Explaining the Rising Concentration of U.S. Industries: Superstars, Intangibles, Globalization or Market Power?

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Abstract

Since the late 1990's, US industries have become more concentrated and more profitable, while non residential business investment has been weak relative to fundamentals. The interpretation of these trends is controversial. We develop a simple model to differentiate four prominent explanations: decreasing domestic competition (DDC); increases in the efficient scale of operation (EFS); the rise of intangible assets (INTAN); and globalization (GLOBAL). We use our model along with case studies for clear superstars (GAFAM) to assess the validity of common proxies for each hypothesis, including measures of concentration, profitability, mark-ups, investment and productivity divergence between laggard and frontier firms. We highlight that some widely used measures of mark-ups and productivity divergence are prone to measurement error, and therefore provide misleading evidence on aggregate trends. In doing so, we also clarify the confusion about the evolution of labor share in the US and in Europe.

Using the proxies found to be reasonably robust, we then decompose the contribution of each explanation to industry-level trends. We show that GLOBAL explains most of the behavior of Manufacturing industries. Faced with increased foreign competition, domestic laggards exited and domestic concentration increased. Moreover, consistent with GLOBAL, surviving leaders responded by increasing investment; while profits as well as import-adjusted concentration remained flat. Estimates of return-to-scale for manufacturing have remained stable or decreased (Ho and Ruzic, 2017). Moving to non-manufacturing sectors, we find that EFS, INTAN and DDC all contributed to the rise in concentration. EFS and INTAN are more important before 2000, particularly in some sectors such as Retail Trade. Since 2000, DDC emerges as the most prominent explanation. This is evidenced by three facts: concentration since 2000 increased in the U.S. but not in Europe; the relationship between concentration and productivity was positive in the 1990s, but is zero or negative in the 2000s; and industry leaders cut investment

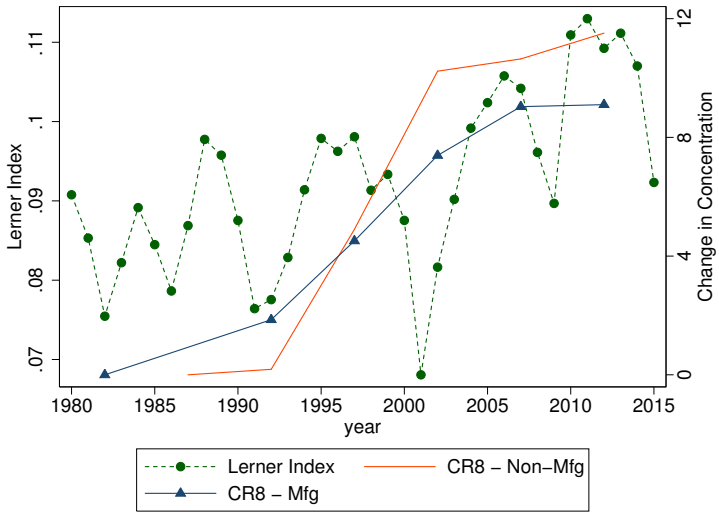
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when concentration increased, in contrast to the predictions of EFS and INTAN. We conclude by constructing an index of industry-level competition intensity that aggregates all relevant proxies using PCA. The index identifies the sectors with the largest declines in competition.

Two important stylized facts have emerged in recent years regarding the U.S. business sector. The first fact is that concentration and profitability have increased across most U.S. industries, as shown by Grullon et al. (2016). Figure 1 shows the aggregate Lerner index (operating income over sales) across all Compustat firms along with the change in weighted average 8-firm concentration ratio in manufacturing and non-manufacturing industries.[1]

Figure 1: Concentration and Mark-ups



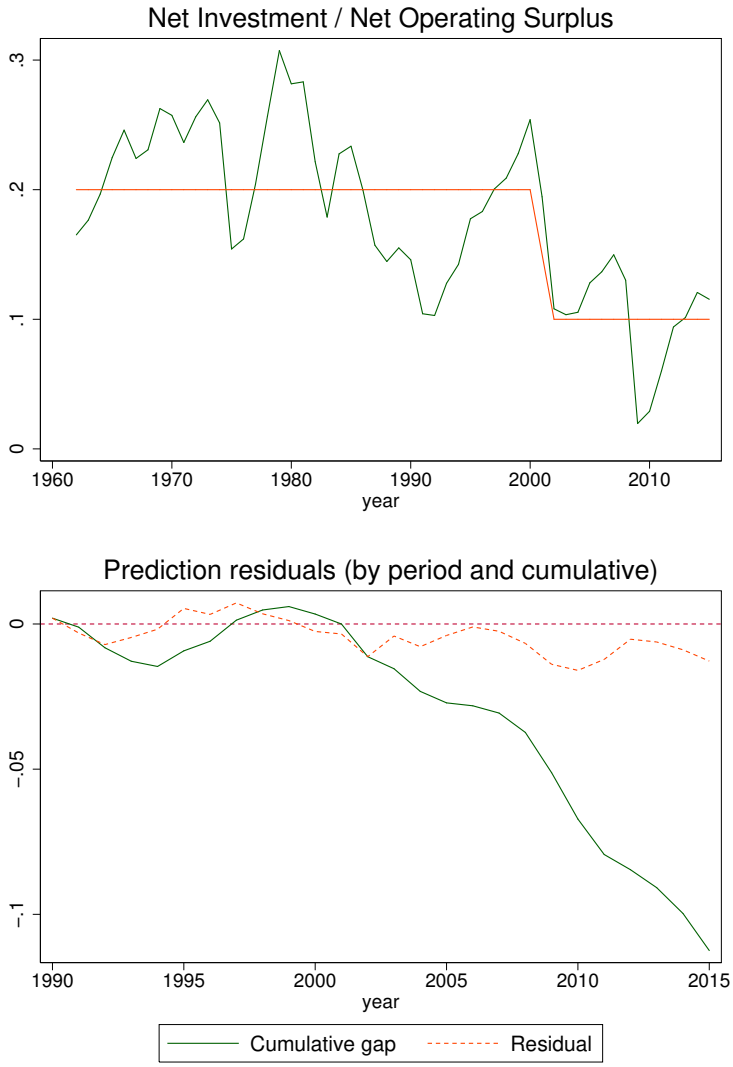
Notes: Lerner Index from Compustat, defined as operating income before depreciation minus depreciation divided by sales. 8-firm CR from Economic Census, defined as the market share (by sales) of the 8 largest firms in each industry. Data before 1992 based on SIC codes. Data after 1997 based on NAICS codes. Data for Manufacturing reported at NAICS Level 6 (SIC 4) because it is only available at that granularity in 1992. Data for Non-Manufacturing based on NAICS level 3 segments (SIC 2).

The second stylized fact is that business investment has been weak relative to measures of profitability, funding costs, and market values since the early 2000s. The top chart in Figure 2 shows the ratio of aggregate net investment to net operating surplus for the non financial business sector, from 1960 to 2015. The bottom chart shows the residuals (by year and cumulative) of a regression of net investment on (lagged) Q from 1990 to 2001. Both charts show that investment has been low relative to profits and Q since the early 2000's. By 2015, the cumulative under-investment is large, around 10% of capital.

While these two stylized facts are well established, their interpretation remains controversial. There is little agreement about the causes of these evolutions, and even less about their consequences. For instance, Furman (2015) and CEA (2016) argue that the rise in concentration suggests "economic rents and barriers to competition", while Autor et al. (2017a) argue almost exactly the opposite: they think that concentration reflects "a winner take most feature" explained by the fact that "consumers have become more sensitive to price and quality due to greater product market competition." Network effects and increasing differences in the productivity of Information Technology could also

[1]The appendix shows that alternate mark-up estimates, notably those based on Barkai (2017), yield similar results.

Figure 2: Net Investment, Profits and Q-Residuals



Notes: Annual data from US Flow of Funds accounts. Net investment, net operating surplus for Non Financial Business sector; Q for Non Financial Corporate sector.

increase the efficient scale of operation of the top firms, leading to higher concentration. The key point of these later explanations is that concentration reflects an efficient increase in the scale of operation. For short, we will refer to this hypothesis as the efficient scale hypothesis (henceforth EFS).

