Industrial Concentration and the Declining Labor Share*

Lijun Zhu†

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Abstract

The labor share of national income in the United States has declined since the 1980s and especially after 2000. My model focuses on the role played by technological change in this process and is motivated by three facts I document. (i) Across sectors, there is a negative correlation between change in concentration and change in the labor share; (ii) large firms usually exhibit a smaller labor share; (iii) in sectors where the labor share declines the decline is especially strong among large firms. Specifically, gains in labor productivity are not associated with comparable increases in wages. I provide a rationale for these facts by assuming that capital and labor are complementary inputs and technological progress is labor saving. Under these assumptions, my model predicts a negative correlation between firm size and labor share. Further, the adoption of new technologies diminishes the labor shares in large firms and increases their market share. As a consequence, the aggregate labor share declines. This technological channel is consistent with the evolution of labor productivity across sectors during the last 30 years.

JEL classification: E23, E25, L11, O33
Keywords: Labor share, firm size, concentration, capital-labor complementarity, technological change

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†Department of Economics, Washington University in St. Louis, One Brookings Drive, St. Louis, MO 63130 (*Email*: lijun.zhu@wustl.edu).

1 Introduction

The relative constancy of labor share (LS), one of the 'Kaldor's facts', is typically viewed as a stylized fact of economic growth. It justifies the widely use of an aggregate Cobb-Douglas production function in Macroeconomics. However, the recent literature documents the break of this constancy: the share of national income that goes to labor has declined in the last 30-35 years in the United States and other developed countries (Karabarbounis and Neiman (2014b); Elsby et al. (2013); Piketty and Zucman (2014)).

My paper studies the role played by technological change in this process, and is motivated by three empirical facts I document using Census of Manufactures data. First, across Manufacturing sectors there is a negative correlation between change in concentration, measured as the value added share of large firms in a sector, and change in labor share. This negative correlation is robust at various digit levels, for different periods and different cutoffs of large firms. Second, in average, the relative labor share for large firms in a sector, defined as the ratio of labor share in these firms to that in the sector, is smaller than other firms. In 2002, the labor share for 50 largest Manufacturing firms[1] is 67% of that for the Manufacturing sector. In the same year, the relative labor share for 50th to 100th, 101st to 150th, 151st to 200th largest firms, and 201st and smaller firms in Manufacturing are 73%, 82%, 97%, and 121%, respectively. Large firms typically offer a higher wage than small ones. However, wage differentials only partially compensate the even larger gap in labor productivity between large and small firms, leading to a smaller labor share in the former.

Third, the relative labor share for large Manufacturing firms has declined since around 1980, coincident with the time when the labor share in Manufacturing starts to decline. The relative labor share for 50 largest firms in Manufacturing is 98% in 1967, 97% in 1977, 92% in 1987, and declines steadily to 72% and 59% in 1997 and 2012, respectively. This indicates that comparing to other firms the decline of labor share in large Manufacturing firms is especially strong. From 1967 to 1977, the relative labor productivity of Top-50 firms increases from 128% to 143%, and their relative wage increases at an approximately equal rate, from 127% to 139%[2]. However, there has been an increasing divergence between the two series since late 1970s. From 1977 to 2012, the relative labor productivity of Top-50 firms increases from 143% to 242%; on the other hand, their relative wage is almost stable, remaining at 144% in 2012. Increasing concentration, i.e. rising market share of large firms that have a lower labor share, and decline of labor shares within large firms both contribute to the decline of aggregate labor share in Manufacturing.

Out of Manufacturing, the negative correlation between (change in) concentration and (changes in) labor share also holds. Declines of labor share, out of Manufacturing, concentrate in Wholesale and Retail Trade[3], and Transportation and Warehousing. These are also sectors where concentration has increased the most. From 1997[4] to 2012, the revenue share of 50 largest firms rises from 20.3% to 27.6% in Wholesale Trade , from 25.7% to 36.9% in Retail Trade, and from 30.7% to 42.1%

[1]The census data provides concentration ratio for 4, 8, 20, and 50 largest firms. In the baseline, I use 4 largest firms for 6 digit NAICS sectors, and 50 largest firms for 2 digit sectors. As shown in text, the empirical pattern is robust to different choices.

[2]Relative labor productivity (wage) of large firms is defined as the ratio of labor productivity in these firms to labor productivity (wage) of that sector.

[3]Without causing confusion, Trade (or Distribution) is used to denote Wholesale Trade and Retail Trade in text.

[4]The NAICS system replaces the old SIC in 1997. For Non-Manufacturing sectors, the data used starts from 1997.

in Transportation. In most Services sectors, the labor share does not decrease, and concentration increases at a slower pace.

Large firms in Non-Manufacturing sectors also have a lower labor share. However, their relative labor share shows different time pattern across sectors. In particular, it declines in Trade and Transportation, but does not show a clear trend in most Services (and Finance) sectors. For Trade and Transportation, as for Manufacturing, the relative labor share of large firms declines over time due to a combination of rising relative labor productivity of these firms and rather stagnant relative wage. From 1997 to 2012, the relative labor productivity of Top-50 firms in Wholesale Trade increases by 95.9%, and their relative wage has only increased by 16.2%. In Transportation, the increase in relative labor productivity of Top-50 firms is 32.8%, significantly larger than the increase in relative wage, 1.6%. In Retail Trade, the increase in relative labor productivity of large firms is also 4.2% larger than the relative wage.

I provide a rationale for these empirical facts based on two assumptions. First, for a given technology, embodied in machines, capital and labor are complementary inputs. In a Constant Elasticity of Substitution (CES) production function, this is equivalent to an elasticity of substitution smaller than 1. Second, technological progress is labor saving in the following sense: new technology embodied in new machines allows less labor input per unit of output. I start from a static model where there are N vintages of capital. Under these two assumptions, my model predicts a negative correlation between firm size[5] and labor share. In particular, more advanced technologies increase output and decrease the labor share. The intuition is the following: technology complements capital and increases its productivity, which further increases demand for effective labor. Therefore firms using more advanced technologies produce more output; On the other hand, technology substitutes raw labor and reduces its share of income.

The static model is then extended to general equilibrium by incorporating heterogeneous firms and capital accumulation. Each Firm is endowed with a level of productivity. Firms optimally choose to adopt one technology from all feasible ones. The fixed cost of using a technology is assumed to be an increasing function of the vintage of technology. Shy away from the large fixed cost of advanced technologies, firms with low productivity find it optimal to employ less advanced and cheaper ones. On the other hand, firms with high productivity benefit more from advanced technologies and optimally adopt them. Due to the negative effect of technology on labor share, more productive firms exhibit a lower labor share.

Given a fixed number of vintages of technology, capital labor complementarity and fixed labor supply, the economy arrives at a steady state. When a new and more advanced vintage of technology (exogenously) becomes available, the most productive firms find it profitable to switch to this new technology. This increases the market share of these firms, given the positive effect of technology on firm size established in the static case. That is, concentration rises. Furthermore, the more advanced technology reduces the labor share in these productive and large firms. As a consequence, the aggregate labor share declines. I then calibrate a version of the model where the economy initially has two vintages of technology and is hit by a third and more advanced technology, to illustrate this effect o technological progress on concentration and labor share[6].

[5]Each technology is interpreted as a firm in the static case, which will be relaxed in general equilibrium.

[6]I choose two vintages of technology to start with since this is the minimum number needed to demonstrate the idea, resembles the binary division of large and small firms, and requires the smallest number of parameters to calibrate.

With a CES production function where capital and labor are complementary inputs, (labor saving) technological change that drives down the labor share also increases labor productivity. We should observe a faster increase in labor productivity in sectors (periods) where the labor share declines. From 1987 to 1997, the labor share in Manufacturing declines 10.3% and labor productivity increases 34.7%. Since late 1990s, both declines in labor share and increases in labor productivity speed up. From 1997 to 2007, the labor share declines 20.2% and labor productivity increases 59.0%. From 1987 to 2016, the economy wide labor productivity has increased 72.7%. For the same period, increases of labor productivity in Manufacturing, Wholesale Trade and Retail Trade are 146.4%, 123.5%, and 128.8%, respectively. This piece of evidence also supports the technological channel, instead of monopoly power, to explain the negative concentration-LS correlation. Labor productivity is measured as the ratio of real value added, net of price change, to hours of labor input. Increasing monopoly power drives up prices, but does not increase labor productivity.

Two recent papers, Barkai (2016) and Autor et al. (2017), also independently document a negative correlation between change in concentration and change in labor share. Barkai (2016) proposes that increasing monopoly power decreases both labor share and capital share, and increases profit share. Autor et al. (2017) conjectures that the concentration-LS correlation is driven by the rise of superstar firms, which have a lower labor share since the fixed overhead labor cost is distributed over a larger output base. My paper differs from both in that I argue it is technological advancement that drives down labor share in large firms and drives up concentration, consequentially leading to declines of the aggregate labor share.

Koh et al. (2016) claims that the decline in the U.S. labor share is accounted for by the growing share of Intellectual Property Products (IPP) in total capital stock, and two thirds of the decline is purely driven by the higher depreciation rate of IPP capital. Karabarbounis and Neiman (2014a) finds that capital depreciation explains about 45% of the 4.7% decrease in gross labor share in U.S. corporate sector, and that both net and gross labor share has declined 'meaningfully' worldwide since 1975. I have adjusted labor share by netting out depreciation of capital (but not the net return to IPP capital as in Koh et al. (2016)), both traditional and IPP, and found robust of the documented empirical patterns in my paper.

