Some Facts about Dominant Firms*

Germán Gutiérrez† and Thomas Philippon‡

October 2020

Abstract

We measure the evolution of dominant firms in the U.S. economy since 1960, and globally since 1990. Contrary to common wisdom, dominant firms have not become larger, have not become more productive, and their contribution to aggregate productivity growth has fallen by more than one third since 2000.

A large and growing literature argues that changes to the economic environment have led to the rise of 'super-star' firms. This rise is then linked to a wide range of aggregate trends across advanced economies – from rising concentration to declining labor shares and declining business dynamism.

Our contribution to the literature is simply to look *directly* at the largest, most valuable companies in the world. We define two main sets of global stars: the top 100 firms by global sales in any given year, and the top 20 firms in each of our 25 industries. Similarly, we define two set of US stars: the top 20 firms by (global) sales and the top 4 firms within each 3-digit industry.

We uncover five stylized facts that contradict the common wisdom. We find that, over the past 20 years:

1. The market share of dominant firms has not increased.
2. The value gap between leaders and followers has not increased.
3. The relative productivity of dominant firms has not increased.
4. Their Hulten growth contribution has decreased to approximately zero.
5. The contribution of top firms to aggregate labor productivity has decreased by about 40%.

*We are grateful to the Smith Richardson Foundation for a research grant, and to seminar participants at the NBER Summer Institute, University of Chicago, New York University, and the 2019 AEA meetings for stimulating discussions, to David Autor, Olivier Blanchard, Charles Hulten and Xavier Gabaix for their comments, and to Steve Davis and John Van Reenen for their comments, discussions, and suggestions.

†New York University

‡New York University, CEPR and NBER

Two issues explain the differences between our findings and those in the literature. The first difference is that we actually look at the largest companies, which, perhaps surprisingly, is not what the literature has done so far. The second difference is that we distinguish domestic and global sales. A commonly used metric in the literature is consolidated sales over domestic GDP. This metric does not provide a reliable picture of the evolution of large firms when there is an upward trend in globalization combined with rapid growth in emerging markets. We argue that one should use either global sales over global GDP, or domestic sales over domestic GDP.

Literature Review There are several versions of the 'super star' story. Autor et al. (2020) argue for a "winner-take-most" mechanism driven by increased price-sensitivity of consumers, perhaps thanks to lower search costs and easier price comparisons. Increased price competition then lowers firm-level markups and also relocates sales towards high markup/high productivity firms. Haskel and Westlake (2017) argue that the growing importance of intangible capital leads to increasing returns to scale. Alexander and Eberly (2016) and Crouzet and Eberly (2018) show that intangible investment is indeed correlated with rising concentration and declining investment in the US; and Bessen et al. (2020) shows that intangible investment by dominant firms leads to greater persistence and reduced leapfrogging by newcomers. Aghion et al. (2018) and Ridder (2019) assume that ICT technologies increase returns to scale. Aghion et al. (2018) assume that firms have heterogenous levels of productivity and that intangible capital increases the span of control of manager. Productive firms can then use intangible capital to enter new markets. In Ridder (2019), some firms are more adept at using intangible capital to reduce marginal costs, which allows them to scale up relative to competitors. Relatedly, Akcigit and Ates (2019a) argue that falling diffusion has allowed leading firms to pull away from the rest. Table 1 in the appendix highlights some predictions of existing theories.

Despite the widespread discussion of large/super-star firms, there is actually little direct evidence on their evolution in the US or globally. The difficulty arises in part from the confusion about what is meant by star firms: are they productive but potentially medium-sized firms? Or are they very large firms with billions of dollars in revenues? In a well-known paper, Andrews et al. (2015) documents an increased dispersion in productivity between global "frontier" firms and "laggard" firms. "Frontier" firms as defined by Andrews et al. (2015), however, are productive but they are not large. The average frontier firm in Manufacturing in their data has about $50 million in revenues and 74 employees (see their Table 1b). The average frontier firm in Services has about $80 million in revenues. These firms are productive medium enterprises but they are not the Google's and Amazon's that seem to motivate the literature. Hsieh and Rossi-Hansberg (2019) similarly build a model motivated by the expansion of the Cheesecake Factory as a prime example of standardization in retail services. The Cheesecake Factory generates about $2.3 billion in revenues and $290 million in operating cash flows. It is a successful business but its market value of $1.8 billion in February 2020 is less than 1% of the market value of Verizon or AT&T, let alone those of Apple or Google. Finally, several papers (Grullon et al., 2019; Autor et al., 2020) document increases in concentration ratios within industries. Setting aside the debate about the proper definition of the market (Shapiro, 2018), we point out that these results do not speak directly to the impact of very large firms and are silent about their contribution to growth.

1 Data and Definitions

1.1 Data

We focus on the largest companies in the world, both public and private. For the US, we use Compustat North America, the US Census, and Forbes' annual publication of "America's Largest Private Companies." For the rest of the world, we use Compustat Global. We also use aggregate and industry level data from the BEA, KLEMs and OECD STAN.

Firms' Consolidated Sales, Profits and Market Value We use firm-level sales, market value and employment data to identify stars. All nominal quantities are converted to US dollars using the exchange rates provided by Compustat. Compustat covers 100% of market capitalization in the U.S. and Canada; over 96% in Europe and over 88% in Asia. Data for the US starts in 1950 but provides stable coverage since 1965. Global data starts in 1987 but provides good coverage for most countries starting in 1990.

US Industry Employment, Prices and Wages We obtain Employment, as well as Gross Output quantities and prices from the BEA GDP by Industry accounts. These data cover 20 sectors since 1948 and 62 industries since 1977. We use these data to estimate industry-level labor productivity (used as a benchmark measure of productivity, for both comparison and reallocation calculations) and to deflate Compustat sales and compute firm-level labor productivity. We obtain payroll, employment and sales for the top 4 firms in each industry and the industry as a whole from the U.S. Economic Census concentration accounts, which are used to compute a labor-quality adjustment and perform robustness analyses on the relative productivity of stars.

Foreign vs. Domestic Sales We have two independent ways to measure domestic and foreign sales. At the industry-level we obtain domestic and foreign sales from the BEA's Data on the Activities of U.S. Multinational Enterprises. Industry segments roughly follow the 62 industries in the GDP by Industry accounts. We estimate the share of foreign sales in a given industry as the ratio of sales by 'Majority-owned Foreign Affiliates of U.S. Multinational Enterprises' (MOFA) to total sales, defined as the sum of U.S. Parent sales and MOFA sales. We refer to domestic sales estimated using this approach as 'Dom 1'. At the firm level we use Compustat Segments to separate domestic from foreign sales. This gives us another measure of domestic sales, 'Dom 2' below.

Global Industry Prices, Labor Force and PPP For Global analyses, we complement our firm-level dataset with three additional sources: first, we use industry-level national accounts to obtain industry-level deflators and measure global industry-level labor productivity. Industry-level deflators are used to compute firm-level labor productivity in Compustat. Global industry-level labor productivity is used as a benchmark for reallocation calculations. Industry-level data is gathered primarily from OECD STAN (which covers 37 countries including nearly all advanced economies), plus the BEA's GDP by industry accounts for the US;

and the KLEMS accounts of China and India given their importance. In order to use consistent industry segments, all data are mapped to 24 sectors which largely match those of EU KLEMS plus an 'Other' category for NAICS code 999.[1] When necessary, we fill-in missing values by applying the weighted average change at the global-industry level to the country-industry quantities. Finally, we gather measures of Global GDP and Global Labor Force from the World Bank's development indicators; and country-level PPP measures from the OECD.

1.2 Definitions

Stars Defining star firms requires two choices: the choice of a cutoff to define the stars, and the choice of a metric along which to rank the firms. For the cutoff we use a global/US rank, and a rank by global/US industry. For the metric, we consider revenues and market-values. Both are unambiguously well defined. Market values more closely resemble the discussion of super-star firms and, since stock prices incorporate investor's growth projections, more quickly incorporate the fast-growing firms of the new economy. In 2016, for example, the Top 20 by market value of equity includes the complete GAFAM but the Top 20 by sales includes only Apple and Amazon. By contrast, sales over-weights manufacturing firms and discounts tech firms which are at the core of the discussion.

Nonetheless, we focus on revenue-based stars in the body of the paper for comparison with the literature (mainly Autor et al. (2020)) and between Compustat and Census Concentration accounts. We report key results using market value-stars in the appendix.[2] In particular, we consider the following groups:

- Global stars
  - Top 100 firms by global sales in any given year (Top 100).
    - These are economy-wide global stars, and include most of the household names. The industry composition varies somewhat over time. The stars in the 1990s include a large number of manufacturing and retail firms (GE, Walmart, Toyota), which are often replaced by new economy firms starting in 2000 (Microsoft, Google, Amazon and Facebook). The largest firms are heavily weighted towards the US until recent years, when Chinese firms such as Tencent and Ali Baba reach the Top 20 firms.
  - Top 500 firms by global sales in any given year (Top 500).
    - These incorporate additional stars. We include it for reference since it is used by Autor et al. (2020).
  - Top 20 firms by global sales within each industry (Top 20 by Industry).
    - These are industry stars. Since we have 25 industries, there are 500 such industry stars each year. The main advantage of this sample is that, by construction, the industry composition is constant. These industry stars include virtually all economy-wide stars.

[1] We keep this industry because several super-stars, including General Electric and Berkshire Hathaway, are assigned this NAICS code. We use the weighted average productivity across all other industries as the benchmark for reallocation.

[2] By incorporating the period of fast-growth, using market values tends to increase the reallocation contribution of the stars but depress their economic footprint.

- US Stars
  - Top 20 firms by global sales in any given year (Top 20).
    - These are economy-wide stars. The industry composition varies significantly over time. The stars of the 1950s were often manufacturing firms (GM, GE). IBM appears in the 1960s. Microsoft and Walmart appear in the 1990s. And of course Google, Amazon and Facebook in recent years.
  - Top 100 firms by global sales in any given year (Top 100).
    - These are larger economy-wide stars. The industry composition again varies over time.
  - Top 4 firms by global sales within each 3-digit industry (Top 4 by Industry).
    - These are industry stars. Since we have 62 industries, there are 248 such industry stars each year. By construction, the industry composition by number of firms is constant. These industry stars include most of the economy-wide stars unless a national star happens to be the fifth in an industry. This actually happens early in the sample, especially when including Oil.

Productivity We define labor productivity of firm i in industry j in year t as

$$z_{i,t} \equiv \frac{sales_{i,t}}{p_{j,t} q_{j,t} n_{i,t}}$$

where $n_{i,t}$ is the number of employees, $p_{j,t}$ is an industry price deflator, and $q_{j,t}$ is a labor quality adjustment based on relative wages. We use this gross output measure as opposed to a value added measure for two main reasons. The first is that we can easily map this measure into census data. Sales is the only measure available in the Census for non-manufacturing industries. The second reason is that imputing value added using Compustat creates a lot of measurement errors because wages are badly measured. We perform a full robustness analysis using a common wage for the industry from the BEA and adjusting it to match the industry's value added to gross output ratios.

