Growing Productivity without Growing Wages: The Micro-Level Anatomy of the Aggregate Labor Share Decline*

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Abstract

The aggregate labor share in U.S. manufacturing declined dramatically over the last three decades: Since the mid-1980's, the compensation for labor declined from 67% to 47% of value added which is unseen in any other sector of the U.S. economy. The labor share of the typical U.S. manufacturing plants, in contrast, *rose* by over 5 percentage points. We reconcile these two facts by documenting (1) an important reallocation of production towards "hyper-productive plants" and (2) a downward adjustment of the labor share of those same plants over time. These two related forces account for almost all the change in the trend of aggregate labor share in the manufacturing sector, with only a small role for exit of high-labor-share plants. Relative to their peers, plants that account for the majority of production by the late 2000's arrive at a low labor share by gradually increasing value added by a factor of three while keeping employment and compensation unchanged.

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JEL classification: E2, L1, L2, L6, O4.

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1 Introduction

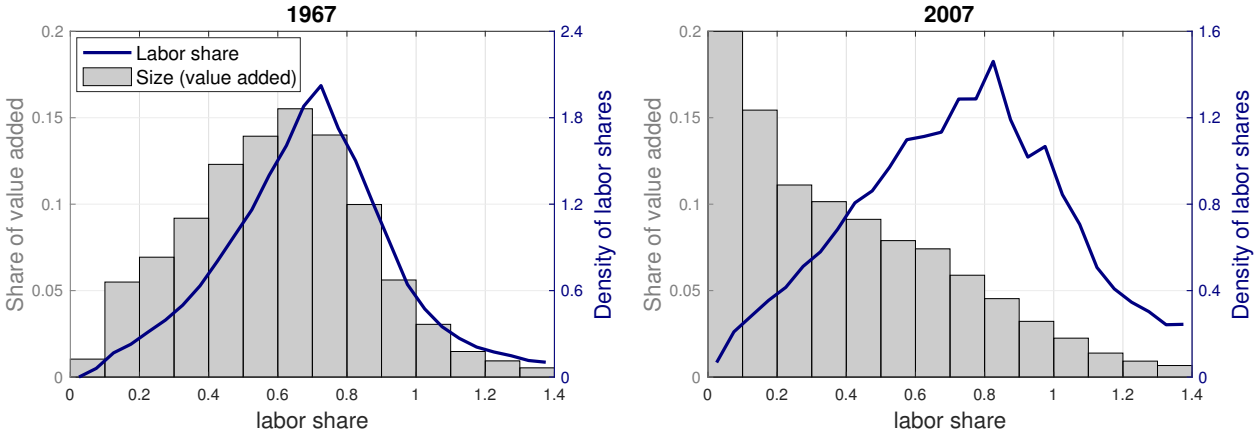
Several recent studies have documented a decline of the aggregate labor share, the portion of gross domestic product paid out in compensation for labor. This finding is very important for a number of reasons: it contradicts one of the stylized facts of Kaldor (1961) which have become foundational for theories of economic growth. It is further at odds with a key building block of standard macroeconomic models, the Cobb-Douglas production function. Lastly, it seems to suggest that an economy's value added gets distributed less to those who produce that value added and more to those that own the means of production.

A growing literature is studying potential causes for this aggregate labor share decline and comes to conflicting conclusions: Elsby et al. (2013) identify offshoring of labor-intensive activities as the main driver of the aggregate labor share decline. Karabarbounis and Neiman (2014b) attribute the labor share decline world-wide to increasingly higher efficiency of new capital. Gaggl and Eden (2016) find that the rise of information and communication capital has replaced routine labor and thus lowered that portion of the labor share. Koh et al. (2016) claim that a higher intangible capital intensity is responsible for the decline in the labor share. Corrado et al. (2005, 2009) made headways in measuring intangible capital and propose that its deepening explains most of labor productivity growth, a concept inversely related to the labor share. Rognlie (2015) identifies a low-frequency fall and rise of the capital share and shows that its recent increase is mostly due to the housing sector.

The common theme across these studies is that they are concerned with finding an aggregate explanation for a labor share pattern they document at the aggregate or sectoral level. What is unknown at this point are the micro-level dynamics that underpin the aggregate labor share decline. Understanding these dynamics will in turn help us better grasp the forces that underlie the fall in the labor share. The present paper fills this gap and uses confidential data from the U.S. Census of Manufactures to study the micro-level anatomy of the aggregate labor share decline. Our focus is on U.S. manufacturing, a sector for which detailed plant-level data is available and that sidesteps or minimizes some of the measurement challenges highlighted above, such as the roles of self-employed income, intangibles or housing. We confirm that the labor share in the manufacturing sector declines by almost 5 percentage points (ppt) per decade between 1967 and 2007. This, however, hides a striking fact: Alongside this aggregate decline, the median establishment actually saw an *increase* in its labor share, by about 1.4 ppt per decade. In fact, this upward trend is present for the vast majority of manufacturing establishments. These two facts are depicted in Figure 1.

To reconcile the opposing trends of the labor share at the aggregate and establishment levels, we document the role of two related forces using a decomposition exercise. First, we show that there has been a dramatic reallocation of production from high- and mid-labor-share establishments towards low-labor-share establishments over this period. We label these latter establishments "hyperproductive plants." Second, we observe a fattening of the tails of the distribution of establishment-level labor shares over time. Per se, this polarization of labor shares should not necessarily have an impact on the aggregate trend. However, because the hyperproductive plants capture a larger and larger portion of aggregate manufacturing value added, the fact that they are able to lower their labor share over time implies that this widening of the distribution also pushes down the aggregate. We also find that most of the downward adjustment in the manufacturing labor share has been happening in the years following recessions. This finding is consistent with the evidence on employment from various authors who note that the disappearance of routine jobs is an important factor behind the recent jobless recoveries experienced in the U.S. and elsewhere (see Acemoglu and Autor (2011); Jaimovich and Siu (2015)).

Figure 1: The changing distributions of labor shares and value added



Note: The cross-establishment distribution of labor shares (solid blue lines) shows no significant locational shift of establishment-level labor shares from 1967 to 2007; the fattening of tails indicates a polarization of labor shares. The distribution of economic activity (value added shares in grey bars), in contrast, dramatically shifts towards low-labor-share establishments. This reallocation of value added is principally responsible for the aggregate labor share decline.

Taken together, these two interlinked forces account for almost all of the change in the evolution of the aggregate labor share since the early 1980s. We attribute a third of the downward pressure on the aggregate labor share to reallocation of economic activity

from relatively high-labor-share to relatively low-labor-share establishments, while half of the downward pressure is driven by those establishments that simultaneously lower their labor share *and* grow disproportionately. Although this latter channel accounts for half of the observed aggregate labor share decline, it is accounted for by only the very small group of "hyperproductive plants." The remaining contributions, which are due to entry and exit as well as mergers and acquisitions, are very limited and add the remaining sixth of the forces pushing the aggregate labor share downward.

In the last part of the paper, we focus our attention on the "hyperproductive" plants that account for most of the decline in the labor share of the manufacturing sector. In order to achieve an average labor share that is more than 2.5 times smaller than that of their peers by 2007, we find that these hyperproductive plants relied almost solely on growing their value added while keeping their wage and employment levels in line with those of other establishments.

Literature review A burgeoning literature has documented and come up with different explanations for the labor share decline. One set of explanations involves technical change. Karabarbounis and Neiman (2014b) have put forward the notion that technical change embodied in new equipment capital has displaced labor and lowered the labor share. Gaggl and Eden (2016) refine this theory by focusing on information and communication technology capital. Koh et al. (2016) emphasize the rise of intangible capital such as intellectual property products, research and development and knowledge capital in the production function of developed economies. Alvarez-Cuadrado et al. (2015) show that industry-specificities in technological change and the elasticity of substitution between capital and labor matters for the dynamics of industry-level factor shares. A common ingredient in the argument of these papers is that the elasticity of substitution between equipment or intangible capital and (routine) labor has to be greater than unity. This has been criticized by Lawrence (2015) and Oberfield and Raval (2014) who present evidence that the elasticity of substitution is in fact smaller than unity, at various levels of aggregation.

Alternatively, Elsby et al. (2013) advocate the role of offshoring as the main driver of the labor share decline. In related work, Boehm et al. (2015) present establishment-level evidence that outsourcing did cut U.S. manufacturing employment while raising profits per worker of surviving production units. Glover and Short (2016) find the age composition of the work force has shifted towards workers that are less capable of extracting their marginal product of labor as a wage.