This paper relates most closely to the Macroeconomic literature on labor share which dates back to at least the early-to-middle 20th century (e.g. Kaldor (1957); Solow (1958)), and the recent studies of its decline in the United States as well as other developed countries. Karabarbounis and Neiman (2014b) attributes the decline of labor share to decrease in the relative price of investment goods, and Piketty and Zucman (2014) to capital accumulation. In a CES production function, these channels lead to a lower LS if capital and labor are aggregate substitutes, i.e. the elasticity of substitution between capital and labor is larger than 1. Different from these approaches, the production function used in my paper features an elasticity of substitution between capital and labor between 0 and 1, which is consistent with the majority of empirical estimations[7]. In addition, at

[7]For example, Brown and DeCani (1963) estimates the elasticity of substitution from 1890 to 1958 ranges from 0.08 to 0.44. David and van de Klundert (1965) estimates an elasticity of 0.32, and the estimate in Wilkinson (1968) is 0.5. Most recent estimates also obtain values between 0 and 1. The estimated elasticity of substitution between capital and (skilled) labor is 0.67 in Krusell et al. (2000). In Antras (2004), the estimated elasticity of substitution between capital and labor ranges from 0.6 and 0.9. Klump et al. (2007) estimates the elasticity to be 0.51. Herrendorf et al. (2015) estimates the elasticity of substitution in Manufacturing to be 0.80, and 0.84 for the whole economy. In particular, Oberfield and Raval (2014) use plant level data and estimate the elasticity in plant level to be 0.51, and 0.71 in the Manufacturing

the aggregate level the return to capital, measured using National Income and Product Accounts (NIPA) tables and taking into account changes in relative prices of investment goods, does not decline in the last 3-4 decades. See Gomme et al. (2011) and the discussion in Section 4.2.

Elsby et al. (2013) decomposes declines of aggregate labor share into sectors, and identifies offshoring of labor intensive tasks as a potential driver. I view my paper complementary, as offshoring, same as other technological change such as automation, makes possible less (domestic) labor input per unit of output and is viewed as a labor saving technology. The increase of offshoring heavily concentrates in Manufacturing[8]. Declines of labor share in Trade and Transportation are also substantial, while offshoring in these sectors has not changed significantly in the last 15-20 years. The technological channel proposed in my paper has the potential to explain the decline of labor share in a wider context.

Several papers use firm level data to understand the decline of aggregate labor share. Loecker and Jan (2017) documents a rise of average markups across public firms since 1980, and suggests increasing markups can account for the decrease of labor share. Kehrig and Vincent (2017) also documents a reallocation of market share to hyper-productive Manufacturing plants, which arrive at a low labor share by gradually increasing value added while keeping employment and compensation unchanged. They display that a concave response of hiring to TFP shocks, and that this response becoming more concave over time, can explain that pattern. My proposed explanation, while consistent with firm level evidence, also agrees with sector heterogeneity in terms of concentration, labor share and labor productivity.

The rest of paper is organized as following: The empirical facts are documented in section II. Section III develops a model that rationalizes the facts and presents a quantitative exercise to illustrate the mechanism. Section IV discusses several related issues, including the return to capital, the evolution of labor productivity across sectors and capital/labor intensity at the firm level. A concluding remark is offered in Section V.

2 Empirical Facts

Several empirical facts are presented in this section. First, I document a negative correlation between change in concentration, measured as value added share of large firms[9], and change in labor share, across Manufacturing sectors. The baseline definition of large firms is 4 largest firms in a 6 digit NAICS sector, or 50 largest firms at the 2 digit level[10]. If large firms have a lower labor share, increases in concentration, i.e. increasing market share of large firms, lead to a lower sector labor share. I introduce the concept of *relative labor share*, defined as the ratio of the labor share in a subset of firms to sector labor share, and find that the relative labor share for large Manufacturing firms is smaller than other firms. In addition, the relative labor share of large firms is stable from 1960s to late 1970s, and declines thereafter. The relative LS for 50 largest Manufacturing firms is 98% in 1967, 97% in 1977, and declines steadily to 59% in 2012.

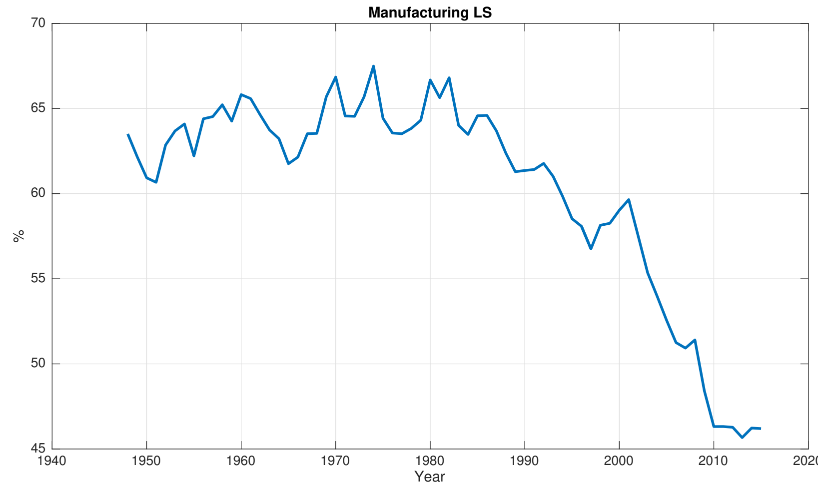
sector.

[8]See Figure 6.2 in Appendix.

[9]Value added is used whenever data is available; when data on value added shares is not available, I use the share of revenue as the measure of concentration. Figure 6.6 in appendix provides a comparison of two measures in Manufacturing and shows that the difference is negligible.

[10]The choice of 4 and 50 partly depends on data availability. The pattern is robust for other measures.

Figure 2.1: LS in Manufacturing, 1947-2015



Note: LS is measured as the fraction of compensation in value added

The empirical pattern in Manufacturing also holds in other sectors. Out of Manufacturing, declines of labor share concentrate in Retail Trade, Wholesale Trade, and Transportation. In these sectors, concentration rises significantly, and the relative labor share of large firms also declines. On the other hand, in most Finance and Services sectors, the labor share does not decline, and the relative labor share of large firms does not show a clear time trend.

2.1 Manufacturing

Figure 2.1 plots the labor share in Manufacturing from 1947 to 2015[11]. The Manufacturing LS is relatively stable from 1940s to early 1980s, and declines steadily thereafter. The magnitude of decline from 1980 to 2015 is as large as 20%. From 1997 to 2007, the baseline period that my dis-aggregated data spreads over, the labor share declines by about 6% in Manufacturing.

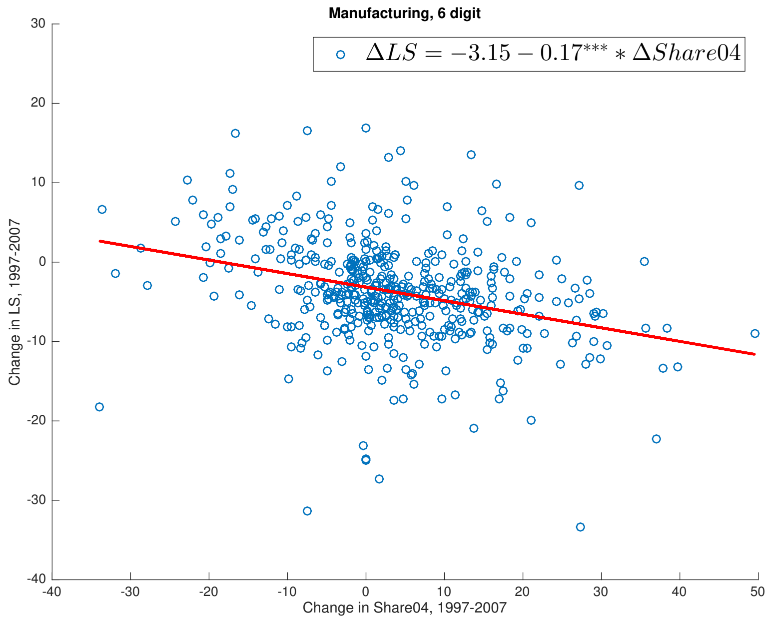
The dis-aggregated data is from Annual Survey of Manufactures (ASM), an annual survey of Manufacturing establishments with one or more paid employees. A summarized and simplified version of ASM data is provided in the NBER-CES dataset. Included in the data are payroll and value added for Manufacturing sectors at various NAICS digit levels. The labor share is the fraction of payroll in value added. Concentration is measured as the share of value added accounted for by 4 largest firms in a sector (*Share04*). The concentration data is available every 5 years from Economic Census, with 2012 the most recent year.

Figure 2.2 plots change in labor share against change in concentration (*share04*), across 6 digit Manufacturing sectors, both from 1997 to 2007[12]. It shows a negative and significant correlation

[11] Labor share in Figure 2.1 is calculated as 'Compensation of Employees' over 'MFG Value added'. The general trend, stable then declining, is robust to adjustment of proprietor's income and depreciation. the non-adjusted series is chosen as the benchmark measure in order to be consistent with the measure in MFG sub-sectors, for which data on proprietor's income and depreciation is not available.

[12] NAICS has been employed starting from 1997. 2007 is chosen as the ending year since there is a major revision in 6 digit code between NAICS code in 2007 and 2012. A very similar result is obtained if concentration is measured in terms of revenue rather than value added.