To perform the labor quality adjustment we obtain the average wage of employees in the top 4 firms in each industry from the census and we define q as the ratio to the average wage in the industry. We select the reported NAICS industries that most closely match those in GDP by Industry accounts. We compute wages as the ratio of 'Annual Payroll' to 'Paid employees for pay period including March 12', and then compute the relative wage of the top-4 firms in each industry as the ratio of wages in the top 4 relative to wages in their industry.[3] The adjustment (q) is then given by changes in relative wages, normalizing the value to 1 in 1997. Industries not covered in the Census Concentration accounts are assigned the weighted average wage adjustment across industries. When we compute relative productivity, we use a common industry deflator as a benchmark and a PPP adjustment in our robustness checks for our global firms. For US firms we use BEA sector average productivity as benchmark.

[3] We could use Q1 payroll, but it overstates the differences because most bonus payments are included in Q1.

2 Are Top Firms Becoming Larger?

We compare the size of top firms to the size of the economy where they operate. Most papers compare consolidated global sales to domestic GDP, but most large firms earn substantial revenues outside their domestic markets. Thus, even if their relative efficiency does not improve, a increase in globalization would increase their size relative to their home country. Instead, one should either compare domestic sales to domestic GDP (Panel A of 1) or consolidated global sales to global GDP (Panel B of 1). We find that top firms have not grown faster than the Global economy in the past 20 years. Their domestic share of domestic GDP has been roughly constant over the past 40 years. The global footprint of top firms has slightly declined since 2000.

Let us start with domestic (US) stars, in Panel A of Figure 1. We define the Domar weight $\omega_{i,t}$ of firm i at time t based on domestic sales:

$$\omega_{i,t} \equiv \frac{(1 - e_{i,t})\, sales_{i,t}}{GDP_t},$$

where $e_{i,t}$ is the share of foreign sales in total sales, or equivalently $(1 - e_{i,t})\, sales_{i,t}$ are domestic sales. The left graph uses Gross Output as a denominator, the right graph uses GDP. The results are similar. The circles and triangles show that consolidated sales have increased relative to GDP as a consequence of global trade. If we consider the domestic sales of star firms, the shares are flat post 1990 and the peak is in fact in the late 1970s. We have two ways to compute domestic sales: 'Dom 1' uses BEA MNE accounts, and 'Dom 2' uses firm-level segments. They give essentially the same trends. The data shows that the reason leading firms appear larger today than in the past is because of their foreign revenues. In terms of domestic revenues, today's stars are exactly the same as the stars of the past 40 years. To give a concrete example, consider AT&T and Apple. In 1987, AT&T's sales were 1.05% of US GDP and almost entirely domestic. In 2017, Apple's sales were 1.18% of US GDP but more than half were foreign sales. Apple's domestic sales were 0.5% of US GDP.

Panel B of Figure 1 looks at Global Stars. We compute consolidated global sales relative to World Gross Output and GDP. We see a rise in the late 1990s, but since 2000 the footprint of global stars has been constant or slightly declining. This is consistent with our results in Panel A and simply shows that global firms grow at the same rate as global GDP, but not faster.

Fact 1. ***The market share of dominant firms has not increased.***

Fact 1 is important because it appears to be inconsistent with theories that argue that today's stars have relatively higher productivity advantages than the stars of the past. In standard models an increase in the relative productivity of the top firms leads to increase in their relative size measured by sales. Relative productivity differences could of course be present lower in the distribution of firms and in specific sectors of the economy. But Fact 1 says that size is not a defining feature of today's top firms.

3 Are Top Firms Pulling Away?

Some theories of the recent dynamics of leading firms emphasize a decrease in the diffusion of knowledge. Andrews et al. (2015) and Akcigit and Ates (2019a) argue that falling diffusion has allowed leading firms to pull away from the rest. In the model of Akcigit and Ates (2019a), the prediction is about the market value of the leading firm relative to that of its direct follower. In the data, we find that the value of the leading firm compared to the value of its direct industry followers has not increased since 2000.

Panel A of Figure 2 looks at US stars. The first plot uses the market value of equity. Across all industries the top firm is roughly 75% more valuable that its direct follower and there is no upward trend. The red circle line expands the comparison group to the top 5 firms. On average, the top firm is 1.5 times more valuable than the average of its top 4 followers. Once again, we do not see an upward trend. The right plot shows relative sales. There is no overall trend but we do see a decline in the 1990s followed by a recovery, which is consistent with the view of the 1990s as a period of fast entry and growth by relatively young companies.

Panel B considers global stars and reaches similar conclusions. Consider for instance the top 10 global firms of a particular industry. The average revenues of a top-3 firm are double those of a top 4-10 firm, and its market value is about three times higher. These are large differences indeed, but they have not increased in recent years.

Fact 2. ***The value gap between leaders and followers has not increased.***

4 Are Top Firms Becoming More Productive?

Panel A of figure 3 shows the relative productivity of top US firms. The left graph compares their productivity to BEA average productivity in their respective industries. We observe an increasing trend in the 1970s and 1980s. After 1995, however, relative productivity remains roughly constant. The right graph compares star firms to other firms in Compustat. This comparison is thus within a group of large firms. As expected, the productivity gap is smaller, around 10% instead of 40%, but the trends are similar. In particular, star firms' relative productivity has not increased since 1995.

Panel B figure 3 considers global stars, starting in 1990. The productivity gap on the left figure is larger than in Panel A, reflecting higher overall dispersion of productivity outside the US, a fact which is consistent with Hsieh and Klenow (2009). The global trends, on the other hand, are similar to the trends in the US. In particular the relative productivity of the global stars has declined since 2000. This basic fact is inconsistent with models that assume that star firms enjoy a growing productivity advantage.

Fact 3. ***The relative productivity of dominant firms has not increased over the past 20 years.***

This fact is important because the super-star literature is motivated by the examples of Google, Facebook and Amazon. Amazon was founded in 1994, Google in 1998, and Facebook in 2004. Since these years, the stars have become neither larger nor more productive than the rest of the economy.

Figure 6 in the appendix breaks down the relative productivity by sectors: manufacturing, non manufacturing, ICT-intensive and non-ICT-intensive. The trends are broadly similar to the ones in Figure 3 but Figure 6 brings some new insights. The first insight is that the results are the same if we use Census data instead of Compustat. The second insight is that ICT intensive industries lag other industries. We find that non-ICT top firms doubled their relative productivity advantage in the 1970s from 19% to 38%. ICT stars experienced the same increase later, between 1985 and 2000. Since 2000, however, relative productivities have been either flat or declining.

In the Appendix we obtain similar facts using the US Economic Census. We compute the weighted average relative wage, labor productivity and wage-adjusted labor productivity of the Top 4 firms by industry, and report results by level of industry granularity. The Census data confirms the fact that star firms have not become relatively more productive over the past 20 years. In fact, quality-adjusted relative labor productivity has been slightly declining between 2002 and 2012: the Top 4 firms by NAICS 6 were 1.11 times more productive in 1997 and only 1.09 times in 2012. This reflects the fact that unadjusted productivity has been roughly flat together with the fact that top firms have been increasingly hiring top workers. It is consistent with the literature on increased assortative matching (Song et al., 2018).

5 Contribution to Productivity Growth

5.1 Hulten

The classic Theorem of Hulten (1978) – recently extended by Baqaee and Farhi (2018) – shows that the contribution of an individual firm to aggregate productivity growth equals its own productivity times its Domar weight. The Hulten contribution is defined as the Domar weight times the firm level increase in log sales per employee. It is a "within" contribution since it uses the initial Domar weight times future productivity growth:[4]

$$g_t^{h*} \equiv \sum_{i \in S_t} \omega_{i,t} g_{i,t}^z,$$

where S_t denotes the set of star firms, as defined earlier. Our baseline specification uses sales to compute the Domar weight $\omega_{i,t}$ as defined earlier, and costs as a robustness check. Productivity growth is averaged over 3 years:

$$g_{i,t}^z \equiv \Delta \log z_{i,t} + \Delta \log z_{i,t+1} + \Delta \log z_{i,t+2} = \log z_{i,t+2} - \log z_{i,t-1},$$

where $z_{i,t}$ is quality adjusted labor productivity defined earlier. This adjustment makes only a small difference to the Hulten component, but it is important for the reallocation measure, and we introduce it here to be consistent.

Figure 4 shows the Hulten contributions of top firms, in the US since 1960, and globally since 1990. The figure shows that top firms have played a key role in making the economy grow. Historically, they have contributed more than half a percent to total labor productivity growth. In recent years, however, their "within" contribution to overall productivity growth has been close to zero.

Fact 4. ***The Hulten contribution of dominant firms has decreased from about 50 basis point per year to approximately zero.***

The result is the same if we use sales or total cost (appropriate under market power) as Domar weights. One possible explanation is that ideas are becoming harder to find as argued by Bloom et al. (2018).

[4] Our results hold with or without oil companies, but oil shocks in the 1970s create a lot of noise in reallocation measures so we choose to exclude oil and gas in our benchmark figures.

5.2 Reallocation and Total Contribution

The Hulten contribution is the main contribution to aggregate growth when revenue factor productivities are equalized across firms. If top firms have higher revenue productivity than other firms, however, they can contribute to productivity growth simply by drawing in more resources. We define the reallocation contribution of top firms as

$$g_t^{r*} \equiv \sum_{i \in S_t} \left(z_{i,t} - \bar{z}_{I,t} \right) g_{i,t}^n,$$

where $\bar{z}_{I,t}$ is labor productivity in industry I at time t. The growth of employment is averaged over 3 years: $g_{i,t}^n \equiv \Delta \log n_{i,t} + \Delta \log n_{i,t+1} + \Delta \log n_{i,t+2} = \log n_{i,t+2} - \log n_{i,t-1}$. Recall that $z_{i,t}$ is quality adjusted. This adjustment is small before 1995 but reaches 30% in the 2000s, as shown in the Appendix, where we also discuss various benchmarks for $\bar{z}_{I,t}$.

We can now combine our two measures. Figure 5 shows the total contribution (Hulten plus reallocation) of top firms to aggregate labor productivity growth in the US and globally. In the US, the reallocation contribution was large in the 1990s. As a result the total contribution of Stars was large, around 1.5 percentage point per year. This is a truly remarkable result. In the late 1990s, just 100 firms added 1.5% of labor productivity growth to the US economy.

Since 2000, the reallocation contribution has declined but, unlike the Hulten contribution, it has remained positive.[5] Overall the total contribution of US Stars to US labor productivity is one third of what it used to be.

Panel B of Figure 5 shows the contribution of global stars to global labor productivity growth. Once again, the mid-1990s stand out as a period where large firms contributed enormously to overall growth, more than one percentage point each year. We observe an increase in the reallocation component in the 1990s, but it is more muted than in the US and it has been closed to zero in recent year. As a result, the total contribution is not very different from the Hulten contribution and is close to zero since 2005.

Fact 5. ***The contribution of top firms to aggregate labor productivity has decreased by about 40% since 2000.***

6 Conclusion

Our results challenge the common wisdom about dominant firms in the new economy and shed light on the productivity paradox. The paradox is often framed as a gap between tremendous innovations at large digital companies and lackluster aggregate productivity growth. Our findings suggest there might not be a paradox after all: the top firms of today are neither larger, nor more productive than the top firms of the past. In fact, their contribution to overall growth has declined in recent years, therefore explaining (some of) the paradox instead of reinforcing it.