Hartman-Glaser et al. (2017) study Compustat data and find a similar dichotomy between the aggregate and average capital share that we find in labor share data. They explain the rise in the aggregate capital share through increasingly risky firm productivity. In their model, more volatile productivity implies that the firm owner can ask for a larger insurance premium, raising in turn the capital share. Even though Davis et al. (2006) have shown that establishment-level outcomes have become less volatile, Kehrig (2011) has shown that the productivity dispersion across establishments has increased significantly. This evidence can be reconciled with Davis et al. (2006) if spreads in the fixed productivity component of new establishments widen while the volatility of the variable components may well have declined. From the perspective of individual workers this widening would also pose an increased risk requiring more ex ante insurance.

Lastly, an emerging strand of the labor share literature emphasizes the role of rising concentration and markups: Autor et al. (2017) present some industry-level evidence on firm concentration shares which is consistent with our finding that a small fraction of "hyperproductive plants" are mainly responsible for the aggregate labor share decline. Grullon et al. (2016) use firm-level data from Compustat to document that most U.S. industries became more concentrated over time, with the "winning firm" making large profits and realizing outstanding stock returns as well as more profitable mergers and acquisitions. Barkai (2017) shows that markups have grown over time, lowering both the labor and capital shares.

Issues related to the measurement of the labor share abound: Elsby et al. (2013) refine the imputation of the labor portion of noncorporate income which mitigates the labor share decline a bit. Bridgman (2014) claims that the rise of less durable capital such as computers and software means that a larger share of value added is spent on replacing depreciated capital. Karabarbounis and Neiman (2014a) explore that issue using world-wide data and show that the potential of higher depreciation to explain the labor share decline is limited: broad trends in the *gross* and *net* labor shares are in fact quite similar.

2 The dynamics of the U.S. labor share

2.1 Data sources and measurement

We use both industry-level data from the Bureau of Labor Statistics (BLS) and confidential establishment-level data from the Census of Manufactures. The BLS data come from the annual "KLEMS Multifactor Productivity Tables by Industry" for both Manufacturing and

Nonmanufacturing Industries and span the period from 1948-2014. We use the SIC based tables until 1987 and then switch to the NAICS based tables from 1987 onwards, adjusting the SIC-based time series so that the SIC and NAICS based times series coincide in 1987.

The U.S. Census Bureau collects data on all manufacturing establishments within the economic census, which is taken every five years from 1967 until 2007. We drop all observations which are administrative records or which are not part of the "tabbed sample" which make up the official tabulations published by Census.

In either dataset, the labor share λ_t in a given industry and year t is defined as

$$\lambda_t = \frac{w_t L_t}{Y_t} \tag{1}$$

where $w_t L_t$ denotes aggregate labor costs and Y_t aggregate value added produced in the manufacturing sector at time t gross of depreciation and taxes.

In the BLS data, labor costs comprise employee compensation (wages, salaries and supplements) as well as a portion of non-corporate income.[1] We compute value added as the value of production minus the costs for materials, energy inputs and purchased services.

In the Census data, we define the following items as labor costs: salaries and wages (item `SW`), involuntary labor costs (item `VLC`) such as unemployment insurance or social security contributions netted out from wages and voluntary labor costs (item `ILC`) such as health, retirement and other benefits paid to employees. Value added in the Census data is measured as sales less inventory investment for final and work-in-progress goods, resales[2], material inputs and energy expenditures. Unlike in the BLS data, purchased services are not reported in the Census data. To account for that, we reduce establishment-level value added by the industry-year-specific ratio of purchased services to value added computed from the BLS data. In addition, we drop all observations outside the one percentiles to avoid outliers driving result. This means we also drop observations with a negative value added (and thus labor share). We do that in order to have one consistent Census sample

[1] The "Technical Information About the BLS Multifactor Productivity Measures" (September 2007) states the assumptions involved in allocating non-corporate income to labor and capital costs in each year: "Initially self-employed persons and unpaid family workers are assumed to receive the same hourly compensation as employees and the rate of return to non-corporate capital is assumed to be the same as in the corporate sector. Based on these assumptions, the resultant income of proprietors is adjusted to match actual proprietors income reported in the GPO data by scaling proportionately the hourly compensation of the self-employed and the noncorporate rate of return. This treats any apparent excess or deficiency in noncorporate income neutrally with respect to labor and capital." (p. 9).

[2] This means we consider the value added by an establishment's production activities, not its trading activities.

in our analyses throughout the paper, some of which would not be meaningful because they involve observations with negative labor shares.

Both the BLS and Census measures lack any non-monetary compensation or ownership rights which have monetary value to an employee. Stock options, for example, are counted as labor income for tax purposes once a manager exercises the option but not at the point in time when the manager acquires the option. Ongoing research in finance is concerned with the rising share of deferred compensation in total labor compensation. This could potentially mitigate the aggregate labor share declines in both the BLS and our Census measure.

Compared to the aggregate BLS labor share, our aggregate labor share measure based on the micro-level Census data will be lower for three reasons. First, we do not include non-corporate (self-employed) compensation as part of labor compensation, so our numerator will be lower. Second, we do not consider establishments with negative value added, so our denominator will be greater. Third, our way to make up for the missing purchased services will likely leave value added higher as well, again making our denominator greater. These three factors imply that the aggregate labor share in manufacturing computed from the Census data is about eight percentage points smaller than in the BLS data.

2.2 The labor shares falls in most U.S. sectors

Before we delve into the plant-level manufacturing data, we first provide evidence on the evolution of the labor share across main U.S. sectors. For each industry, we compute the labor share as in equation (1), using sectoral data from the BLS as described in the previous section. Table 1 presents the share of value added of each sector in 2007 alongside its labor share decline over the 1987-2014 period.

The results indicate that while the drop in labor share is particularly pronounced for Manufacturing as well as other sectors such as Mining or Wholesale Trade, the overall trend is broad-based. Only a few sectors, such as Education or Arts & Recreation experienced a noticeable increase. This confirms us in our focus on the manufacturing sector: it is not an outlier, yet the fact that it experienced a clear and pronounced decline of its labor share makes us more confident that we can identify significant dynamics from the micro-level data. Even though it lost some share in the aggregate economy, it still is one of the main sectors and thus important enough to warrant attention. In addition, manufacturing is less prone to some of the issues highlighted in the literature, such as the role of self-employment income, intangibles or housing capital in driving the decline in the labor share.

Table 1: Labor share decline by sector

Sector	Labor Share decline (in percentage points)	Share of value added 1987	2014
Agriculture	+0.0	2.4	1.7
Mining	−6.6	1.8	3.1
Utilities	+0.7	4.1	2.7
Construction	−1.2	5.4	4.9
Manufacturing	−6.6	22.8	14.3
Non Durables	−8.8	8.9	6.6
Durables	−4.2	13.9	7.7
Trade	−3.5	13.3	12.3
Wholesale Trade	−4.1	5.8	6.3
Retail Trade	−2.4	7.4	6.0
Transport & Warehousing	−2.8	3.7	3.5
Information	−0.5	4.7	5.7
Finance, Insurance, Real Estate	−0.6	12.1	13.6
Services	−0.3	19.9	26.7
Health	−0.4	4.1	5.6
Other	−1.0	5.8	6.1

Note: Authors calculations of sectoral labor share declines (in percentage points) per decade based on BLS data from the KLEMS Multifactor Productivity Tables by Industry, data range 1987-2014. Shares in nominal aggregate value added are in percent.
"Other" collects Education, Arts & Recreation, Hotels & Restaurants and Other Services.

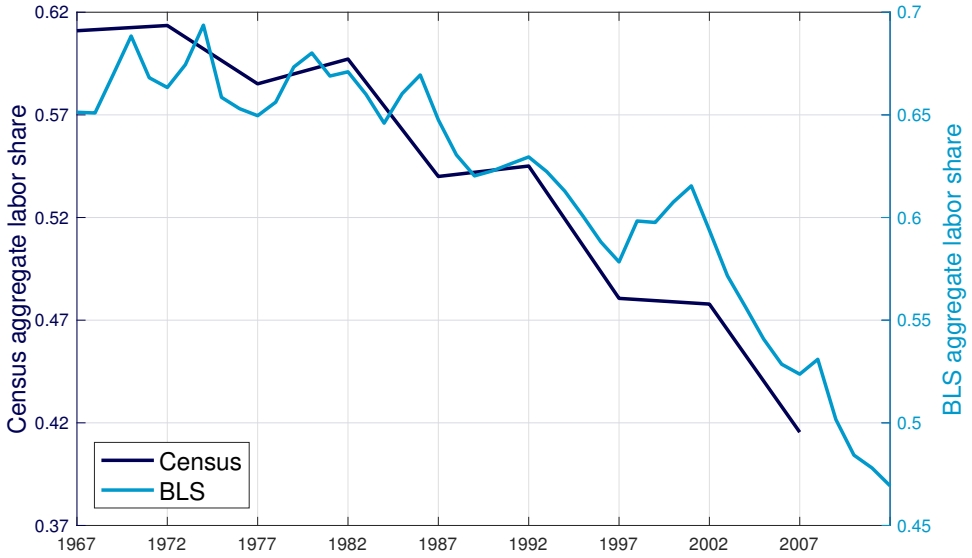
2.3 The labor share in U.S. manufacturing

From now on we will focus on the labor share dynamics in the U.S. manufacturing sector. We choose to focus on that sector for two reasons. First, as shown above and also highlighted by Elsby et al. (2013), manufacturing is one of the sectors where the labor share decline is most pronounced, making it a good starting point to study the macro and micro dynamics of the labor share decline. Second, micro-level data from the U.S. Census Bureau are available down to the level of the individual establishment and for a long time period. This allows us to contrast the dynamics of the labor share both before and after the start of its secular decline, around the early 1980s. In our analysis, we will use the quinquennial Census of Manufactures which started in 1963 and were conducted every five years from 1967 onwards. This gives us a history of labor share dynamics that is longer than the ones available in other sectors, which the U.S. Census Bureau only started to sample in the 1980s.