Figure 2.2: ΔLS v.s. $\Delta Share04$, MFG. 1997-2007



Note: LS in the vertical axis is the fraction of payroll in value added; Concentration in the horizontal axis is the value added share of 4 largest firms. Each circle is a 6 digit Manufacturing NAICS sector.

between change in concentration and change in labor share. When a sector becomes more concentrated, the labor share in this sector tends to decline. From 1997 to 2007, the MFG labor share, based on ASM data, has decreased by 5.61%, a majority of which, 73%[13], is from within-sector decrease. For the same period, concentration has increased in 65% of 465 6-digit Manufacturing sectors.

The result of a single variable regression, with change in the labor share and change in *Share04* as the dependent and independent variable, respectively, is[14]

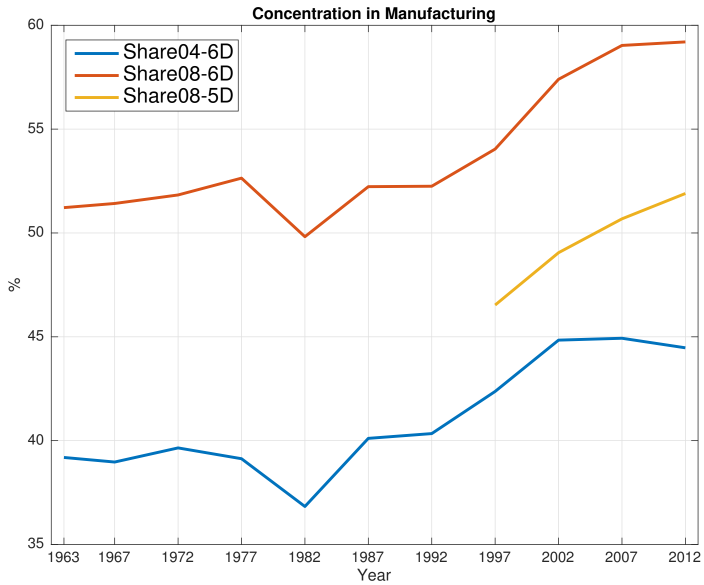
$$\Delta LS = -3.15 - \underbrace{0.17^{***}}_{(0.02)} * \Delta Share04 + \epsilon, \qquad R^2 = 0.1025,\ obs. = 464$$

As shown in appendix Table 6.1, 6.2, and Figure 6.3, The negative correlation between concentration and labor share holds across Manufacturing sectors at other digit levels (3, 4 and 5), and across different periods. The results are also robust if concentration is measured by value added share of 8, 20 and 50, instead of 4, largest firms within a sector. In addition, the qualitative result is not affected by the omission of fringe benefits in measuring labor share. Since 2005, the publicly available tables of Annual Survey of Manufacturing provide information on payroll as well as benefits. Compensation is the sum of payroll and total fringe benefit, which contains employer's cost for health insurance, defined benefit pension plans, other defined contribution plans, and other fringe benefits. Table 6.3 in appendix shows a similar negative and significant correlation

[13] This number is based on a standard within-between decomposition.

[14] Blank magnetic and optical recording media manufacturing (NAICS code 334613), has a labor share larger than 100% in 2007, and is excluded

Figure 2.3: Concentration in Manufacturing, 1963-2012



Note: The blue (red) line the average revenue share of 4 (8) largest firms across 6 digit MFG sectors, with revenue as weights. The yellow line is the the average revenue share of 8 largest firms across 5 digit MFG sectors, with revenue as weights.

between changes in concentration and changes in the revised labor share[15].

Concentration in Manufacturing has been increasing. For industrial classifications, Census of Manufactures uses SIC before 1992 and switched to NAICS after 1997. There are revisions even within each system. However, total numbers of 4 digit SIC sectors, are comparable to that of 6 digit NAICS sectors. The total number of 4-D SIC sectors is 444 in 1977; In 2007, there are 467 6 digit NAICS Manufacturing sectors[16]. Manufacturing concentration, is measured as the average *Share04*, as well as *Share08*, across 4 digit SIC sectors before 1992, and 6 digit NAICS sectors after 1997, weighted by revenue[17]. The results from 1963 to 2012[18] are presented in Figure 2.3.

Concentration in Manufacturing has been relatively stable from 1960s to early 1980s, and has been steadily increasing in the last 30 years. Before 2000, the increasing concentration is mainly from 4 largest firms in each sector, as the increase of the average share of 8 largest firms is similar as 4 largest firms. After 2000, the average *share04* is relatively stable, but average *share08* keeps increasing, which suggests that the expansion of large firms, but not the very largest, drive up the concentration in the past decade. From 2007 to 2012, total number of 6 digit NAICS sectors

[15]In 2012, there is a major revision in Manufacturing NAICS code at the 6 digit level, with total numbers of 6 digit sectors reduce from 467 in 2007 to 362 in 2012. Data at the 5 digit level, which are largely consistent between the two years, is employed. There are 184 5 digit Manufacturing sectors in 2007 and 180 in 2012, and 175 in common.

[16]See Table 6.6 in Appendix for details.

[17]The concentration measure is in terms of revenue (in stead of value added) since that is the measure available for 1992 and earlier years in dis-aggregated Manufacturing sectors. The pattern is robust to various measures. See Table 6.6 in Appendix.

[18]I didn't find original full reports of Census of Manufactures for 1947, 1954 and 1958, and thus exclude these 3 years.Based the summary report in 1958, the concentration is stable in most sectors from 1947 to 1958.

Table 2.1: Share of industry statistics (%), Manufacturing. 2002

Firm groups	Emp.	Payroll	Vadd.	Rel. LP	Rel. Wage	Rel. LS
50 largest	12.1	16.9	25.3	209	140	67
50th to 100th largest	5.3	6.1	8.4	158	115	73
101st to 150th largest	3.9	4.1	5.0	128	105	82
151st to 200th largest	3.1	3.6	3.7	119	116	97
201st and smaller	75.5	69.3	57.5	76	92	121

Note: Firms/companies are ranked by value added, and a firm/company is defined as a business organization consisting of one establishment or more under common ownership or control.
Data Source: *'Concentration Ratios: 2002 Economic Census, Manufacturing, Subject Series'*, in *Census of Manufactures*, 2002.

decrease from 467 to 364. I further provide *Share08* at the 5 digit sector, which are consistently defined over time.
The increase in concentration means transfer of market share from small to large firms. If the labor share is lower in large firms, an increase in concentration mechanically decreases sector labor share. Comparison of labor shares among different firms is feasible by using the concentration data from Economic Census. To that goal, define THE relative labor share (RLS) for a subset of firms, e.g. 50 largest firms, Top-50, with firm size measured as value added or revenue, as the ratio of labor share for these firms to the sector labor share. A relative labor share for Top-50 firms that is lower than 100% means that the labor share in Top-50 firms is lower than the sector average.

The relative labor share for Top-50 firms is calculated as

$$\text{RLS-Top50} \equiv \frac{\text{LS-Top50}}{\text{LS-Sector}} \times 100\% = \frac{\text{Payroll-Top50 / Payroll-Sector}}{\text{Vadd-Top50 / Vadd-Sector}} \times 100\%$$

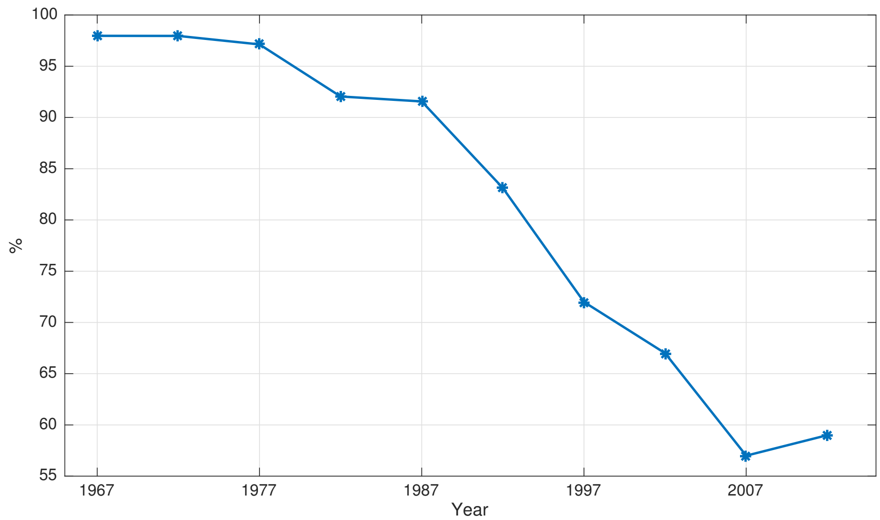
That is, the relative labor share for Top-50 firms equals the ratio of payroll share for these 50 firms in the sector to their value added share. In a similar way, the relative labor productivity and relative wage can be defined accordingly. Labor productivity (LP) is measured as value added per worker[19]. The relative labor productivity (wage) for Top-50 firms is measured as the ratio of labor productivity (wage) for Top-50 firms to that of sector. Note that, defined this way, the relative LS of Top-50 firms equals the ratio of their relative wage to their relative LP.

Table 2.1 presents relevant statistics for Manufacturing in 2002. The values for share of employees, payroll and value added are from original tables, while relative LP, Wage, and LS are calculated based on definitions above.

