2020

Productivity, Prices and Productivity in Manufacturing: a Demsetzian Perspective

Sam Peltzman

Productivity, Prices and Concentration in Manufacturing: A Demsetzian Perspective

Sam Peltzman[1]

University of Chicago, Booth School of Business

[1] samp@uchicago.edu. This paper was prepared for a conference to honor the memory of Harold Demsetz. I want to thank Dennis Carlton and John Asker for comments and suggestions. A previous version appears as "Productivity, Prices and Concentration in Manufacturing During an Era of Rising Concentration" available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3168877

Abstract

Concentration has increased since the 1980s in a variety of industries. Price-cost margins have also increased over this period. These developments have raised concern about weakened competition and resulting harm to consumers. Calls for tougher antitrust enforcement have become louder. Many years ago Harold Demsetz (1973) cautioned against inferring weakened competition from a confluence of rising margins and concentration. He argued that productivity differences across firms were a potential "omitted variable." This paper provides evidence on the interplay between concentration, prices and productivity across several hundred US manufacturing industries over two 15 year periods from 1982-2012. The consistent pattern is that high and rising concentration has been on average associated with better productivity growth. Rising concentration has also been associated with widening margins of price-cost margins. I show that widening margins generally, whether related to concentration or not, are mainly driven by productivity gains, not prices. as in the competitive process outlined in Demsetz (1973). Some skepticism about tougher antitrust policy may be warranted, since this would risk harm to productivity without benefitting consumers.

JEL Classifications: L11, L40, D24, D4, K21

Keywords: Concentration, Prices, Productivity, Margins, Manufacturing, Antitrust Policy

1. Introduction

Harold Demsetz (1973) made a seminal contribution to the literature on the effects of industrial concentration. Much has happened since then - in the economy, in the policy arena and in academia. In this paper I will reopen some of the questions Demsetz raised nearly 50 years ago, and I will show that some of his answers are quite durable.

Within a decade of publication of Demsetz's (1973) article on concentration and profits, industrial concentration in the US began rising (Peltzman, 2014). This ended a long period of stability dating back to the beginning of the twentieth century. In 1982 antitrust policy on mergers also changed decisively. The Department of Justice Merger Guidelines of 1982 [2]adopted a less restrictive policy focused mainly on mergers in very highly concentrated industries. That policy remains in place today. Profit margins have also increased in the post-Guidelines period.[3] The relaxed merger policy, the increased concentration and the economic effects thereof have come under increased scrutiny by economists and also in the policy and political arenas.[4]

This paper is about prices, costs and productivity in US manufacturing since the advent of the merger guidelines. US manufacturing has been buffeted by many forces beside antitrust policy during this period. These include the shift of economic activity toward services, increased imports of manufactured goods and inputs (global supply chains), and so on. Manufacturing's share of the total

---

[2] See US Department of Justice and Federal Trade Commission (2010) for the current version.

[3] For the manufacturing sector, which is the focus of this paper, the National Income and Product Accounts show a margin (gross output – (purchased inputs + employee compensation) of 8.6 percent of gross output in 1982. This rises sharply to 15.6 percent by 1997 and then more gently to 18.2 percent in the subsequent 15 year period ending 2012. (Data available at https://apps.bea.gov/histdata/index.cfm). This paper and much of the cited literature use Economic Census data, which generally yield higher margin data, mainly because the Census-based margin does not deduct the cost of purchased services and the value of non-payroll employee benefits such as employee provided health insurance. However, both versions have the same trend – a sharp rise to the late 1990s and a more gentle rise subsequently.

[4] See.e.g., Galston and Hendrickson, 2018.

economy has declined substantially. In 1982, manufacturing accounted for 19 per cent of both GDP and non-agricultural employment. By 2012, the end of my sample period, these had declined to 12 and 9 percent respectively. The decline was especially pronounced in the second half of this period.

I focus on manufacturing because the relevant data are more complete and readily available. Concentration, price, cost and productivity measures at industry levels roughly matching plausible antitrust markets are available at sufficient frequency over most of the post- Merger Guidelines period.[5] However, manufacturing, especially in its current shrunken state, is not necessarily representative of the larger economy. Another caveat is that nothing in this paper implies a causal link running from concentration to performance measures like prices and productivity. This paper is essentially about descriptive correlation among these variables. Indeed, I will argue, as did Demsetz (1973), that the more plausible stories underlying these correlations are non-causal, in the sense that the correlations are capturing common forces operating on the key variables.

The empirical work addresses a number of questions, such as: has increased concentration, on balance, been associated with rising prices over this period? With widening price-cost margins? With better or worse productivity performance? The answers to such questions are policy relevant even if they are just describing what occurred in a particular period. Antitrust merger policy presumes a causal link between concentration and prices. But the policy is entirely prospective. So risks of error are inevitable: approving a merger that turns out to harm competition or rejecting a merger that would have improved competition. A more restrictive policy, such as the one before 1982, increases the risk of rejecting beneficial mergers. The more lenient recent policy increases the risk of approving harmful mergers. Accordingly, in thinking about whether a more or less lenient policy is the better one, we want

[5] Concentration data for some non-manufacturing industries, such as retailing, have also become available. However, these are for the entire US, while many retail markets are local. By now some post 2012 manufacturing data are also available, but this has not as of mid-2020 been integrated into the NBER's manufacturing database, which I use extensively. A major industry re-classification in 2012 also raises comparability issues.

to ask which of the two kinds of error risk is likely to be the greater. Where we locate our priors on the answer, depends on facts such as those summarized in this paper. For example, if increased concentration since 1982 has usually been accompanied by increased prices, a reasonable reaction, pending further investigation, would be toward more skepticism about the more permissive recent merger policy.

The aggregated facts are not too helpful here. For example, from 1982 -2012 the relative price index for all manufactured goods has declined even as concentration in the sector has increased. Specifically manufacturing good prices increased by 1.7 per cent annually and 2.3 per cent annually for all private industry.[6] However, the superior manufacturing price performance is essentially coming from one sector – computers and electronics – with extraordinary productivity growth. As I show later, there has been much variety across manufacturing industries in both the change in market structure and the change in performance. This paper analyzes that variety. It is thus a throwback to an older, now unfashionable empirical literature that uses cross-industry analysis to draw inferences about competition.

This is not the place for a detailed review of that literature.[7] In the next section I try to give just enough background to surface the main results and some of the problems that ultimately led industrial organization economists elsewhere. I also try to connect the unfinished business from that literature to more recent concerns about the link between market structure and industry performance. In this discussion my debt to Demsetz (1973) will be obvious. His seminal insight was that the interplay of structure and performance involved not just prices but also costs and productivity. I follow this discussion with a description and analysis of the data on concentration and prices and productivity.

---

[6] Based on deflators for gross output by industry available at https://www.bea.gov/industry/gdpbyind_data.htm
[7] Schmallensee (1989) has a comprehensive review that is nearly complete, since the literature died out soon thereafter.

Finally, I analyze the recent behavior of price-cost margins, which was the specific outcome measure at the heart of the Demsetz (1973) article, and I show some of the durable lessons of his analysis for a recent revival of interest in price-cost margins as a proxy for monopoly pricing. Overall, the results provide no compelling reason for tougher antitrust enforcement.

2. Cross Industry Analysis Then and Now

At one time – roughly 1950-1990 – analysis of cross-industry data was a staple of empirical industrial organization. The most well-worn path involved estimating a cross-industry relationship between some profitability measure, such as measured rates of return on capital or revenue-cost markups, and some market structure measure, such as concentration ratios or, later on, a Herfindahl-Hirschman Index (HHI). The motive here was to implement the so-called "Structure-Conduct-Performance" (SCP) paradigm associated with Edward Mason and his students in the founding generation of Industrial Organization at Harvard. This was more a view than a well worked out theory. Then as now there was no consensus oligopoly model. The SCP view was that more concentrated markets (the S in SCP) bred weaker competition (the C) in a variety of ways that all pointed to higher prices (the P). So the basic empirical model was P=f(S,…). This was usually estimated on cross-sections of industry data, where price was proxied by some profitability measure, such as a price-cost margin[8]. The typical result was a positive correlation of profitability and concentration, and this was regarded as confirming that prices were higher in more concentrated markets. Any possible connection between concentration and the costs that also fed into the profitability measure was neglected.

[8] The proxy was needed as a normalizing device, because price itself is incommensurable across industries. The price-cost margin was conveniently available in Census cross-industry data. The typical margin calculation was the value of output less material and labor costs as a percent of the value of output. With everything divided by physical output, the margin is output price less unit labor and material costs as a percent of price. This markup measure seemed like a reasonable proxy for the Lerner index of monopoly ((price-marginal cost)/price).

That neglect ended with Demsetz (1973) who surfaced what we would call today a potential omitted variable bias. He argued that a cost advantage for one or a subset of competitors would set off a dynamic process consistent with the positive concentration-profitability correlation. It didn't matter whether the cost advantage was acquired by luck or skill. The advantaged firm(s) would attract capital and expand their market share. So concentration would increase. At the same time industry level measures of costs would fall and industry profitability would rise. In the simplest version of this story price would remain unchanged at the marginal cost of the marginal (high cost) firm.[9] In this way, the positive concentration-profitability correlation could be consistent with competition. Note that concentration is not causing higher profitability in Demsetz's story: they are moving together in response to another force – differential efficiency across firms.[10]

Demsetz's differential efficiency story shows how industry rents are consistent with perfect competition. The more efficient infra marginal firms garner the rents in part by taking market share from the marginal firms. Perfect competition is a provocative counter to the then prevailing monopoly rents interpretation of margin-concentration correlations, but the Demsetz process can also operate in imperfectly competitive contexts.[11]

---

[9] The starting point here is constant cost competition. More complicated structures, such as rising long-run industry supply, could yield higher industry output and lower prices. Industry aggregate profitability would increase as long as any net output addition did not reduce prices enough to offset the lower costs.