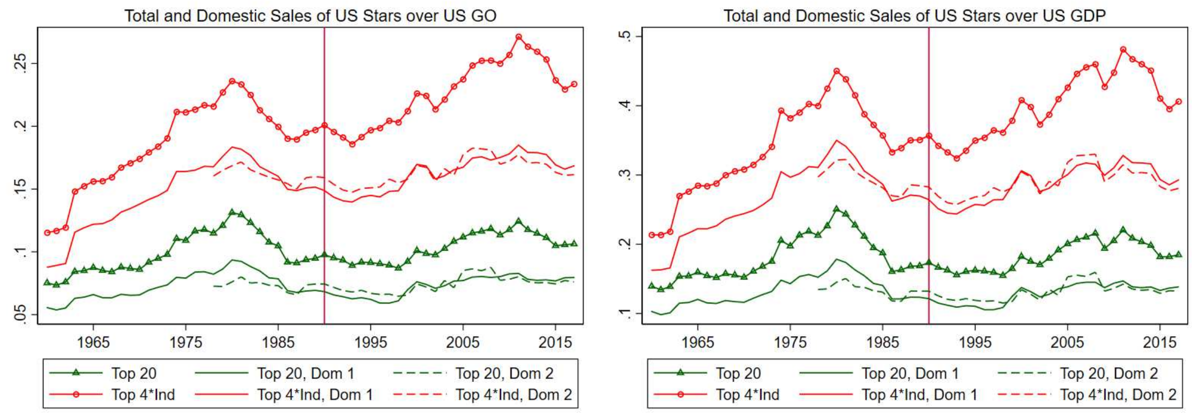
[5]The overall increase in the reallocation contribution comes in part from the growing importance of non-manufacturing sectors. The average contribution of reallocation is larger outside manufacturing than inside manufacturing. This is consistent with the evidence in Mansury and Love (2008) who argue that innovation in business services has a positive effect on growth (size) but not on measured productivity. In other words, in the service sector, the "innovation" might be to reach and convince new clients, as opposed to reducing the unit cost of existing services.

If we are correct, the most important question is to understand what has changed between the 1990s and the 2000s. During the 1990s large firms made tremendous contributions to overall growth, both internally (Hulten) and externally (reallocation). In the 2000s these beneficial effects have all but disappeared. Why are star firms not contributing as much as they used to? We do not have a definite answer but it is clear that something changed around 2000. Perhaps ideas are becoming harder to find as Bloom et al. (2018) argue. Or perhaps declining competition and rising barriers to entry have allowed incumbents to cut genuinely useful investment and innovation as Gutiérrez and Philippon (2019) argue.

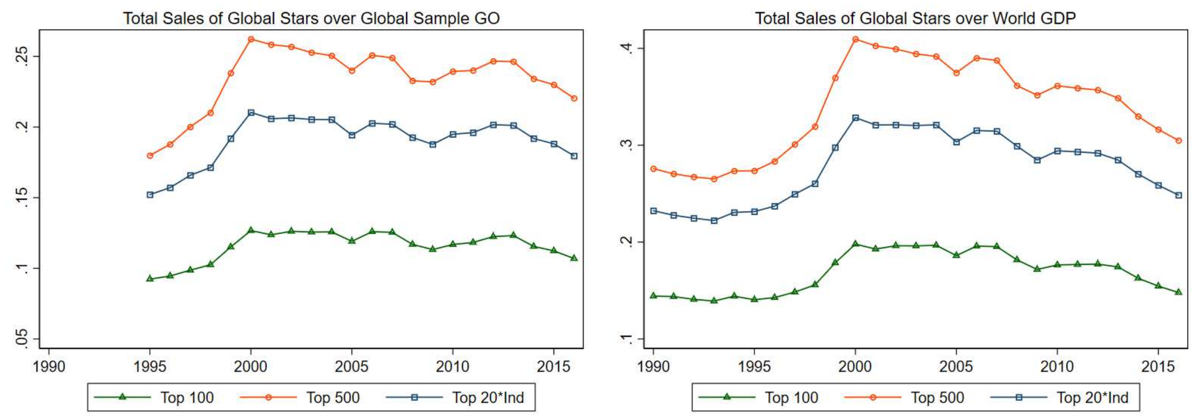
Figures

Figure 1: *Sales Footprint of Stars*

Panel A: US



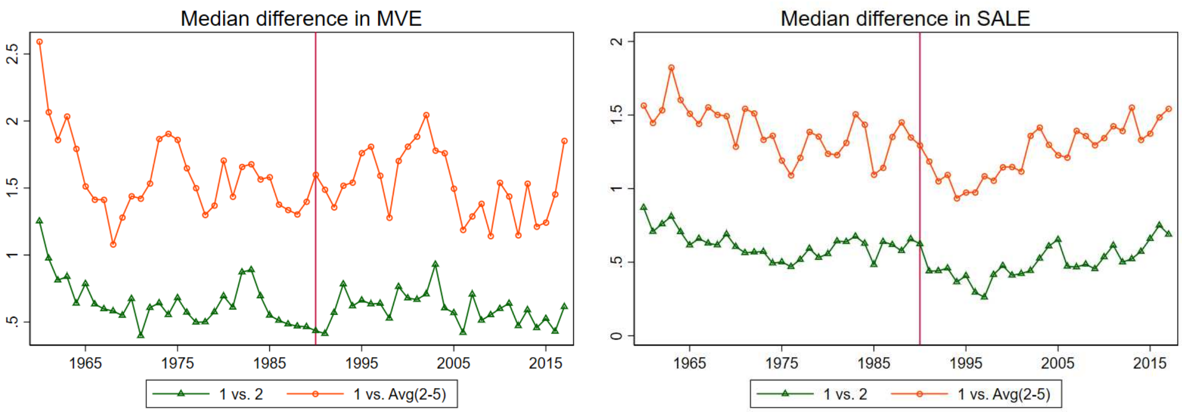
Panel B: Global



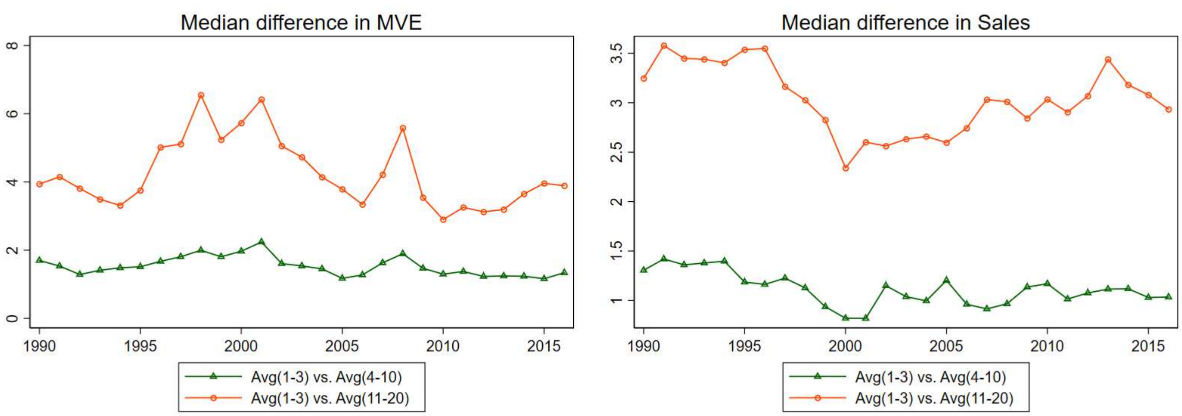
Note: Panel A plots the ratio of sales of US Stars to US Gross output and US GDP. Dom 1 denotes domestic sales estimated using the share of foreign sales from the BEA's MNE accounts. Dom 2 denotes domestic sales as reported in Compustat segments. The vertical line at 1990 denotes the initial year of our global sample. It is included to facilitate comparisons across figures. Panel B plots the ratio of global sales of Global Stars to gross output in our sample (OECD STAN + China and India) and world GDP.

Figure 2: *Relative MV and Sales of Stars vs. Near-Stars*

Panel A: US Stars



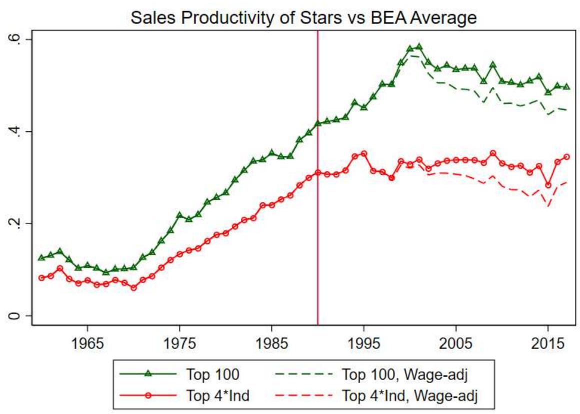
Panel B: Global Stars

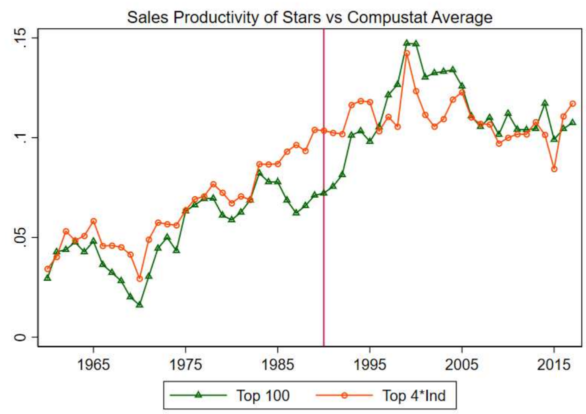


Note: Figure reports the relative value of stars vs. near-followers. Each series is constructed as follows: we first compute the average market value and sale for each group of firms (Top 1 and 2-5 in US, and Top 1-3, 4-10 and 11-20 globally, as noted in the legends). We then compute the relative-difference between the two groups, and aggregate across industries by taking the median. The vertical line at 1990 denotes the initial year in our global sample. It is included to facilitate comparisons across datasets.