Manufacturing labor share declines strongly As a first exercise, we confirm that the aggregate labor share in the U.S. manufacturing sector as measured in the Census establishment-level data is consistent with the labor share in the industry-level BLS data. To that end, we compute the aggregate labor share in the Census data by aggregating labor costs and value added across all plants in a given year to compute the numerator and denominator of equation (1). In Figure 2 we compare the aggregate manufacturing labor shares in both the BLS and the Census data from 1967 onwards.

Figure 2 shows that the BLS labor share is about 8 ppt higher in general because both labor compensation and value added are measured differently in the BLS and Census data (see above). We also drop observations with negative value added in the Census data, thus lowering the labor share. Yet, the two labor series line up well in terms of level and, more importantly, trends. While the original work by Karabarbounis and Neiman (2014b) documents a 1.4 ppt decline per decade in the global corporate sector, the labor share in manufacturing declines by a stunning 4.9 ppt per decade over our sample period. The vast majority of this decline occurred since the mid 1980s: Up to 1982, the manufacturing labor share fell by only a meager 0.9 ppt per decade while it dropped by 7.3 ppt per decade since the 1982 Census. Importantly, since we consider data from the producer side and focus on the manufacturing sector, our analysis is unlikely to be impacted by the measurement problems present in household-level data. For example, Elsby et al. (2013) argue that self-employment income was an important contributor to these trends. Conversely, Rognlie (2015) documents that income from housing alone was responsible for the labor share dynamics computed

Figure 2: The aggregate labor share in U.S. manufacturing



from household-side surveys, and Gaggl and Eden (2016) document a similar pattern for residential capital income in more aggregate income and product accounts. Our analysis, focusing on manufacturing plant level data, circumvents these issues.

Labor share adjustment over the business cycle Next, we show that there exist significant differences in the extent of the adjustment of the labor share over the various phases of the business cycle. Ríos-Rull and Santaeulàlia-Llopis (2010) noted that the labor share is coutercyclcial which may result from wages or labor that are relatively sluggish compared to output. This can be explained in a model of technology shocks with search frictions, labor adjustment costs and/or sticky wages due to Nash bargaining. We add to this cyclical pattern our new observation that the secular labor share decline occurs in expansions rather then recessions. Based on the annual BLS data for the manufacturing sector, we find that prior to the 1980s, the aggregate labor share generally increased by 2-3 ppt in a recession and declined by the same amount in the subsequent recovery. The medium slump in U.S. manufacturing in 1986 initially follows this pattern with a 2-percentage-point rise, but the subsequent recovery sees the size of the labor share drop heavily, by about 5 ppt. Every business cycle since has shown similar dynamics: a modest rise of the labor share in the recession, followed by a large decline thereafter. This pattern was particularly dramatic between the 2001 and 2009 recessions, with a decline of 9 ppt. This evidence adds

to the job polarization literature. Jaimovich and Siu (2015), for example, who show the anatomy of jobless recoveries over the last 30 years: despite recoveries in aggregate output, employment picks up only slowly following the 1991, 2001 and 2009 recessions because the middle-occupation jobs eliminated in the previous recessions do not come back.

Different declines in production and non-production compensation The labor costs used in the numerator of the labor share contain various components. In the Census data, we can distinguish between production worker wages, salaries for non-production workers as well as ancillary labor costs. Production worker wages include the wage bill of all employees engaged in the core manufacturing activities such as fabricating, processing, assembling, inspecting, receiving, packing, warehousing, maintenance, repair, janitorial and guard services and record keeping. Salaries of non-production workers refer instead to the compensation of all employees above line-supervisor level. It comprises executive, purchasing, professional and technical sales, logistics, advertising, credit, clerical and routine office functions. Finally, the ancillary labor costs comprise legally required labor costs (such as social security tax, unemployment tax, workmen's compensation insurance and state disability insurance pension plans) as well as voluntary labor costs (such as health benefits, life insurance premiums, supplemental unemployment compensation and deferred profit sharing plans).

We investigate whethere these three components declined symmetrically. This question is important as some theories of the labor share decline such as deunionization or the automation of routine jobs would be expected to have a disproportionately large impact on the wages of production workers, while affecting to a lesser degree the two other components. Other theories such as a change in the competitive landscape would likely have a more symmetric effect on all three labor share components.

We study this question by decomposing the aggregate labor share into these three components. The results are shown in Figure 3 and Table 2:

$$\lambda_t = \underbrace{\frac{w_t^{pw} L_t^{pw}}{Y_t}}_{\text{Wage bill}} + \underbrace{\frac{w_t^{npw} L_t^{npw}}{Y_t}}_{\text{Salaries}} + \underbrace{\frac{w_t^{ben} L_t^{ben}}{Y_t}}_{\text{Ancill. labor costs}} .$$

We find that the compensation of production workers declines secularly, by about 4.6 ppt per decade, mirroring the average rate of decline of the overall labor share. However, while the aggregate labor share stays roughly constant until the early 1980s, the compensation of

Figure 3: Dynamics of labor share components

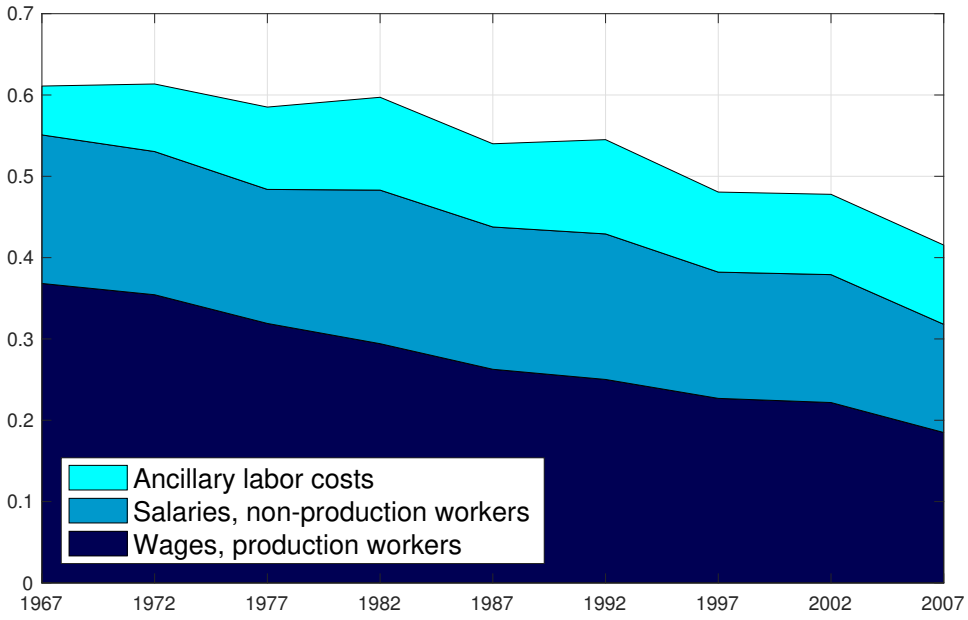


Table 2: Dynamics of labor share components per decade (percentage point change)

Component	1967-2007	1967-1982	1982-2007
	(percentage point changes)		
Aggrgate labor share	−4.9	−0.9	−7.3
Production worker wages	−4.6	−4.9	−4.4
Non-production worker salaries	−1.2	+0.4	−2.2
Ancillary labor costs	+0.9	+3.6	−0.7

production workers declines steadily since the beginning of our dataset in the late 1960s. In fact, once the downward trend in the overall labor share starts in the early 1980s, the compensation decline for production workers slows down slightly. All in all, had the production-worker labor share not declined at all, the aggregate labor share would have stayed more or less constant (-0.3 ppt per decade).