[10] An implication of the story is that if all surviving firms can eventually adapt to the initial productivity shock, the correlation would disappear, in the sense that concentration might remain higher than before but profits would be competed away.

[11] For an example, consider canonical Cournot duopoly with linear demand and constant and initially equal marginal and average costs. This produces equal sized firms, and so a baseline HHI of 5000. Inequality can increase from this baseline only with some kind of differential cost shock. In this example, a Demsetzian efficiency shock to one of the duopolists will raise the HHI and raise the industry margin, but price will decline. For example, with demand given by P=100-Q and initial costs of 25 for each firm we get a baseline of P*=50, Q*=50 (25 per firm) and a baseline margin of 50 percent of industry revenues (The P of 50 is a markup of 25 over the cost of 25).

Now suppose one duopolist (firm A) finds a way to produce at a unit cost of 15, or 10 less than previously. In the new equilibrium Firm A will expand output by 6.67 to 31.67, B will contract to 21.67. So Q* rises to 53.33, and, with B's loss of market share the HHI will increase to 5176 from 5000. The increased Q* reduces P* from 50 to 46.67 but also increases the (quantity weighted) average margin to 59.2 percent from 50. In this case, concentration and margins move up together, but price falls and so consumer welfare increases.

Cross-industry tests of the SCP view ultimately faded from the literature, perhaps partly in response to the "Demsetz critique."[12] This was part of a general retreat from cross-sectional analyses in industrial organization and elsewhere. Recently, however, in response to concern over increased concentration and its effects, SCP-style analysis has been revived in several forms.

One is retrospective merger analysis, which examine price changes after mergers. These can be case studies of a single merger, as in Kwoka and Shumilkina (2010) or Luo (2014), or of samples of mergers (Ashenfelter and Hoskin, 2010). But the salience of merger retrospectives comes from the cross-section aspect. Specifically, Kwoka's (2012, 2015) meta analyses find that prices typically increase after mergers. Gaynor et al's (2015) survey of correlations between price and concentration across geographic health care markets reaches a similar conclusion. As these authors acknowledge, these conclusions come with caveats. For example, the studies tend to focus on a few industries, such as airlines and health care, with substantial merger activity. This raises issues like selection, representativeness, and so forth.[13]

Another relevant literature concerns the recent decline in business "dynamism." Steve Davis, John Haltiwanger and co-authors have shown that various measures of business turnover have been declining over a long period. The measures include job creation and destruction, business entry and exit, size transitions among firms and so on, all of which point to less turnover today than c 1980. (See e.g., Davis et al, 2010, Davis et al 2011, Haltiwanger, 2012). These authors do not always connect any of

---

Note that any differential cost shock will increase the HHI in the canonical Cournot model. So, e.g., a differential positive shock will raise the HHI and also price. Depending on demand conditions, such a shock can raise or lower margins. This ambiguity illustrates Demsetz's larger point, which is that there is no unambiguous mapping from margins to price.

[12] There were twists and turns along the way that I am ignoring here for brevity. For example, one response was to regress direct measures of price on concentration. These could be prices for one good across differently structured geographic markets (as in Weiss, 1989) or changes in price indexes correlated with changes in concentration (as in Peltzman, 1977 and later on in this paper).

[13] Airlines and health care were arguably responding to policy shocks (deregulation in the case of airlines and growing importance of Medicare/Medicaid payments and rules in the case of health care).

the dots between declining dynamism and concentration, productivity and prices. However, the potential connections are clear, sometimes even explicit. In broad terms, the literature surfaces two kinds of potential explanations for declining dynamism: Benign interpretations, in which better outcomes go hand in hand with reduced turnover and opposite, malign interpretations. These also have opposite implications for the correlation between market structure and performance.

Malign interpretations are motivated by the slowdown in productivity growth that has accompanied the decline in dynamism.[14] Decker et al (2018) connect the two via diminished responsiveness to shocks. They show that the process emphasized by Demsetz (1973) - reallocation of market share toward more productive firms – has been an historically important contributor to productivity growth. But their version has different implications for market structure, because the more efficient firms tend initially to be small new entrants. These are generally riskier than established firms, so many fail and exit. But this churn produces productivity growth because those who do succeed get bigger and replace the established laggards. According to Decker et al (2018) the responsiveness of this firm growth to the idiosyncratic productivity advantage has diminished. They do not identify specific new "adjustment frictions" behind the slower responsiveness. However, the slower responsiveness will tend to increase industry concentration, because the slower growth of efficient small firms will leave larger market shares for the established (larger) firms. Accordingly, higher concentration will tend to be correlated with lower productivity growth. (Again, this is not causal but a common reflection of the enhanced adjustment frictions.)

A benign interpretation follows a similar logic but switches the firms with the productivity advantage. Davis and Haltiwanger (2014) use the retail sector as an example. They cite data showing

[14] For example, in the data I analyze later in the paper, multifactor productivity growth across 473 manufacturing industries averages .8 per cent annually before 1980 and only .3 percent annually thereafter.

increased productivity growth in that sector and connecting it to reallocation from established to newer stores. The difference is that here the newer stores are bigger and owned by bigger firms such as "Wal-Mart and other big-box firms [which] transformed supply chains, wholesale distribution, inventory management, pricing, and product selection in recent decades." (p10). In other words, the reason smaller firms exited is that the new procedural and logistical practices in this industry require large scale – both at the store and firm level- to be more efficient, but once implemented at scale they deter (small scale) entry and speed (small scale) exit. The implication for the concentration – productivity correlation is opposite to the malign story.

More recent literature examines these implications explicitly and generally finds support for the benign interpretation. A common strand in papers such as Hsieh and Rossi-Hanberg (2019), Ganapati (2019), Kehrig and Vincent (2018) and Autor et al (2019) is the Demsetz (1973) mechanism of the more productive firm gaining market share, sometimes embellished by scale advantages in implementing more productive techniques. One strand of this literature finds that information technology adoption is an important source of the differential productivity advantage of large and growing firms (Bessen, 2017; Calligaris et al, 2018). A less-than-benign variant locates the large/growing firm advantage in growing regulation and resultant lobbying (Gutierrez and Philippon, 2019), whereby increased regulation and lobbying deter entry and expansion of small firms.[15]

[15] The implications of their argument for correlations of concentration and prices or productivity are mixed. A regulatory shock to an industry increases costs and prices. It also increases concentration, because large firms have lower compliance costs. On this account, prices and concentration are positively correlated. On the other side, the shock is endogenous: more concentrated industries can better avoid regulation in the first place (via lobbying etc). On this account, concentration and prices would be negatively correlated.

Another recent literature (e.g.,De Loecker and Eeckhout, 2017; Gutierrez and Philippon, 2017; Barkai, 2020 ; De Loecker et al, 2020) revives the use of price-cost markups to imply monopoly rents. These are mainly concerned with macro-economy trends, such as the decline in the labor share of GDP, sluggish business investment, slower growth, etc. The common thread in this literature is the presumption of the pre-Demsetz SCP literature that higher markups signal weaker competition.

The various stories about recent industrial history are not mutually exclusive. Both malign and benign interpretations of business turnover imply increased market concentration and declining measures of dynamism. Higher margins can signal greater efficiency in some industries and less competition in others. In subsequent sections I try to let the data tell us whether on balance this increasing concentration is associated with higher or lower productivity and prices. The next section describes the data I use, and the subsequent Section 4 uses them to describe the connection between concentration and prices and productivity over the whole of the post-1982 period. The literature that revives margins-as-monopoly-rents raises more general questions, and I defer discussion of that work to a separate Section 5.

3. Data on Productivity, Prices and Concentration

I match two data sources to produce two sub-samples of the period since 1982. Price and productivity data come from the NBER-CES Manufacturing Industry Database, which at the time of writing is available through 2011.[16] There are two versions of these data, one based on the 1987 Standard Industrial Classification (SIC) and the other on the 1997 North American Industrial

[16] The data can be downloaded at http://www.nber.org/data/nberces.html. The database is a joint venture of the National Bureau of Economic Research and the US Census' Center for Economic Studies.

Classification System (NAICS). Both are available annually from 1958.[17] Here I use SIC based data for 1982-1997 and NAICS based data for 1997 and beyond. These comprise two fifteen year subsamples of the post 1982 period, 1982-1997 and 1997-2012, and they are henceforward referred to as the SIC and NAICS samples or subsamples.

The data are at the 4 digit SIC or 6 digit NAICS level of classification, which gives over 450 industries in any year prior to 2012. For each industry, the database provides a variety of industry summary data, such as shipments, payroll and employment, material purchases, etc. There are also price indexes for shipments, materials purchased and investment goods as well as indexes of total factor productivity (TFP). A TFP index is an output index deflated by an index of input quantities weighted by cost shares.[18] I use the TFP4 index (or DTFP4, the change of ln(TFP4)) which has four inputs: production labor, supervisory (non-production) labor, materials and capital goods. I also calculate a labor productivity (output per hour worked) index,[19] as well as an index of the arguably exogenous component of input prices, which is discussed later.[20]

My goal is to describe the connection between industry concentration and productivity and prices over long periods, specifically the 15 years spanned by both the SIC and NAICS samples. So I matched the NBER-CES data to concentration data (HHIs) from the Census of Manufactures for the terminal years of each sample. The HHIs for any Census are based on the industry classification for that Census year. These classifications change over time.

[17] The SIC was the operative classification system until 1997, when the NAICS took over. However, the NBER-CES database reclassified manufacturing establishments into either NAICS or SIC industries to produce industry time series going back to 1958 or forward to 2011 as needed.
[18] See the documentation section at the NBER-CES link shown above for fuller explanation.
[19] The data have hours worked by production workers and number of supervisory employees. The note to Table 1 describes how I estimated hours worked by supervisory employees.
[20] In Section 5 on margins I also calculate and describe productivity and price indexes for labor plus material inputs. This differs from TFP by excluding capital.