The evolution of profits and investment could also be explained by intangible capital deepening, as discussed in Alexander and Eberly (2016). More precisely, an increase in the (intangible) capital share together with a downward bias in our traditional measures of intangible investment could lead, even in competitive markets, to an increase in profits (competitive payments for intangible services) and a decrease in (measured) investment. We will refer to this hypothesis as the intangible deepening hypothesis (henceforth INTAN). Finally, trade and globalization can explain some of the same facts (Feenstra and Weinstein, 2017). Foreign competition can lead to an increase in measured (domestic) concentration (e.g. textile industry), and a decoupling of firm value from the localization of investment. We refer to this hypothesis as the globalization hypothesis (henceforth GLOBAL).[2]

These hypotheses are not mutually exclusive. A combination of EFS, INTAN and GLOBAL is often heard in the discussion of internet giants Google, Amazon, Facebook or Apple. INTAN can also contribute to DDC since patents and other similar assets can create barriers to entry and increase the value of managing industry regulators and the challenges of litigation.

This paper decomposes the contribution of EFS, INTAN, GLOBAL and DDC to aggregate and sector-level trends in concentration, profitability and investment. We develop a simple model to clarify these hypotheses. We then show that Globalization explains most of the dynamics in the Manufacturing sector. In line with models of strategic interactions, increased foreign competition forced laggards to shrink or exit, while leaders responded by increasing investment – particularly in intangible assets. Domestic concentration increased, but profits and import-adjusted concentration (i.e., properly accounting for foreign firms selling in the U.S. as in Feenstra and Weinstein (2017)) remained flat.

We then study the remaining sectors. We find limited support for GLOBAL but strong support for EFS, INTAN and DDC. EFS and INTAN explain most of the dynamics in select sectors (e.g., Retail Trade) and are particularly important before 2000. Since 2000, however, DDC emerges as the most prominent explanation. Intangible intensity has remained flat since then, while concentration and profits have increased drastically. Moreover, profitability and concentration has increased in sectors that (arguably) have been less affected by technological changes. We discuss long run trends in profitability, concentration and investment; and present three pieces of evidence in support of DDC and against EFS and INTAN. The first piece of evidence is a comparison with Europe. We consider industries with significant increases in concentration in the U.S., such as the Telecom industry, and we show that these same industries have not experienced similar increases in concentration and profit rates in Europe, even though they use the same technology and are exposed to the same foreign competition. Secondly, EFS predicts that concentration should lead to productivity gains

[2]One could entertain other hypotheses – such as weak demand or credit constraints – but previous research has shown that they do not fit the facts. See **?** for detailed discussions and references.

at the industry level, as high productivity leaders expand. There is some evidence for EFS during the 1990s as the relationship between concentration and productivity was positive, but it is zero or negative in the 2000s. Thirdly, EFS predicts that leaders should increase investment and R&D in concentrating industries. We find the opposite: the relative investment of leaders is lower in concentrated industries, in physical and intangible capital.

[IN PROGRESS] We conclude by constructing an index of industry-level competition intensity that aggregates measures of mark-ups, profitability, concentration, investment and productivity, among others. A decline in competition affects all of these quantities in particular ways, such that combining them can provide a better proxy of competition intensity that reduces some of the limitations of any one measure. The index identifies [XXX] as the sectors with the largest declines in competition. These sectors exhibit higher profits, higher concentration and lower investment relative to Q and slower productivity growth compared to Europe.

Related Literature. Our paper is related to several strands of literature. There is a growing literature studying trends on competition, concentration, and entry. Davis et al. (2006) find a secular decline in job flows. They also show that much of the rise in publicly traded firm volatility during the 1990's is a consequence of the boom in IPOs, both because young firms are more volatile, and because they challenge incumbents. Haltiwanger et al. (2011) find that "job creation and destruction both exhibit a downward trend over the past few decades." Decker et al. (2015) argue that, whereas in the 1980's and 1990's declining dynamism was observed in selected sectors (notably retail), the decline was observed across all sectors in the 2000's, including the traditionally high-growth information technology sector. Furman (2015) shows that "the distribution of returns to capital has grown increasingly skewed and the high returns increasingly persistent" and argues that it "potentially reflects the rising influence of economic rents and barriers to competition."[3] CEA (2016) and Grullon et al. (2016) are the first papers to extensively document the broad increases in profits and concentration. Grullon et al. (2016) also show that firms in concentrating industries experience positive abnormal stock returns and more profitable M&A deals. Blonigen and Pierce (2016) find that M&As are associated with increases in average markups. Dottling et al. (2017) find that concentration has increased in the U.S. while it has remained stable (or decreased) in Europe. Faccio and Zingales (2017) show that competition in the mobile telecommunication industry is heavily influenced by political factors, and that, in recent years, many countries have adopted more competition-friendly policies than the US. Autor et al. (2017a) study the link between concentration and the labor share. An important issue in the literature is the measurement of markups and excess profits. The macroeconomic literature focuses on the cyclical behavior of markups (Rotemberg and Woodford, 1999; Nekarda and Ramey, 2013). Over long horizons, however, it is difficult to separate excess profits from changes in the capital share. De-Loecker and Eeckhout (2017) estimate markups using the ratio of sales to costs of goods sold, but in the long run this ratio

[3] Furman (2015) also emphasizes emphasizes the weakness of corporate fixed investment and points out that low investment has coincided with high private returns to capital, implying an increase in the payout rate (dividends and shares buyback).

depends on the share of intangible expenses, and the resulting markup does not directly provide a measure of market power. Barkai (2017), on the other hand, estimates directly the required return on capital and finds a significant increase in excess profits.

The weakness of investment has been discussed in the context of weak overall growth (IMF, 2014; Furman, 2015; Hall, 2015; Fernald et al., 2017). Alexander and Eberly (2016) emphasize the role of intangible investment. Gutiérrez and Philippon (2017a) show that the recent weakness of investment relative to Tobin's Q is not explained by low expected productivity growth, low expected demand, or financial frictions. Consistent with our emphasis on market power, Lee et al. (2016) find that capital stopped flowing to high Q industries in the late 1990's. A large literature, surveyed by Gilbert (2006), studies the relationship between competition, innovation and investment. Comin and Philippon (2005) find that "firm volatility increases after deregulation [and] is linked to research and development spending." Aghion et al. (2009) study how foreign firm entry affects investment and innovation incentives of incumbent firms. Varela (2017) studies the feedback effects on investment from relaxing laggards' financial constraints. She finds that improving laggards' access to funding not only increases their own investment, but also pushes leaders to invest more to remain competitive. Corhay et al. (2017) study the link between (risky) markups and expected excess returns.

Last, our paper is related to the effect of foreign competition – particularly from China (see Bernard et al. (2012) for a review). Bernard et al. (2006) show that capital-intensive plants and industries are more likely to survive and grow in the wake of import competition. Bloom et al. (2015) argue that Chinese import competition leads to increased technical change within firms and a reallocation of employment towards more technologically advanced firms. Frésard and Valta (2015) find that tariff reductions lead to declines in investment in markets with competition in strategic substitutes and low costs of entry. Within-industry, they find that investment declines primarily at financially constrained firms. The decline in investment is negligible for financially stable firms and firms in markets featuring competition in strategic complements. Hombert and Matray (2015) show that R&D-intensive firms were better able to cope with Chinese competition than low-R&D firms. They explain this result based on product differentiation, using the Hoberg and Phillips (2017) product similarity index. Autor et al. (2013); Pierce and Schott (2016); Autor et al. (2016); Feenstra et al. (2017) study the effects of Chinese import exposure on U.S. manufacturing employment. Feenstra and Weinstein (2017) estimate the impact of globalization on mark-ups, and conclude that mark-ups decreased in industries affected by foreign competition. Some of these papers find a reduction in investment for the 'average' firm, which is consistent with our results and highlights the importance of considering industry leaders and laggards separately.

