188	0.0394	0.222
	(0.00804)	(0.00202)	(0.00831)	(0.0232)
L.log(Output)	0.00864	-0.00108	0.00756	0.00997
	(0.00444)	(0.00305)	(0.00516)	(0.0190)
LS.log(Output)	0.102	-0.0164	0.0852	-0.0757
	(0.0370)	(0.0111)	(0.0367)	(0.0795)
r2	0.152	0.400	0.165	0.175

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.0107	-0.00667	0.00404	-0.0353
	(0.00232)	(0.00588)	(0.00623)	(0.00441)
L.log(Output)	-0.0000600	0.00666	0.00660	-0.000961
	(0.00171)	(0.00416)	(0.00422)	(0.00248)
LS.log(Output)	0.00190	0.117	0.119	0.0334
	(0.00677)	(0.0362)	(0.0365)	(0.0120)
r2	0.531	0.169	0.236	0.160
Observations	2982	2982	2982	2982

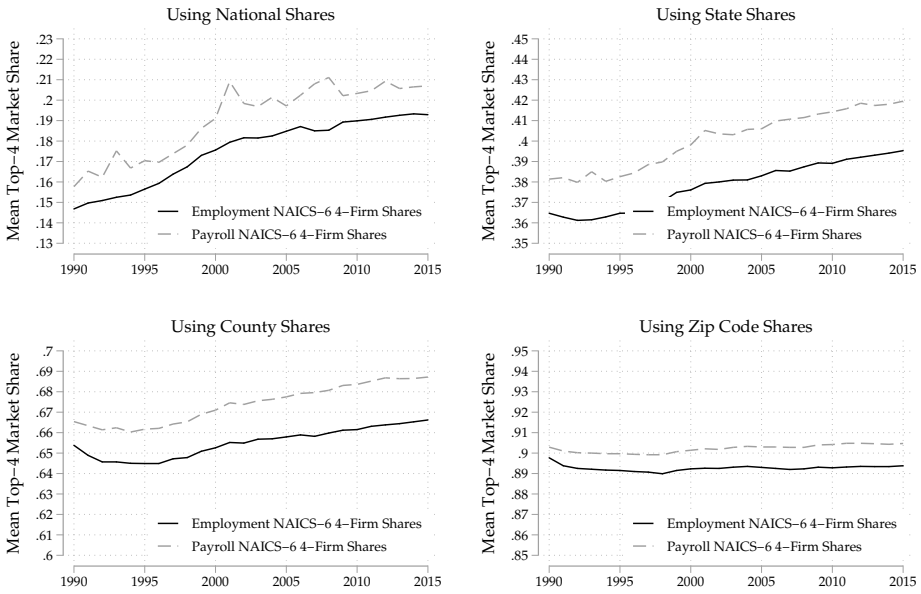
(b) 4-Firm Market Shares & Labor Productivity

	Δ Ln Output	Δ Ln Price	Δ Ln Revenue	Δ Ln Labor Productivity
Std Δ Ln 4-Firm Share	-0.000857	0.0143	0.0134	0.222
	(0.00618)	(0.00236)	(0.00714)	(0.0232)
Std Δ Ln Productivity	0.173	-0.0559	0.117	
	(0.00830)	(0.00585)	(0.0103)	
L.log(Output)	0.00692	-0.000527	0.00639	0.00997
	(0.00400)	(0.00254)	(0.00544)	(0.0190)
LS.log(Output)	0.115	-0.0206	0.0941	-0.0757
	(0.0360)	(0.00965)	(0.0371)	(0.0795)
r2	0.384	0.506	0.263	0.175