The compensation for non-production labor, in contrast, is steady at first and then starts to decline after 1982, but not as strongly as that of production labor. If the compensation for non-production labor had stayed constant rather than declining at 1.2 ppt per decade, the aggregate labor share would have only declined by 3.7 ppt per decade instead of 4.9 ppt. Ancillary labor costs display the opposite pattern: they push the aggregate labor share up by almost one percentage point per decade. In the early decades of our data, the increase in the ancillary labor costs and salaries offset the decline in production worker wages thus leaving the aggregate labor share constant until 1982. After that, the ancillary labor costs decline only slightly. Had they not dampened the overall decline of labor compensation, the aggregate labor share decline would have been stronger at 5.8 ppt per decade instead of the observed 4.9 ppt decline.

2.4 The labor share decline across industries and regions

Industry factors The observed aggregate labor share decline could stem from specific industries which experience a decline while others experience only a small or no change in their labor share. Likewise, the aggregate labor share could fall because economic activity in terms of value added gets reallocated to relatively low labor-share industries.

To test for such compositional effects, we decompose the aggregate labor share decline into a component within and across industries using equation (2):

$$\Delta\lambda_t = \underbrace{\sum_j \Delta\lambda_{jt}\omega_{jt-1}}_{\text{Within adjustment}} \underbrace{+\sum_j \lambda_{jt-1}\Delta\omega_{jt}}_{\text{Between reallocation}} \underbrace{+\sum_j \Delta\lambda_{jt}\Delta\omega_{jt}}_{\text{Residual}}. \tag{2}$$

Table 3 displays the results from the within-between industry decomposition. It shows that most of the labor share decline from 1967-2007 stems from within-industry adjustment. Defining an industry at the 3-digit NAICS level, 3.3 ppts of the 4.9 ppt decline is due to within-industry adjustment, while between-industry reallocation only account for 0.7 ppts. The residual interaction term can be interpreted as either adjustment of relatively expanding

industries or reallocation directed to industries that lower their labor share.

Table 3: Within- vs. between-industry factors in the labor share decline

Portions of labor share change	1967-2007	1967-1982	1982-2007
	(percentage point changes)		
Aggregate labor share change	−4.9	−0.9	−7.3
NAICS-3 industries			
Within-industry adjustment	−3.3	−0.0	−5.3
Between-industry reallocation	−0.7	−0.4	−1.0
Residual	−0.9	−0.6	−1.0
NAICS-4 industries			
Within-industry adjustment	−2.6	+0.8	−4.7
Between-industry reallocation	−0.7	−0.2	−1.0
Residual	−1.7	−1.5	−1.8

Regional factors As in the within-between industry decomposition of the labor share change, one could study regional factors. Such a regionally differential effect would be possible if firms sort into different regions according to their labor share. For example, states may provide tax incentives if firms open a new establishment in their state. If labor laws in these states are more lax, then workes may not be compensated as much as they are in other states. There is a vast array of reasons how some regions could have a different effect on the labor share than others. So we decompose the aggregate labor share decline into a within- and between region effect analogously to the within-between industry decomposition. Defining j in equation (2) as one of the nine Census divisions, Table 4 displays the results.

As with the industry decomposition, most action occurs inside the regions rather than reflecting between-regional reallocation shifts: Of the 7.3 ppt decline since 1982, 6.5 ppt occur within divisions, whereas between-division reallocation accounts for a meek 0.1 ppt of the whole decline.

Table 4: Within- vs. between-regional factors in the labor share decline

Portions of labor share change	1967-2007	1967-1982	1982-2007
	(percentage point changes)		
Aggregate labor share change	−4.9	−0.9	−7.3
Census divisions			
Within-region adjustment	−4.1	−0.1	−6.5
Between-region reallocation.	−0.3	−0.6	−0.1
Residual	−0.6	−0.2	−0.8

2.5 The micro-level anatomy of the aggregate labor share decline

2.5.1 The labor share *increases* in most establishments

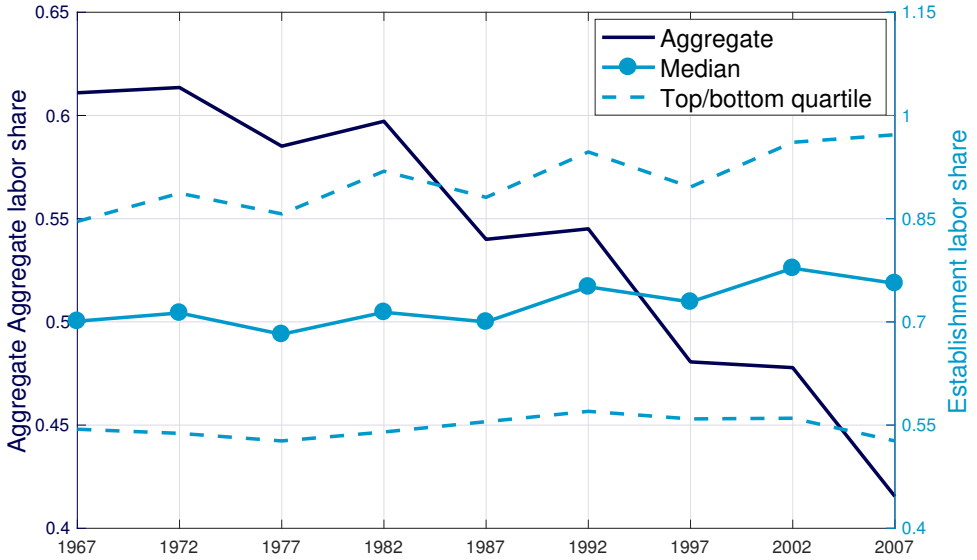
Next, we study the labor share dynamics for individual establishments in the U.S. manufacturing sector. To do so, we start by decomposing the aggregate labor share λ_t as:

$$\lambda_t = \frac{\sum_i w_{it} L_{it}}{\sum_i Y_{it}} = \sum_i \lambda_{it} \omega_{it} \tag{3}$$

where λ_{it} corresponds to the labor share of establishment i at time t and $\omega_{it} = Y_{it}/Y_t$ denotes the value added weight of establishment i. As a first step, we study the distribution of the micro-level labor shares λ_{it} and the role played by reallocation through the weights $\omega_{it} = Y_{it}/Y_t$. Figure 4 plots several quantiles of the raw distribution of establishment-level labor shares λ_{it} alongside the aggregate labor share in a given Census year. To do so, we construct the labor share for each establishment and study the cross-sectional distribution in every Census year since 1967.

Figure 4 immediately reveals that the distribution of the establishment-level labor shares does not mimic the evolution of the aggregate labor share. While the aggregate labor share declines by 4.9 ppt per decade, the median labor share *increases* by 1.4 ppt per decade. The top and bottom quartiles strongly co-move with the median and increase as well. This evidence highlights diverging trends in the the labor shares at the aggregate and establishment level, a pattern particularly prevalent since 1982. An implication of this finding is that the aggregate labor share decline is not the result of a simple shift of the distribution of labor shares in individual establishments. Instead, our evidence points to the importance of

Figure 4: Aggregate and establishment-level labor shares



reallocation as the main driver of the aggregate labor share dynamics. This is what we turn our attention to next.

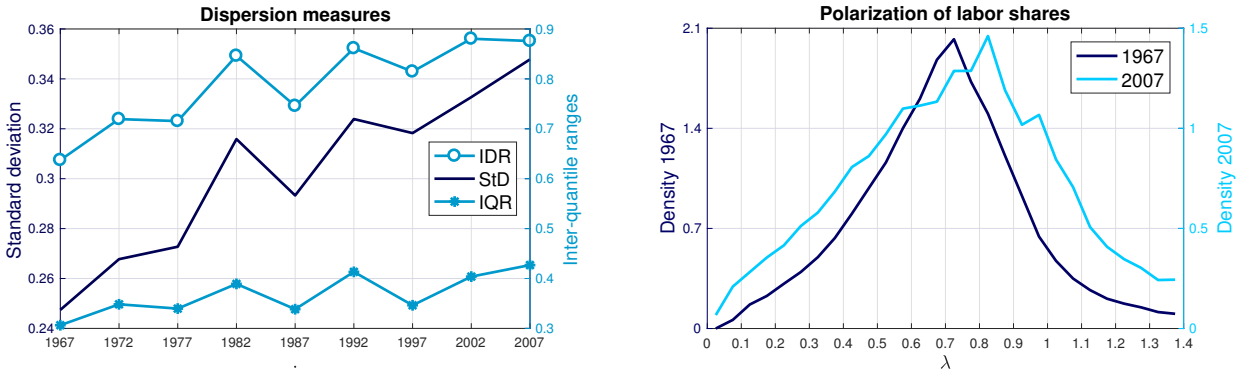
2.5.2 The polarization of labor shares

The evolution of the unweighted distribution of plant-level labor shares reveals a second pattern: the distribution of (raw) labor shares becomes more polarized over time. Figure 4 suggests a widening of the raw labor share distribution around the median labor share. We examine the dynamics of the labor share distribution more carefully in Figure 5 by first plotting various dispersion statistics in the left panel. All of them are increasing over time: both the inter-quartile and inter-decile range are 40% more spread out in 2007 than they are in 1967, and the cross-sectional standard deviation rises strongly over time. In line with the quantile evidence from Figure 4, we notice that most of this widening of the distribution occurs at the right tail of the distribution, i.e. high-labor-share establishments pull farther away from the median relative to low-labor-share establishments.