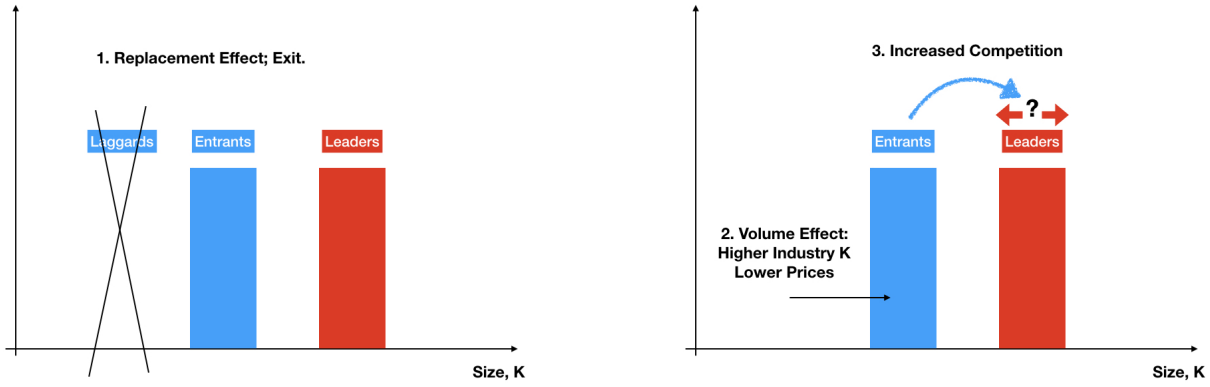
The remainder of this paper is organized as follows. Section 2 discusses our dataset and shows that the growth in profits and investment gap is driven by industry leaders in concentrating industries. Section 1 develops a simple model to clarify the hypotheses. Section 3 focuses on Manufacturing while Section 4 focuses on non-manufacturing. Section 7 concludes.

1 Model

To be completed with testable implications.

The previous section has shown that international, industry, and firm level evidence is inconsistent with EFS and consistent with DDC in the US. We now make the case that competition increases investment, and therefore that DDC has caused a shortfall in business investment. Establishing causality is challenging because entry, exit – and therefore concentration – are endogenous. We thus propose three different identification strategies. Figure 3 summarizes the testable predictions. Consider an industry, initially in equilibrium with some leaders and some laggards, but disrupted by entrants that are more productive than the current laggards. There is first a replacement effect, as the laggards are forced out. Then, because the entrants are productive, industry output expands and prices fall. Finally, the leaders react. This third effect is theoretically ambiguous, as discussed at length in the literature (Gilbert, 2006). In non-strategic models (Klette and Kortum 2004, monopolistic competition with iso-elastic demand curves, etc.), leaders would cut investment. In strategic models (entry deterrence, neck-and-neck competition, etc.) leaders could increase investment and innovation.

Figure 3: Testable Predictions



Which of these predictions we can test depends on the context. If competition is domestic, we can test the industry level response of investment, as well as the response of leaders. If entrants are foreign competitors we can only test the investment response of the leaders, because there is no reason to expect domestic investment to increase.

2 Data and Stylized Facts

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[INTRODUCE THE DATA AND MEASURES OF COMPETITION USED TO TEST ALL HYPOTHESES.]

For each of the following, we discuss (i) data sources, (ii) trends (manufacturing and non-manufacturing), (iii) divergence between leaders and laggards and (iii) measurement problems.

- Concentration
- Profit rates
- Mark-ups (DLE)
- TFP
- Labor Productivity
- Investment and Q
- Business dynamism (potentially entry, churn among leaders)

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In this Section we summarize the data used throughout the paper, and we present two new stylized facts that are critical to understanding the dynamics of concentration and investment.

2.1 Data

We use a wide range of aggregate-, industry- and firm-level data, summarized in Table 1. We describe the treatment of intangible assets and the calculation of Herfindahls in the rest of this section.

2.1.1 Intangible Assets

It is essential to account for intangible assets when measuring capital, investment and Q. It is not always possible to use exactly the same definitions in aggregate/industry datasets and in firm-level datasets.

Aggregate and Industry-level data. Aggregate and industry-level data are sourced from U.S. and European National Accounts. Since 2013, these accounts capitalize 'identifiable' intangible assets such as software, R&D, and entertainment, literary, and artistic originals. We use the corresponding measures of I and K in our analyses. When estimating Q, we follow the literature and measure the ratio of market value to the replacement cost of capital including intangibles (Gutiérrez and Philippon, 2017a).

Firm-level data. US firm-level data are sourced from Compustat and therefore follow GAAP. Under GAAP, firms report stock and flow measures of tangible capital in the Property, Plant and Equipment (PP&E) and Capital Expenditures (CAPX) line items. The treatment of intangible assets, however, is more nuanced. Internally created intangibles are expensed on the income statement and almost never appear on the balance sheet – these include R&D and advertising expenses,

Table 1: Summary of Key Data Sources

Data type	**Key Data fields**	**Source**	**Region**	**Granularity**
Aggregate/sector-level	I, K, OS, and Q	Flow of Funds	US	Country and Sector (NFCB, NFNCB)
Industry-level data	I, K and OS	BEA	US	~NAICS L3
		OECD STAN	EU	ISIC Rev 4
Concentration Measures	Herfindahls and Concentration Ratios	Economic Census	US	NAICS L3-L6
		Compustat	US	BEA segments
		CompNET	EU	ISIC Rev 4
		BvD Amadeus	EU	ISIC Rev 4
Firm Financials	I, K, OS,Q and other controls	Compustat NA	US	Firm
		Compustat Global	EU	Firm
China	Import Exposure	UN Comtrade	Global	HS code
	NTR Gap and import value	Peter Schott's website	US	NAICS L6
Productivity & controls	TFP & Mfg Industry Controls	NBER-CES Database	US	NAICS L6
	TFP	BLS KLEMS	US	BEA segments
Other	Analyst Forecasts	I/B/E/S	US	Firm
	Intangible Capital	Peters & Taylor	US	Firm

for example. Externally created (i.e., acquired) intangible assets are capitalized and reported in the Intangible Assets line item. These include Goodwill and Other (identifiable) Intangible Assets such as patents and software.

Peters and Taylor (2016) (PT for short) estimate firm-level intangible capital by combining estimates of internally and externally-created intangibles. For the former, they follow Corrado and Hulten (2010) in using granular investment and depreciation assumptions on the R&D and Sales, General & Administrative (SGA) line items to capitalize R&D as well as "expenditures on product design, marketing and customer support, and human capital and organizational development." For the latter, they use the balance sheet measure of externally created intangibles directly.[4] We use PT's estimates of I and K in our firm-level analyses, and report results separately for tangible, intangible and total capital where appropriate. For Q, PT advocate a measure labeled 'total Q' and defined as the ratio of market value of productive assets to tangible plus intangible capital. We deviate from this definition and instead estimate firm-level Q as the market-to-book ratio, in line with Gutiérrez and Philippon (2017a). Gutiérrez and Philippon (2017a) compare the distribution and performance of market-to-book and 'total Q' and find that market-to-book is more stable over time and relies on fewer measurement assumptions. Nonetheless, we confirm that our results are robust to using 'total Q'.

2.1.2 Adjusted Herfindahls

Our ideal competition measure should cover the whole economy and take into account foreign competition (i.e., imports).