	Δ Ln Mean Wage	Δ Ln Employees	Δ Ln Payroll	Δ Ln Labor Share
Std Δ Ln 4-Firm Share	0.00386	-0.000857	0.00300	-0.0104
	(0.00217)	(0.00618)	(0.00654)	(0.00269)
Std Δ Ln Productivity	0.0309	-0.0262	0.00470	-0.112
	(0.00389)	(0.00830)	(0.00883)	(0.00520)
L.log(Output)	-0.000368	0.00692	0.00655	0.000159
	(0.00151)	(0.00400)	(0.00423)	(0.00245)
LS.log(Output)	0.00424	0.115	0.119	0.0249
	(0.00625)	(0.0360)	(0.0366)	(0.00967)
r2	0.583	0.176	0.236	0.524
Observations	2982	2982	2982	2982

Notes: Robust standard errors clustered on BEA industry codes. Regressions include year-sector fixed effects. Sectors computed using two-digit sector codes according to Table 4. Observations at the NAICS 6-digit level for 1997-2012 and at the SIC 3 and 4-digit level for 1972-1992. Data from 1992 and 1997 are from non-comparable industrial classification systems. Market shares and productivity changes are standardized by subtracting means and dividing by standard errors.
Sources: Author's Calculations based on US BEA, BLS, Census, NBER-CES data,

Figure 8: Market Share by Employment and Payroll, 1990-2015 - Balanced Panel

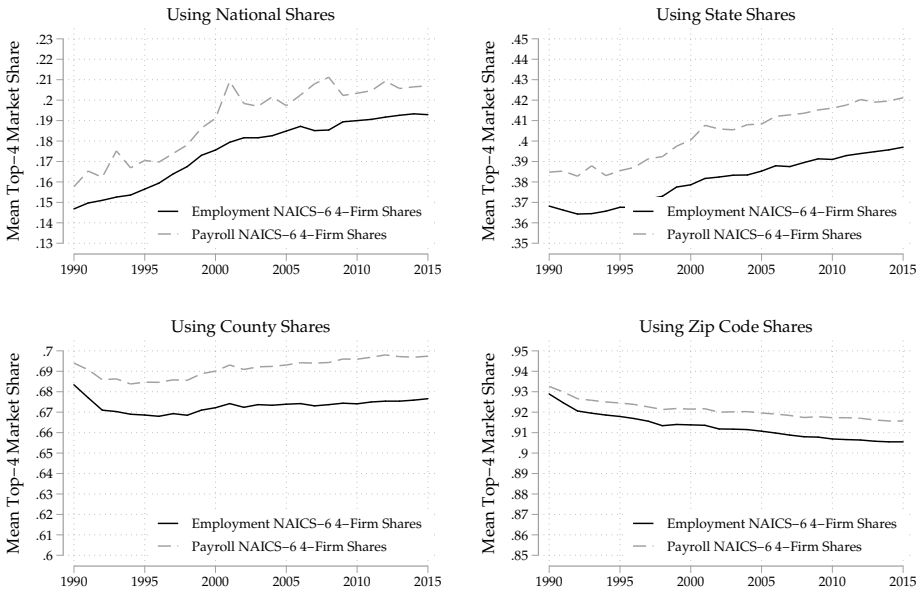


Notes: These four graphs plot changes in the average market share of the top four firms across 6-digit NAICS codes. Data drawn from a balanced panel from 1990 through 2015, with data weighted using employment levels in 1990. Counterclockwise from the top left, I use national market definitions, state market definitions, county market definitions, and finally 5-digit Zip code market definitions. The solid trend-line plots market shares computed using payroll. The dotted trend-line plots market share computed using employment. Data aligned from 1990-2005 to 2012 NAICS codings from the Longitudinal Business Database for all firms with either payroll or employment.

E Market Concentration Robustness

Rinz (2018) and Rossi-Hansberg et al. (2018) find that local market concentration has decreased, while I find that market concentration at the Zip code level is relative constant. I broadly replicate their findings and show that this is simply due to disappearing markets and extremely small markets. Suppose a world has two locations, a city and small town. For simplicity, assume that the underlying population stays constant. The city has many highly competitive firms. The small town has a set of firms that operates as an oligopoly. Suppose that some time passes and the firms in the city become more concentrated and all the firms in the small town become bankrupt. Has the average level of market concentration gone up or down? This depends on how you aggregate markets without any firms. See this table:

Figure 9: Market Share by Employment and Payroll, 1990-2015 - Unbalanced Panel



Notes: These four graphs plot changes in the average market share of the top four firms across 6-digit NAICS codes. Data drawn from a *unbalanced* panel from 1990 through 2015, with data weighted using employment levels in 1990. I use national market definitions, state market definitions, county market definitions, and finally 5-digit Zip code market definitions. The solid trend-line plots market shares computed using payroll. The dotted trend-line plots market share computed using employment. Data aligned from 1990-2005 to 2012 NAICS codings from the Longitudinal Business Database for all firms with either payroll or employment.