Both labor productivity and wage are higher in large firms. However, the labor share in large firms is lower. The relative labor share for 50 largest Manufacturing firms is 67% of the whole sector. Though wage in small firms is lower, it accounts for a larger share of per-capita value added in these firms, as reflected in their 121% of relative labor share. The pattern that large firms have smaller labor shares also holds for other years. See Table 6.7 in Appendix for the results in 1997,

[19]The actual labor productivity is output, instead of value added which is equal to output times price, per working hours. The relative labor productivity defined in text reflects the differences in actual labor productivity across firms if differences in prices and average working hours across firms are small

Figure 2.4: Relative LS of 50 largest MFG firms



Note: Relative LS in this graph measures the ratio of LS in 50 largest Manufacturing firms to LS in the Manufacturing sector.

2007 and 2012.

The trend of relative labor share for 50 largest Manufacturing firms[20] from 1967 to 2012 is presented in Figure 2.4. It remains relatively constant from 1960s to 1980s, and shows a clearly downward trend thereafter. The relative labor share for 50 largest Manufacturing firms is 98% in 1967, 97% in 1977, and declines steadily to 59% in 2012.

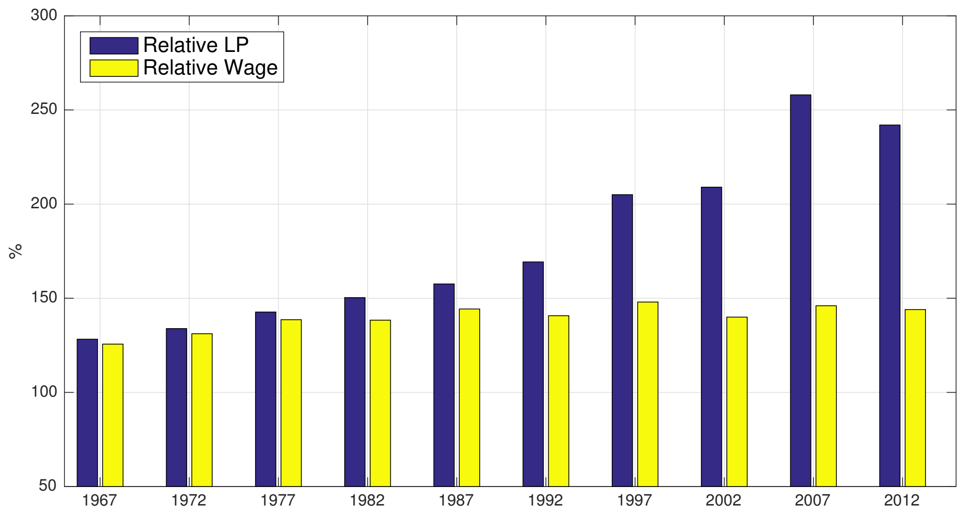
Recall that the relative LS equals the ratio of Relative Wage to Relative LP. Figure 2.5 shows trends of relative labor productivity and relative wage for 50 largest Manufacturing firms. From 1967 to 1977, the relative labor productivity of Top-50 firms increases from 128% to 143%, and their relative wage increase at an approximately equal rate, from 127% to 139%. From 1977 to 2012, the relative labor productivity of Top-50 firms increases from 143% to 242%. However, their relative wage is almost stable, remaining at 144% in 2012. The clear divergence between relative labor productivity and wage after 1980s suggests that marginal workers in large and small firms are easily substitutable with each other. From the Census of Manufactures public data, the relative labor share for 100 and 200 largest firms can also be calculated. As shown in Table 6.8 in appendix, similar patterns are observed[21].

In 1990s and 2000s, the relative labor share of large firms is significantly smaller than other firms. An increase in concentration thus leads to a decline in sector labor share. In 1960s and early 1970s

[20]Firms are ranked by value added.

[21]Manufacturing is a sector with many heterogeneous sub-sectors. 50 is a small subset of total firms. From 1997 to 2012, the value added share of Top-50 firms increases from 24.5% to 26.1%. This relative small increase is because the increase of Non-top50 but large firms has also expanded. For example, the share of 200 largest Manufacturing firms has increased by 2.9% for the same period; the average share of 50 largest firms across 3 digit Manufacturing sectors increases 5.7%. On the other hand, the relative labor share of Top-50 firms is still very informative, as seen from the very similar pattern of the relative labor share for 100 and 200 largest firms. Data for Top-50 firms is available for Non-Manufacturing sectors, and is used as the baseline mainly for consistency across sectors.

Figure 2.5: Relative LP and Wage of 50 largest MFG firms



Note: Relative LP (Wage) is the ratio of labor productivity (wage) in 50 largest Manufacturing firms to labor productivity (wage) in the Manufacturing sector.

Table 2.2: Relative LS, Manufacturing 1977

SIC	Index	1-4	5-20	21-50	≥51
4 digit	average	91.0%	99.4	108.8	119.5
4 digit	weighted average	91.6	97.2	108.6	119.8

Note: 1-4 denotes 4 largest firms, (weight=value added).

where the difference in labor shares between large and small firms are moderate. An increase in concentration is expected to cause a relatively smaller decline in labor share. Table 6.2 in appendix shows the single variable regression results with changes in the labor share and changes in concentration as dependent and independent variables from 1963 to 1966, and from 1972 to 1977. The coefficients in front of concentration are significantly smaller than those found in 1980's, 1990's and 2000's.

The pattern that large firms have lower labor shares also hold in more dis-aggregated Manufacturing sub-sectors. I find public data that allows to calculate relative labor share in more dis-aggregated Manufacturing sectors from the Census of Manufactures report in 1977, but not for more recent years. The original data contains payroll and value added for 4, 8, 20, and 50 largest firms in each 4 digit SIC sector. Firms are classified into 4 groups: '1-4', the 4 largest firms in terms of value added; '5-20', the 5th to 20th largest firms; '21-50', 21st to 50th, and '≥51', 51th and smaller firms. Table 2.2 summarizes the result. It shows the same pattern that the relative labor share of large firms are smaller than other firms.

It is possible to investigate the change of relative labor share within more dis-aggregated Manufacturing sectors using Compustat data. Among Compustat firms, about 85% of firms report sales,

Table 2.3: Size-LS correlation in Manufacturing

	70-74	75-79	80-84	85-89	90-94	95-99	00-04	05-09	10-14
Size	0.41^{***}	0.48^{***}	0.22^{**}	-0.22^{**}	0.01	-0.88^{***}	-1.61^{***}	-1.31^{***}	-1.93^{***}
	(0.12)	(0.10)	(0.12)	(0.12)	(0.12)	(0.15)	(0.15)	(0.15)	(0.13)
Sector D.	Yes	–	–	–	–	–	–	–	–
Year D.	Yes	–	–	–	–	–	–	–	–
R^2	0.46	0.40	0.37	0.24	0.23	0.22	0.27	0.26	0.32
Obs.	1674	1847	1428	1222	1166	1145	1035	957	1528

Note: $***: p < 1\%$, $**: p < 5\%$; $*: p < 10\%$. Size is measured as assets (in log). LS is the share of compensation in revenue. Results are qualitatively similar if using employments.
Data Source: Compustat, Manufacturing firms ($SIC \in [2000, 3999]$).

and only 22% report total staff expenses. The latter includes wages, salaries, pension costs, profit sharing and incentive compensation, payroll taxes and other employee benefits, and is close to Compensation of Employees in NIPA. Since value added data for firms is not directly available, firm level labor share is approximated by the fraction of compensation in sales. Sector Dummies are for each 2 digit SIC sector (e.g. Textile mill products; Electronic and other Electronic Equipment). From 2010-2014, one sector has in average 18 firms in a single year.

The following regression is run among Manufacturing firms ($SIC \in [2000, 3999]$) for each 5-year period.

$$LS_i = \beta_0 + \beta_1 * Size_i + Sector\ Dummies + Year\ Dummies + \epsilon_i$$

Size is measured by assets (in log). Table 2.3 presents the coefficients β_1 for different periods. The correlation coefficient also shows a downward trend[22], consistent with what's observed in the aggregate. This suggests that the trend in Figure 2.4 reflects actual changes between large and small firms within sectors, rather than simply a shift of large firms towards less labor intensive sectors[23].

2.2 Non-Manufacturing sectors

This section moves from Manufacturing to Non-Manufacturing sectors. It is shown that the negative correlation between changes in concentration and changes in labor share also holds. Furthermore, in Non-Manufacturing sectors where the labor share declines, as in Manufacturing, concentration increases, and the relative labor share of large firms declines.

Following Elsby et al. (2013), change in aggregate labor share can be decomposed into a within-sector and a between-sector component.

$$LS = \Sigma_i \omega_i LS_i \quad \Rightarrow \quad \Delta LS \approx \underbrace{\Sigma_i LS_i \Delta\omega_i}_{\text{Between}} + \underbrace{\Sigma_i \omega_i \Delta LS_i}_{\text{Within}}$$

[22]The coefficient is positive in 1970 and early 1980s. This is in line with the fact that relative labor share for 50 largest firms is higher than that of 100 and 200 before 1980s. This might be because of stronger union power in the largest Manufacturing firms in 1970s and early 1980.

[23]Among the 50 largest Manufacturing firms in 1980, 18 are related to 'Petroleum & Coal Products', 2 'Computer & other Electronic products', and 0 Pharmaceuticals. These numbers in 2012 are 9, 8, and 5.