For Manufacturing, Feenstra and Weinstein (2017) (FW for short) construct such a measure. They use Census Herfindahls for the U.S. and import data for foreign countries. The replication files available at the author's website include Herfindahls at the country- and 4-digit Harmonized System (HS-4) level, from 1992 to 2005. We start from these Herfindahls, aggregate them and map them to BEA segments.[5] We then extend the series to cover 1990 to 2015 by regressing FW Herfindahls on Compustat Herfindahls and share of sales.[6] The detailed calculations are described

[4] Because it includes non-identifiable assets such as Goodwill, marketing and human capital, PT's measure of intangible capital is broader than that of National Accounts. It results in higher capital estimates. Our conclusions are robust to excluding Goodwill from PT's measure of intangible capital

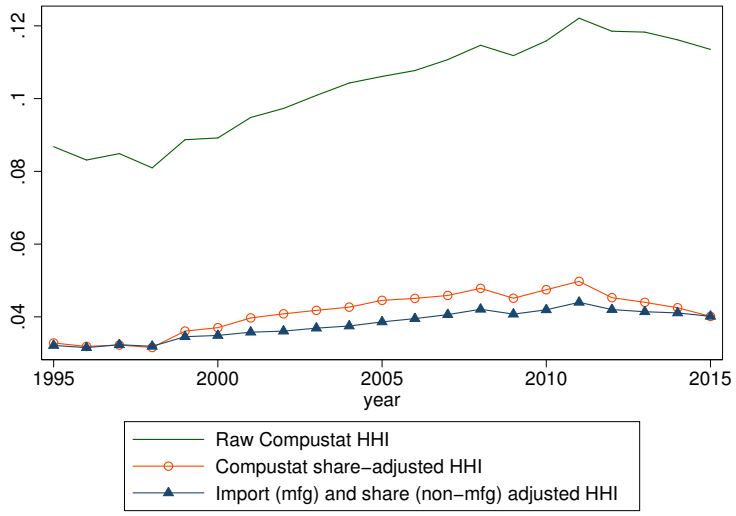
[5] First, we aggregate country-sector Herfindahls HHI_t^{cj} across countries c to obtain the *Overall Herfindahl Index* for HS-4 sector j $\left(HHI_t^j\right)$. Next, we use the correspondence of Pierce and Schott (2012) to map HS-4 sectors to NAICS-6 sectors, which can then be mapped to BEA segments (which roughly correspond to ~NAICS-3 segments). Last, we aggregate Herfindahls across HS-4 segments j into BEA segments k, to obtain Herfindahls at the BEA segment k: HHI_t^k.

[6] FW Herfindahls are based on SIC segments before 1997 and NAICS segments afterwards, which results in a jump in HHI_t^k for some series. We control for the jump by subtracting the 1997 change in HHI_t^k from all HHI_t^k series after 1998. We then extend the time series through a regression of the form $log\left(HHI_t^k\right) = log\left(HHI_t^{k,CPraw}\right) + log\left(s_{kt}^{CP}\right) + \alpha^k + \varepsilon_{kt}$, where $HHI_t^{k,CP}$ denotes the Herfindahl from Compustat and s_{kt}^{CP} denotes the share of sales of Compustat firms as a percent of total US output plus imports. The Compustat Herfindahl $\left(HHI_t^{k,CP}\right)$ is highly correlated with the FW Herfindahl $\left(HHI_t^k\right)$ at the BEA segment-level, particularly once controlling for the share of Compustat sales. For instance, the R^2 of the regression above excluding fixed effects is 42% and including fixed effects is 95% – so the filled-in Herfindahls seem accurate. The level of HHI_t^k following FW tends to be lower than

in the appendix.

Outside Manufacturing, neither Census nor foreign Herfindahls are available – so we have to use Compustat. We start with the "raw" Herfindahls from Compustat and adjust them to account for the domestic coverage of Compustat as well as the share of imports. Consider an industry with x firms in Compustat and N firms globally, all with equal shares of the U.S. market. The Compustat share of output is $s^{CP} = \frac{x}{N}$, and the Compustat-based Herfindahl $HHI^{CP} = \frac{1}{x}$. Under these assumptions, the adjusted Herfindahl can computed as $HHI_t^k = \frac{1}{N} = HHI_{kt}^{CP} \times s_{kt}^{CP}$ where s_{kt}^{CP} is the share of Compustat sales in US output plus imports. We refer to this measure as the "Compustat share-adjusted" Herfindahl (HHI_{kt}^{CPadj}). For service sectors, import data is not available but these are typically small, so we set them to zero.

Figure 4: Weighted Average Herfindahls



Notes: Annual data. Figure shows the weighted average of three measures of Herfindahls. The Raw Compustat HHI is the sum of squared Compustat market shares. The Compustat share-adjusted HHI adjusts for the Compustat share of sales. The Import and Share adjusted HHI is based on FW Herfindahls for Manufacturing and Compustat share-adjusted Herfindahls for non-manufacturing.

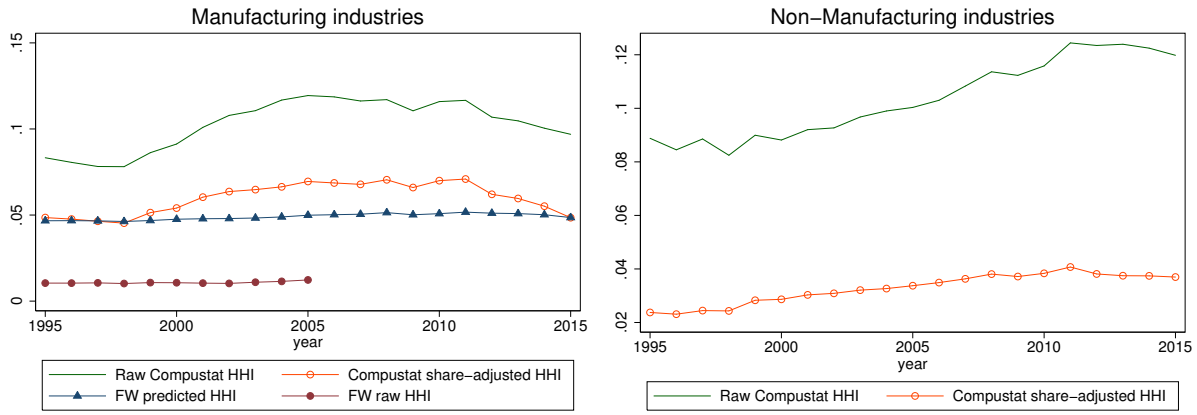
Figure 4 shows the impact of both adjustments sequentially. The Compustat share adjustment accounts for the share of Compustat sales in domestic output plus imports, while the import adjustment accounts for the concentration of foreign firms. All three series have increased since 1995, by 30%, 22% and 25%, respectively. [7]

the level implied by Compustat. Most of our regressions include fixed effects, so this is not an issue. However, for columns 1-2 in Table **??** as well as some Figures, the level of the HHI_t^k matters. We therefore add a constant across all manufacturing segments, to match the average level of HHI_t^k to that of $HHI_t^{k,CP}$ across all manufacturing industries.

[7] We validate the use of Compustat in two ways. First, we compare the evolution of Herfindahls adjusted for the Compustat share of sales (HHI_{kt}^{CPadj}) to alternate Compustat- and FW-based Herfindahls, as described in the Appendix. HHI_{kt}^{CPadj} exhibits the highest correlation with FW-Herfindahls (81% in levels and 66% in changes). Second, we gather census CRs and use them to (i) test the robustness of key results to using Census CRs instead of import-adjusted Herfindahls; and (ii) compare Compustat CRs against Census CRs. Most of our results are robust

Figure 5 shows that, controlling for imports, the concentration of Manufacturing industries remained largely stable. By contrast, concentration of non-manufacturing industries increased significantly.

Figure 5: Weighted Average Herfindahls by Sector



Notes: Annual data. Figure plots the weighted average of alternate HHI measures, by sector. The Raw Compustat HHI is the sum of squared Compustat market shares. The Compustat share-adjusted HHI adjusts for the Compustat share of domestic output plus imports. The FW predicted HHI is computed as described in the text. Last, the FW raw HHI is the FW HHI after subtracting the change from 1997 to 1998.

2.2 Two Stylized Facts

This section shows why it is critical to understand the dynamics of concentrating industries, and within industries, of the leading firms.