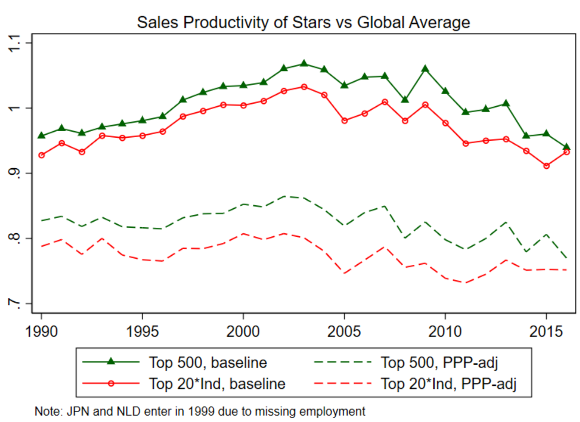
Figure 3: *Relative Revenue Productivity of Stars*

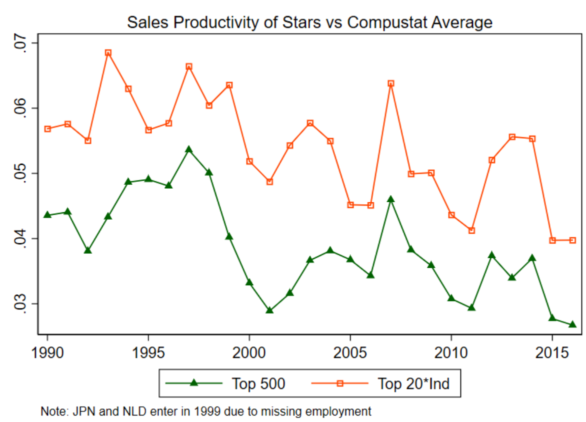
Panel A: US Stars





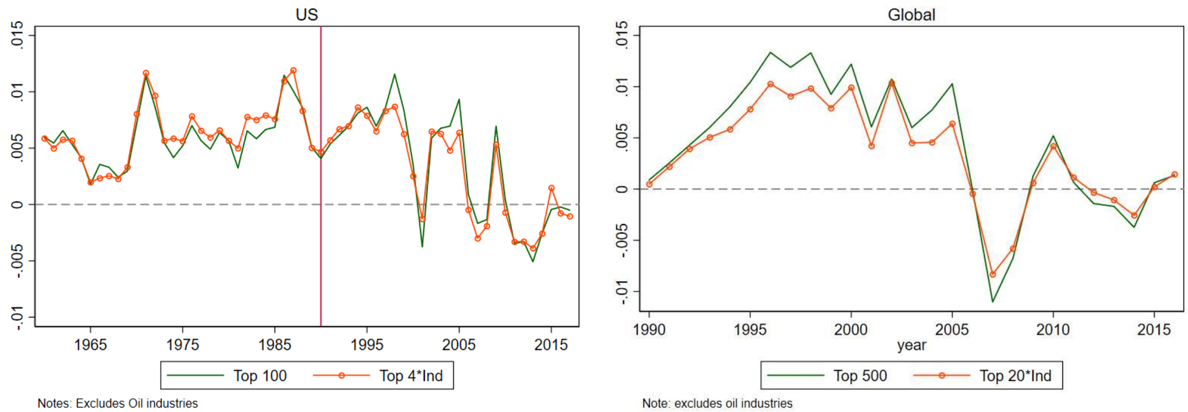
Panel B: Global Stars





Note: Figure plots weighted average log-difference in sales per employee between star firms and their corresponding industry. Top charts focus on the US. Left plot uses the average and labor quality-adjusted sector productivity from the BEA (solid and dotted, respectively) as benchmarks. Labor quality adjustment based on the divergence in relative wages of the stars and non-stars, estimated using the census concentration accounts. Right plot uses the weighted average productivity across all Compustat firms in the given industry as benchmark. Bottom charts use global data. Left plot considers the weighted average global industry productivity (solid) and the PPP-adjusted global average productivity (dotted), all based on a common global industry deflator. Right plot uses the weighted average productivity across all Compustat firms located in the US, EU or Japan to account for the increasing entry of developing economy firms over time.

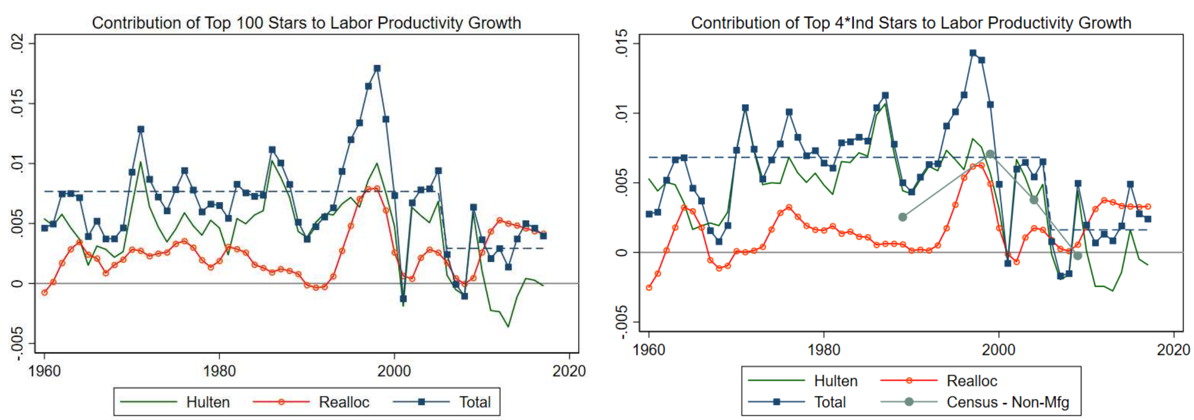
Figure 4: *Hulten Contributions of the Stars*



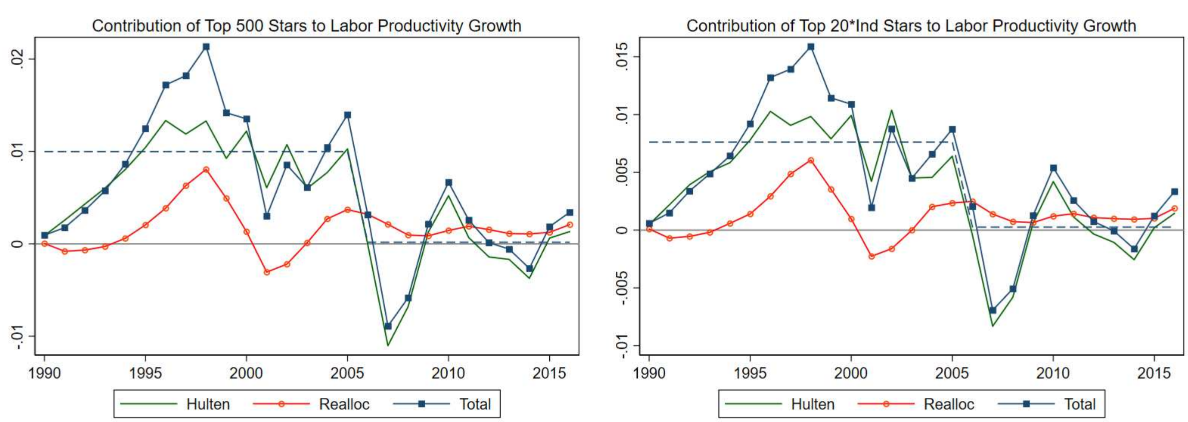
Note: Green line uses sales/GDP as Domar weight. Red line uses cost/GDP as Domar weight. Hulten contribution using Labor Quality Adjusted measures in the US; and a common global industry deflator globally.

Figure 5: *Total Contributions of the Stars*

Panel A: US Stars



Panel B: Global Stars



Note: the figure plots the contributions of star firms to US and Global labor productivity growth. The dashed lines show the averages for 1960-2005, and 2006-2017. Top 100 US averages: 77 bps down to 33 bps. Top 4 by Industry US averages: 68 bps down to 19 bps. Top 500 Global averages: 100 bps down to 2 bps. Top 20 by Industry Global averages: 76 bps down to 3 bps. See appendix figure 17 for a validation of the US results using the Economic Census.

References

Aghion, P., A. Bergeaud, T. Boppart, P. J. Klenow, and H. Li (2018). A theory of falling growth and rising rents.

Akcigit, U. and S. Ates (2019a). Ten facts on declining business dynamism and lessons from endogenous growth theory. Technical report, NBER Working Paper.

Akcigit, U. and S. Ates (2019b). What happened to u.s. business dynamism? Technical report, NBER Working Paper.

Alexander, L. and J. Eberly (2016). Investment hollowing out. *Working Paper*.

Andrews, D., C. Criscuolo, and P. N. Gal (2015). Frontier firms, technology diffusion and public policy: Micro evidence from oecd countries. *OECD Working Papers*.

Autor, D., D. Dorn, L. F. Katz, C. Patterson, and J. V. Reenen (2017). The fall of the labor share and the rise of superstar firms.

Autor, D., D. Dorn, L. F. Katz, C. Patterson, and J. V. Reenen (2020). The fall of the labor share and the rise of superstar firms. *Quarterly Journal of Economics*.

Baqaee, D. R. and E. Farhi (2018). The macroeconomic impact of microeconomic shocks: Beyond hulten's theorem.

Bessen, J., E. Denk, J. Kim, and C. Righi (2020). Declining industrial disruption. *BU Law School Working Paper*.

Bloom, N., C. I. Jones, J. V. Reenen, and M. Webb (2018). Are ideas getting harder to find?

Crouzet, N. and J. Eberly (2018). Understanding weak capital investment: the role of market concentration and intangibles. Technical report, Jackson Hole Economic Policy Symposium.

Crouzet, N. and J. Eberly (2019). Rents and intangibles: a q+ framework.

Fernald, J. (2014). A quarterly, utilization-adjusted series on total factor productivity. *FRB Working paper*.

Ganapati, S. (2018). The modern wholesaler: Global sourcing, domestic distribution, and scale economies.

Grullon, G., Y. Larkin, and R. Michaely (2019). Are us industries becoming more concentrated? *Review of Finance*.

Gutiérrez, G. and T. Philippon (2019). The failure of free entry.

Haskel, J. and S. Westlake (2017). *Capitalism without Capital*. Princeton University Press.

Hsieh, C.-T. and P. Klenow (2009, November). Misallocation and manufacturing tfp in china and india". *Quarterly Journal of Economics*, 1403–1448.

Hsieh, C.-T. and E. Rossi-Hansberg (2019). The industrial revolution in services.

Hulten, C. R. (1978). Growth accounting with intermediate inputs. *Review of Economic Studies 45*(3), 511–518.

Mansury, M. A. and J. H. Love (2008). Innovation, productivity and growth in us business services: A firm-level analysis. *Technovation 28*(1), 52 – 62.

Ridder, M. D. (2019). Market power and innovation in the intangible economy.

Shapiro, C. (2018). Antitrust in a time of populism. *International Journal of Industrial Organization*.

Song, J., D. J. Price, F. Guvenen, N. Bloom, and T. von Wachter (2018, oct). Firming up inequality. *The Quarterly Journal of Economics 134*(1), 1–50.

A Appendix: Additional Results and Robustness

This appendix presents additional results, including some robustness analyses.

- Theory and Data
  - Table 1 highlights some predictions of existing theories of superstar firms.
  - Table 2 shows the coverage of Economic Census statistics over time
- Relative Productivity
  - Compustat-based
    * Figure 6 breaks down the relative productivity by sectors: manufacturing, non manufacturing, ICT-intensive and non-ICT-intensive. The trends are broadly similar to the ones in Figure 3 but Figure 6 brings some new insights. The first insight is that the results are the same if we use Census data instead of Compustat (top-left plot, line with squares). The second insight is that ICT intensive industries lag other industries. The right graphs of Panel A shows that non-ICT stars doubled their relative productivity advantage in the 1970s from 19% to 38%. ICT stars experienced the same increase later, between 1985 and 2000. Since 2000, however, relative productivities have been either flat or declining.
    * Figures 7, 8 and 9 present robustness analyses for the measurement of relative productivity. Figure 7 measures productivity using value added instead of sales. Figure 8 considers market value-based stars instead of sales-based stars. Last, figure 9 uses country x industry deflators instead of a common global industry deflator. As shown, all variations yield similar trends in the relative productivity of the stars as sales.
  - Census-based
    * Figure 10 shows our wage adjustment series, which is based on non-manufacturing industries at the Top-4 firms vs. the rest.
    * Table 3 shows that using the US Economic Census to measure relative productivity yields similar conclusions as Compustat. The table reports the weighted average relative wage, relative labor productivity and relative wage-adjusted labor productivity of the Top 4 firms by industry. All of these quantities have remained stable.
    * Table 4 breaks down the evolution of census-based relative productivity by industry. The only industries where top firms appear to have increased their relative productivity between 1997 and 2012 are Transportation and Wholesale Trade. The increase in Wholesale Trade is consistent with Ganapati (2018).
- Hulten Contribution
  - Figures 11 and 12 present robustness analyses for the Hulten contribution. Figure 7 measures productivity using value added instead of sales. Figure 8 considers market value-based stars instead of sales-based stars. As shown, all variations yield similar trends in the Hulten contribution of the stars.