Table 2.4: 'Within' component of declines in LS, 1987-2013

Sector	Aggr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔLS	-3.62%	2.25	-18.02	-7.36	-6.07	-10.0	-3.79	0.22
$\omega\Delta LS$		0.06	-3.43	-0.56	-0.51	-0.38	-0.23	0.02
	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
ΔLS	-0.99	8.88	2.36	1.72	5.25	3.97	-0.45	10.21
$\omega\Delta LS$	-0.16	0.70	0.08	0.02	0.42	0.05	-0.02	0.33

Note: LS is the share of compensation in value added. (1)-Utilities; (2)-Manufacturing; (3)-Wholesale Trade; (4)-Retail Trade; (5)-Transportation and Warehousing; (6)-Information; (7)-Finance and Insurance; (8)-Real Estate, rental and leasing; (9)-Professional, Scientific and Technical Services; (10)-Administrative and Waste Management Services; (11)-Educational Services; (12)-Health Care and Social Assistance; (13)-Arts, Entertainment, and Recreation; (14)-Accommodation and Food Services; (15)-Other Services. Data Source: NIPA Value-added-by-Industry.

where i denotes a sector, and ω_i represents the share of sector $i's$ value added in the economy. Average values of LS and ω are used to calculate the 'between' and 'within' components. The baseline measure of sector labor share is the fraction of compensation in value added. As shown in Table 6.13 in Appendix, the majority of the decline in labor share is the 'within-sector' component. Structural change plays a definitely secondary role.[24]. Table 2.4 summarizes the 'within' component. Sectors where labor share has declined significantly are Manufacturing, Whole and Retail Trade, and Transportation. The labor share in most Finance and Services sectors has not decreased.

This result is robust to adjustment of labor share for depreciation and proprietor's income. Table 6.14 in Appendix shows the decomposition results when value added is adjusted for capital depreciation. Capital depreciation contains depreciation of both traditional capital (equipment and structures) and the newly capitalized Intellectual Property and Products (IPP). Neither does proprietor's income change the baseline pattern in any substantial way, since the share of proprietors' income in value added, as shown in Table 6.15 in Appendix, is relatively stable over time in most sectors[25].

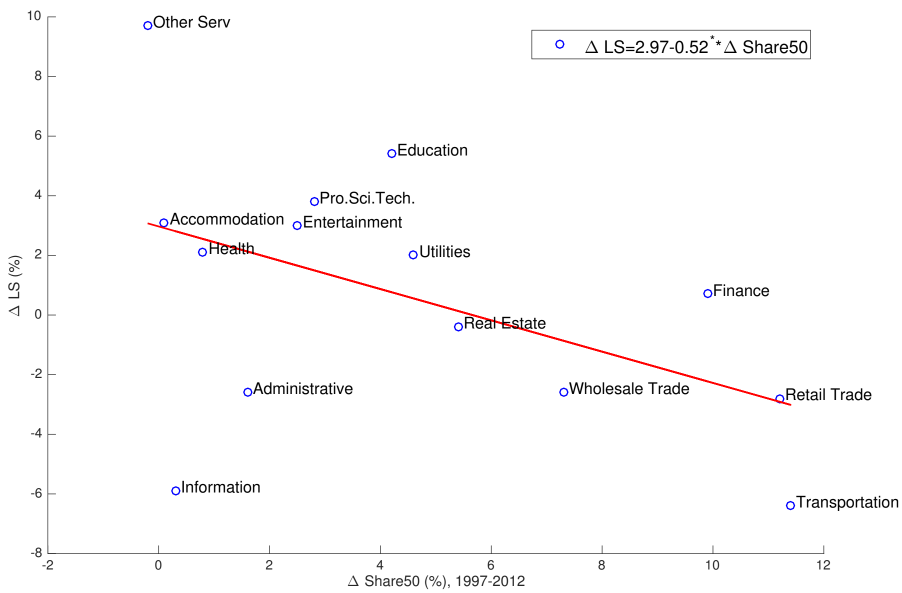
Figure 2.6 presents the relation between change in labor share and change in concentration across 2 digit Non-Manufacturing sectors[26]. The labor share is measured as the share of Compensation

[24]The statistics excludes agriculture and government. It further excludes 'Mining', 'Construction' and 'Management of Companies and Enterprises' since there is no concentration data for these three sectors. Together, sectors included account for 77% of GDP and 89% of private sector GDP in 2012. From 1987 to 2013, the labor share in Mining has decreased by about 20%. The decrease concentrates in 2 years, 2000 and 2003; the labor share in construction declines moderately and mainly during two recessions. Given the relative small value added, changes in labor share in these excluded sectors have limited effects on overall labor share. The results in Table 6.13 largely agree with that in Elsby et al. (2013). The slight difference might be due to: 1. We focus on non-farm private sector and exclude three sub-sectors that have no concentration data, and that paper on the corporate sector; 2. we use data that reflects IPP (i.e. Intellectual Property and Products) revisions and Elsby et al. (2013) use pre-revision data.

[25]One widely used way to adjust labor share for proprietors' income is to assume a constant labor share for proprietors and the corporate sector. Labor share under this assumption is defined as $\frac{\text{Compensation}}{\text{Value added} - \text{Proprietors' Income}}$. The decreasing shares of proprietors' income in value added in 'Professional, Scientific and Technical Services' and 'Health Care' are partly responsible for their increase of labor share in Table 6.13

[26]Out of Manufacturing, labor share can not be measured systematically at dis-aggregated sectors since value added

Figure 2.6: ΔLS v.s. ΔCR, NON-MFG, 1997-2012



Note: LS in the vertical axis is the fraction of compensation of employees to value added. Concentration in the horizontal axis is the revenue share of 50 largest firms.

of employees in Value added; Concentration is measured as the share of revenue by 50 largest firms in a sector[27].

From 1997 to 2012, a similar negative pattern between changes in labor share against changes in concentration emerges. The correlation is significant at 10% significance level. Out of Manufacturing, the decline of LS concentrates in Transportation, and Retail and Wholesale Trade. These are also sectors where concentration increases the largest. The decline of LS in *Information* and *Administrative and Waste Management* likely captures the temporary increase of labor share around 2000,, partly due to realization of stock options during the internet bubble, instead of long run trend[28]. In most Finance and Service sectors, labor share has actually increased slightly from 1997 to 2012. At the same time, increases in concentration for most Finance and Services sectors are moderate.

For Non-Manufacturing sectors, the relative labor share is approximated by the ratio of payroll share of large firms to their revenue share (instead of value added shares as in Manufacturing),

data is not available. For Services sectors and in 1997, concentration measures are available only for establishments subject to federal income tax. The same measure for these sectors is used in 2012. See Figure 6.4 in Appendix for the relation between changes in labor share and changes in concentration, measured as revenue share of 4 largest firms. Labor share in some sectors fluctuates instead of showing a monotonic trend. Table 6.9 in Appendix lists LS for all 15 sectors. Based on observing the trend, I tried to make minimum adjustments. In particular, LS for 'Information' in 1996, instead of 1997, and the average LS for 'Education services', between 1996 and 1998, instead of 1997, are employed. The revised pattern are presented in Figure 6.5.

[27]For Non-Manufacturing sectors, The census provides concentration in terms of revenue, instead of value added. Concentration ratios for 4, 8, 20 and 50 largest firms are available for each sector. Overall, average concentration ratios for 4 largest firms at 6 digit level is comparable to that for 50 largest firms at 2 digit level.

[28]See Table 6.9 and Figure 6.7 in Appendix for labor share in 2 digit sectors from 1987 to 2015.

Table 2.5: Relative LS, LP and Wage of TOP-50 firms

	Wholesale Trade			Retail Trade			Transportation		
	R. LS	R. LP	R. Wage	R. LS	R. LP	R. Wage	R. LS	R. LP	R. Wage
1997	39.9%	323.7	129.1	96.4	85.3	82.3	103.7	108.7	112.7
2002	36.4	332.1	120.9	95.2	92.9	88.5	86.6	126.1	109.2
2007	30.8	383.3	117.8	95.4	97.4	93.0	81.9	141.3	115.7
2012	26.9	419.6	112.9	92.9	101.0	93.8	80.1	142.5	114.1
Δ 97-12	-13.0%	95.9	-16.2	-3.5	15.7	11.5	-23.6	32.8	1.6

Note: Relative LS (LP, Wage) in this table measures the ratio of LS (LP, Wage) in 50 largest firms to that in the sector.

with firms also ranked by revenue[29]. Table 6.11 in Appendix presents the relative labor share in Non-Manufacturing sectors at various NAICS digit levels[30]. Same as in Manufacturing, the relative labor share for large firms is smaller than other firms. For 6 digit sectors, the average labor share in 4 largest firms of a sector is 18% lower than the sector, while a typical firm in the smallest firm size group has a labor share that is 20% higher than sector average.

In Wholesale Trade, Retail Trade, and Transportation, sectors where labor shares decline largely, the relative labor share of large firms has also decreased. Table 6.16 in Appendix presents relative labor share for 50 largest firms and there market share (*Share50*) from 1997 to 2012. In that period, the relative labor share of 50 largest firms decreases from 39.9% to 26.9% in Wholesale Trade, from 96.4% to 92.9% in Retail Trade, and from 103.7% to 80.1% in Transportation.