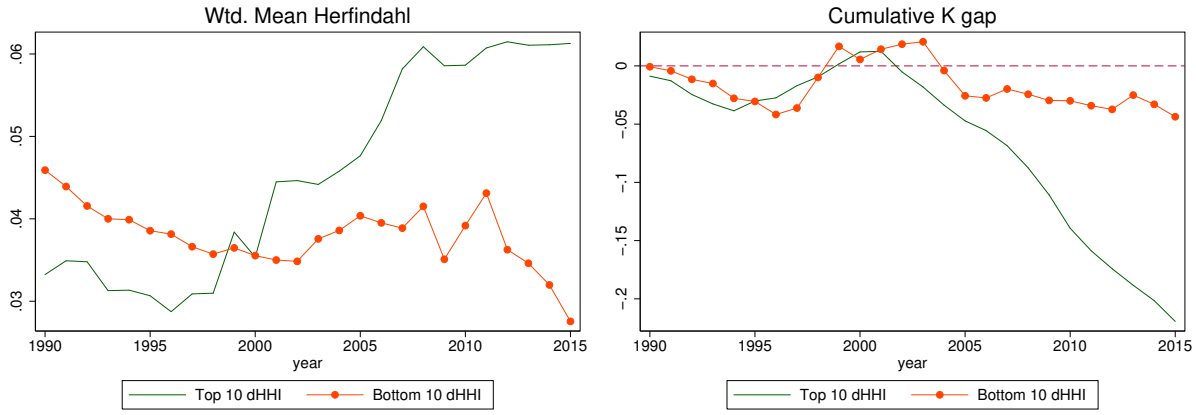
Fact 1: The Investment Gap Comes from Concentrating Industries. Figure 6 shows that the capital gap is coming from concentrating industries.[8] The solid (dotted) line plots the implied capital gap relative to Q for the top (bottom) 10 concentrating industries. For each group, the capital gap is calculated based on the cumulative residuals of separate industry-level regressions of net industry investment from the BEA on our measure of (lagged) industry Q from Compustat.[9] The Herfindahl index for the bottom 10 turns out to be rather stable over time, and investment

to using Census CRs instead of import-adjusted Herfindahls (see Appendix for details). In addition, Census and Compustat CRs are strongly correlated at the BEA segment-level (80% in levels and 56% in changes). We also perform extensive sensitivity analyses to adjustments in the calculation of import-adjusted Herfindahls (e.g., using s_{kt}^{BEA} instead of s_{kt}^{CP}). The Appendix provides additional details on the tests and comparisons. See Davis et al. (2006) for additional discussion of the limitations in using Compustat to measure industry concentration

[8] We define concentrating industries based on the relative change in import adjusted Herfindahls from 2000 to 2015. The top 10 concentrating industries include Arts, Health other, Inf. motion, Inf. publish and software, Inf Telecom, Transp pipeline, Transp truck, Min exOil, Retail trade, Transp_air. We exclude Agriculture because Compustat provides limited coverage for this industry.

[9] To be specific, each line is computed as follows: we first compute the residuals from separate industry-level regressions of net investment on (lagged) mean industry Q, from 1990 to 2001. Then, we average yearly residuals across the industries with the ten largest and ten smallest relative changes in import-adjusted Herfindahls from 2000 to 2015. Last, we compute the cumulative capital gap by adding residuals from 1990 to 2015, accounting for depreciation.

Figure 6: Cumulative Capital Gap for Concentrating and Non-Concentrating Industries



Notes: Annual data. Left plot shows the weighted average import adjusted Herfindahl for the 10 industries with the largest and smallest relative change in import-adjusted Herfindahl. Right plot shows the cumulative implied capital gap (as percent of capital stock) for the corresponding industries. See text for details.

remains largely in line with Q for this group.

Fact 2: Industry Leaders Account for the Increased Profit Margins and for the Investment Gap. In Table 2, we define leaders by constant shares of market value to ensure comparability over time.[10] Capital K includes intangible capital as estimated by Peters and Taylor (2016). Table 2 shows that the leaders' share of investment and capital has decreased, while their profit margins have increased.

Table 2 suggests that leaders are responsible for most of the decline in investment relative to profits. To quantify the implied capital gap, Figure 7 plots the percentage increase in the capital stock of the U.S. non-financial private sector assuming that Compustat leaders continued to invest 35% of CAPX plus R&D from 2000 onward, while the remaining groups invested as observed. The capital stock would be ∼3.5% higher under the counter-factual. This is a large increase considering that our Compustat sample accounts for about half of investment (see Appendix **??** for details) and that the average annual net investment rate for the U.S. Non Financial Business sector has been less than 2% since 2002. A macroeconomic simulation by Jones and Philippon (2016) (taking into account general equilibrium effects and monetary policy) based on our implied markup series suggests a shortfall of 5 to 10%.

3 Manufacturing

[SUMMARIZE STYLIZED FACTS RELATED TO MANUFACTURING, AS DISCUSSED IN DATA SECTION ABOVE]:

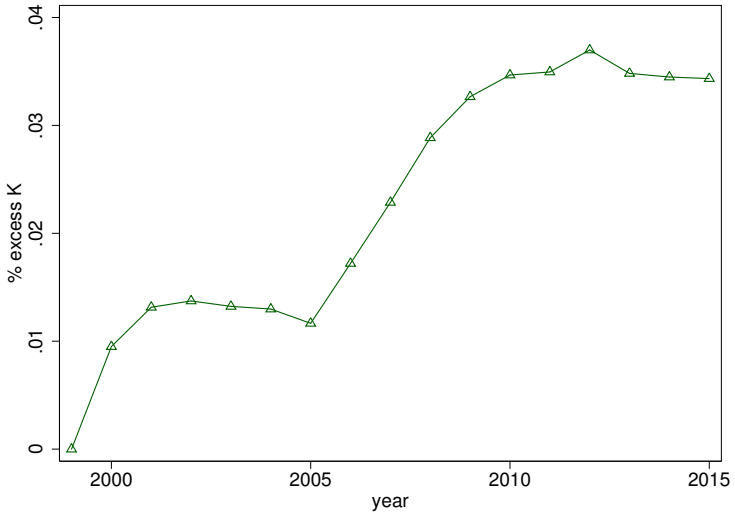
[10] OIBDP shares are stable which is consistent with stable shares of market value and stable relative discount factors. Because firms are discrete, the actual share of market value in each grouping varies from year to year. To improve comparability, we scale measured shares as if they each contained 33% of market value.

Table 2: Investment, Capital and Profits by Leaders and Laggards

Table shows the average value of a broad set of investment, capital and profitability measures by time period and market value. Leaders (laggards) include the firms with the highest (lowest) MV that combined account for 33% of MV within each industry and year. Annual data from Compustat. Lerner Index defined as $(OIBDP - DP)/SALE$.

	1980-1995			**1996-2015**			**Difference**		
	Leaders	**Mid**	**Laggards**	**Leaders**	**Mid**	**Laggards**	**Leaders**	**Mid**	**Laggards**
	0-33 pct	33-66 pct	66-100 pct	0-33 pct	33-66 pct	66-100 pct	0-33 pct	33-66 pct	66-100 pct
Share of OIBDP	0.33	0.34	0.33	0.33	0.33	0.33	**0.00**	0.00	0.00
Share of CAPX + R&D	0.35	0.32	0.34	0.29	0.32	0.39	**-0.06**	0.01	0.05
Share of PP&E	0.32	0.33	0.34	0.30	0.31	0.39	**-0.02**	-0.02	0.05
Share of K	0.31	0.33	0.36	0.27	0.33	0.39	**-0.03**	0.00	0.04
(CAPX+R&D)/OIBDP	0.71	0.67	0.71	0.52	0.57	0.70	**-0.20**	-0.10	-0.01
Lerner Index	0.10	0.09	0.07	0.13	0.11	0.07	**0.02**	0.02	0.001

Figure 7: Implied Gap in K due to Leader Under-Investment



Notes: Annual data. Figure shows the cumulative implied excess capital (as percent of total U.S. capital stock for the industries in our sample) assuming Compustat leaders continue to account for 35% of CAPX and R&D investment from 2000 onward. Non-leaders assumed to maintain their observed invest levels. Excess investment assumed to depreciate at the US-wide depreciation rate. US-wide capital and depreciation data from BEA.