To show the polarization of labor shares more directly, the right panel of Figure 5 plots their distributions at the beginning and end of our sample. Compared to the 1967 distribution of labor shares, the 2007 distribution has less weight in the middle and more mass both in the higher and the lower tails. This polarization can be also shown using the fourth

normalized moment: excess kurtosis falls from +0.24 in 1967 down to −0.62 in 2007. That the distribution becomes more platykurtic over time is typical of a polarization pattern.Of note is that fact that low-labor share establishments do not appear to take over the market, as there is no /emphprima facie evidence of strong exit dynamics. In fact, by 2007 there is a relatively larger portion of establishments with very high labor shares.

Figure 5: The polarization of labor shares

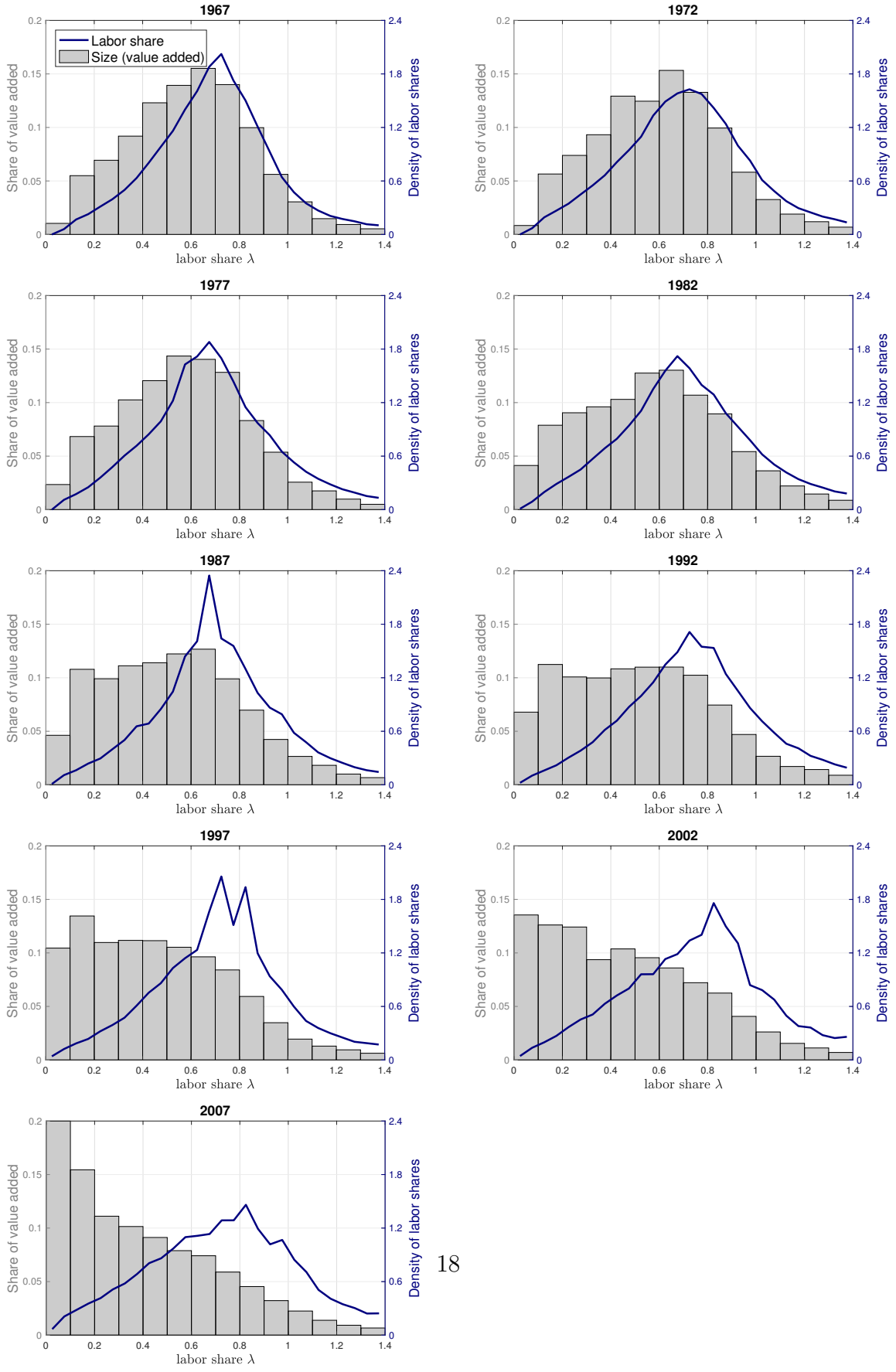


2.5.3 The importance of reallocation

So far, we have considered changes in the distribution of establishment-level labor shares, corresponding to the λ_{it} terms in the decomposition of the aggregate labor share of equation (3). The upward trend of the raw labor share distribution, the increasing polarization and the widening of the distribution at the upper tail are in stark contrast to the decline of the aggregate labor share. Therefore, the ω_{it} terms in equation (3) must be the major force driving down the aggregate labor share, through a reallocation of value added to the lower tail of the labor share distribution. The more value added concentrates on low-labor share establishments, the lower the aggregate labor share holding the marginal distribution of labor shares constant. In the previous subsection, we saw that the latter is the case. We now consider where in the spectrum of labor shares value added is created. In other words, we divide the distribution of labor shares λ into bins and consider the share of aggregate value added created in each bin and year. This will allow us to determine where in the labor share distribution most of the economic activity occurs, and how this pattern evolved over time..

Figure 6 displays both the distribution of labor shares λ_{it} and value-added weights ω_{it} for each available Census year. The panels paint a stark picture: most of value added in 1967

Figure 6: Labor share and the size distribution



is produced by establishments with a middle-of-the-road labor share between (50 and 80%); the value added weighted median is 62%. Over the following decades, however, the economic activity shifts gradually and persistently to the low-labor share spectrum. By 2007, half of aggregate value added if accounted for by establishments with a labor share less than 32%.

2.5.4 Reallocation along the extensive margin

There are several channels through which this concentration of economic activity across the labor share spectrum may occur: relatively high labor share establishments may exit; relatively low labor share establishments may enter; or there could be reallocation across continuing establishments. This section sheds light on the quantitative contributions of these three potential candidates.

First, we investigate whether the labor share of entrants and exiters is different than that of incumbents. To do so, whenever we observe a plant that enters, exits or changes owner, we compare its labor share to that of the other plants in the firm it just joined or left. The results are presented in Table 5, once we average these comparative statistics at the plant level. Generally speaking, we find that the differences in labor share between entering/exiting establishments and incumbent ones are sizable. Table 5 shows that exiting establishments are characterized by a labor share that is on average 5.6 ppt higher than that of their continuing peers. This difference is even stronger (13.2 ppt higher) when all establishments of the firm exit, while plants that are shut down by their continuing parent firm have a labor share that is 3.2 ppt higher. Establishments that are sold to a new owner, too, have a higher labor share of about 3.8 ppt. Maybe surprising is the fact that entering establishments have a labor share that is about 1 ppt higher than that of their incumbent peers. At first sight, this appears at odds with the notion that new entrants are high-productivity entrants. This seems at odds with the fact that the lower share of entering plants built by existing firms is considerably *lower* (about 4 ppt) than the average. Yet, there are potential reasons that may jointly explain these two facts. For one, it may reflect the fact that new establishments without an incumbent parent firm are too credit constrained to build capital, so they have to operate with an inefficiently low capital intensity. Alternatively, it could be the artefact of the important role played by learning.

Next, to assess the role played by each margin in the decline of the aggregate labor share,

Table 5: Labor shares by establishment type (percentage points)

Labor share of ...			
new establishments in		establishments acquired by	
new firms	exist. firms	new firms	exist. firms
... relative to incumbent establishment operated by same firm			
+7.3	−4.0	+5.2	+0.8

Labor share of ...			
exiting establishments in		establishments sold by	
exiting firms	continuing firms	exiting firms	continuing firms
... relative to continuing establishment operated by same firm			
+13.2	+3.2	+3.9	+3.7

we perform the following decomposition:

$$\begin{aligned}\Delta\lambda_t &= \sum_{i\in en}\lambda_{it}\omega_{it} + \sum_{i\in inc}\lambda_{it}\omega_{it} - \sum_{i\in ex}\lambda_{it-1}\omega_{it-1} - \sum_{i\in inc}\lambda_{it-1}\omega_{it-1} \\ &= \underbrace{\alpha_t^{en}(\lambda_t^{en} - \lambda_t^{inc})}_{\text{Contribution Entry}} \underbrace{-\alpha_{t-1}^{ex}(\lambda_{t-1}^{ex} - \lambda_{t-1}^{inc})}_{\text{Contribution Exit}} \underbrace{+\lambda_t^{inc} - \lambda_{t-1}^{inc}}_{\text{Change of incumbents}}\end{aligned}$$

where λ_t^{en} denotes the aggregate labor share of the set of establishments that enter in period t, λ_t^{inc} that of establishments that continued from the previous period and λ_{t-1}^{ex} that of establishments which existed last period and then exited. α_t^{en} and α_{t-1}^{ex} are the weights of the entering and exiting populations which correspond to their respective shares of aggregate value added.