- Reallocation Contribution
  - Figure 13 shows the impact of using alternate benchmarks when estimating the reallocation contribution of the stars.
  - Figure 14 presents a series of robustness on the reallocation contribution of US stars. The first plot shows the outside impact of the oil shocks on reallocation. The second plot considers backward-looking reallocation contributions (i.e., when the contribution of a star today is based on it's growth the past three years instead of the next two years. The third plot considers value added – instead of revenue – productivity. The last plot considers market value instead of sales stars. The conclusions remain largely stable across variations.
  - Figure 15 presents the same robustness analyses as figure 14, for Global stars instead of US stars.

- Total Contribution
  - Figure 16 contrast the total contribution of the stars against the economy-wide productivity growth as measured by Fernald (2014).
  - Figure 17 contrasts the Compustat-based contribution of the stars to an analogous census-based estimate for non-manufacturing industries.
  - Figure 18 presents a series of robustness on the total contribution of stars to using value added productivity instead of revenue productivity as well as alternate deflators for the Global calculation.
  - Figure 19 presents robustness on the total contribution of stars when using market value instead of sales-based stars.

A.1 Theory and Data

Table 1: *Some Theoretical Predictions for Stars*

Theories	**Size of leader**	**Gap between leader and followers**	**Relative Productivity of leader**	**Hulten Growth contribution**
IRS due to Intangible (Crouzet and Eberly (2019); Aghion et al. (2018); Ridder (2019),...)	+	+	+	+...-
Increasing Competition (Autor et al. (2017),...)	+	+	NA	NA
Declining Diffusion (Andrews et al. (2015); Akcigit and Ates (2019b),...)	+	+	+	+...-

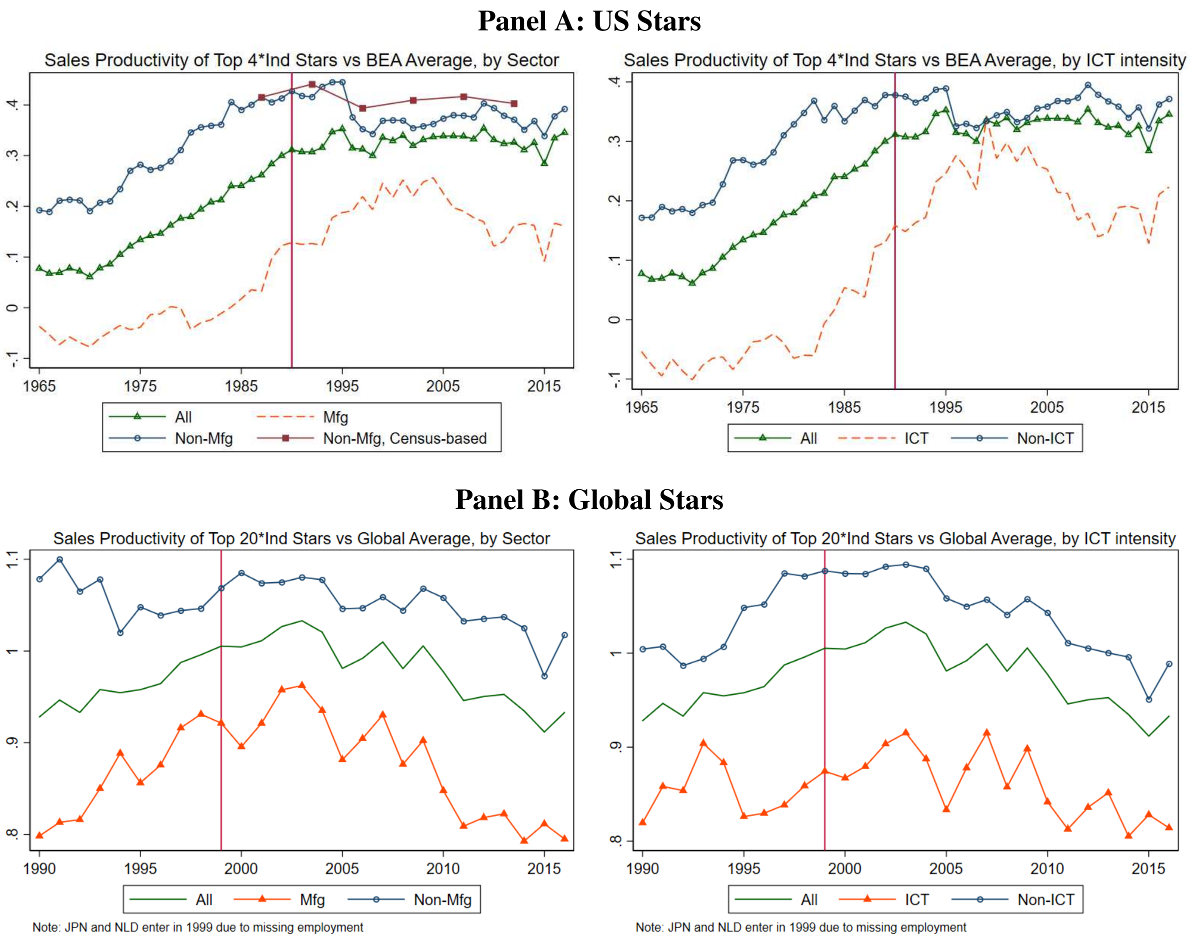
Table 2: *US Concentration Accounts: Coverage over time*

	1987	1992	1997	2002	2007	2012
Sector	SIC		NAICS			
Agriculture						
Mining						
Construction						
Manufacturing						
Transportation	Partial		X	X	X	X
Communication	Partial		X	X	X	X
Utilities				X	X	X
Wholesale Trade	X	X	X	X	X	X
Retail Trade	X	X	X	X	X	X
FIRE				X	X	X
Services	X	X	X	X	X	X

A.2 Relative Productivity

A.2.1 Compustat-based

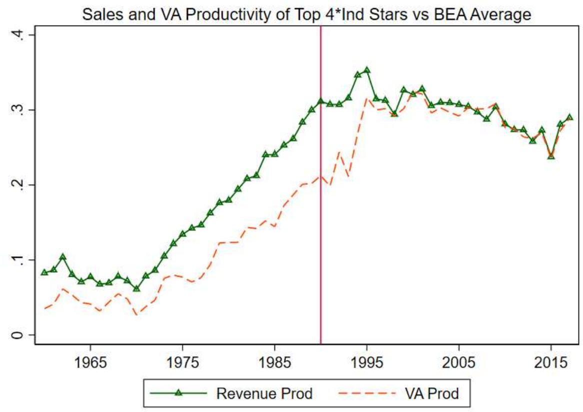
Figure 6: *Relative Productivity of Stars, by Sector*

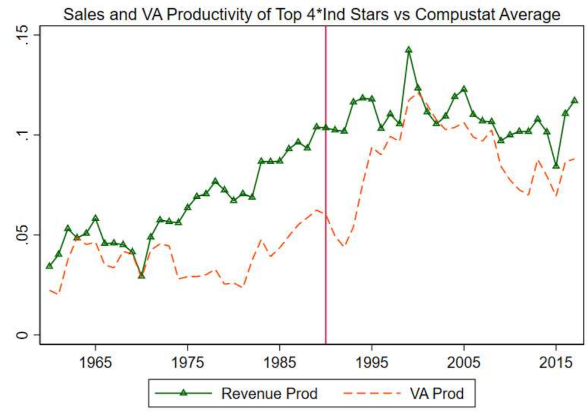


Note: Figure shows the relative productivity of stars by sector/ICT-intensity. Relative productivity defined as the employment-weighted average log-difference in productivity between the stars and their industry/sector. See figure 3 for details on the construction. Top plots focus on the US and use the average BEA sector (left) and Compustat (right) productivity as benchmarks. Top-left plot includes the weighted average relative productivity as measured in the Economic Census, using SIC-4 industries up to 1992 and NAICS after 1997, normalized to match the Compustat series in the initial period. Bottom plots are global. Left plot uses the global industry average as benchmark. Right plot uses the average among Compustat firms in the US, EU and Japan. ICT manufacturing industries include 'Electrical, electronic and optical equipment', 'Machinery and equipment n.e.c.' and 'Transport equipment' (26 to 30). ICT non-manufacturing industries include Transportation and storage, Publishing, audiovisual and broadcasting activities, Telecommunications, IT and other information services (49 to 53, 58 to 63). For global analyses, we also include Professional, scientific and technical activities; administrative and support service activities (69T82) as ICT given the use of a combined industry to match the KLEMS data of China and India to the more recent vintages of STAN.

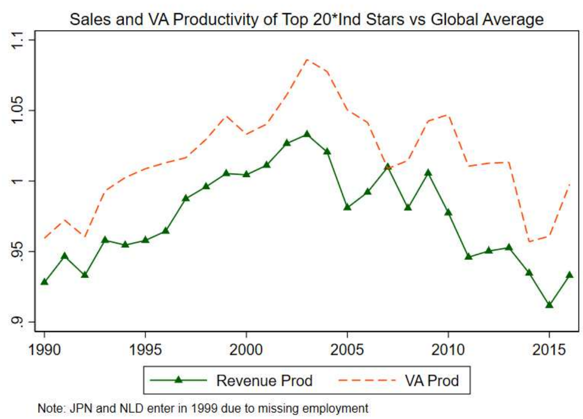
Figure 7: *Relative Productivity of Stars: Sales vs. VA Productivity*