- Flat Profits.
- Flat Concentration
- No/small gap in investment vs. Q
- Tightening productivity divergence?
- Stable churn among leaders?

Then identify the effect of Globalization using Chinese Competition as an IV. Use results from China paper.

3.1 Identification with Chinese Competition

Our first test is based on increased competition from China during the 2000's, following Autor et al. (2016) and Pierce and Schott (2016). Pierce and Schott (2016) exploit changes in barriers to trade following the United States granting Permanent Normal Trade Relations (PNTR) to China. PNTR became effective on December 2001 as China entered the WTO.

Chinese competition leads to a strong replacement effect, consistent with Figure 3. Figure 8 shows the normalized number of firms in industries with high and low Chinese import penetration. Both groups have the same pre-existing trends, including during the dot-com boom, but start to diverge after 2000. The number of firms in industries with high import penetration decrease much faster than the number of firms in industries with low import penetration.

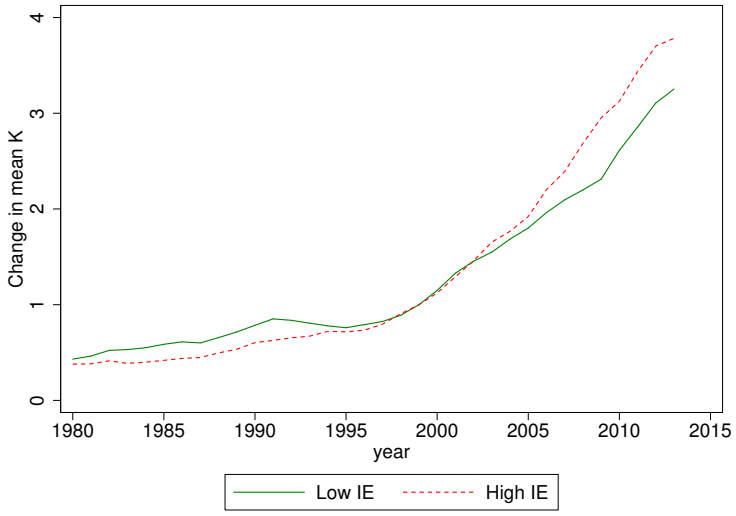
Figure 8: Number of firms by Chinese exposure (1991 = 1)



Notes: Annual data. Firm data from Compustat; import data from UN Comtrade. Manufacturing industries only, split into 'high' (above-median) and 'low' (below-median) exposure based on import penetration from 1991 to 2011.

Let us now focus on the surviving firms. Figure 9 plots the average stock of K across Compustat firms in a given year, split by the level of import exposure. As shown, average K increased faster in high exposure industries than low exposure industries. Moreover, the increase within high exposure industries is concentrated in leaders.

Figure 9: Change in average firm K^{PT} by Chinese Exposure (1999 = 1)



Notes: Annual data. US incorporated firms in manufacturing industries only. Industries assigned to high (low) exposure if they have above (below) median NTR gap (see below for definition). Similar patterns for PP&E and Intangibles.

Figure 3 above is based on actual import penetration and one can worry about endogeneity. In our regressions (and graphical analyses of K such as Figure 9) we therefore use the instrument proposed by Pierce and Schott (2016). Before PNTR, China was considered a non-market economy which, under the Smoot-Hawley Tariff Act of 1930, are subject to relatively high tariff rates (known as "Non-Normal Trade Relations" tariffs or "non-NTR rates"). From 1980 onward, U.S. Presidents began temporarily granting NTR tariff rates to China, but required annual re-approval by congress. The re-approval process introduced substantial uncertainty around future tariff rates and limited investment by both U.S. and Chinese firms (see Pierce and Schott (2016) for a wide range of anecdotal and news-based evidence). This ended in 2000, when the U.S. granted PNTR to China. The granting of PNTR removed uncertainty around tariffs, leading to an increase in competition. Pierce and Schott (2016) show that industries facing a larger NTR gap experienced a larger increase in Chinese imports and a larger decrease in U.S. employment. We quantify the impact of granting PNTR on industry j as the difference between the non-NTR rate (to which tariffs would have risen if annual renewal had failed) and the NTR tariff rate that was locked in by PNTR

$$NTR\,Gap_j = Non\,NTR\,Rate_j - NTR\,Rate_j.$$

This measure is plausibly exogenous to industry demand and technology after 2001. The vast majority of the variation in NTR gaps is due to variation in non-NTR rates set 70 years prior to passage of PNTR. See Pierce and Schott (2016) for additional discussion. We then examine the link between increased competition and investment (by leaders and laggards) using a generalized difference-in-differences (DiD) specification:

$$\begin{aligned}\log(K_{i,j,t}) = {} & \beta_1 Post-2001 \times NTR\,Gap_j \times \overline{\Delta IP_t^{US}} \\ & + \beta_2 Post-2001 \times NTR\,Gap_j \times \overline{\Delta IP_t^{US}} \times Leader_{i,j,0} \\ & + \boldsymbol{Post-2001} \times \boldsymbol{X_{j,91}}'\boldsymbol{\gamma} + \eta_t + \mu_i + \varepsilon_{it},\end{aligned} \tag{1}$$

where the dependent variable is a given measure of capital for firm i in industry j during year t. $\overline{\Delta IP_t^{US}}$ captures time-series variation in Chinese competition averaged across all industries.[11] The first two terms on the right-hand side are the DiD terms of interest. The first one is an interaction between the NTR gap and $\overline{\Delta IP_t^{US}}$ for the post-2001 period. The second term adds an indicator for leader firms to capture differences in investment between leaders and laggards. The third term interacts the post-PNTR dummy with time-invariant industry characteristics such as initial capital and skill intensity.[12] We include year and firm fixed effects η_t and μ_i. Our main sample for this

[11] The appendix presents results excluding $\overline{\Delta IP_{j,t}^{US}}$ to mirror the specification of Pierce and Schott (2016), as well as following the approach of Autor et al. (2016) – which instruments $\Delta IP_{j,t}^{US}$ with the import penetration of 8 other advanced economies ($\Delta IP_{j,t}^{OC}$). $\Delta IP_{j,t}^{US}$ is defined in the Appendix, following Autor et al. (2016).

[12] These industry characteristics are sourced from the NBER-CES database. They include initial year (1991) (i)

analysis includes all U.S. incorporated manufacturing firms in Compustat over the 1991 to 2015 period, but we also report results only with continuing firms (i.e., firms that were in the sample before 1995 and after 2009).

Table 3 shows that leaders increase investment in response to exogenous changes in foreign competition. We consider three different measures of capital: PP&E, Intangibles (measured as in PT) and total capital (equal to the sum of PP&E and Intangibles).[13] This supports a strategic interaction/neck-to-neck competition model, where leaders invest more to deter entry, while laggards reduce investment or exit. Columns 4 to 6 focus on continuing firms; and show that leaders invested more than laggards, even when compared only to firms that survived the China shock.

Our results are consistent with Frésard and Valta (2015) and Hombert and Matray (2015). Frésard and Valta (2015) find a negative average impact of foreign competition in industries with low entry costs and strategic substitutes. They briefly study within-industry variation, and find that investment declines primarily at financially constrained firms. Hombert and Matray (2015) studies within-industry variation with a focus on firm-level R&D intensity. They show that R&D-intensive firms exhibit higher sales growth, profitability, and capital expenditures than low-R&D firms when faced with Chinese competition, consistent with our finding of increased intangible investment. They find evidence of product differentiation using the index of Hoberg and Phillips (2017). In the Appendix we study the dynamics of employment and find that leaders increase both capital and employment, while laggards decrease both. Employment decreases faster than capital so that K/Emp increases in both groups of firms.