As noted before, the relative labor share can be decomposed into relative labor productivity and wage. Table 2.5 presents the relative labor productivity and wage, for Trade and Transportation sectors. From 1997 to 2012, the relative labor productivity of large firms in Wholesale Trade increases by 95.9%, but their relative wage has decreased by 16.2%. In Transportation, the increase in relative labor productivity, 32.8%, is also significantly larger than the increase in relative wage, 1.6%. In Retail Trade, the gap is not as large as Wholesale Trade and Transportation, but the increase in relative labor productivity is also 4.2% higher than relative wage[31].

On the other hand, in most Finance and Services sectors, the relative labor share of large firms does not show a clear trend in the last 15-20 years[32]. The results above hold if 20, instead of 50 largest firms in each sector is used, as shown in Table 6.17 in appendix, and also largely hold in a

[29]This approximation implicitly assumes that within a sector, the rank of firms based on value added is the same as that based on sales, especially at the top. It also assumes that the share of value added by large firms is similar as their share of revenue. While the first assumption seems reasonable, the second can be directly verified from Manufacturing data, for which both share of value added and revenue for large firms are available. Figure 6.6 in Appendix show that differences between these two measures are small.

[30]There are several sectors, especially at 6 digit level, that have a relative labor share above 200% for "51st largest and smaller" firms. Small firms in these sectors typically have both a very small payroll share and value added share. These outliers are excluded.

[31]The reason that the relative labor productivity and relative wage for large firms are smaller than 100% in Retail Trade might be that, 50 largest retail firms is a mix of traditional and new online retailers. For example, in 2012, Walmart is still the largest retailers in terms of revenue in the United States. Amazon is ranked 15th in that year. The relative labor productivity for 4 largest firms is 96.1%, and for 5-8 and 9-20 firms are 106.6% and 108.4%, respectively.

[32]See Table 6.16 for details.

Table 2.6: Economy-wide LS, Concentration, and RLS-Top50 firms

Year	1987	1992	1997	2002	2007	2012
LS	51.83%	51.48	50.49	51.21	50.30	49.00
CR-Top50	26.00%	26.57	26.69	29.52	30.51	31.31
RLS-Top50	82.20%	81.23	79.37	78.20	74.86	76.37

Note: The labor share is measured as the fraction of compensation in value added. Agriculture, Government, and Mining, Construction and Management of Companies and Enterprises are excluded.

more dis-aggregated level[33].

2.3 The aggregate pattern

To summarize the facts, in Manufacturing, Trade and Transportation, both the sector labor share and relative labor share of large firms have been declining; In most Services sectors, the labor share does not decline, neither does the relative labor share of large firms show a clear trend; Concentration increases across all sectors, more in Manufacturing, distribution and Transportation, and less in Services. While sector heterogeneity helps identify underlying driving forces, this paper aims to understand the decline of labor share in the aggregate[34].

Table 2.6 presents concentration and the relative Labor share, both for 50 largest firms[35], averaged across 2-digit sectors, with weight equal to the average value added share of a sector from 1987 to 2012[36].

Note that change in LS can be decomposed as

$$LS = \Sigma_{i=l,s} LS_i \omega_i \;\Rightarrow\; \Delta LS \approx \underbrace{\Delta CR * (LS_l - LS_s)}_{CR} + \underbrace{\omega_l * \Delta LS_l}_{\text{Fall in large}} + \underbrace{\omega_s * \Delta LS_s}_{\text{Fall in small}}$$

[33]See Table 6.18 in Appendix. It should be noted that results at 2 digit sectors is less sensitive to the problem of classification of multi-establishment firms, changes in industrial code and re-classification of firms over time. For example, the increase in concentration in retail trade sector is partly caused by rising online retailers such as Amazon, which typically sell goods in various categories. The 3 digit NAICS code for Amazon is 454, 'Nonstore Retailers', while a typical book store is in NAICS 451, 'Sporting Goods, Hobby, Book, and Music Stores'. At the 2 digit level, they both belong to NAICS 44-45, 'Retail Trade'

[34]Concentration can increase for non-technological reasons. For example, relaxation of merger & acquisitions laws might contribute to the rising concentration in some sectors. My paper does not address the moderate increase of concentration in Services sectors.

[35]Again, the labor share is not adjusted for proprietor's income to be consistent with that in more dis-aggregated sectors. The choice of 50 is largely driven by data availability. In general, 50 would be a too small number for sectors like Manufacturing where 50 largest firms account for 26% of value added in 2012, and a relatively large number for sectors like Utility where the value added share of 50 largest firms is 69% in the same year. Any choice of a simple cutoff would face the same trade-off. The relative LS of Top50 firms in 'Administrative and Support and Waste Management and Remediation' suspiciously increases from 109% in 2007 to 125% in 2012. The value for 'RLS-Top50' in 2012 is 75.86 if the 2007 value is used for this sector.

[36]The code of industrial classification changed from SIC to NAICS in 1997. In 1987 and 1992, both concentration and relative LS are available for Manufacturing, Retail Trade, and Wholesale Trade. For 2 digit sectors in Transportation, Finance, and Services, I first see whether CR and RLS show any linear trends from 1997 to 2012. If there is a linear trend that is significant at the 10% significance level, I then use these trend to obtain values in 1987 and 1992. If there is no significant trend, I use their average values from 1997 to 2012 as an approximation for 1987 and 1992.

Table 2.7: Decomposition of declines in LS, 1987-2012

Δ LS	*CR*	*Fall in large*	*Fall in small*
-2.83%	-0.80%	-1.48%	-0.57%
% contributed	28%	52%	20%

Note: See text for details.

l and *s* denote large and small firms respectively. The decline in aggregate LS comes from three sources: decline of labor share in large firms, decline of labor share in small firms, and increasing concentration. From 1987 to 2012, the economy wide labor share declines -2.83%. For the same period, the economy wide concentration rises by 5.31%, while the average difference of labor share between large (Top50) and small firms is 15.12%. The first term, *CR*, contributes to 0.80% declines of the labor share. The second and third components can be similarly calculated. Table 2.7 presents the decomposition results.

The fall of labor share is mainly from the fall of labor share in large firms, which accounts for 52% of the aggregate decline, and the increasing concentration, which accounts for another 28%. The contribution of *Fall in small firms* is 20%. Two comments follow: First, the labor share in small firms is 55.07% in 1987 and 54.28% in 2012. Its contribution is smaller if the cutoff of large firms is relaxed from 50 to include more firms. Second, the labor share in small firms is 55.85% in 2007. If this is used, instead of the 2012 value, the term *Fall in small* actually increases the aggregate labor share. This paper therefore focus on the first two components.

Large firms in the 2010s might not be the same as those in 1980s. From *Compustat* firm level data, a large fraction of declines occurs within the same firms in Manufacturing and Transportation[37]. In Wholesale and Retail Trade, the decline seems to mainly come from creation of new firms (e.g. online retailers) that have lower labor shares and grow large over time. In either case, large firms in the 2010s have lower labor shares, and larger market shares, comparing to their counterparts in the 1980s. Both lead to the decline of aggregate labor share.

3 Model

This section develops a model that rationalizes the empirical facts. As noted earlier, my model builds on two assumptions: First, for a given technology, embodied in machines, capital and labor are complementary inputs; Second, technological progress is labor saving. I first illustrate the effect of technologies on firm size and labor share in a static model. In particular, more advanced technologies generate a larger firm size and lower labor share. Then I add capital accumulation and heterogeneous firms and extend the static model into general equilibrium. It is shown there that the introduction of new technologies increases concentration, and decreases labor shares of large firms. Consequentially, the aggregate labor share declines.

[37] see Figures 6.8 and 6.9 in appendix for LS (measured as the fraction of compensation in revenue) in large Manufacturing and Transportation firms.

3.1 Static model

There are N vintages of capital, and each embodies a generation of technology. Denote $j = 1, 2, ..., N$ the vintage of capital. In the static model, a technology is interpreted as a firm. Technology j combines capital j and labor, and produces a single final goods in the following way

$$[(1-\alpha)k_j^\rho + \alpha(\gamma_j \ell)^\rho]^{\frac{1}{\rho}}$$

γ_j denotes the level of technology embodied in capital j. The following assumptions are made

Assumption 1. *Capital-labor complementarity:* $\rho < 0$.

Assumption 2. *Labor Saving technological progress:* γ_j *increases with j.*

The elasticity of substitution between capital and labor is given by $\frac{1}{1-\rho}$. The first assumption states that given a technology (embodied in machines), the elasticity of substitution between capital and labor is between 0 and 1, i.e. capital and labor are complementary inputs. This is consistent with what the majority of empirical estimates have found (e.g. Antras (2004); Klump et al. (2007); Herrendorf et al. (2015)). Recently, Oberfield and Raval (2014)) use plant level data from Census of Manufactures, and estimates an average plant level elasticity of substitution of about 0.5 in 1987. The estimated aggregate elasticity in Manufacturing is 0.71 in 1987 and 0.75 in 2007.

The second assumption states that technological progress is labor saving in the following sense: new technology embodied in new machines requires less labor input per unit of output. Labor augmenting technological progress is typically assumed in growth models to be consistent with a balanced growth path (Barro and Sala-iMartin (2004)). See Acemoglu (2003) and Jones (2005) for theoretical justifications.