NBER-CES industry data are based on a single classification, either the 1987 SIC or the 1997 NAICS. Accordingly, matching HHIs to NBER-CES data encounters various problems.[21] I leave details in footnotes and focus on general issues arising from these classification changes. In many cases only numbering and labeling changes, and for these there is no problem. Problems arise when products, firms and establishments are moved from one industry to another. Simply deleting such industries would substantially restrict sample sizes and introduce possible biases[22]. Including such industries requires industry data to be combined or separated or otherwise approximated to align HHIs with the NBER-CES data. Resolving these matching problems inevitably introduces measurement errors.

The NAICS samples is the less problematic in this respect. The classification changed substantially only in the 2012 Census (one year after the NBER-CES data end). This required rebasing all the NAICS industry data to the 2012 classification. The 2012 NAICS changes reflect the shrinkage of manufacturing, especially in industries like textiles, apparel, metal fabrication and the like where imports now dominate. Around 100 industries were eliminated by combining the remnants into more broadly defined aggregates. In the majority of these cases the combination just replaced all the 6 digit constituents of a 5 digit NAICS industry with the 5 digit aggregate, and for these matching is straightforward.[23] However, for 34 NAICS 2012 industries 1997 data had to be partly estimated.[24]

[21] There are also missing data problems, especially for a few highly concentrated industries where HHIs are suppressed to maintain confidentiality. I estimated HHIs for these interesting cases from other available data, most commonly by interpolating from other concentration data and HHI data in nearby Census years. In addition to the HHI the Census gives 4, 8, 20 and 50 firm concentration ratios. These can be used to bound the HHI: the lower bound can be obtained by assuming equal market shares among the largest four firms, the next 4 and so forth. The upper bound can be obtained by assuming one large firm and then equal shares for firms 2 through 8, etc. Where an HHI from a nearby year is available, I can locate the HHI within the permissible range for that year and then assume the same location for the year where the HHI is missing. If no nearby year's HHI is available, I use a location for the HHI of a comparably concentrated industry within the same 2(3) digit SIC (NAICS) industry sector.

[22] The classification changes respond to changes in the market, such as product innovation. Industries with stable classifications tend to have less of such innovation.

[23] We have 5 digit HHIs for both 1997 and 2012. For NBER-CES data, we can aggregate the 6 digit components either directly or using output weights.

[24] The 1997 NBER-CES data could be obtained directly by aggregating. However, the 1997 HHI was unavailable directly for these 34 industries. A lower bound could be obtained as the weighted sum of constituent HHIs, where

The SIC sample is more troublesome, because it involves two major changes. One is the switch to NAICS in 1997, which required matching SIC based data to NAICS. The other is a major SIC classification change in 1987, which required matching 1982 SIC data to the 1987 version. Well under half the 1982 industries remain comparably defined in 1997. To avoid overly compromising sample size I adopted a 90 percent plus rule: I retained an industry if in both 1982 and 1997 I could determine that at least 90 percent of shipments came from establishments classified into the industry in the other year.[25]

I dropped several semiconductor based industries and tobacco from both samples.[26] Some of the key variables in these industries are several standard deviations away from the rest of the sample, and this can distort comparisons across samples of the sizes I am working with. In the semiconductor related industries Moore's Law has resulted in exceptional rates of productivity growth and price

---

the weights are the squared shares of the constituent industries in the aggregate. This estimate is exact if all the significant firms in one constituent industry are different from those in the other. If the firms overlap this estimate is too small. From data on 5 digit industries and their 6 digit components, we can infer that the understatement is on the order of 10-15%. Instead of just inflating estimates by a constant, I used a regression adjustment. First, for industries with available data, the difference between known 5 digit HHIs and the weighted sum of 6 digit HHIs was regressed on the log of 5 digit value of shipments per firm and the number of 6 digit industries in the aggregate. (The latter two had positive coefficients. Aggregating more industries raises the odds that firms in one of them will produce something in another industry, and bigger firms are more likely to produce multiple products.). Then coefficients from this regression and 1997 x's for the 34 industries with missing HHIs were then used to calculate estimated adjustments to be added to the weighted sum of 1997 HHIs to obtain 1997 HHI estimates for the NAICS 2012 industry definition.

[25] That is, (shipments of the 1997 industry from establishments in the 1982 industry)/(total shipments of the 1997 industry) > .9 and (shipments of the 1982 industry from establishments in the 1997 industry)/(total shipments of the 1982 industry) > .9. The necessary information comes from concordances available either from the NBER-CES website or from the Bureau of Census website and also from US Census (2000). Since the SIC-NAICS matching uses the 1987 SIC, industries with changed definition between 1982 and 1987 had to undergo two 90 percent plus tests. These were retained if the product of the relevant ratios exceeded .9.

[26] These were, for the SIC sample, all industries in SIC 357 Computer and Office Equipment and SIC 3674 Semiconductors and Related Devices as well as SIC 21 Tobacco. The deleted NAICS sample counterparts are NAICS 334111 Electronic Computer Manufacturing, NAICS 334112 Computer Storage Device Manufacturing and NAICS 334118 Computer Terminal et al Manufacturing, NAICS 334413 Semiconductor and Related Device Manufacturing as well as NAICS 312230 Tobacco manufacturing.

declines. Tobacco is dominated by the events surrounding the 1998 Master Settlement Agreement, which resulted in exceptional price increases, especially in the NAICS sample period.

The preceding adjustments left a NAICS sample of 359 industries, which is essentially all of the NAICS 2012 manufacturing industries aside from the tobacco and semiconductor based industries. The SIC sample has 288 industries. This is around 60 percent of all contemporary industries and raises some questions about representativeness and measurement error in the SIC sample.[27] Table 1 summarizes the two samples.

The bottom panel of Table 1 (ignore lines 7 and 8 for now) captures the continual increase in concentration over both sample periods. (The levels on line 6 are not comparable, because of the 2012 consolidation of NAICS industries)[28]. The mean increase amounts around 17 percent of the average level in the SIC sample and 12 percent in the NAICS sample As detailed in the next table, there are roughly twice as many industries with increasing concentration as with decreasing concentration in both periods. However, and though caution is warranted in making the comparison, even by 2012 few industries have levels of concentration exceeding the Merger Guidelines red lines of 1800 or 2500.[29]

[27] For example, I assigned each industry the available HHI for the 1997 and 1982 industry definitions without adjustment for industry size. However, HHIs will generally be larger if classification changes put 1982 establishments into a different 1997 industry, or vice versa. Also, where industries could be exactly matched by aggregating whole industries (e.g., the 1997 industry is the sum of several 1982 industries) I used the weighted (by squared industry shares) sum of constituent industry HHIs, which is also subject to error as discussed in n.23.

[28] The 2012 consolidations increase industry size, which tends to reduce firm market shares and thus industry HHIs.

[29] The current version of the guidelines sets a presumptive red line at 2500 and a pink one at 1800, which was the previous red line. Mergers that push concentration beyond these triggers are likely to be challenged. These numbers refer to antitrust markets as defined in preliminary analysis of the merger, and these need not coincide with industries defined by the SIC or NAICS. As of 2012, 39 of 359 NAICS industry HHIs exceeded 1800 and 20 exceeded 2500.

Table 1. Summary Statistics. Prices, Productivity and Concentration. US Manufacturing Industries. NAICS (1997-2012) and SIC (1982-1997) Samples.

Variable/period	Units	NAICS Sample Mean	NAICS Sample SD	SIC Sample Mean	SIC Sample SD
Prices & Costs					
1. price of shipments, change per year	ln x 100	1.98	1.58	2.07	1.04
2. price of inputs, change per year	ln x 100	2.30	0.83	2.01	0.51
Productivity					
3. total factor productivity, change per year	ln x 100	0.10	1.53	0.67	1.17
4. output per hour, change per year	ln x 100	2.72	1.79	2.45	1.53
Concentration					
HH Index					
5. ___change over period	units	95	511	142	509
6. ___average level	units	781	736	822	683
HHI^.5					
7. __change over period	units	2.00	7.37	2.43	7.20
8__average level	units	25.0	12.0	26.0	11.4
Number of Industries		359		288	

Sources: shipment prices, input prices, productivity: NBER-CES Manufacturing Industry Database. http://www.nber.org/data/nberces.html.

I use the two available versions of this database for the two samples. The SIC version is based on the 1987 Standard Industrial Classification and the NAICS version is based on the 1997 North American Industrial Classification System. I use the SIC version for 1982-97 and the NAICS version for the subsequent period. The NAICS database ends in 2011. Both databases have over 450 industries. The smaller number of industries in my samples is due to a) differences between the 1982 and 1987 SICs, b) the switch from the SIC to NAICS in 1997, c) the consolidation of NAICS 6-digit manufacturing industries in 2012 and d) the exclusion of semiconductor based and tobacco industries as described in the text

Sample variables are related to variables in the NBER-CES database (NAMES in parentheses) as follows:

1. Shipment prices: ln of deflator for value of shipments (PISHIP)

2. Input costs: weighted average of hourly cost of production & supervisory labor, material cost deflator (PIMAT) and deflator for investment goods (PIINV). Weights are average beginning period cost shares (1980-82 and 1995-1997 respectively). Hourly labor costs are estimated at the 2 digit SIC or 3 digit NAICS level. These are averages of 4 and 6 digit industry data on total payroll (PAY), production worker wages (PRODW) , production worker hours (PRODH) and author's estimate of supervisor hours. This estimate multiplies the number of supervisory employees (EMP-PRODE) by estimated hours per supervisory employee. These are set at .92* (PRODH/PRODE) for non-durable industries and .9*(PRODH/PRODE) in durables industries. These multipliers are from Bureau of Labor Statistics data on hours by industry available from 2006 on at www.bls.gov. PAY and PRODW are grossed up to include fringe benefits. the multiplier here come from the ratio of compensation to payroll for the industry's 2 digit SIC or 3 digit NAICS sector in the national income and product accounts found at https://www.bea.gov/industry/gdpbyind_data.htm.