We display the contributions of each component of this exact decomposition in Table 6, over the entire sample as well as separately before and after then onset of the aggregate labor share decline in the early 1980s. Our results show that the impact of entrants on the labor share is rather small on average. Surprisingly, it actually contributes *positively* to the aggregate labor share in the second half of our sample. Even though new establishments built by incumbent firms lower the aggregate labor share in principle, this effect weakens in the second part of our sample. Both pieces of evidence clearly rule out entry as a leading candidate for the labor share decline.

Exit, in contrast, does impact the aggregate labor share negatively and more so since the 1980s. Exiting establishments are characterized by a labor share which is about 5 ppt

Table 6: Contributions to the labor share decline: extensive vs. intensive margins

Portions of labor share change	1967-2007	1967-1982	1982-2007
	(percentage point changes)		
Aggregate labor share change	−4.9	−0.9	−7.3
Establishment entry	+0.3	−0.9	+1.1
... into new firms	+1.2	+0.3	+1.7
... into incumbent firms	−0.9	−1.3	−0.7
Establishment exit	−2.3	−1.4	−2.8
... from exiting firms	−1.6	−0.8	−2.1
... from continuing firms.	−0.7	−0.5	−0.7
Intensive margin	−3.0	+1.4	−5.5

higher than that of their continuing peers. They also account for enough of aggregate value added to matter quantitatively for the fall in the aggregate labor share: In the first part of the sample, exit contributes about 1.4 ppt a falling labor share; this jumps to 2.8 ppt of the aggregate labor share decline since 1982. Had this increased selection not occurred, the aggregate labor share decline would have only been 5.6 ppt instead of the observed 7.3 ppt. Interestingly, the increased impact of exit comes almost exclusively from firms shutting down entirely, while the closure of less productive plants by continuing firms contributes little to the overall decline.

The lion's share of the aggregate labor share dynamics, however, is accounted for by the intensive margin. This margin can be active if there are changes in the labor share in the population of incumbents, or through the reallocation of value added to relatively low labor share establishments away from their less productive peers. We find that this term is moderately positive with an upward contribution of 1.4 ppt per decade until 1982; this reflects the general right-ward shift of the labor share distribution documented above (more details on that below). But since the early 1980s, the intensive margin term becomes very negative (annual contribution of 5.5 ppt contribution per decade since 1982). In a nutshell, without this intensive margin, the decline in the aggregate labor share would be been only 2.2 instead of 7.3 ppt.

2.5.5 Reallocation along the intensive margin

The importance of the intensive margin warrants more investigation. As we mentioned earlier, it could be negative due to the reallocation of value added from relatively high- to relatively low-labor-share establishments, or because establishments have adjusted their labor share (or both). We modify a conventional shift-share decomposition[3] as follows:

$$\begin{aligned}\lambda_t^{inc} &= \int \lambda\omega_t(\lambda)dF(\lambda_t) \\ &= \int_{\lambda^{\min}}^{\lambda^1} \lambda\omega_t(\lambda)dF(\lambda_t) + ... + \int_{\lambda^{q-1}}^{\lambda^q} \lambda\omega_t(\lambda)dF(\lambda_t)... + \int_{\lambda^{99}}^{\lambda^{\max}} \lambda\omega_t(\lambda)dF(\lambda_t).\end{aligned}$$

Then, the aggregate labor share change can be written as:

$$\begin{aligned}\Delta\lambda_{inc}^t &= \int \lambda\omega_t(\lambda)dF(\lambda_t) - \int \lambda\omega_{t-1}(\lambda)dF(\lambda_{t-1}) \\ &\approx \underbrace{\sum_q \Delta\tilde{\lambda}_t^q \omega_{t-1}(\lambda_{t-1}^q)}_{\text{Adjustment (Shift)}} + \underbrace{\sum_q \tilde{\lambda}_{t-1}^q \Delta\omega_t(\lambda_t^q)}_{\text{Reallocation (Share)}} + \underbrace{\sum_q \Delta\tilde{\lambda}_t^q \Delta\omega_t(\lambda_t^q)}_{\text{Interaction term}}\end{aligned}$$

where $q = 1, 2, ..., 100$ denotes a percentile in the raw labor share distribution. "Adjustment" refers to shifts of the whole labor share distribution where each percentile change is weighted by the share of aggregate value added, $\omega_t(\lambda)$. $\tilde{\lambda}_t^q$ refers to the average labor share in percentile q and $\omega_t(\lambda^q) = \sum_{i:\lambda_{it}\in\left[\lambda_t^{q-1},\lambda_t^q\right)} \omega_{it}$. "Reallocation" refers to reallocation of market share across the labor share distribution (rather than plants). As always, the interaction term is harder to interpret; fortunately, it is almost zero in our application.

Figure 7 displays graphically the contribution of each term of the intensive margin, while

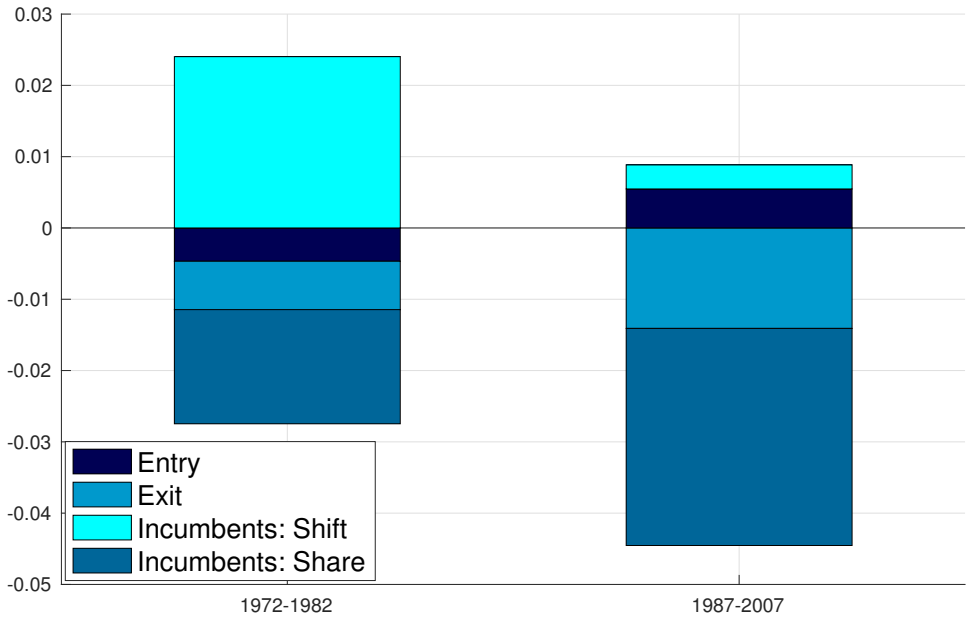
[3] A traditional approach is the shift-share decomposition along plants (in the spirit of e.g. Baily et al. (1992)):

$$\Delta\lambda_t^{inc} = \underbrace{\sum_i \omega_{it-1}\Delta\lambda_{it}}_{\text{Shift: } +15.0\%} + \underbrace{\sum_i \Delta\omega_{it}\lambda_{it-1}}_{\text{Share: } +8.8\%} + \underbrace{\sum_i \Delta\omega_{it}\Delta\lambda_{it}}_{\text{Interaction: } -26.8\%}.$$

While intuitive, the difficulty arises from interpreting the interaction term should it be quantitatively relevant. It may be interpreted as "directed reallocation," i.e. reallocation to establishments that *lower* their labor share (as opposed to undirected reallocation (Share) which captures reallocation to establishments that have a relatively low labor share). Alternatively, the interaction term might be interpreted as a differential adjustment of establishments that are growing in size relative to their peers. In our application, the first two terms are strongly positive (!) and the last "interaction term" turns out to be enormously negative and dominating everything mechanically. That the interaction term has an opposite sign than the other two and dominates quantitatively makes this decomposition useless.

Table 7 provides the detailed numbers. Two results stand out.