Market	Market Weight	HHI by Year	
		1990	2010
City	0.9	1000	1200
Town	0.1	5000	

HHI Statistic	HHI by Year	
	1990	2010
Unbalanced Panel	1400	1200
Balanced Panel	1000	1200

If we use a balanced sample, we only consider the market share in the city - where we have a continuous sample. And market shares then increase - entirely due to the effect in the city. On the other hand if we use an unbalanced sample, then market share decreases, as the highly concentrated town drops out of the sample, completely masking the increased market share in the city. With an unbalanced panel, if an area loses a monopolist, aggregate concentration decreases. This does not occur with a balanced panel.

For example a grocery store may go out of business. This is extremely common in our data at the Zip Code - 6-digit NAICS level. There are approximately 42,000 5-digit zip codes and 1,000 6-digit NAICS industries. Combined, there are 42 million possible markets. In 1999, there were only 5,408,174 active establishments. In 2015, there were 6,786,097 active establishments.[43] Zero market shares are extremely common.[44]

Figures 8 and 9 compare these two approaches, first using a balanced panel and the second using an unbalanced panel.[45] Data at the National and State level look largely identical. Results start diverging at the County or Zip code level. The balanced panel finds small increases in market concentration at the county level and nearly no change in market concentration at the zip code level. The unbalanced panel finds slight decreases at both the county and zip code level. For example, the 4-firm payroll concentration at the zip-code level decreases from 93% to 92%. While there is a slight decrease, this also obscures a related point. If bins are drawn extremely narrowly (such as at the zip code level), concentration will mechanically be extremely high.

Extremely local market concentrations can be misleading. Furthermore, this approach assumes that markets are *mutually exclusive*, without spillovers. Consumers may switch to a store in a neighboring zip code, or buy products from a superstore that combines both groceries and consumer durables. To illustrate this point, consider Hudson County, which includes Hoboken and West New York. It is part of New Jersey, and part of the New York MSA and commuting zone 19600. New York County is across the Hudson river and consists of Manhattan. It is part of New York State, part of the New York City MSA, but part of commuting zone 19400.

If we use national markets or MSAs, these counties are part of the same market. If we use

[43] See US Census Business Dynamics Statistics at https://www.census.gov/ces/dataproducts/bds/data_firm2015.html.

[44] For example there were 8,721 pawnshops operating in the United States in 2012, but over 42,000 zip codes. Even split between 3,000 counties, many counties will not have a pawn shop.

[45] Results that vary weights by time period show broadly similar results.

counties, states, or commuting zone, these counties are part of different markets. The Industrial Organization literature seriously accounts for this, by looking at the cost of distance, in a market-by-market fashion (For an example see Davis, 2006). However this has not been systematically exploited at a macro-economic scale, looking across industries - likely for data availability reasons.

The analysis by Rinz (2018) aims to look at local labor markets finds that as more workers move to dense agglomerations, monopsony power decreases. As a retail worker may switch sectors, but still work within retail, Ritz aggregates data to commuting zones and high-level industry aggregates. The analysis by Rossi-Hansberg et al. (2018) is a bit different. The authors look at market concentrations at the 8-digit level, using a proprietary dataset that claims to include establishment level revenue counts. As such data is quite imprecise, even when using administrative tax data, more work needs to be done to understand the nature of the underlying data set. For example, what happens to internal firm transfers? How are data validated? How is value-added attributed up and down the supply chain?