3. Total factor productivity: average annual DTFP4 (=change in ln of TFP4)

4. Output per hour: [value of production (VSHIP + change in INVENTories)/PISHIP]/ total hours, as described in 2. above.

Concentration: US Bureau of the Census. Census of Manufacturing, Subject Series. Concentration Ratios in Manufacturing, various years and formats. See text for description of matching of concentration data to price and productivity data.

The top panel of Table 1 summarizes output and input prices. On average, both prices are increasing around 2 per cent a year nominally in both samples.[30] The middle panel gives the growth rates of two productivity measures – total factor productivity (TFP, or log output minus log of an index of labor, material and capital inputs) and the more familiar labor productivity. Mean growth rates move in different directions. Average TFP growth slows by half a percentage point in the NAICS period, but labor productivity growth actually increases. This increase reflects a substantial shrinkage of the manufacturing work force (over 3 per cent per year) in the context of a milder decline in output (around a half per cent per year in this sample). The divergence between TFP and labor productivity reflects, in part, the more capital intensive manufacturing sector that emerged as manufacturing declined.[31]

There is considerable cross-industry variety in productivity growth, as indicated by the large standard deviations in Table 1 (lines 3 and 4). For example, while TFP growth is lower on average in the NAICS period around 30 percent of the NAICS industries have greater TFP growth than the mean SIC industry before 1997. Moreover, the cross-industry variety widens in the NAICS period with standard deviations of productivity growth around 30 log basis points higher in the NAICS period. This is not an artifact of differences in sampling.[32]

Cross-industry analysis might shed light on the decline in productivity, since a substantial part of the sample is performing relatively well. The next section summarizes cross sectional patterns in these data with a particular emphasis on co-movements between the concentration data on one hand and the

---

[30] The higher input cost inflation in the NAICS sample (2.3 per cent annually) reflects a commodity price boom that peaked toward the end of the period. This particularly affected some food processing, petroleum and petrochemical and metal fabricating industries.

[31] For example, in 1997 labor compensation was 38.2 percent of value added (the total of labor and capital compensation) in manufacturing. By 2011, this had shrunk to 30.5 percent as much labor intensive production had been shifted outside the US. There was also an increase in material input intensity related partly to the previously noted commodity price boom.

[32] The levels and changes of the relevant standard deviations are virtually identical in the full sample of SIC industries to those in the sample used here.

price/productivity data on the other. To repeat the obvious, such co-movements are descriptions, not causal statements. They give answers to questions like: has higher concentration on balance been associated with higher prices? If so, is this particularly true in already concentrated markets (as assumed in the Merger Guidelines)? Is increased concentration (or high concentration) more consistent with a benign or a malign interpretation of declining business dynamism?

4. Concentration, Prices and Productivity

Cross tabulations in Table 2 give a rough first cut of the relevant co-movements. The three panels classify data by HHI change, HHI level and combination of these two. The columns give results for two productivity measures (columns 3 - 8) and prices (columns 9-11). Cross tabulating by both change and level of concentration is motivated by antitrust policy and ambiguity in some of the motivating stories outlined above.[33] The important results are on the last line in each panel or sub-panel, which gives the mean difference (DIFF) and its t-ratio in each outcome for the different market structures under consideration.

The outcomes are annual averages over each sample period. These long fifteen year periods are meant to capture the more permanent relationships that I want to focus on. Also, as a practical matter, the higher frequency outcome data within sample periods are noisy in potentially misleading ways.[34]

[33] Merger policy tries to deter increases in concentration, but only when the level of concentration is or would cross a threshold. One benign story about the same event would be that productivity improves when "best practices" are applied at large scale (a level-of-concentration effect) and also when firms that discover these practices increase their market share (a change effect).

[34] Specifically, I found persistent negative autocorrelation for most every productivity growth or price change series within the typical industry. That is, short period changes have temporary (or mis-measured) components that tend to be subsequently reversed. The negative autocorrelation holds for changes over periods up to at least four years, which suggests that even long sub-period data may have considerable noise.

The differences in the price changes (columns 9-11) range on both sides of zero, and there is no clear pattern. For example, in panel I increasing concentration seems to raise prices in the NAICS period but not in the SIC sample. Contrary to typical intuition, large increases in concentration have no greater (possibly a lesser) effect than small increases (line 4c). Panel III, which incorporates the Merger Guidelines focus on both change and level, also shows little consistency. Within the more concentrated industries, prices do rise more when concentration increases, but only for the NAICS period (line 3, panel III). And, within both period, the price increases associated with rising concentration are about the same for the less concentrated industries than for the more concentrated industries (line 5, panel III). The lack of any clear connection between concentration and price changes, let alone one consistent with the specific concerns of the Merger Guidelines, will be a consistent feature of these data.

The productivity data in columns (3) through (8) show a more consistent pattern that lends some support to the benign view of concentration. With the conspicuous exception of TFP growth in the SIC period, the relevant differences are well bounded away from zero in the benign direction. That is, high and rising concentration tend to be associated with greater productivity growth. There is no consistent overall effect from changes (line 3, panel I), but industries with large increases in concentration (line 4c, panel I) as well as highly concentrated industries (line 3, panel II, or line 5 panel III) tend to have superior productivity growth.

Table 2. Cross-Tabulations of Productivity Growth and Price Changes by Change and Level of Concentration. US Manufacturing. NAICS (1997-2012) and SIC (1982-1997) Samples

Concentration Variable and Sample	N	Productivity Growth (ln x 100 per year)						Price Change (ln x 100 per yr)		
		Total Factor			Output per Hour					
		Mean	SD or SE	|t|	Mean	SD or SE	|t|	Mean	SD or SE	|t|
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I. Change in HHI										
1. Increasing										
___NAICS sample	232	.086	1.470		2.727	1.838		2.187	1.527	
___SIC sample	191	.572	1.165		2.481	1.444		2.078	1.019	
2. Decreasing										
___NAICS sample	127	.122	1.642		2.700	1.706		1.599	1.600	
___SIC sample	97	.850	1.161		2.376	1.694		2.055	1.073	
3. DIFF:1-2										
___NAICS sample		-.036	.169	0.21	.027	.198	0.14	.588	.172	**3.43**
___SIC sample		-.278	.145	1.92	.105	.191	0.55	.021	.129	0.16
4. Large v Small HHI Increases										
a. Above Median Increase										
___NAICS sample	116	.405	1.609		3.303	1.961		2.112	1.694	
___SIC sample	95	.604	1.219		2.889	1.424		2.070	.915	
b. Below Median Increase										
___NAICS sample	116	-.232	1.234		2.151	1.508		2.262	1.342	
___SIC sample	96	.539	1.114		2.078	1.353		2.084	1.118	
c. DIFF: 4a-4b										
___NAICS sample		.637	.188	**3.38**	1.152	.230	**5.02**	-.149	.201	0.74
___SIC sample		.065	.169	0.39	.811	.201	**4.03**	-.014	.148	0.10

Table 2. (Continued)

	N	TFP Mean	SD	t	Q /Hr Mean	SD	t	P chg Mean	SD	t
II. Level of HHI										
1. High (above median)										
___NAICS sample	180	0.469	1.698		3.115	1.990		1.963	1.739	
___SIC sample	144	.719	1.270		2.794	1.605		1.931	.992	
2. Low (below median)										
___NAICS sample	179	-.272	1.233		2.318	1.464		1.995	1.399	
___SIC sample	144	.612	1.059		2.097	1.371		2.208	1.063	
3. DIFF: 1-2										
___NAICS sample		.741	.157	**4.73**	.797	.184	**4.32**	-.031	.167	0.19
___SIC sample		.107	.138	0.78	.697	.176	**3.96**	-.277	.121	**2.28**
III. Level & Change										
1. High and Increasing HHI										
___NAICS sample	103	.505	1.675		3.261	2.042		2.283	1.646	
___SIC sample	96	.598	1.21		2.943	1.397		1.950	0.922	
2. High & Decreasing HHI										
___NAICS sample	77	.419	1.738		2.916	1.913		1.536	1.778	
___SIC sample	48	.961	1.364		2.497	1.938		1.894	1.129	
3. DIFF: 1-2										
___NAICS sample		.086	.256	0.33	.345	.299	1.15	.747	.257	**2.91**
___SIC sample		-.363	.223	1.63	.446	.345	1.58	.056	.176	0.32
4. Low and Increasing HHI										
___NAICS sample	129	-.249	1.177		2.299	1.536		2.111	1.426	
___SIC sample	95	.545	1.123		2.014	1.343		2.205	1.099	
5. DIFF:1-4										
___NAICS sample		.754	.188	**4.01**	.962	.235	**4.09**	.172	.202	0.85
___SIC sample		.053	.169	0.31	.929	.198	**4.68**	-0.255	0.147	1.74

Note:

N=number of industries satisfying criterion indicated in column 1.

DIFF line shows difference in means, its standard error and the |t|ratio. |t|>2 shown in **BOLD**

The contrast between the productivity and price effects hints at another feature of subsequent data. Productivity growth implies lower costs. So if there are benign productivity effects from concentration but no price effects, the implication is that the cost effects are offset by rising margins. This is the possible dilemma for antitrust merger policy raised a long time ago by Oliver Williamson (1968). It is also the heart of the Demsetz (1973) critique of inferring monopoly rents from price-cost margins.

Subsequent tables refine these cross-tabs by allowing concentration to be continuous and by taking account of some industry background conditions.[35] Table 3 summarizes the connection between productivity and concentration, while Table 4 does the same for prices. In Table 3 the dependent variables are average annual growth rates of TFP and labor productivity. The independent variables are the level and change of concentration. For this and subsequent tables, concentration is measured as the square root of HHI. This transformation removes most of the extreme skewness in both the level and change of the HHI.[36] (Summary statistics for the transformed variables are on lines 7 and 8 of table 1.)