4 Non-Manufacturing

In this section we make the case that the increase in concentration reflects DDC. As explained above, we adjust our concentration measures to take into account foreign competition. The main alternative explanation is then EFS. The efficient scale argument is that technological change – information technology, networks, winner-take-all, etc – has increased the efficient relative size of the best firms in each industry. The key point here is that increasing skewness is a efficient response to changes in the environment. We present three pieces of evidence that are inconsistent with this interpretation but consistent with DDC.

4.1 Stylized Facts

[PRESENT AND DISCUSS STYLIZED FACTS AT MORE GRANULAR SECTOR-LEVEL]

percent of production workers, (ii) ratio of capital to employment; (iii) ratio of capital to value added; (iv) average wage; (v) average production wage; and (vi) an indicator for advanced technology industries.

[13] In unreported robustness tests, we confirm that our results are robust to including only balance sheet intangibles or excluding goodwill in the PT measure.

Table 3: Chinese Competition: $\log(K_t)$ results based on $NTRGap_j \times \overline{\Delta IP^{US}_{j,t}}$

Table shows the results of firm-level panel regressions of measures of capital on $NTRGap_j \times \overline{\Delta IP^{US}_{j,t}}$, following equation (1). We consider three measures of capital: PP&E, intangibles defined as in Peters and Taylor (2016) and their sum (total). Regression over 1991 - 2015 period. Leaders defined as firms with MV in top quartile as of 1999 within each NAICS Level 6 industry. Industry controls include measures of industry-level production structure (e.g., PPE/Emp). Annual data, primarily sourced from Compustat. Only US-incorporated firms in manufacturing industries included. Standard errors in brackets, clustered at the industry-level. + p<0.10, * p<0.05, ** p<.01.

	(1) $log(PPE_t)^a$	(2) $log(Int^{PT}_t)^b$	(3) $log(k^{PT}_t)^{a+b}$	(4) $log(PPE_t)^a$	(5) $log(Int^{PT}_t)^b$	(6) $log(k^{PT}_t)^{a+b}$
$Post01 \times NTRGap$	-7.136**	-1.096	-1.223	-6.901*	-2.236	-2.075
	[2.56]	[1.99]	[1.61]	[2.75]	[1.87]	[1.56]
$Post01 \times NTRGap \times Lead_{99}$	**7.251****	**6.143****	**5.795****	**5.848***	**7.097****	**6.469****
	[2.22]	**[1.31]**	**[1.33]**	**[2.31]**	**[1.58]**	**[1.55]**
Observations	29854	29980	29982	13988	14009	14021
R^2	0.088	0.508	0.46	0.131	0.541	0.496
Industry controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Sample	All firms			Continuing firms		

4.2 Decomposing the contribution of GLOBAL, EFS, INTAN and DDC

[TEST CONTRIBUTION OF EACH HYPOTHESIS USING REGRESSIONS –> SPECIFICS TBD]

4.3 Three pieces of evidence in support of DDC

[TO BE UPDATED: EXCLUDE MANUFACTURING. ADJUST DISCUSSION TO HIGHLIGHT KEY SECTORS AS NEEDED]

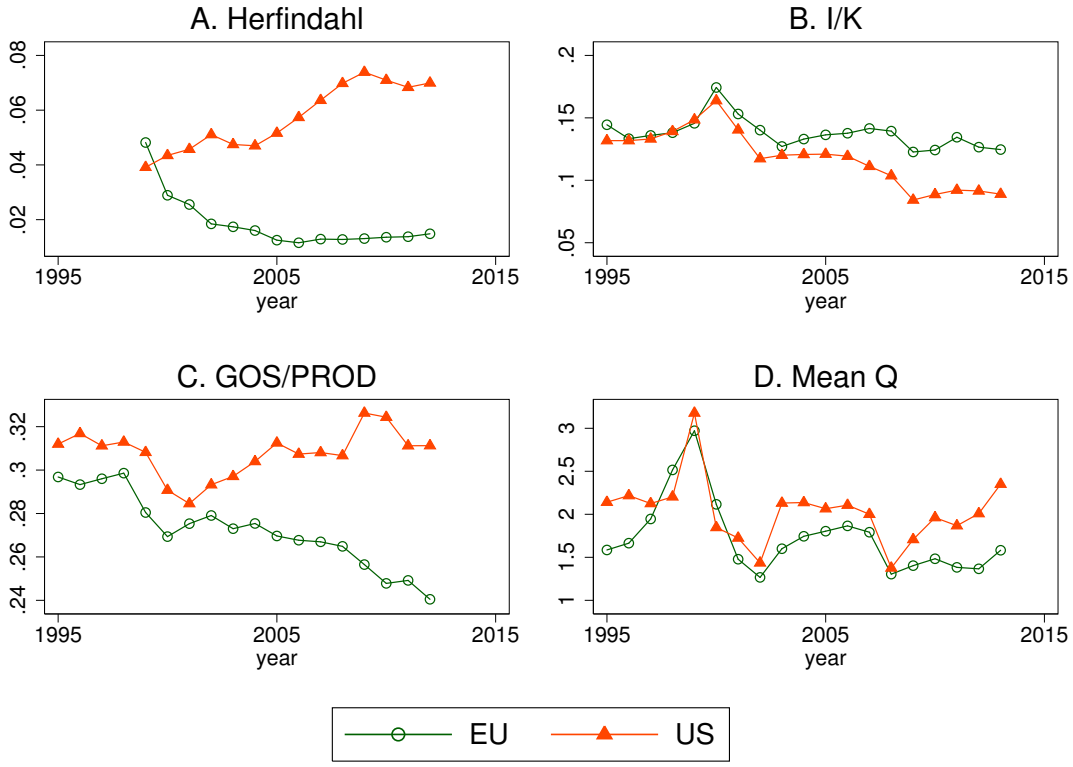
4.3.1 US vs. Europe

The comparison with Europe is extremely data-intensive. We rely on the dataset of Dottling et al. (2017), which includes industry- and firm-level series of profit, investment and concentration for the U.S. and Europe under consistent industry segments.[14] We present only key comparisons of industries with significant increases in concentration in the U.S. (such as Telecom). Figure 10

[14]Firm-level data is based on Compustat (NA and Global). Industry-data is based on the BEA, EU KLEMS and OECD STAN. Concentration measures are based on Compustat NA for the U.S. and BvD Orbis for Europe (given the larger presence of private firms in Europe). We are grateful to Sebnem Kalemli-Ozcan and Carolina Villegas-Sanchez for providing us with a historical time series of Herfindahls and Top-firm Market Shares computed based on the BvD Orbis merged vintage dataset of Kalemli-Ozcan et al. (2015). See Dottling et al. (2017) and Appendix **??** for additional details.

compares the weighted average (domestic) Herfindahl, investment rate, operating margin and Q for the 5 industries that concentrate the most in the US. We exclude the Manufacturing - Textiles industry even though it exhibits a rise in domestic concentration because the increase is primarily due to foreign competition. Accounting for imports, the Herfindahl increased much less than for the remaining 5 concentrating industries.

Figure 10: Comparison with EU for Top 5 Concentrating Industries in US



Notes: Figure based on the top 5 concentrating industries in the US. These industries are Information Telecom, Arts and Recreation, Wholesale and Retail trade, Other Services and Information Publishing (which includes software). Panel A plots the weighted average Herfindahl across these industries, weighted by sale. For the EU, each industry's Herfindahl is the weighted average Herfindahl across countries. Panel B plots the weighted average investment rate, weighted by the capital stock. Panel C plots the the weighted average ratio of Gross Operating Surplus to Production. Last, Panel D plots the weighted average mean Q, by assets. All weights are based on the U.S. share of industries to control for differences in industry sizes across regions.

The series are aggregated across industries based on US share of sales, capital, output and assets (respectively) to ensure a common weighting across regions.[15] Concentration, profits and Q increased in the U.S., while investment decreased. By contrast, concentration decreased in Europe, and investment remained (relatively) stable despite lower profits and lower Q. This true even

[15]We present results using BvD Orbis Herfindahls, and also confirm that conclusions are robust to using Concentration Measures from the ECB's CompNET (see Appendix for details).

though these industries use the same technology and are exposed to the same foreign competition. As shown in the Appendix, these conclusions remain when looking at the underlying industries – such as Telecom and Airlines.[16] EFS, GLOBAL and INTAN therefore cannot explain the concentration in the US. On the other hand, these trends are consistent with DDC since antitrust enforcement in Telecom and Airlines has indeed become more aggressive in Europe than in the US in recent years (see Faccio and Zingales (2017) for Telecoms, Economist (2017) for Airlines, and Gutiérrez and Philippon (2017b) for all industries).