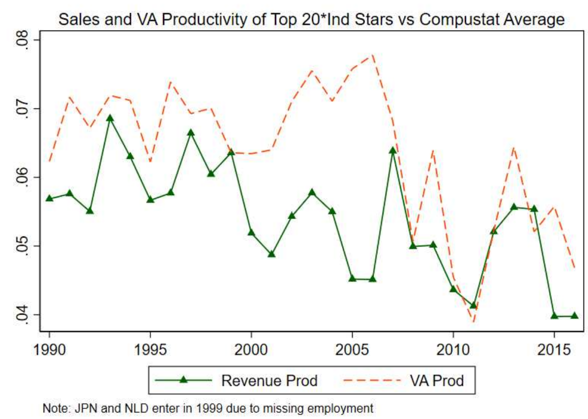
Panel A: US Stars





Panel B: Global Stars

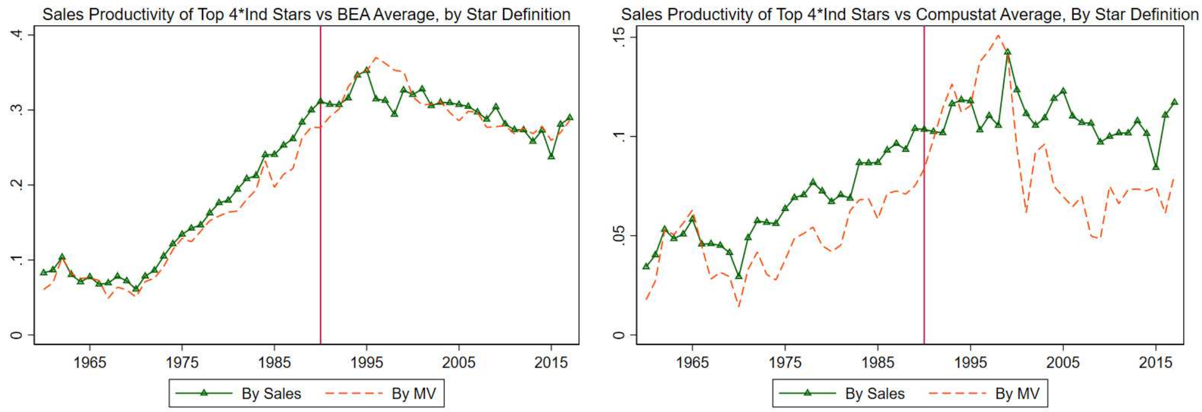




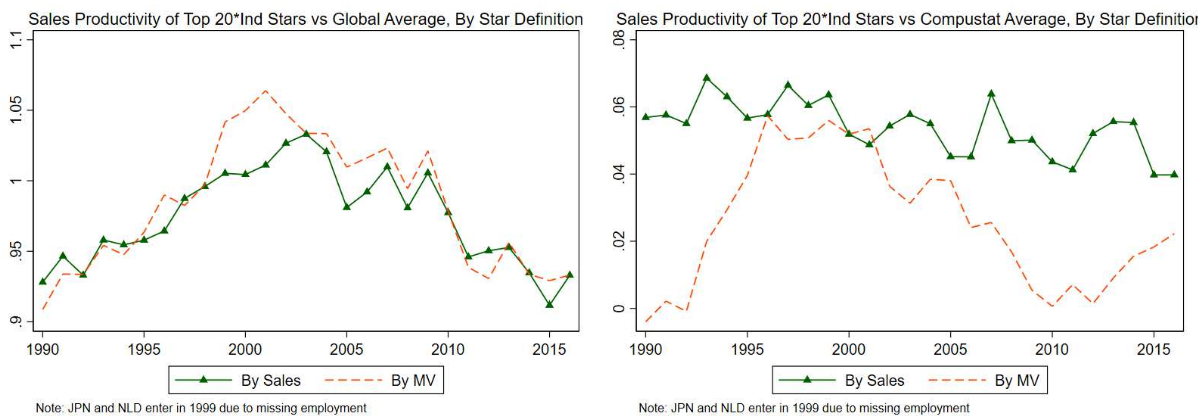
Note: Figure shows the relative productivity of stars when using Sales and VA to measure output. Relative productivity defined as the employment-weighted average log-difference in productivity between the stars and their industry/sector. Value added estimated as operating surplus (OIBDP) plus estimated wage compensation using a common wage based on reporting Compustat firms. See text for details. Top plots focus on the US and use the average BEA sector (left) and Compustat (right) productivity as benchmarks. Bottom plots are global. Left plot uses the global industry average as benchmark. Right plot uses the average among Compustat firms in the US, EU and Japan.

Figure 8: *Relative Productivity of Stars: MV vs. Sale Stars*

Panel A: US Stars

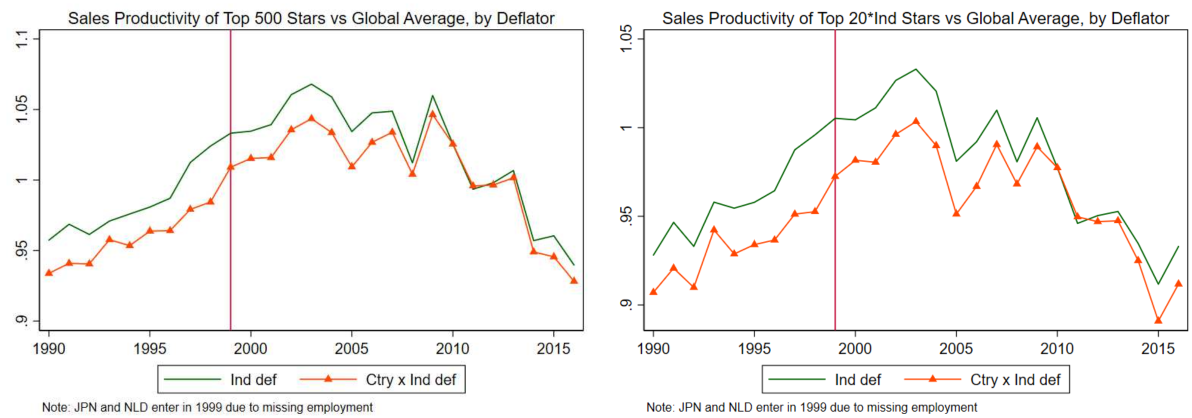


Panel B: Global Stars



Note: Figure shows the relative productivity of Sales and Market value stars. Relative productivity defined as the employment-weighted average log-difference in revenue productivity between the stars and their industry/sector. Top plots focus on the US and use the average BEA sector (left) and Compustat (right) productivity as benchmarks. Bottom plots are global. Left plot uses the global industry average as benchmark. Right plot uses the average among Compustat firms in the US, EU and Japan.

Figure 9: *Relative Productivity of Global Stars, by Deflator*



Note: Figure shows the relative productivity of Global stars using a common Global industry deflator vs. a country x industry deflator. Relative productivity defined as the employment-weighted average log-difference in revenue productivity between the stars and their industry/sector. Both figures use the global industry average productivity as benchmark.

A.2.2 Census-based

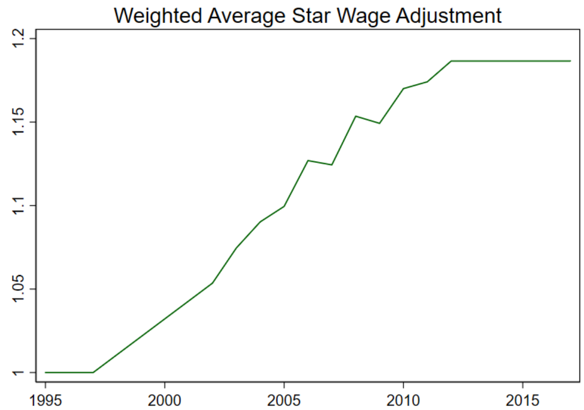
Given the potential measurement issues associated with the use of Compustat data (e.g., firms operate across narrowly defined industries, in many geographies, etc.), we replicate our main results for non-manufacturing industries using the U.S. Economic Census concentration accounts. The Census' concentration accounts are based on establishment-level data as reported to the Economic Census. They cover the entire population of firms and classify economic activity to NAICS codes at the establishment-level, so that multi-industry firms are properly allocated across industries. For non-manufacturing industries, these accounts report the value of shipments, payroll and employment for the largest 4, 8, 20 and 50 firms within each narrowly defined industry, which we use to compute the labor productivity and labor shares of the stars relative to their narrowly defined industry.

Data are reported following the 1987 SIC system in both 1987 and 1992, though there are small adjustments across years. Data after 1997 is based on NAICS, with each of the 1997, 2002, 2007 and 2012 reports using slightly different NAICS vintages. Data for service industries are reported by tax-paying segments. We keep tax-payable firms because they are reported consistently over time and are closest to our analysis. Data for wholesale trade are reported as a total and by type of merchant (e.g., merchant wholesaler, manufacturer). We keep only the total.

The industries covered increase over time, as summarized in Table 2 in the appendix. From 1987 to 1992, this includes all Service industries, Retail and Wholesale Trade as well as partial coverage of Transportation and Communication industries. Together these accounted for 40% of GDP over the period. From 1997 onwards, coverage of Transportation and Communication industries is complete, and Utilities enter the sample – so that the complete sample accounts for over 65% of GDP and 75% of the output of private industries. The main excluded sectors are agriculture (1.2%), mining (2.5%), construction (3.6%), manufacturing (12%) and government output (14%).

Table 3 reports the simplest results. We compute the weighted average relative wage, labor productivity

Figure 10: *Relative Wages*



and wage-adjusted labor productivity of the Top 4 firms by industry, and report results by level of industry granularity. The Table confirms the fact that star firms have not become relatively more productive over the past 20 years. In fact, quality-adjusted relative labor productivity has been slightly declining between 2002 and 2012: the Top 4 firms by NAICS 6 were 1.11 times more productive in 1997 and only 1.09 times in 2012. This reflects the fact that unadjusted productivity has been roughly flat together with the fact that top firms have been increasingly hiring top workers. It is consistent with the literature on increased assortative matching. For instance, Song et al. (2018) find that high-wage workers have become more likely to work in high- wage firms and with other high wage workers.

Table 3: *Relative productivity of Stars, Census-based Non-manufacturing industries*

			Relative LP			Relative Wage			Relative Wage-Adj. LP		
	lev	**year**	**Mean**	**Med.**	**Wtd. Avg**	**Mean**	**Med.**	**Wtd. Avg**	**Mean**	**Med.**	**Wtd. Avg**
SIC	**3**	**1987**	1.97	1.27	1.24	1.06	1.06	1.06	1.50	1.11	1.13
	3	**1992**	1.76	1.26	1.17	1.05	1.05	1.05	1.40	1.17	1.09
NAICS	**4**	**1997**	1.85	1.25	1.20	1.06	1.06	1.06	1.43	1.15	1.13
	4	**2002**	1.77	1.28	1.23	1.08	1.08	1.08	1.45	1.15	1.15
	4	**2007**	1.90	1.26	1.25	1.12	1.12	1.12	1.48	1.13	1.12
	4	**2012**	1.87	1.34	1.25	1.14	1.14	1.14	1.45	1.13	1.10
NAICS	**5**	**1997**	1.95	1.32	1.18	1.05	1.05	1.05	1.46	1.18	1.11
	5	**2002**	1.88	1.32	1.21	1.07	1.07	1.07	1.47	1.16	1.13
	5	**2007**	1.93	1.40	1.22	1.10	1.10	1.10	1.47	1.15	1.11
	5	**2012**	1.94	1.40	1.22	1.11	1.11	1.11	1.44	1.17	1.10
SIC	**4**	**1987**	2.07	1.32	1.26	1.06	1.06	1.06	1.60	1.14	1.16
	4	**1992**	2.00	1.32	1.27	1.11	1.11	1.11	1.58	1.19	1.13
NAICS	**6**	**1997**	1.81	1.30	1.17	1.05	1.05	1.05	1.38	1.15	1.11
	6	**2002**	1.82	1.29	1.19	1.07	1.07	1.07	1.41	1.13	1.11
	6	**2007**	1.86	1.37	1.20	1.09	1.09	1.09	1.41	1.14	1.10
	6	**2012**	1.86	1.40	1.20	1.10	1.10	1.10	1.39	1.16	1.09