Each triplet of regressions in Table 3 begins with one that includes only the HHI level and change on the right. The second regression adds sector (SIC 2 digit or NAICS 3 digit industry) fixed effects, and the third adds interaction between high and rising concentration. The fixed effects are meant to capture background conditions affecting productivity and concentration over broad groups of industries (e.g., food products), so the regressions then capture the correlations across the industries

[35] These can be troublesome if they are correlated with concentration. For example, the significantly higher price change for increasing concentration industries in the NAICS period (panel I, col 11) is driven by a rise in the world price of crude oil. This is a significant input for a variety of petroleum and chemical product industries. As a group these industries also saw above average increases in concentration. As will be seen, the apparently significant difference disappears once account is taken of input prices.

[36] The HHI summarizes squared shares, so large shares (or changes in shares) are overweighed. The result is a long right tail in the cross-industry HHI (and change in HHI) distribution, which violates typical Gaussian assumptions. The skewness is reduced by taking square roots. (A log transformation also accomplishes this, but at a cost of over-emphasizing inconsequentially large percentage changes in very unconcentrated markets). However, I should also note that untransformed HHIs yield results similar to those subsequently reported.

within these groups (i.e., across dog and cat food, confectionary products, etc.). The interaction of the change with levels of concentration addresses the central distinction in the Merger Guidelines.

The results in Table 3 reinforce the cross-tabs. Again with the exception of TFP growth in the SIC sample, both the level and change of concentration tend to be positively correlated with productivity growth. This is true across the whole sample and within industry sectors. There is no meaningful difference between effects of changes in more or less concentrated markets. The implied magnitudes can be substantial. For example, consider a NAICS industry that begins the period with concentration one standard deviation below the mean and ends with concentration one standard deviation above the mean. The NAICS regression (2) coefficients would imply an improvement in TFP growth of .37 standard deviations, which exceeds the mean slowdown of TFP growth between the two sample periods.[37]

Table 4 is in two parts (4A and 4B) and explores the interaction of prices, productivity and concentration. The dependent variable here is the average annual log percentage change in the price of shipments. Aside from sector fixed effects, there is only one plausibly exogenous control. This is the average annual change in an input cost index, which is a weighted average of labor, material and capital good prices. Details are in the note to Table 1. The weights are cost shares at the beginning of each sample period, so they are unaffected by (possibly endogenous) within-period changes in cost shares. Also, to avoid issues about (also possibly endogenous) division of value added between labor and capital, I use sector wide rather than industry specific labor costs.[38] Table 4A shows unconstrained

[37] The change would be +12 units and it would raise the average level (which is the average of beginning and ending value) by 6 units. The coefficients multiplying these changes (.033 and .028 respectively) yield a sum of +.564 log percentage points of TFP growth, which is 37 percent of the standard deviation (1.528 points). In HHI units, the change is around 600 points, or a little over one standard deviation of the sample average change.

[38] A part of the old cross-industry structure-performance literature argued that rents from concentration were shared between labor and capital. See Schmallensee (1989, p990) for a summary. Another issue arises from firm ownership and organization. Management or family owned firms, especially those organized as pass-through entities (S-corps), have discretion in allocating value added between wages and profits.

Table 3. Productivity Growth and the Change and Level of Concentration.

US Manufacturing. NAICS (1997-2012) and SIC (1982-1997) Samples

Independent Variables and Sample	Total Factor Productivity Growth(x100)						Labor Productivity Growth (x100)					
	(1)		(2)		(3)		(4)		(5)		(6)	
	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|
1. Change in HHI ^.5												
___NAICS sample	.026	**2.5**	.033	**3.1**			.046	**3.7**	.059	**4.9**		
	-											
____SIC sample	.004	0.4	.014	1.4			.023	1.9	.041	**3.4**		
a) change in high HHI industries												
___NAICS sample					.031	**2.6**					.063	**4.8**
____SIC sample					.013	1.2					.046	1.8
b) change in low HHI industries												
___NAICS sample					.047	1.9					.037	1.3
____SIC sample					.019	0.9					.029	**3.8**
2. Average Level of HHI^.5												
___NAICS sample	.035	**5.5**	.028	**4.0**	.029	**4.0**	.038	**5.0**	.040	**5.1**	.039	**4.9**
____SIC sample	.004	0.7	.005	0.7	.005	0.8	.035	**4.6**	.029	**3.8**	.029	**3.8**
3. Industry fixed effects?												
___NAICS sample (3 digit)	no		yes		yes		no		yes		yes	
____SIC sample (2 digit)	no		yes		yes		no		yes		yes	
Summary Statistics												
adj R^2												
___NAICS sample	.09		.14		.14		.09		.22		.22	
____SIC sample	<0		.13		.13		.08		.24		.23	
SEE												
___NAICS sample	1.46		1.41		1.41		1.71		1.58		1.58	
____SIC sample	1.17		1.09		1.09		1.47		1.34		1.34	

|t|>2 showin in **BOLD**

NAICS sample is 359 industries

SIC sample is 288 industries

estimates of the effect of this exogenous cost shifter. These are always important empirically, and the coefficients are often around the benchmark of +1 implied by constant cost competition.

Table 4A is in two parts. One controls only for input costs and another adds productivity variables. The key results can be gleaned from the even numbered regressions – (2), (4) and (6) – which include sector fixed effects. (The odd numbered regressions show that basic results hold between as well as within sectors and that there is, again, no consistent interaction between the change and level of concentration.) The important contrast is between regression (2), on one hand, and (4) and (6) on the other. Without a productivity control concentration effects on prices are small and weak statistically. For example, the regression (2) coefficients imply that a one standard deviation increase in the concentration variable is associated with around a 5 per cent standard deviation increase in the price measure in either sample. However, when productivity controls are added, as in regressions (4) and (6), the concentration effect becomes more meaningful statistically and economically; the marginal concentration effects here are roughly triple those in column (2).[39]

[39] All the regressions also control for the level of concentration, but this does not matter in any consistent way.

Table 4A. Prices, Productivity and Concentration. US Manufacturing. NAICS (1997-2012) and SIC (1982-1997) Samples

Independent Variables and Sample	No Productivity Control						Productivity Control							
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|
1. Change input cost x 100														
___NAICS sample	1.079	12.9	.693	5.6	.693	5.6	1.146	10.9	1.149	10.9	.706	6.9	.710	6.9
____SIC sample	0.956	9.0	.999	7.1	1.006	7.1	.849	8.1	.857	8.1	.828	6.6	.836	6.7
2. Productivity growth x 100														
(productivity measure)							TFP		TFP		q per hr		q per hr	
___NAICS sample							-.541	13.8	-.541	13.7	-.436	12.7	-.437	12.7
____SIC sample							-.545	14.8	-.546	14.8	-.325	9.1	-.325	9.1
Concentration (HHI^.5)														
3. Change														
___NAICS sample	.009	1.0	.012	1.2			.023	3.1			.037	4.6		
____SIC sample	.005	0.6	.006	0.7			.014	2.3			.019	2.8		
3a Change in High Conc Ind														
___NAICS sample					.012	1.1			.023	2.8			.039	4.5
____SIC sample					.003	0.3			.011	1.7			.017	2.2
3b Change in Low Conc Ind														
___NAICS sample					.012	0.5			.026	1.5			.027	1.5
____SIC sample					.018	1.0			.027	2.1			.032	2.1
4 Level (average for period)														
___NAICS sample	.006	1.0	-.01	1.6	-.01	1.6	.008	1.5	.008	1.5	.008	1.5	.007	1.4
____SIC sample	-.006	1.3	-.004	0.7	-.003	0.5	-.002	0.4	-.001	0.2	.005	1.2	.006	1.4
5. Fixed effects														
____NAICS 3 digit ind	no		yes		yes		yes		yes		yes		yes	
____SIC 2 digit ind	no		yes		yes		yes		yes		yes		yes	
Summary Statistics														
adj R^2														
___NAICS sample	.34		.41		.41		.63		.62		.60		.60	
____SIC sample	.23		.28		.28		.60		.61		.45		.45	
SEE														
___NAICS sample	1.29		1.21		1.21		.97		.97		.99		.99	
____SIC sample	0.91		0.88		0.88		.65		.65		.77		.77	

Dependent variable in all regressions is average annual change in ln price of shipments x 100.

Input cost, TFP, q per hr as described in Table 1

So the main message in Table 4A is that once the change in the level of costs is comprehensively controlled – the upward shift due to input prices and the offsetting downward shift due to productivity growth[40] – the margin of price over cost has widened where concentration has increased. The hitch in attributing this wider margin to greater market power is that, as Demsetz (1973) warned and as seen in Table 3, the level of costs may not be independent of the concentration increase.

This hitch also creates a potential estimation issue. In principle a point of TFP growth shifts costs down as much as a point of input cost growth shifts costs up. This implies equal and opposite signed coefficients on the two in regression (4) or (5). Instead we find somewhat smaller TFP effects and (t-test not shown) we can comfortably reject the null. Table 4B imposes equal and opposite signs on the input cost and TFP measures as robustness tests. The first two regressions in this table impose a benchmark of textbook constant cost competition – i.e., prices completely determined by the level of

[40] Conceptually only TFP growth provides a comprehensive cost proxy. Labor productivity affects costs also, but the magnitude depends on labor's cost share. On the other side, there are measurement issues unique to TFP, such as treatment of the capital cost share as a residual and the exclusion of user costs from the price index. I include the mis-specified regressions (6) and (7) to show that the pattern of results holds with either productivity measure.

Table 4B. Prices, Productivity and Concentration. Constrained Estimates. US Manufacturing.