Denote k_j the supply of capital j, and L labor supply. To single out the effect of technology in the static model, all $k_j's$ are fixed at 1, and the inelastic labor supply is also normalized to 1. Labor moves freely among firms. I study the labor allocation problem and investigate the effects of technologies on firm size and labor share. The marginal productivity of labor in firm j is

$$MPL_j = [(1-\alpha)(\frac{k_j}{\ell})^\rho + \alpha\gamma_j^\rho]^{\frac{1}{\rho}-1}\alpha\gamma_j^\rho$$

When the employment in firm j approaches 0, its marginal productivity of labor is

$$MPL_j(0) = \alpha^{\frac{1}{\rho}}\gamma_j$$

Due to the fact that capital is fixed at a positive number, the marginal productivity of labor at zero employment is not equal to infinity, i.e. the Inada condition doesn't hold. Therefore, some firms might not hire any labor in equilibrium. In addition, firms that use more advanced technologies have a higher marginal productivity of labor at zero. The employment flow always begins with firm $j = N$, and moves downwards step by step. The first unit of labor goes to the most productive firm N. As firm N accumulates labor, its marginal productivity of labor declines. Once it decreases to the marginal productivity of labor at zero employment of the second advanced firm, that second firm starts to hire labor. This process continues until full employment is reached.

The labor market equilibrium condition is[38]

$$w = MPL_j = [(1-\alpha)(\frac{k_j}{\gamma_j \ell_j})^\rho + \alpha]^{\frac{1}{\rho}-1}\alpha\gamma_j$$

It follows that more advanced technologies, i.e. technologies with a higher γ_j, lead to a lower adjusted capital labor ratio, $\frac{k_j}{\gamma_j \ell_j}$.[39] The labor share in firm j is

$$LS_j = \frac{w\ell_j}{y_j} = \frac{1}{\frac{1-\alpha}{\alpha}(\frac{k_j}{\gamma_j \ell_j})^\rho + 1}$$

Sine the labor share is an increasing function of $\frac{k_j}{\gamma_j \ell_j}$, firms that use more advanced technologies have a lower labor share.

Technology also affects firm size. Firm size is measured as value added/revenue as in the concentration data. Combine the formula for firm size with the labor market clearing condition to derive the following expression

$$y_j = k_j[\frac{1-\alpha(\frac{w}{\alpha\gamma_j})^{\frac{-\rho}{1-\rho}}}{1-\alpha}]^{\frac{-1}{\rho}}$$

It can be seen from this formula that the output is larger if the value of γ_j is higher. That is, a more advanced technology increases firm size. Therefore, the single parameter of technology (γ_j) generates a negative correlation between firm size and labor share, as observed in the data. Formally, the following proposition holds

Proposition 1. *The effects of technology on firm size and labor share*

- *If $j > j'$, $LS(j) < LS(j')$, i.e. firms that use more advanced technologies have a lower labor share*
- *If $j > j'$, $y(j) > y(j')$, i.e. output in firms that use more advanced technologies is larger*

The intuition for this result is the following: technology (γ) complements capital and increases productivity of capital, which further increases demand for effective labor ($\gamma\ell$). Therefore firms using more advanced technologies produce more output; on the other hand, technology substitutes raw labor and reduces its share of income.

3.2 Competitive equilibrium

It is now ready to incorporate capital accumulation and heterogeneous firms into the model developed in the previous section. The goal in this section is to develop a model that can be used to study the effect of creation of new technologies on concentration and labor share.

[38]This condition holds only for firms that have positive employment in equilibrium.

[39]Note that, the true capital labor ratio, $\frac{k_j}{\ell_j}$, can be increasing or decreasing with γ_j. The direct effect of technologies with a higher γ is to substitute raw labor. However, that technology also increases the productivity of capital, which increases labor demand. The equilibrium $\frac{k_j}{\ell_j}$ depends on which effect dominates. See appendix for a detailed discussion. If capital is also adjustable, as shown in next section, the capital labor ratio is positive function of the technology parameter, γ.

The introduction of firms follows the tradition of span of control models as in Lucas (1978), but without its career choice component. Production requires three inputs: capital and labor as before, and entrepreneurial skill. Without causing confusion, entrepreneurial skill and productivity are used interchangeably. There is a continuum of firms $i \in [0,1]$, each endowed with a productivity. Firm i draws its productivity z_i from the following Pareto distribution[40] at the beginning of time

$$z_i \sim f(z) = \begin{cases} \frac{\lambda}{z^{\lambda+1}} & \textit{if } z \geq 1 \\ 0 & \textit{o.w.} \end{cases}$$

Firms optimally choose to adopt one among N technologies, which are embodied in different machines. If firm i adopts technology j, it accesses to the following production function

$$y_i(j) = z_i^{1-\eta}[(1-\alpha)k(j)^\rho + \alpha(\gamma(j)\ell)^\rho]^{\frac{\eta}{\rho}}$$

where $0 < \eta < 1$ is the span-of-control parameter. Note that the time subscript t is dropped. To simplify analysis, I assume the following structure of capital: The household supplies and accumulates a *general* capital. Firms purchase this *general* capital at a common interest rate, and convert it into capital of vintage j at a cost. One unit of *general* capital can be converted into $\frac{1}{q(j)}$ units of capital of vintage j. In addition, to adopt technology j, or equivalently, to use capital of vintage j, firms need to pay a lump sum fixed cost $\phi(j)$. It is assumed that

Assumption 3. *Both $\phi(j)$ and $q(j)$ are increasing with j. That is, more advanced technologies require a larger fixed cost. In addition, machines that embodies more advanced technologies are more costly to produce.*

Firms optimally choose technology j and employ capital $k_i(j)$ and labor ℓ_i, while taken interest rate and wage as given. If none of the N technologies generate net positive profit, firms will stay inactive. The optimal choice problem of firm i reads[41]

$$\Pi_i \equiv \max \left\{ \max_{j, k_i(j), \ell_i} y_i(j) - r * q(j)k_i(j) - w\ell_i - \phi(j),\ 0 \right\}$$

For future reference, define an indicator $\sigma_i(j)$ as

$$\sigma_i(j) = \begin{cases} 1 & \textit{if} \quad \text{firm } i \text{ adopts technology } j \\ 0 & \textit{otherwise} \end{cases}$$

Note that if firm i chooses to stay inactive and not to adopt any of the N technologies, $\sigma_i(j) = 0$ for all j.

There exists a representative household which accumulates the *general* capital, and inelastically supplies L units of labor to maximize present value utilities

$$\Sigma_{t=0}^{\infty} \beta^t \log C(t)$$

[40] Axtell (2011) documents that the firm size distribution is well approximated by a Pareto distribution. The same distribution is used in recent papers, e.g. Buera et al. (2011) and Dinlersoz and Greenwood (2016).

[41] Firms can freely switch technologies from period to period. The model omits firms growth since focus here is the effect of technology on the labor share and firm size distribution.

β is the discount factor. The household obtains income from wage, rental income and profit, and distribute total income into consumption and investment. Its budget constraint is

$$C(t) + I(t) \leq w(t)L + r(t)K(t) + \int \Pi_i(t)dF(z_i),$$

where $F(z_i)$ is the cumulative distribution function of z_i. In addition, the household respects the law of motion for the *general* capital

$$K(t+1) = (1-\delta)K(t) + I(t).$$

with δ denoting the depreciation rate.

To conclude the model, the competitive equilibrium of the economy is defined as a sequence of prices, $\{r(t)\}_{t=0}^{\infty}$, $\{w(t)\}_{t=0}^{\infty}$, and a sequence of aggregate quantities, $\{C(t)\}_{t=0}^{\infty}$, $\{K(t)\}_{t=0}^{\infty}$, technological adoption decisions, $\{\sigma_i(j,t)\}_{t=0}^{\infty}$, and capital and labor demand, $\{k_i(j,t)\}_{t=0}^{\infty}$ and $\{\ell_i(t)\}_{t=0}^{\infty}$ for all i, such that

1. Given prices, $\{C(t)\}_{t=0}^{\infty}$ and $\{K(t)\}_{t=0}^{\infty}$ maximize household's utility
2. Given prices, technology choices $\sigma_i(j,t)$ and factor demand $k_i(j,t)$ and $\ell_i(t)$ maximizes firms' profits for all t
3. Markets clear
   - Capital market
   $$\int \Sigma_j k_i(j,t)\sigma_i(j,t)q(j)dF(z_i) = K(t); \quad \forall t.$$
   - Labor market
   $$\int \ell_i(t)dF(z_i) = L; \quad \forall t.$$
   - Goods market
   $$C(t) + K(t+1) - (1-\delta)K(t) + \int \Sigma_j \sigma_i(j,t)\phi(j)dF(z_i) = \int y_i(t)dF(z_i); \quad \forall t.$$

Technology, Labor Share and Firm Size It has been shown in the static model that more advanced technologies lead to lower labor shares and larger outputs. The results developed there still hold here. To save notion, write the conversion cost $q(j)$ as a function of $\gamma(j)$, q_γ. The production function of firm i which uses capital of vintage j is

$$y_i = z_i^{1-\eta}[(1-\alpha)(\frac{k_i}{q_\gamma})^\rho + \alpha(\gamma\ell_i)^\rho]^{\frac{\eta}{\rho}}$$

where k_i is the *general* capital which demands a common interest rate r. From first order conditions of firm $i's$ optimization, the capital intensity (K/L)[42] in firm i is

$$\frac{k_i}{\ell_i} = (\frac{1-\alpha}{\alpha}\frac{w}{r})^{\frac{1}{1-\rho}}(\gamma q_\gamma)^{\frac{-\rho}{1-\rho}}$$

[42]The capital used in measuring capital intensity is the *general* capital. In data, the value of capital stock already contains price information of different machines, which reflects quality differences.