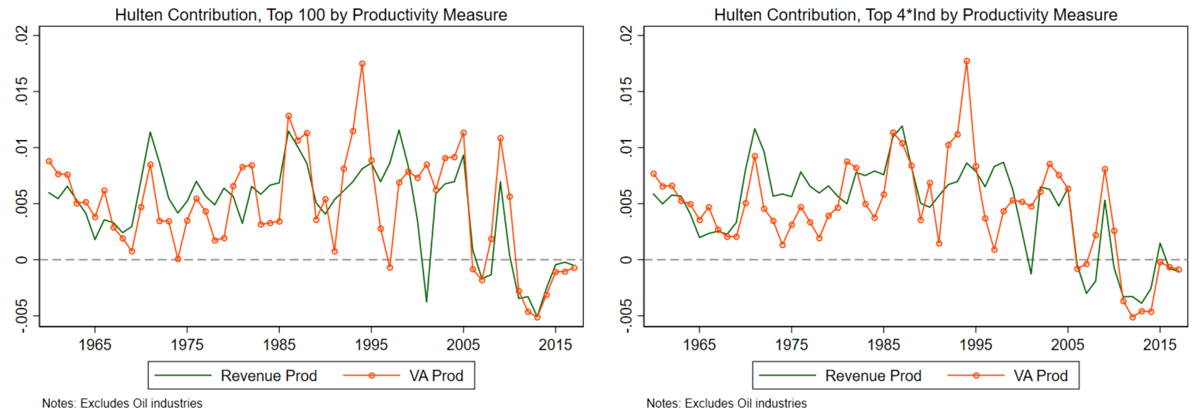
Table 4: *Relative productivity of Stars, Census-based Non-manufacturing industries*

Sector	**Measure**	**1987**	**1992**	**1997**	**2002**	**2007**	**2012**	**Change 97-12**
Education	Relative LP			1.44	1.58	1.53	1.65	0.21
	Relative Wage-Adj. LP			1.23	1.08	1.19	1.11	-0.12
Finance	Relative LP			1.19	1.16	1.23	1.08	-0.10
	Relative Wage-Adj. LP			1.12	1.03	1.12	0.96	-0.16
Health	Relative LP	1.01	1.04	1.09	1.10	1.16	1.17	0.08
	Relative Wage-Adj. LP	1.06	1.00	1.04	1.06	1.06	1.04	-0.00
Information	Relative LP	1.08	1.20	1.33	1.25	1.18	1.23	-0.10
	Relative Wage-Adj. LP	0.97	1.08	1.18	1.11	1.05	1.07	-0.11
Other Serv	Relative LP	1.18	1.15	1.14	1.19	1.22	1.18	0.04
	Relative Wage-Adj. LP	1.04	1.06	1.05	1.08	1.06	1.04	-0.01
Real Estate	Relative LP			1.32	1.28	1.33	1.31	-0.01
	Relative Wage-Adj. LP			1.17	1.15	1.17	1.14	-0.03
Retail Trade	Relative LP	0.99	1.10	1.07	1.08	1.07	1.11	0.04
	Relative Wage-Adj. LP	1.07	1.07	1.09	1.07	1.06	1.09	0.00
Transportation	Relative LP		1.11	1.10	1.18	1.41	1.24	0.14
	Relative Wage-Adj. LP		0.94	1.01	1.12	1.28	1.18	0.17
Utilities	Relative LP			1.25	1.30	1.23	1.12	-0.13
	Relative Wage-Adj. LP			1.10	1.11	1.16	0.98	-0.12
Wholesale Trade	Relative LP	2.11	2.09	1.91	1.88	1.91	2.03	0.12
	Relative Wage-Adj. LP	1.63	1.64	1.62	1.71	1.67	1.79	0.15

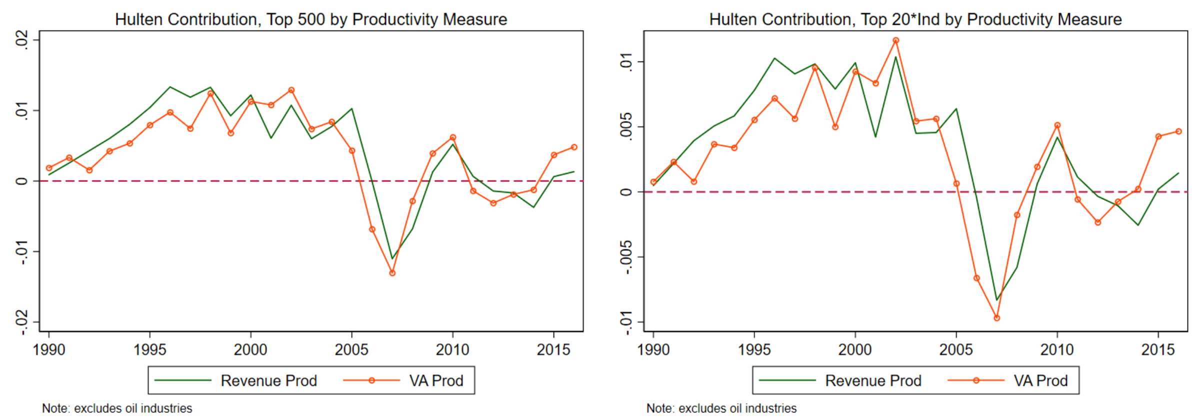
A.3 Hulten Contribution

Figure 11: *Hulten Contribution of the Stars: Sales vs. VA Productivity*

Panel A: US Stars



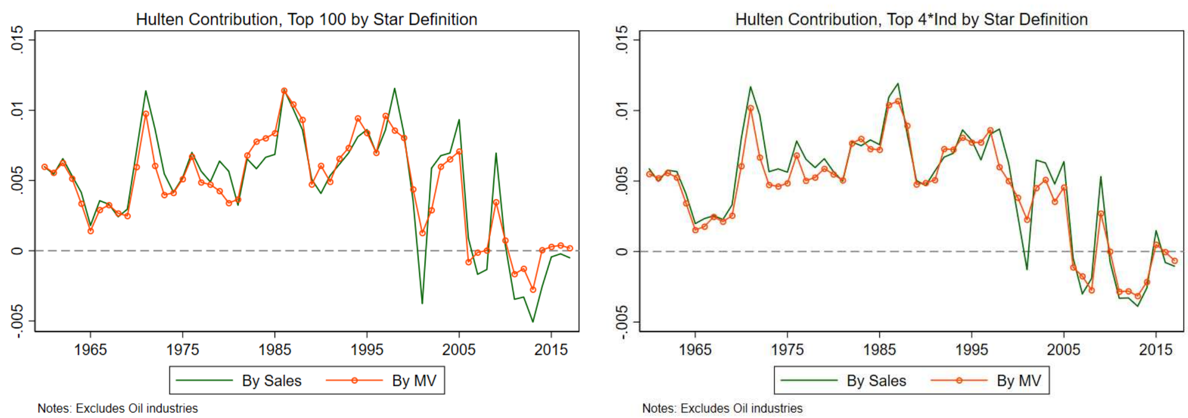
Panel B: Global Stars



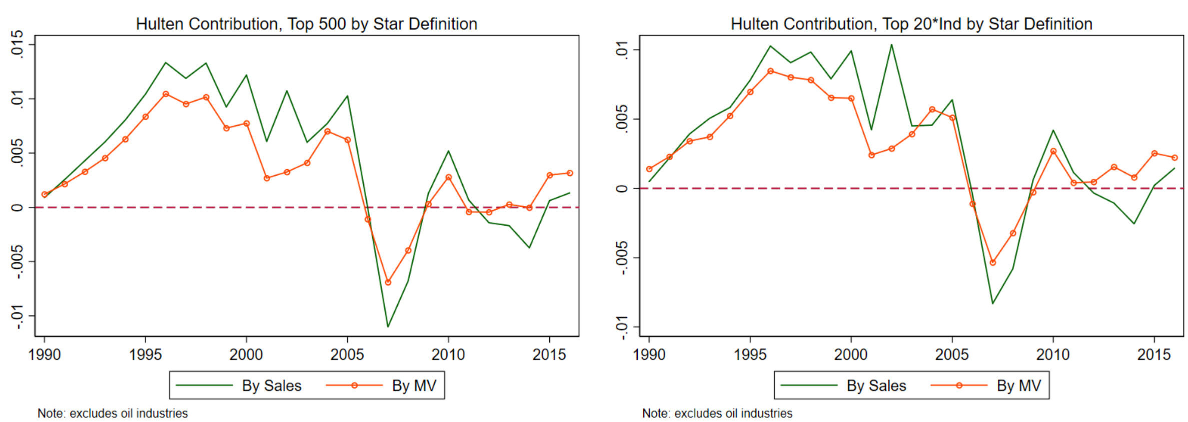
Note: Both lines use sales/GDP as Domar weight. Green line based on revenue productivity. Red line based on value added, imputed using profits plus estimated labor compensation as described in the text.

Figure 12: *Hulten Contributions of the Stars: Sale vs. MV Stars*

Panel A: US Stars



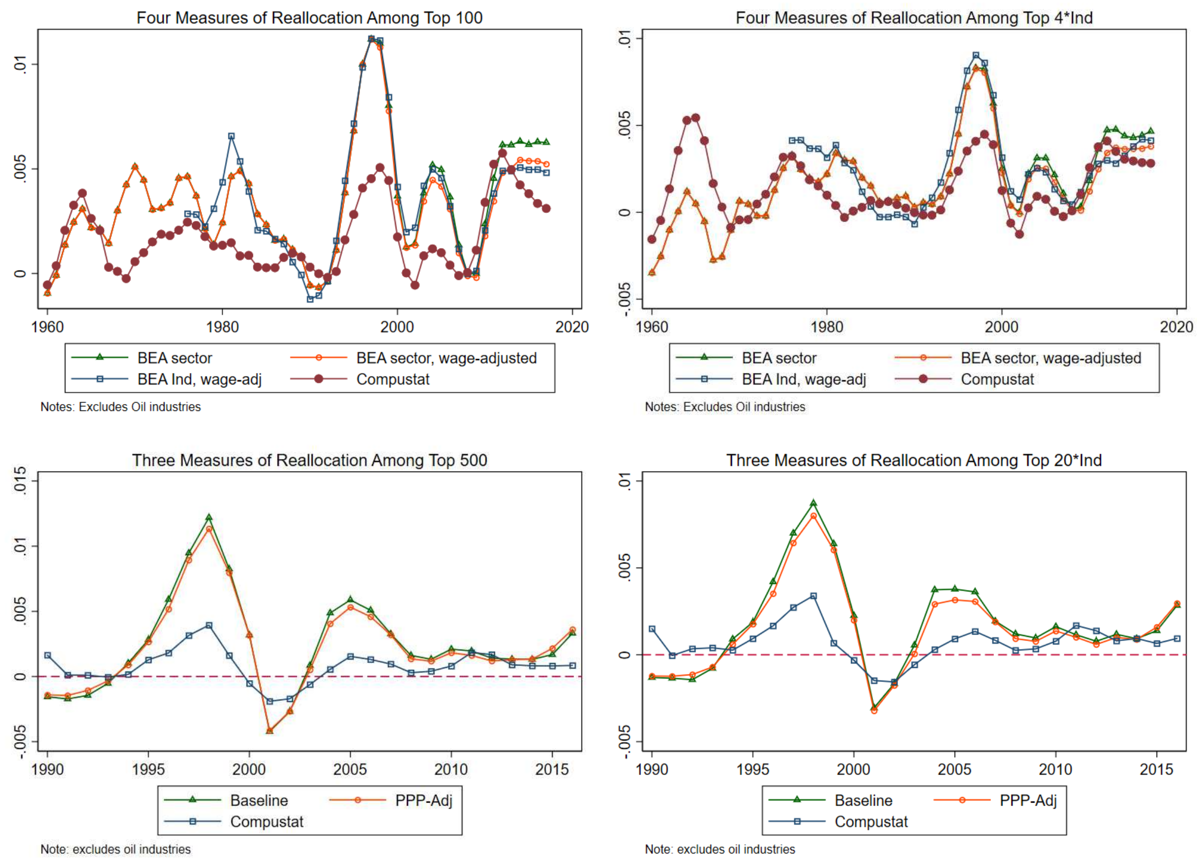
Panel B: Global Stars



Note: Both lines use sales/GDP as Domar weight. Green line based using Sales-based stars. Red line using MV-based stars.