4.3.2 Concentration and TFP

According to the EFS hypothesis, concentration reflects an *efficient* increase in the scale of operation. A key prediction of the EFS hypothesis is therefore that concentration leads to productivity gains at the industry level, as high productivity leaders expand. It has happened before, for instance in Retail Trade during the 1990's.[17] The question is whether EFS is the main driver of concentration over the past 20 years as hypothesized by Autor et al. (2017a). To test this idea, we study the relationship between changes in concentration and changes in industry TFP at two levels of granularity. First, we study the more granular NAICS Level 6 manufacturing industries using productivity measures from the 2017 release of the NBER-CES database (which contains data up to 2011). Next, we broaden the sample to all US industries by using KLEMS, at the expense of considering more aggregated ∼NAICS Level 3 industries.[18] For all analyses, we consider domestic concentration to align with domestic TFP estimates. We only include industry segments that remain stable over each 5-year period in our regressions, so that no aggregation/mapping is necessary.

Table 4 reports the results. Columns (1) to (3) focus on NAICS Level 6 manufacturing industries. As shown, the relationship is positive and significant over the 1997 to 2002 period but not after. In fact, the relationship is negative in the 2007 to 2012 period.[19] Columns (4) and (5) show that the results are similar (and more significant) when we broaden the scope to all industries in our sample.[20] The positive relationship at the beginning of the sample is consistent with the results in Autor et al. (2017b), but the results in the 2000's are not. To be clear, Autor et al. (2017b) make two points. The first is that economic activity has shifted towards firms with lower labor shares, a fact also documented by Kehrig and Vincent (2017) and that we replicate in our data. The second

[16] Airlines is not included in Figure 10 because EU KLEMS combines the entire Transportation and Storage sector, hence was combined in the analyses of Dottling et al. (2017). But we can compare concentration and mark-up trends using the ECB's CompNET.

[17] The Retail Trade industry became substantially more concentrated – and more productive – over the 1990's. Lewis et al. (2001) find that over the 1995 to 2000 period, a quarter of the U.S. productivity growth is attributable to advances in the retail industry, and almost a sixth of that is attributable to Walmart.

[18] When necessary, we use the sales-weighted average to aggregate concentration ratios across NAICS Level 3 segments to match the granularity of KLEMS.

[19] The number of observations decreases in column 3 due to substantial changes to NAICS Level 6 categories between NAICS 2007 and NAICS 2012. Results before 2007 are robust to considering only those industries with consistent segments from 1997 to 2012. In unreported tests, we find a negative and significant coefficient when considering the 10Y period from 2002 to 2012

[20] In unreported tests, we find positive correlations between concentration and value-added per worker, but this would be true under any model of increasing market power irrespective of productivity.

Table 4: Industry regressions: Concentration vs. TFP

Table shows the results of industry-level OLS regressions of contemporaneous changes in TFP and Concentration over the periods specified. Observations are weighted by value added. Columns 1-3 include NAICS-6 manufacturing industries, with TFP from NBER-CES database. Columns 4-5 include all industries in our sample, with TFP from U.S. KLEMS. Standard errors in brackets. + p<0.10, * p<0.05, ** p<.01. † TFP change to 2011 in column 3, and to 2014 in the last 5Y period of column 5 due to data availability.

	(1)	(2)	(3)	(4)	(5)
	ΔTFP$(t, t-5)$			ΔTFP$(t, t-5)$	
	97-02	02-07	07-12†	90-00	00-14†
ΔCensus CR8$(t, t-5)$	**1.456****	0.237	-1.35		
	[0.312]	[0.652]	[0.871]		
ΔCP CR8$(t, t-5)$				**0.461***	**-0.208**+
				[0.198]	**[0.115]**
Sectors	Mfg			All	
Granularity	NAICS-6			KLEMS	
Observations	469	469	299	86	129
R^2	0.045	0	0.008	0.061	0.025

point is that the concentration is explained by EFS. We find some evidence in favor of EFS in the 1990s, but evidence against it in the 2000s.

4.3.3 Investment by Leaders

According to the EFS hypothesis, leaders should increase investment in concentrating industries, reflecting their increasing relative productivity. We test this at the firm-level, by performing the following regression for firm i that belongs to BEA segment k:

$$\begin{aligned}\Delta \log(K_{it}) =& \beta_1 Q_{it-1} + \beta_2 HHI^k_{t-1} \times Leader^k_{it-1} + \beta_3 HHI^k_{t-1} \\ &+ \beta_4 Leader^k_{it-1} + \beta_5 \log(Age_{it-1}) + \eta_t + \mu_i + \varepsilon_{it},\end{aligned} \tag{2}$$

where K_{it} is firm capital (PP&E, Intangibles, or Total), HHI^k_t the import-adjusted Herfindahl, and $Leader^k_{it}$ is an indicator for a firm having a market value in the top quartile of segment k. We include Q_{it-1} and $\log(Age_{it-1})$ as controls, along with firm and year fixed effects (η_t and μ_i). β_2 is the coefficient of interest. Table 5 shows that leaders in concentrated industries under-invest. This is inconsistent with EFS and consistent with DDC. Appendix **??** reports results using Census-based measures of concentration, and including the Noisy Entry instrument (defined below) instead of Herfindahls as an exogenous measure of competition. In unreported tests, we confirm that results are robust considering manufacturing and non-manufacturing industries separately.

Table 5: Investment by Leaders

Table shows the results of firm-level panel regressions of the log change in the stock of capital (deflated to 2009 prices) on import-adjusted Herfindahls. Regression from 2000 to 2015, following equation (2). We consider three measures of capital: PP&E, intangibles defined as in Peters and Taylor (2016) and their sum (total). Leaders measured as the two-year moving average of an indicator for a firm having market value in the top quartile of the corresponding BEA segment k. Q and log-age included as controls. As shown, leaders decrease investment with concentration, rather than increase it. Annual data, primarily sourced from Compustat. Standard errors in brackets, clustered at the firm-level. + p<0.10, * p<0.05, ** p<.01.

	(1) $\Delta log(PPE)^a$ ≥ 2000	(2) $\Delta log(Int_{PT})^b$ ≥ 2000	(3) $\Delta log(K_{PT})^{a+b}$ ≥ 2000
Q_{it-1}	6.84**	3.38**	4.01**
	[0.24]	[0.13]	[0.13]
HHI^k_{t-1}	15.82	11.25	21.32*
	[14.43]	[9.40]	[9.44]
$Leader^k_{it-1}$	0.91	0.37	0.22
	[1.16]	[0.96]	[0.85]
$HHI^k_{t-1} \times Leader^k_{it-1}$	**-34.41***	**-24.43**+	**-29.28****
	[13.92]	**[12.89]**	**[11.20]**
$\log(Age_{it-1})$	-6.10**	-14.02**	-12.52**
	[1.38]	[0.89]	[0.87]
Observations	59361	56472	56704
R^2	0.06	0.08	0.09
Year FE	YES	YES	YES
Firm FE	YES	YES	YES

5 Comparison with existing work

Discuss the mark-up estimates of De-Loecker and Eeckhout (2017).

The divergence in labor productivity between frontier and laggard firms emphasized by Andrews et al. (2015) suffers from a lack of labor quality adjustments.

6 An Index of Industry Competitiveness

[CREATE INDEX OF INDUSTRY COMPETITIVENESS USING PCA OR SOME OTHER VARIANCE REDUCTION TECHNIQUE ON THE COLLECTION OF 'VALID' MEASURES OF COMPETITION]

7 Conclusion

[TO BE COMPLETED]

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