Figure 7: Contribution to the labor share decline



Reallocation to low labor-share incumbents The first main finding is that there is significant reallocation from high percentiles to low percentiles of the labor share distribution of incumbent establishments. We already knew from the decomposition in Section 2.5.3 that in the overall distribution, reallocation plays the key role rather than adjustment. Yet this need not be true for incumbents alone since the adjustment margin could be cancelled out through an opposite adjustment in the entry/exit margin. Our decomposition now allows us to make a stronger statement than the one following Figure 6. We find that reallocation always puts downward pressure of the labor share, but especially so after 1982: its contribution to the overall labor share decline almost doubles in magnitude, from -3.2 ppt up to 1982 to -6.1 ppt afterwards.

Reallocation to incumbents which decrease their labor share Our second main result is that the adjustment margin is strongly positive before the 1980s and then drops to almost zero in the second part of the sample. This means that those portions of the raw labor share distribution that shifts downward (the left tail) accounts for an increasing share of economic activity. It is important to interpret this adjustment term jointly with the evidence

Table 7: Contributions to the labor share decline: components of the intensive margin

Portions of labor share change	1967-2007	1967-1982	1982-2007
	(percentage point changes)		
Aggregate labor share	−4.9	−0.9	−7.3
Establishment entry	+0.3	−0.9	+1.1
Establishment exit	−2.3	−1.4	−2.8
Intensive margin	−3.0	+1.4	−5.5
Adjustment (Shift)	+2.2	+4.8	+0.7
Reallocation (Share)	−5.0	−3.2	−6.1
Interaction term	−0.2	−0.2	−0.1

of the raw labor share distribution. We documented above that the overall distribution is gradually shifting to the right over time, especially at the upper end of the distribution; the left tail of the distribution, on the other end, shifts slightly left. At the beginning of the sample, economic activity is evenly distributed across the upward-moving right tail and the downward-moving left tail of the distribution. This means that the adjustment term is positive as the entire distribution shifts right by an average 4.8 ppts per decade. Since the 1980s, however, more and more economic activity moves towards the low end of the labor share distribution, so that changes in this portion of the distribution no longer merely offset the upward movements in the right tail, but instead dominate them. The upshot is that for the purpose of its contribution to the decline in the aggregate labor share, the adjustment term makes it *look like* the distribution of plant-level labor shares shifted gradually and symmetrically to the left, while in fact it is the product of the interaction of both polarization and reallocation: While both the left tail declines and the right tail rises – thus leading to the polarization of labor shares –, any adjustment in the left tail is much more relevant because these establishments have grown more relative to those at the top tail of the labor share distribution. The small, but economically relevant shift at the left tail cancels the pervasive and large, but economically less relevant, rightward shift at the high end of the distribution: the adjustment term drop from 4.8 ppts down to 0.7 ppts per decade.

To summarize, we find that the change in the evolution of the aggregate labor share since the early 1980s can be decomposed in three main components: 1/6th of the downward

pressure was driven by more intense exit of relatively high-labor-share establishments; 1/3 by reallocation and 1/2 by the disproportionate growth of low-labor-share establishments. The contribution from the entry of relatively high labor share plants is *positive* but small.

In the next section, we turn to the analysis of these incumbent establishments that contributed most to the decline in the aggregate manufacturing labor share.

3 The importance of "hyper-productive plants"

3.1 Growing output versus cutting the wage bill?

In the previous section, we found that most of the fall in the manufacturing labor share was due to a reallocation of value added towards low labor share plants, as well as the downward adjustment of their own labor share over time. We now analyze more specifically this set of establishments, that we dub *hyperproductive (HP) plants*.

We define HP plants as those being the biggest contributors to a low aggregate labor share in 2007. Recall that we can write the aggregate labor share in 2007 as follows

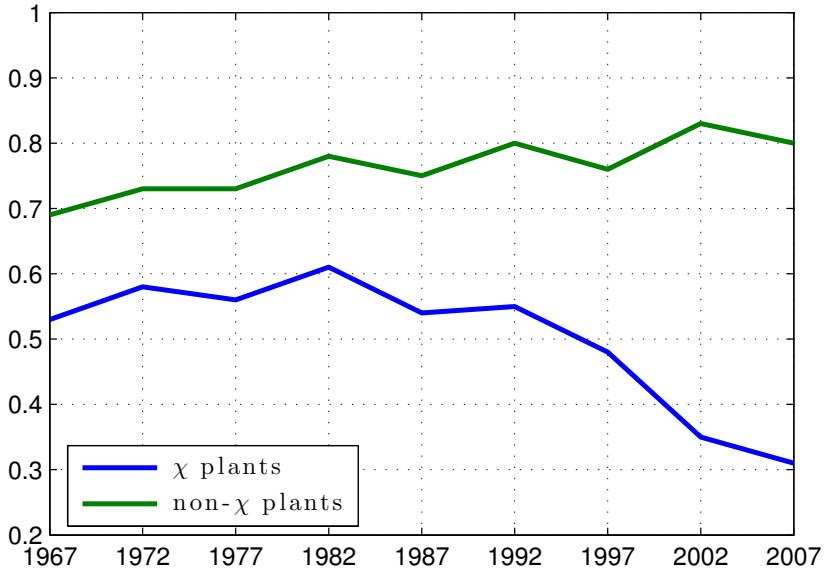
$$\lambda_{2007} = \sum_i \omega_{i,2007}\lambda_{i,2007}.$$

Then, we consider a plant part of the HP universe if it belongs to the quintile with the most negative $\omega_{i,2007}(\lambda_{i,2007} - \lambda_{2007})$. That is, an establishment can be an HP plant if its labor share is far below the aggregate or of it is slightly below the aggregate and large. Focusing on a strongly balanced panel to avoid selection issues, we track these HP plants over time. We compute their labor share development and study their characteristics early on that will predispose them to develop into a future HP plant.

First, we plot the unweighted average labor share of HP and non-HP plants in every Census year in Figure 8. The divergence starting from 1982 is startling: while those plants identified as HP in 2007 always tended to have a lower labor share on average, they experienced an upward trend in their labor share in the early part of the sample very similar to that of non-HP establishments. The two series clearly diverge afterwards, however. Non-HP plants see their labor share continue on the same upward trend. HP plants, on the other hand, see their labor share decline dramatically: from about 60% in 1982 to 30% in 2007.

How did HP plants manage this feat? Compared to non-HP plants, there are three

Figure 8: Average λ of HP and non-HP plants



Note: The year-by-year average labor share of the HP plants (χ) versus their ordinary peers (non-χ).

potential channels for HP plants to lower their labor share: disproportionately increasing value added; lowering their wage bill, either through lower employment or wages; or yet a combination of all these factors. To answer this question, we do a simple exercise. For each plant in our balance panel, we compute the log of each component of the labor share: value added, wages and employment. We then run a general panel regression of the kind:

$$\log z_{it} = \beta_0 + \beta_1 t + \beta_2 \chi_i + \beta_3 \chi_i \times t + \beta_4 X_{it} \tag{4}$$

where z corresponds to either the average wage (w), employment (l) or value added (y); t is a time trend; χ is a dummy variable equal to one in the case of a HP plant and 0 otherwise; and X is a set of industry and age controls. We focus on the coefficient estimate β_3 to describe how different the trajectory of each component has been between HP and non-HP plants over the 1982-2007 time period.

Table 8 reports the results as well as interpretations of the coefficients in terms of differential growth rates. The evidence is clear and striking: almost all the divergence in the labor share trends between the two types of plants is due to value added. According to the coefficient estimates, the typical HP plant was able to grow its value added by a staggering

250% more than the typical non-HP establishment, or about 3.7% per year. This, amazingly, has come with very little divergence in the growth of the wage bill across the two types of plants, either through wages or employment. That means, HP plants do not arrive at their low labor share by cutting employment and then growing. Neither do they cut wages. In fact, the β_2 in regression (4) for wages is slightly positive meaning HP plants pay a wage premium and do not lower this premium over time.