A.4 Reallocation Contribution

Figure 13: *Different Benchmarks for Measuring Reallocation*

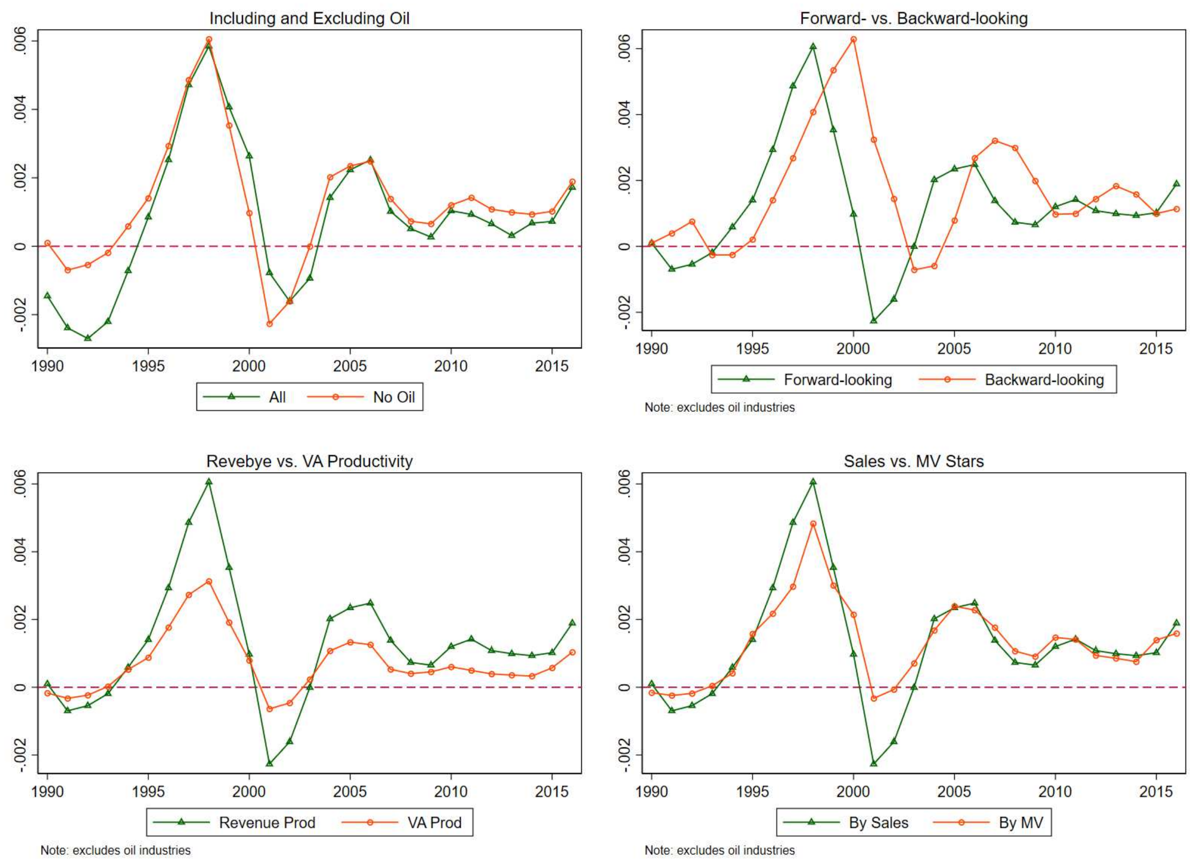


Note: For US, we report measures of reallocation productivity using 4 benchmarks: average sector productivity from BEA; sector BEA adjusted for labor quality; industry BEA and Compustat industry average. BEA industry productivity available only after 1977. Globally, we report measures of reallocation productivity using 3 benchmarks: global industry average productivity, global ppp-adjusted average productivity and Compustat average for US, EU and Japan.

Figure 14: *Reallocation Contribution of Top 4*Ind US Stars, Alternate Measures*

Note: All figures use sector BEA sector average productivity adjusted for labor quality as benchmark.

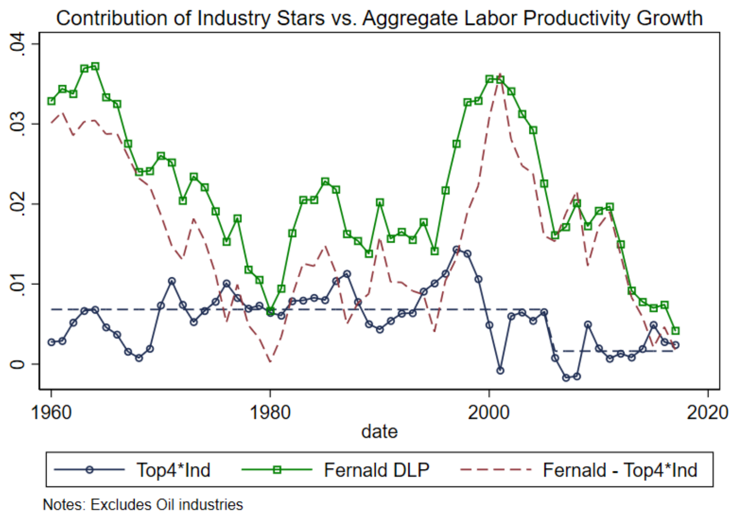
Figure 15: *Reallocation Contribution of Top 20*Ind Global Stars, Alternate Measures*



Note: All figures use global industry average productivity as benchmark.

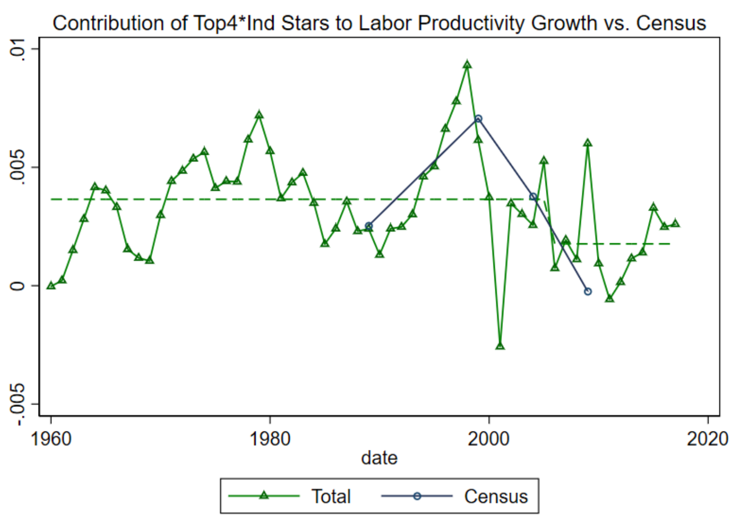
A.5 Total Contribution

Figure 16: *Total Contributions of US Stars vs. US Aggregate Productivity Growth*



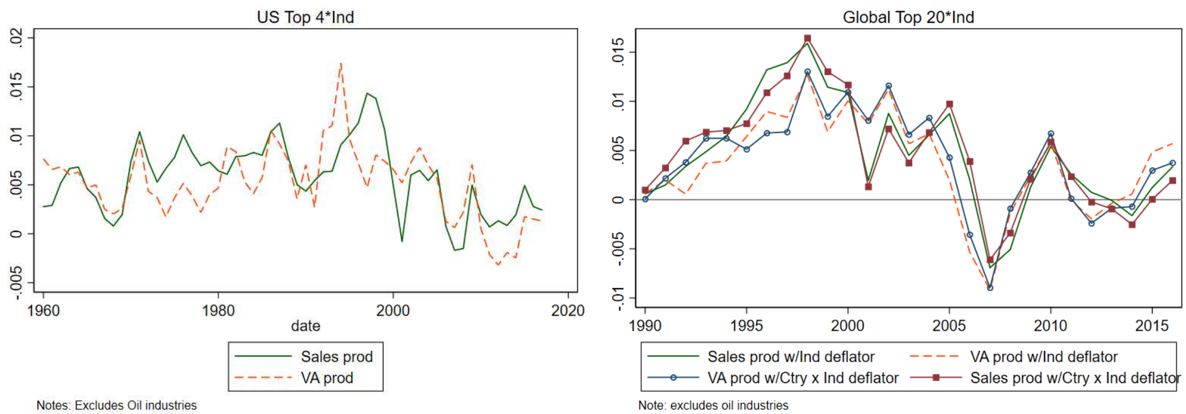
Note: the figure plots the contributions of US stars to US labor productivity growth, including 5Y MA growth in US labor productivity as measured by Fernald (2014).

Figure 17: *Total Contributions of US Stars: Comparison to Census*



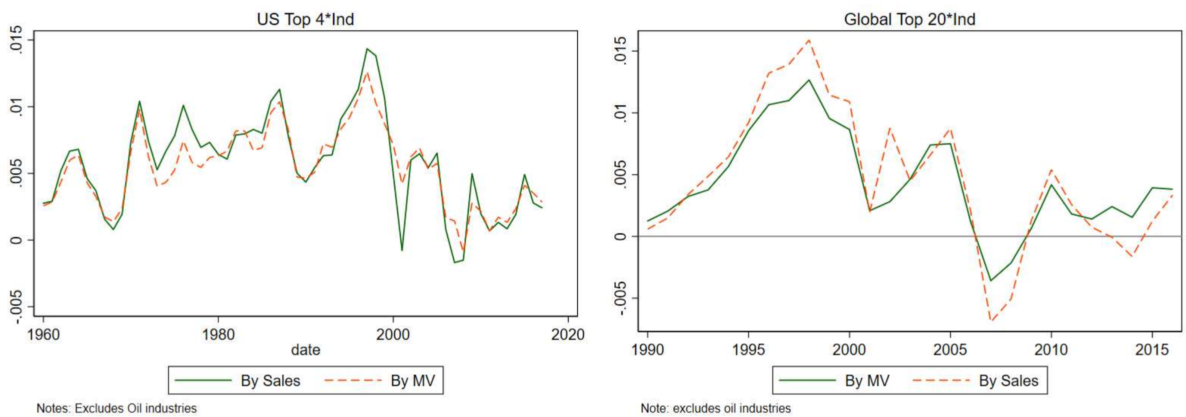
Note: the figure plots the contributions of top4*ind sale-based stars to US labor productivity growth, including only those industries covered by the Census. Green line with triangles based on Compustat, including those sectors for which Census concentration data includes employment (Non-manufacturing excluding Agriculture, Mining and Construction). Gray line with squares based on Census concentration data. Each dot represents the contribution of stars to labor productivity growth from 1987-1992, 1997-2002, 2002-2007 and 2007-2012.

Figure 18: *Total Contribution of Industry Stars, by Productivity Measure and Deflator*



Note: the figure plots the contributions of star firms to labor productivity growth using alternate definitions of productivity and deflators.

Figure 19: *Total Contribution of Industry Stars, by Star Definition*



Note: the figure plots the contributions of star firms to labor productivity growth using alternate definitions of stars.