NAICS (1997-2012) and SIC (1982-1997) Samples

Baseline Constraint-->	Constant Cost Competition				Equal & Opposite Effects of Productivity and Input prices			
Independent Variables and Sample	(1)		(2)		(3)		(4)	
	Coef	|t|	Coef	|t|	Coef	|t|	Coef	|t|
1. Change input cost x 100								
___NAICS sample	1	na	1	na	.556	13.5	.556	13.5
_____SIC sample	1	na	1	na	.585	17.2	.587	17.2
2. Productivity growth x 100								
___NAICS sample	-1	na	-1	na	-.556	13.5	-.556	13.5
_____SIC sample	-1	na	-1	na	-.585	17.2	-.587	17.2
Concentration (HHI^.5)								
3. Change								
___NAICS sample	.041	4.5			.032	4.1		
_____SIC sample	.019	2.6			.015	2.6		
3a Change in High Conc Ind								
___NAICS sample			.038	3.0			.030	3.6
_____SIC sample			.016	2.0			.013	2.0
3b Change in Low Conc Ind								
___NAICS sample			.051	2.5			.041	2.3
_____SIC sample			.036	2.2			.027	2.1
4 Level (average for period)								
___NAICS sample	.020	3.4	.020	3.4	.005	1.0	.006	1.0
_____SIC sample	.001	0.2	.002	0.5	-.002	0.6	-.014	0.8
SEE								
___NAICS sample	1.18		1.18		1.02		1.02	
_____SIC sample	.82		.82		.66		.66	

Dependent variable in all regressions is average annual change in ln price of shipments x 100.

Productivity variable in all regressions is TFP growth x 100.

All regressions include fixed effects for naics 3 digit or SIC 2 digit industry groups.
na=not applicable. R^2 not calculated.

costs in the long run, which implies coefficients of +1 and -1 on the input cost and TFP changes respectively. The last two regressions impose the looser constraint that the two coefficients should be equal and opposite signed, as might be implied by, say, imperfect competition.[41] The constrained regressions yield the same pattern of results (and similar magnitudes) as in Table 4A – i.e., significant price effects of changed concentration when holding changes in input costs and productivity constant.

In sum, increased concentration tends to be associated with little net change in output price, faster productivity growth and, consequently, wider price-cost margins. I defer discussion of the relevant magnitudes to the concluding section. The next section discusses and analyzes price-cost margins more generally – i.e., independently of any association with concentration.

5. Margins and Monopoly

The use of price-cost margins to proxy for non-competitive pricing has recently been revived (e.g.,De Loecker and Eeckhout, 2017; Gutierrez and Philippon, 2017; Barkai, 2020 ; De Loecker et al, 2020). The failure of this literature to engage the Demsetz critique has been noted (Berry et al 2019). Heretofore I have been following Demsetz's original concern with using margins as a left hand side variable in regressions on market concentration. But the Demsetz critique is more general. It is about the information conveyed by price-cost margins.

Margins measure a wedge between price and a unit cost. When margins are used as a proxy for monopoly pricing there is a perhaps implicit assumption that the margins are being driven by output prices, with costs either unaffected or part of the noise. This is true whether the application is a margin-

[41] For example, linear firm demand would imply coefficients of +.5 and -.5 (absent cross-firm price effects).

concentration regression in the SCP heyday or, as more recently, a monopoly explanation for some ailments of the macro-economy. This assumption leads to statements such as:

> "… there has been a steady rise in market power since 1980, from [markups of] 18% above cost to 67% above cost. Over a 35 year period, that is an increase in the price level relative to cost of 1% per year." (De Loecker and Eeckhout, 2017, p1)

The numbers work out, given the assumptions. But what if the higher markups are due to lower unit costs rather than higher prices?

Demsetz's answer was that cost-driven markup increases were not only conceivable but could emerge from a competitive process. Therefore, without further investigation, there is no basis for inferring more monopoly pricing from higher markups. Demsetz's point goes beyond his particular application to the empirical SCP literature. Any unit cost shock that is uneven across firms can affect industry margins without a change in the state of competition.[42] It is worth an arithmetic detour to spell out what industry margins consist of. Then I will use the arithmetic to examine what has been driving margins in the recent past and what this might imply for competition and monopoly.

For convenience I start with the margin defined as:

(1) $R = VPROD / LMCOST$

where,

VPROD = value of production

LMCOST= labor + material cost.

[42] For example, suppose, as in Decker et al (2018) that small firms with favorable cost shocks expand. The initial impact on concentration could well be negative, since the expanding smaller firms would be taking market share from the less innovative larger firms. Here the industry margin would rise as concentration fell.

The difference between numerator and denominator is the markup over cost commonly used in empirical work. It represents the part of value added available to non-labor claimants such as owners and creditors. By dividing numerator and denominator by output (X), R can be expressed as:

(2) $$R = P(X)/[LMCOST / X] ,$$

where,

P(X) = price of output (=VPROD/X)

LMCOST/X = unit labor + material cost.

When the two terms in the denominator of (2) are each divided by some index of labor and material input (LM), unit labor and material cost can be expressed as:

(3) $$[LMCOST / X] = P(LM) / LMP ,$$

Where,

P(LM) = price of a unit of labor and material input (=LMCOST/LM) , and

LMP = labor and material productivity (LMP) = X/LM, or output per unit of labor and material input.

Combining (2) and (3) and using lower case letters to denote the change in logs, we get

(4) $$r = p(x) - p(lm) + lmp ,$$

So (4) tells us that margins can increase if output price increases or if the price of inputs falls or if labor and material productivity improves.

Equation (4) is an arithmetic definition, but it provides a framework that can help distinguish two views of what drives margins: a "monopoly pricing" view and a "Demsetzian" view. The monopoly pricing view is that margins are driven by p(x), the first term in (4). In this view high and rising margins signify high and rising prices relative to given costs. Costs are given in the sense that some variation in market power is driving the margins in the long run, and technology and input prices are givens. In empirical applications the last two terms in (4) are implicitly part of the noise (with p(x) on the left and r on the right). The monopoly pricing view of margins underlies the old SCP (structure-conduct-performance) empirical literature: something like R was the y-variable, proxying for output price, and market concentration was the x- of-interest. But the monopoly pricing view of margins is more general than that particular linkage. Anything that weakens competition – e.g., it could be more relaxed restrictions on inter-firm cooperation or on anti-competitive vertical restrictions or, as later on in the SCP literature, technological barriers to entry – would raise output prices and, thereby, margins The recent revival of margins-as-monopoly exemplified by the above quote from De Loecker and Eeckhout, 2017 is more about a general weakening of competition that includes, but is not limited to, increased concentration.

The Demsetzian view focuses on the last two terms of (4) (or the denominator of (2)) and, in particular, how they are linked to firm heterogeneity. In purest form output price is given, in the sense that it is the competitive price that covers the costs of the marginal firm. The reason margins vary is that some firms can combine inputs more efficiently (or adapt better to input costs). Their costs are lower than the marginal firm's costs. Demsetz (1973) emphasized how these low cost, infra-marginal firms would gain market share and so induce the observed correlation between margins and concentration in a competitive world. Most of this paper follows Demsetz's focus on the market structure aspect as well. But the Demsetzian view is also general. Anything that widens or narrows the cost advantage of infra-marginal firms will translate directly into industry average margins. This would be so even if the implications for market structure are different from those central to Demsetz (1973). For example, the small firm dynamism emphasized in Decker et al (2013) has a changing cast of small firms and new entrants as the infra-marginal firms and the larger established players as the marginal firms. This is different than the once-and-for-all shock to one firm that Demsetz (1973) emphasized. More "dynamism" (more or better innovative small firms) would widen industry margins and perhaps reduce concentration.[43] The essence of the Demsetzian view is that margins reflect the different costs of marginal and infra-marginal firms in a mainly competitive world.

The two views have different implications for empirical counterparts to the variables in equation (4). While (4) is a mathematical definition, the relative importance of the three right-hand terms can vary. Specifically, if industry margins increase is this, as in the monopoly view, primarily because prices are rising? Or is it, as in the Demsetzian view, primarily because of more favorable cost/productivity conditions for some firms? Or where between these extremes does the truth lie?

The answers cannot definitively rule out one or another interpretation. For example, it is conceivable that margins driven entirely by costs could reflect market power. But then it would have to be that in industries with falling costs market power has risen, while in industries with rising costs market power has fallen. And in each case the changed market power has exactly offset the cost changes. Occam's razor would seem to cut in favor of the Demsetzian view here.

Table 5 shows the margin decomposition in equation (4) for the manufacturing data since 1982. The results favor the Demsetzian view. Indeed, output prices have played no role in driving margins over the whole post 1982 period. The dominant force has been productivity growth. The table divides both the NAICS and SIC samples into groups of industries with rising or falling margins. Margins

[43] If the small efficient firms taken as a whole gain market share. This need not happen if there is enough turnover ("churn") among the innovative small firms. In Peltzman (1977) I found that large decreases in concentration, as well as large increases, were correlated with lower prices; this lent some support to a more nuanced view of the size of infra-marginal firms.

Table 5. Change in Price-Cost Margins and Components.