Table 8: Drivers of labor share decline of HP plants

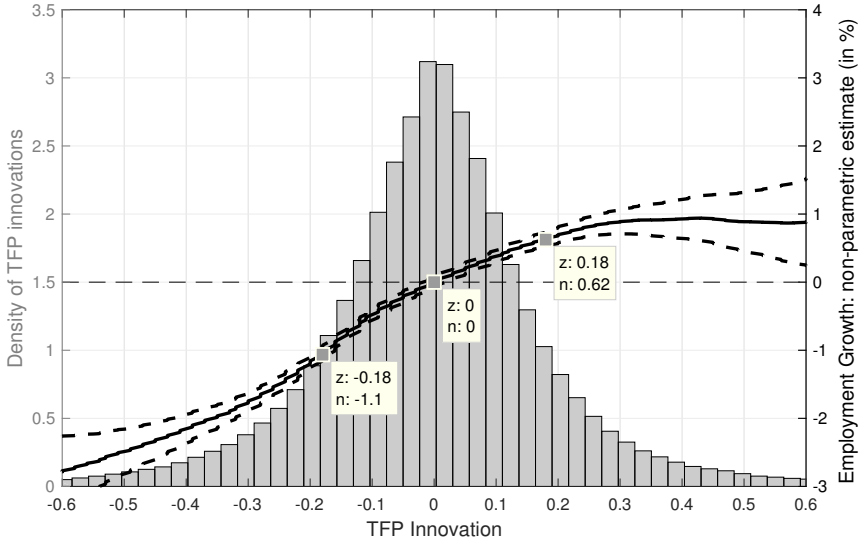
Dependent variable	$\hat{\beta}_3$	Growth above non-HP plants	
		Annually	*1982-2007*
$\log w$	0.0057***	0.1%	2.9%
	(0.0006)		
$\log l$	0.0075***	0.15%	4.0%
	(0.002)		
$\log y$	0.185***	3.7%	250%
	(0.0014)		

3.2 The weakening relationship between TFP shocks and hiring

In the previous subsection, we demonstrated how hyper productive plants arrive at a low labor share: they grow value added while they do not look very different to their peers in terms of employment or wage per worker. In a standard firm dynamics model with a standard production function, more productive firms should be larger. That is, firms should respond to positive TFP innovations by hiring more employees. We now study to what extent this is the case and if the relationship between TFP innovations and hiring changed over time.

Our starting point is the key empirical finding of Ilut et al. (forthcoming) which document a concave relationship between TFP innovations and employment growth at the establishment level. They find that on average a firm contracts employment by 1.1% after a negative technolgoy shock while after a similarly sized positive technology shock it expands by only 0.6%. Figure 9 displays that asymmetric relationship estimated from the Annual Survey of Manufactures, a comprehensive dataset of manufacturing establishments collected annually since 1972. Ilut et al. (forthcoming) ahve shown that this concave relationship between TFP

Figure 9: The TFP innovation-hiring asymmetry

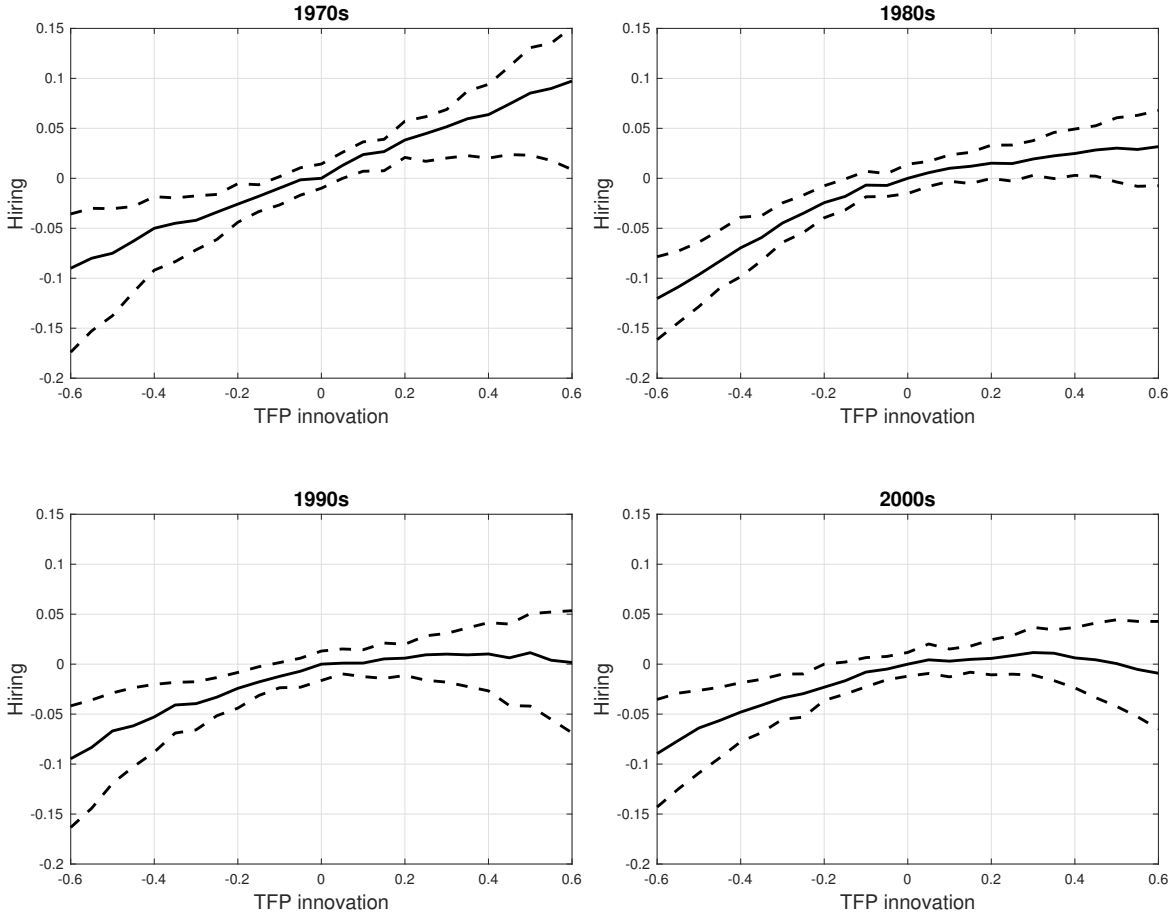


Note: Reproduced from Figure 8 in Ilut et al. (forthcoming).

innovations and hiring can explain several facts about cross-sectional and time-series distributions of employment growth in a meaningful quantitative way. In this paper, we expand on their analysis to study if that TFP shock-hiring asymmetry has changed over time. Arguably, if it became more asymmetric, it might contribute to the labor share decline. We hence non-parametrically regress establishment employment growth on TFP innovations obtained analogously to Ilut et al. (forthcoming) after controlling for including industry, age and size effects.

Recent research – Decker et al. (2017a,b) among others – have emphasized that business dynamism in the U.S. economy has declined since the mid-1980s. In the context of our technology-hiring relationship this fact might be interesting as the asymmetric hiring rule identified in Ilut et al. (forthcoming) might have become more concave over time. To address that possibility, we re-estimate hiring as a function of technology shocks per decade. Figure 10 displays the results of this non-parametric estimation which we carry out separately for each decade since the 1970s. It shows how hiring is an almost linear function in TFP innovations in the 1970s – the time when the labor share is still constant. Starting in the 1980s, however, this relationship becomes concave: plants with a positive innovation to their TFP do not expand as much in heir employment as they used to. While a typical positive TFP shock in the 1970s led to an employment expansion of about 3%, this number plummets

Figure 10: The increasingly asymmetric productivity-hiring relationship



to 1.5% in the 1980s. In the subsequent decades, plant hiring after positive shocks decline even further to the point that it is almost zero.

Are there analogous changes at the other end of the productivity distribution? That is, do plants with a typical negative TFP shock become more aggressive in firing? While the evidence points to a larger degree of concavity over time, the magnitudes at the lower end of the productivity distribution are similar.

We conclude from this analysis that plants with positive profitability shocks – among them most notably the "hyperproductive plants – do not translate this into hiring any more. On the other hand, we do not find evidence for increased firing activity at the unproductive tail of the distribution.

4 The role of capital

Several researchers advance the notion that capital deepening of some sort leads to a lower labor share. Karabarbounis and Neiman (2014b) attribute investment-specific technical change as the main driver for the labor share decline while Gaggl and Eden (2016) emphasize the specific nature of information and communications equipment. Acemoglu and Restrepo (2017) also emphasize the increasing automation and displacing of jobs through robots as an important driver in recent growth.

4.1 Does investment lead to a lower labor share?

We find no evidence that investment spikes lower the labor share:

- put regression table here
- neither total and equipment investment lead to meaningful labor share declines, but they do increase market share

4.2 Did low-labor share plants invest disproportionately?

We find no evidence that plants that contribute to a low aggregate labor share – plants whose labor share is below average and that are large – did invest significantly more in the past than their peers:

- put regression table here

- low-labor-share plants are not characterized by either larger capital stocks or larger past investment projects

5 Conclusion

A large literature has recently documented and studied the decline in the labor share, both at the national and sectoral levels. In this paper, we dissect the underlying dynamics behind this phenomenon by using plant-level data for the U.S. manufacturing sector between 1967 and 2007. We first document a startling fact: while the aggregate labor share declined by almost 5 ppts per decade starting in the early 1980s, the labor share of the median plant *rose* over the same time period.

This apparent disconnect is due to two main factors: a drastic reallocation of production from high labor share plants towards their low labor share peers, as well as an additional downward adjustment of the labor share of these latter establishements, which we label *hyperproductive plants*. We show that these plants were able to decrease their labor share by increasing their value added drastically, without raising wages or employment significantly more than other plants. In ongoing work, we investigate further the characteristics of these hyperproductive plants in order to better understand the channels that are behind the decline in the aggregate labor share.

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