US Manufacturing. NAICS (1997-2011) and SIC (1982-1997) Samples

All Industries	Variable & Sample	Industries With: Increasing Margins	Decreasing Margins	Difference
(1)		(2)	(3)	(4)=(2)-(3)
Mean (SD)		Mean (SD)	Mean (SD)	Mean |t|
N=465	**A. NAICS sample**	**N=263**	**N=202**	
1.439	1. Price-Cost Ratio (PCR)	1.459	1.414	**.045**
(.273)		(.29)	(.25)	**2.0**
1.86	2. Change lnPCR(x100):1997 to 2011	9.18	-7.65	**16.83**
(11.91)		(9.05)	(7.71)	**21.2**
	Components of line 2.:Change in ln(x100) of			
26.72	3. Price of shipments	27.41	25.82	1.59
(21.88)		(20.69)	(23.33)	0.8
42.30	4. Price of materials+labor	43.04	41.33	1.71
(13.47)		(12.51)	(14.62)	1.4
17.44	5. Productivity of materials+labor	24.81	7.85	**16.96**
(21.33)		(21.04)	(17.59)	**9.2**
-0.76	*addendum: change in tfp (lnx100)*	*5.93*	*-9.45*	***15.37***
(24.34)		*(25.10)*	*(20.31)*	***7.1***
N=447	**B. SIC sample**	**N=381**	**N=66**	
1.372	1. Price-Cost Ratio (PCR)	1.374	1.359	.015
(.228)		(.232)	(.200)	0.6
8.60	2. Change lnPCR(x100):1982 to 1997	10.84	-4.32	**15.16**
(9.45)		(8.21)	(4.42)	**14.6**
	Components of line 2.:Change in ln(x100) of			
31.18	3. Price of shipments	31.50	29.35	2.15
(15.52)		(15.08)	(17.87)	1.0
34.51	4. Price of materials+labor	34.05	37.12	**-3.07**
(9.87)		(9.94)	(9.13)	**2.3**
11.93	5. Productivity of materials+labor	13.39	3.45	**9.94**
(15.03)		(14.34)	(16.20)	**5.1**
9.49	*addendum: change in tfp (lnx100)*	*11.31*	*-1.03*	***12.34***
(17.61)		*(16.65)*	*(19.34)*	***5.4***

(Notes to Table 5): Source: NBER-CES Database (see note to Table 1). The samples include all manufacturing industries except the tobacco and semi-conductor related industries specified in the note to Table 1.

PCR is as defined in the text. See notes to Table 1 for details on other variables.

Price of materials + labor is an index of labor and material prices using beginning of period expenditure weights. It differs from the input cost index in previous tables by excluding capital input prices.

Productivity of materials+labor is an index of output (deflated VPROD) divided by an index of labor+material input (labor + material expenditures deflated by the labor+material price index). The last line in each panel shows averages for DTFP4 in the database for comparison.

Sample standard deviations are in parentheses. In column 4 absolute t-ratios are shown below means. t-ratios > 2 are shown in **BOLD.**

Within each panel and column line 2= line 3 - line 4 + line 5 up to rounding error grew more in the SIC period (1982-1997) than the NAICS period (1997-2011) (see line 2, column (1)). So there are fewer industries with falling margins in the SIC sample (66 v 202 in the NAICS sample), which raises questions about statistical power and representativeness in that sample. Nevertheless, the two samples tell a fairly similar story. Average margins are about the same in rising and falling margin industries in both periods (line 1). The mean difference between rising and falling margin industries (line 2, column (4)) is substantial – well over a standard deviation of the whole sample. Lines 3 to 5 then decompose line 2 into the components in equation (4). Two results stand out. One is the complete irrelevance of output prices, statistically and economically, to changing margins. Nominal output prices rose on the order of 30 log points on average in both periods, with no meaningful difference between industries with rising and falling margins. This should come as a surprise to those used to thinking of rising margins as a proxy for rising prices. The other outstanding result is the importance of productivity growth. The particular measure in the table (output per unit of material and labor input) accounts for all of the differential margin growth in the NAICS period (compare line 5 to line 2 in column (4)). Productivity accounts for around 2/3 of the differential margin growth in the SIC period, with the balance accounted for by differences between output and input price growth.[44]

The table shows similar results for the more conventional total factor productivity measure.

This outsize importance of productivity growth in margin changes should also be a surprise to those with monopoly-pricing priors about margins, and it suggests caution about policies suggested by such priors. Productivity growth has been weak over the entire post-1980 period – zero TFP growth

[44]In isolation that difference could favor a monopoly view of margins. But it is not repeated in the NAICs period. And there is also a Demsetzian interpretation: suppose the marginal firm is one that is less affected by industry average input costs (uses different technology than most firms). Then infra-marginal firm costs and margins will vary with input prices, because output prices are relatively unaffected.

after 1997 and less than one per cent annually from 1982-1997 in my data.[45] Notably, any and all TFP growth in manufacturing since the 1980s has been coming from industries with increasing margins. In the most recent period, productivity has actually been falling in the declining margin industries. Taken together with the (non) result on output prices, this strong connection between margins and productivity growth lends weight to a Demsetzian interpretation where industry margins reflect the dynamism of the infra-marginal firms, not the firms at the price-determining margin.

6. Summary and Implications

Industrial concentration has been increasing over the entire period since the promulgation of the Merger Guidelines in 1982. It is unclear whether this trend has yet run its course. There is concern that higher concentration has led to weaker competition as evidenced, e.g., by higher prices in the wake of many mergers. There is also concern about the possibly reinforcing interplay between rising concentration and declining business dynamism and productivity (e.g., Council of Economic Advisers, 2016). I have tried to inform these concerns by describing salient trends in one sector – US manufacturing – over the long period since the 1982 Merger Guidelines.

Specifically, instead of looking only at mergers in a few industries, I ask some more general questions: is higher concentration usually associated with higher prices across many manufacturing industries? I also ask about the productivity-concentration nexus. Have the newly concentrated industries been more or less productive than other industries? And how does the answer fit with the previous one about prices? These are old questions in industrial organization. The price question dominated empirical organization for a long time. The productivity question was raised forcefully by Harold Demsetz in 1973. Interest in the price-cum-productivity proxy that Demsetz and the others were

[45] Which, recall, excludes the exceptional productivity growth of semiconductor related industries

concerned with back then– price cost-margins – has also been revived, because margins have been increasing along with concentration. So I also investigated the relative importance of the price and productivity components of margin changes since 1982.

The results tell a broadly consistent story in which output prices play a minor role. For example, real prices are about as likely to rise as fall in more concentrated industries. This seems to be the resultant of opposing tendencies that roughly cancel: the more concentrated industries seem to be more productive but firms in these industries also seem to retain most of the resulting efficiency gain in higher margins. Subsequent results on margins shows that this tendency is general, not just limited to industries with increased concentration.

There is variety in the underlying results depending on sample periods, definitions of productivity and the like. However, table 6 summarizes the central tendency with respect to market structure. Here I walk through two scenarios - one involving an increase in concentration and the other comparing industries with different levels of concentration. Table 6 does this separately for each 15 year sample period, using results from the previous tables, as indicated in column (1), as the steps in this walk. In panel I, I work through the case of a one standard deviation increase in the change of concentration (which translates into around 90 extra HHI points in either period), and in panel II I compare industries with average and one SD above average concentration (a difference that works out to around 700 HHI points). To keep things simple I'll focus on the results involving TFP growth and measure everything in SD units.

Panel I starts with the productivity effect associated with the increased concentration (A.1): +.161 SD extra TFP growth in the NAICS period. The relevant price regression implies a .085 SD price reduction (panel I, B.1) from this much TFP growth. Then I add back the markup effect (i.e., price effect

Table 6. Summary of Productivity and Markup Components of Price Changes

Associated with Changes and the Levels of Concentration.

US Manufacturing. NAICS (1997-2012) and SIC (1982-1997) Sample

Counterfactual and Components of Price Change	Source :Table (Regression)	NAICS Sample		SIC Sample	
		change amount	change in SD units	change amount	change in SD units
	(1)	(2)	(3)	(4)	(5)
I. Change in HHI^.5 increases by 1 SD from sample mean	1	+7.37		+7.20	
A. Productivity effect					
1) on TFP growth	3(2)	.246	.161	.098	.084
2) on output per hour growth	3(5)	.432	.241	.295	.193
B. Implied effect of productivity change on price					
1) TFP change	4(4)	-.133	-.085	-.053	-.052
2) q per hour change	4(6)	-.188	-.119	-.096	-.093
C. Markup effect on price (for given productivity)					
1) TFP change	4(4)	.170	.108	.101	.097
2) q per hour change	4(6)	.273	.173	.137	.132
D. Sum of productivity and markup effects on price					
a) TFP basis=C.1)-B.1)		.036	.023	.047	.046
b) q per hour basis=C.2)-B.2)		.084	.054	.041	.039
c) from regression excluding productivity effect	4(2)	.088	.056	.043	.042

(Table 6 continues on next page)

Table 6 (continued)

Counterfactual and Components of Price Change	Source :Table (Regression)	NAICS Sample		SIC Sample	
		change amount	change in SD units	change amount	change in SD units
	(1)	(2)	(3)	(4)	(5)
II. Level of HHI^.5 increases by 1 SD from sample mean	1	+12.0		+11.4	
A. Productivity effect					
1) on TFP growth	3(2)	.336	.220	.057	.049
2) on output per hour growth	3(5)	.480	.268	.331	.216
B. Implied effect of productivity change on price					
1) TFP change	4(4)	-.182	-.115	-.031	-.030
2) q per hour change	4(6)	-.209	-.133	-.107	-.104
C. Markup effect on price (for given productivity)					
1) TFP change	4(4)	.06	.038	-.023	-.022
2) q per hour change	4(6)	.072	.046	.057	.055
D. Sum of productivity and markup effects on price					
a) TFP basis=C.1-B.1		-.122	-.077	-.053	-.052
b) q per hour basis=C.2-B.2		-.137	-.087	-.050	-.049
c) from regression excluding productivity effect	4(2)	-.120	-.076	-.0456	-.044

Table shows effects of assumed 1 standard deviation (SD) increases in the change and level of concentration on productivity and prices. The sources of these effects are the relevant coefficients in the regressions indicated in column (1).

The effects are shown as amounts (coefficients x 1 SD change in the concentration measure) in columns (2) and (4) and in SD units of the outcome variable in columns (3) and (5). For example, the .161 in part I column (3) line A. 1 means that the 1 SD increase in concentration change is associated with .246 log percentage points extra MFP growth (col. (2), which is .161 SD extra TFP growth in the NAICS sample.

holding productivity and input costs constant) of .108 SD (panel I, C. 1). The net implied effect (-.085+.108) is the .023 shown on line a) of panel 1, D. a). This pattern of extra productivity and extra markup netting out to a small price increase (.046 SD) holds for the SIC regressions. For comparison I also show results for the "reduced form" regression of price on productivity (panel I, D .c).

Panel II does the same exercise for the level of concentration. Here we get consistently favorable productivity effects and inconsistent price effects that sum to small price reductions in both periods (-.077 SD and -.052 SD; panel II, D. a). The table does not include the interaction between the two concentration effects (rising concentration also increases the average level), which would reduce or essentially eliminate the already small positive price effects in panel I.

In short, the exercise tells of trivial net price effects arising from sometimes more sizeable productivity and markup effects that roughly offset each other. This pattern has been in place for 30 years or more. If it hasn't run its course by now, there are at least two important implications. One is for the sources of increased concentration. Perhaps relaxed antitrust enforcement is part of the story, but it is not the whole story.

Another, perhaps more important part of the story is the one anticipated by Harold Demsetz a decade before the 1982 Merger Guidelines. It is that rising concentration is an outcome of competition rather than a source of monopoly. Low cost firms will tend to grow, and as they replace higher cost firms industry productivity metrics improve. One variant of this Demsetzian process with some support in recent literature is that operating at large scale seems to have become a lower cost way of doing business in some industries, perhaps because of information technology advances that lower the cost of coordinating large organizations.

This Demsetzian interpretation is reinforced by examining margin changes independently of any connection to market structure. Competition from low cost firms will tend to raise margins whether or not it also raises concentration. As long as those low cost firms remain infra-marginal, output price will be unaffected and price-cost margins will widen along with the growth of the more efficient firms. I do not have firm specific data here, but cross-industry data are consistent with this version of Demsetzian competition: in the most recent period, all of the variety in margin growth reflects productivity differences. None of it has anything to do with prices.

The results here have implications for further research. One involves measurement, especially of capital. Except for removing some obvious outlier industries I have mainly taken existing industrial statistics at face value. This may be risky. For an example, intangible capital, such as software, has become increasingly important, but it is hard to measure, because there is no depreciable capital asset on the user's or vendor's books. Instead intangible capital is typically produced with some risky current expenditure, such as R&D. The difficulty of measuring intangible capital can affect the accuracy of conventional price and productivity measures as well as margins. (Brynjolfsson et al, 2020). Specifically, the measured capital stock will be understated. But the risky current expenditures producing this capital ultimately have to be paid for in higher margins. One of the benign interpretations of increased concentration (Bessen, 2017; Davis and Haltiwanger, 2014), is that IT intangibles are more effectively deployed by large firms. If so, concentration and margins would increase together in IT using industries for reasons unrelated to market power. Measurement issues like these need further work even if they are only part of the story behind the patterns described in this paper (as argued in Syverson, 2017).

Industrial Organization economists have become comfortable relaxing part one of the canonical competitive model, the part about price taking producers of identical goods. They have paid less attention to part two. On the cost side more or less homogeneous firms and flat long run supply curves reign if only by default.[46] One implication of the results here is that firm heterogeneity perhaps needs to

[46] There is also a logical tension between differentiated products and undifferentiated producers.

be taken more seriously. Another, from the business dynamism literature, is that the heterogeneities will not disappear even over long horizons. The continual churn of firms and market shares implies that industries are always populated by a mix of marginal and infra-marginal firms whose identities and technologies change over time. The motivating examples of infra-marginal firms in Demsetz (1973) were GM and IBM. Within the next decade both had lost that place and not because they were imitated by rivals[47].

There is, finally, an implication for antitrust policy. Current policy is increasingly faulted for being too relaxed about mergers and perhaps other kinds of horizontal and vertical cooperation among firms. But the relaxation has not hurt consumers. On the other side, calls for tougher enforcement entail a risk of reducing productivity without helping consumers.

[47] GM lost share to more fuel efficient, smaller imports mainly from Japan. IBM lost to the switch from mainframes to smaller more flexibly located machines.

References

Ashenfelter, Orley and Daniel Hoskin. 2010. "The Effect of Mergers on Consumer Prices: Evidence for Five Mergers on the Enforcement Margin." *Journal of Law and Economics* 53(3):417-466.

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson and John Van Reenen. 2020. "The Fall of the Labor Share and the Rise of Superstar Firms." *Quarterly Journal of Economics.* Forthcoming.

Barkai, Simcha. 2020. "Declining labor and Capital Shares." *Journal of Finance,* Forthcoming.

Berry, Steven, Martin Gaynor and Fiona Scott-Morton. 2019. "Do Increasing Markups Matter? Lessons from Empirical Industrial Organization." *Journal of Economic Perspectives* 33 (3):44-68.

Bessen, James. 2017. "Industry Concentration and Information Technology." Boston University School of Law Paper No. 17-41.

Brynjolfsson, Erik, Daniel Rock and Chad Syverson. 2020. "The Productivity J-Curve: How Intangibles Complement General Purpose Technologies." National Bureau of Economic Research. Working Paper 25148

Calligaris, Sara., Chiara Criscuolo and Luca Marcolin.2018., "Mark-ups in the digital era", OECD Science, Technology and Industry Working Papers, 2018/10, OECD Publishing, Paris. available at http://dx.doi.org/10.1787/4efe2d25-en

Council of Economic Advisers. 2016. "Benefits of Competition and Indicators of Market Power." *Issue Brief.* April.

Davis, Steven, R. Jason Faberman, John Haltiwanger, Ron Jarmin and Javier Miranda. 2010. "Business Volatility, Job Destruction and Unemployment." *American Economic Journal: Macroeconomics* 2(2):259-287.

Davis, Steven, Jason Faberman and John Haltiwanger. 2011. "Labor Market Flows in Cross-section and Over Time." *Journal of Monetary Economics.* 59(1):1-18

Davis, Steven and John Haltiwanger. 2014. "Labor Market Fluidity and Economic Performance." National Bureau of Economic Research. Working Paper 20479.

Decker, Ryan, John Haltiwanger, Ron Jarmin and Javier Miranda. 2018. "Changing Business Dynamism and Productivity: Shocks v Responsiveness." National Bureau of Economic Research. Working Paper 24236.

De Loecker, Jan and Jan Eeckhout. 2017. "The Rise of Market Power and the Macroeconomic Implications." National Bureau of Economic Research, Working paper 23687.

De Loecker, Jan, Jan Eeckhout and Gabriel Unger. 2020. The Rise of Market Power and the Macroeconomic Implications. *Quarterly Journal of Economics.* Forthcoming.

Demsetz, Harold. 1973. "Industry Structure, Market Rivalry and Public Policy." *Journal of Law and Economics.* 16(1):1-10.

Galston, William and Clara Hendrickson. 2018. "A policy at peace with itself: Antitrust remedies for our concentrated, uncompetitive economy." Brookings Institution. Available at https://www.brookings.edu/research/a-policy-at-peace-with-itself-antitrust-remedies-for-our-concentrated-uncompetitive-economy/

Ganapati, Sharat. 2019. "Growing Oligopolies, Prices, Output and Productivity." US Census Center for Economic Studies Working Paper 18-48

Gaynor, Martin, Kate Ho and Robert J. Town. 2015. "The Industrial Organization of Health-Care Markets." *Journal of Economic Literature.* 53(2):235-284.

Gutierrez, German and Thomas Phillipon. 2017. "Declining Competition and Investment in the U.S."" National Bureau of Economic Research, Working Paper 23583.

Gutierrez, German and Thomas Phillipon. 2019. "The Failure of Free Entry." National Bureau of Economic Research, Working Paper 26001.

Hsieh, Chang-Tai and Esteban Rossi-Hansberg, 2019. "The Industrial Revolution in Services." National Bureau of Economic Research. Working Paper 25968

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

Kwoka, John. 2013. "Does Merger Control Work? A Retrospective on U.S. Enforcement Actions and Merger Outcomes." *Antitrust Law Journal* 78:619-649.

Kwoka, John. 2015. *Mergers, Merger Control, and Remedies: A Retrospective Analysis of U.S. Policy.* Cambridge: MIT Press.

Kwoka, John and Evginia Shumulkina. 2010. "The Price Effect of Eliminating Potential Competition: Evidence from an Airline Merger." *Journal of Industrial Economics* 58(4):767-793

Luo, Dan. 2014. "The Price Effect of the Delta/Northwest Airlines Merger." *Review of Industrial Organization* 44(1):27-48.

Peltzman, Sam. 2014. "Industrial Concentration under the Rule of Reason." *Journal of Law and Economics.* 57(S3):S101-S120.

Peltzman, Sam. 1977. "The Gains and Losses of Industrial Concentration." *Journal of Law and Economics.* 20(2):229-263.

Schmallensee, Richard. 1989. “Inter-Industry Studies of Structure and Performance.” Ch. 16 in *Handbook of Industrial Organization, v II,* edited by Richard Schmallensee and Robert Willig, 952-1009. Amsterdam:North-Holland.

Syverson, Chad.2017. "Challenges to Mismeasurement Explanations for the US Productivity Slowdown." *Journal of Economic Perspectives*, 31 (2): 165-86.

US Census. 2000. *1997 Economic Census. Core Business Statistics Series. Bridge Between NAICS and SIC.* Accessed at http://www.census.gov/prod/ec97/97x-cs3.pdf

U.S. Department of Justice and the Federal Trade Commission. 2010. *Horizontal Merger Guidelines.* Available at https://www.ftc.gov/sites/default/files/attachments/merger-review/100819hmg.pdf

Weiss, Leonard W. (ed). 1989. *Concentration and Price.* Cambridge:MIT Press.

Williamson, Oliver E. 1968. “Economies as an Antitrust Defense: the Welfare Tradeoffs.” *American Economic Review* 58(1):18-36.