That is, firms that use more advanced technologies have a higher capital labor ratio. The labor share in firm i is

$$LS_i \equiv \frac{w\ell_i}{y_i} = \frac{\eta\alpha}{\alpha + (1-\alpha)(\frac{r}{w}\frac{\alpha}{1-\alpha})^{\frac{-\rho}{1-\rho}}(\gamma q_\gamma)^{\frac{-\rho}{1-\rho}}}$$

Therefore, a more advanced technology, i.e. a higher value of γ, results in a lower labor share. Since all firms face the same wage, labor productivity, defined as

$$LP_i \equiv \frac{y_i}{\ell_i} = \frac{w}{LS_i},$$

is an increasing function of γ. Note that all these three properties are independent of firm productivity z_i.

Firm $i's$ output y_i is[43]

$$y_i = z_i \underbrace{(\frac{\eta(1-\alpha)}{r})^{\frac{\eta}{1-\eta}} q_\gamma^{\frac{-\eta}{1-\eta}} [(1-\alpha) + \alpha(\frac{r}{w}\frac{\alpha\gamma q_\gamma}{1-\alpha})^{\frac{\rho}{1-\rho}}]^{\frac{\eta(1-\rho)}{\rho(1-\eta)}}}_{\equiv g(\gamma,r,w)} \tag{1}$$

The effect of technology on firm size, measured as output, is twofold: more advanced technology increases demand for capital and effective labor and increases firm size, as in the static case; on the other hand, the conversion cost make firms optimally decrease employment of capital as well as labor.

Firms' technology adoption decision Note that firm $i's$ profit equals to

$$\begin{aligned}\Pi_i &= y_i - w\ell_i - rk_i - \phi \\ &= (1-\eta)y_i - \phi \\ &= (1-\eta)z_i g(\gamma, r, w) - \phi\end{aligned}$$

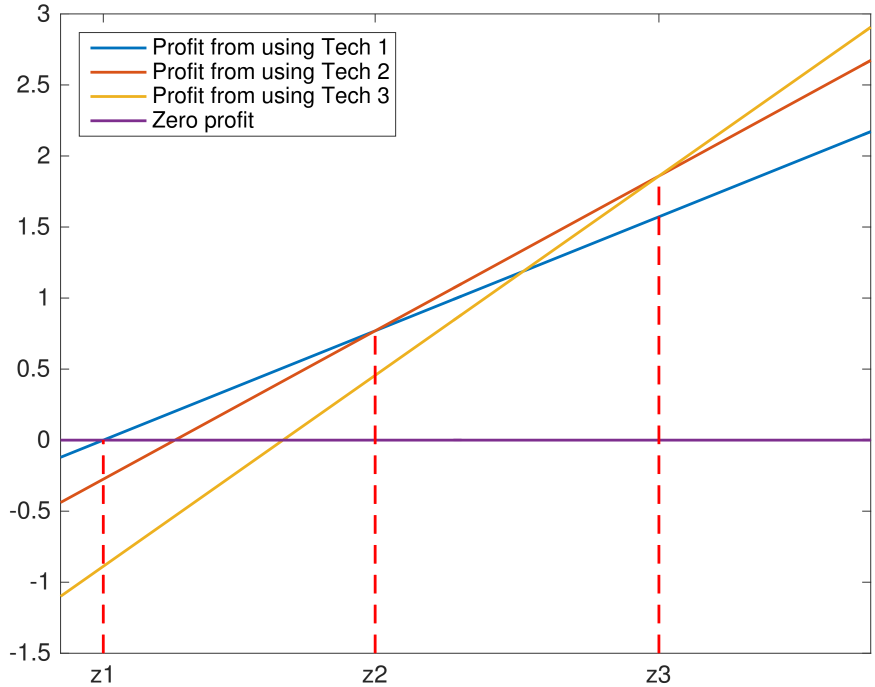
where $g(\gamma, r, w)$ is defined in the firm size formula (1). A nice property is that profit Π_i is a linear and increasing function of productivity z_i. If $g(\gamma, r, w)$ is an increasing function of γ, the profit function (as a function of productivity z_i) has a smaller intercept, $-\phi$, and a larger slope, $g(\gamma)$, for more advanced technologies. In this case, more productive firms optimally choose more advanced technologies. Formally, the following proposition holds

Proposition 2. *Firms' optimal technology adoption: Given the condition $g'(\gamma) > 0$ satisfied, where $g(\gamma)$ is defined in equation (1), if firm i with productivity z_i optimally adopt technology j, then firm i' with productivity $z_{i'} > z_i$ adopts technology $j' \geq j$.*

To illustrate the intuition, Figure 3.1 provides an example case of three technologies, with technology 1 the least and technology 3 the most advanced one. As shown in Figure 3.1, the profit function associated with technology 1 starts high and increases slower, while the function with technology 3 starts low and increases faster. Denote $\Pi(z_i, \gamma_j), j = 1, 2, 3$ the profit function of adopting technology j. There are three intersection points, $\bar{z}_1$, where $\Pi(z_i, \gamma_1)$ intersects with the zero profit line;

[43]See appendix for the expression of capital and labor demand in firm i. Substituting capital and labor demand into firm's production function gives this result.

Figure 3.1: Profit functions and technology adoption



Note: This graph shows profit functions in an example case where there are three technologies. Technology 1 (3) is the least (most) advanced one. The horizontal axis is the productivity of a firm.

$\bar{z}_2$, the intersection of $\Pi(z_i, \gamma_2)$ and $\Pi(z_i, \gamma_1)$, and $\bar{z}_3$, the productivity where $\Pi(z_i, \gamma_3)$ surpasses $\Pi(z_i, \gamma_2)$. Firms' technology adoption therefore follows a threshold rule[44].

$$T_i = \begin{cases} \text{stay inactive} & \text{if } z_i < \bar{z}_1; \\ \text{adopt technology 1} & \text{if } z_i \in [\bar{z}_1, \bar{z}_2); \\ \text{adopt technology 2} & \text{if } z_i \in [\bar{z}_2, \bar{z}_3); \\ \text{adopt technology 3} & \text{if } z_i \geq \bar{z}_3. \end{cases}$$

A sufficient condition for $g'(\gamma) > 0$ is that the conversion cost q_γ is a constant. In this case, more advanced technology increases firms' output. The intuition is what is illustrated in the static case: advanced technology (γ) complements capital and increases employment of effect labor ($\gamma\ell$)[45]. By continuity, $g'(\gamma) > 0$ holds as long as $q'(\gamma)$ is small enough. In the quantitative analysis, I always choose the conversion cost function such that $g'(\gamma) > 0$. This rules out the non-interesting case where the costs of new machines are so large that no firms would like to adopt them.

More productive firms choose to adopt more advanced technologies. Since firm size, measured by output/value added, is an increasing function of both productivity and technology, firms with

[44]Note that it is possible that, e.g. ϕ_3 is slightly smaller than ϕ_2, and $\bar{z}_3 < \bar{z}_2$. This is equivalent to the case where there are only 2 technologies available. This possibility is not considered since the discussion of N technologies is general enough.

[45]This can also be seen from equation (1) by equating $q_\gamma = c$.

higher productivity have larger size. It has been shown, in the static case, that more advanced technologies lead to a higher labor productivity and lower labor share. The model therefore generates a negative relation between firm size and labor share.

Arrival of new technology In an economy with N technologies where capital and labor are complementary, and labor is fixed, the model economy will arrive at a steady state. In that steady state, productive firms choose more advanced technologies, have a larger firm size and lower labor share. The (exogenous) arrival of the $(N+1)th$ technology drives the economy to a new steady state. In the new steady state, the most productive firms find it profitable to switch to the cutting-edge technology, becomes even larger which increases concentration, and have lower labor shares than before. As a result, the aggregate labor share declines[46]. To show this effect more clearly, I next calibrate a version of model initially with 2 technologies and study the effect of the introduction of new technology (a $3rd$ one in this case) on concentration and labor shares.

3.3 Quantitative exercise

This section provides a simple calibration and quantitative analysis. The economy initially has 2 technologies, and a 3rd technology exogenously arrives. I choose 2 technologies to start with since this is the minimum number needed to illustrate the idea, resembles the binary division of large and small firms, and requires the smallest number of parameters to calibrate. It should be emphasized that the primary goal here is to show the qualitative effect of new technology on concentration and the labor share.

The model has 5 parameters in preference and production functions: discount rate β, depreciation rate δ, the span of control parameter η, elasticity of substitution between capital and labor ρ, labor weight in production function α; 1 tail parameter λ in the Paretro distribution of productivity; 5 technology and cost parameters: levels of labor saving technology γ_1 and γ_2, two fixed costs ϕ_1 and ϕ_2. The conversion cost of capital j, $q(j)$ is assumed to be a power function of $\gamma(j)$, $q(\gamma) = \gamma^{\epsilon}$. This brings the last parameter ϵ. The fixed labor supply is normalized to 1.

The discount rate β and depreciation rate δ are widely used in macro literature. I choose $\beta = 0.96$ to match an annual interest rate of 4%, and the discount rate is chosen to be at $\delta = 6\%$ per year. In the model, the span of control parameter η determines the share of profit, which is typically considered part of capital income, in firms' value added. I pick $\eta = 0.75$, corresponding to 25% of profit share[47].

The majority empirical estimates of the elasticity of substitution between capital and labor, ($\frac{\rho}{1-\rho}$ in model) obtain values that are smaller than 1. Using micro level Census of Manufactures data and a CES production function, Oberfield and Raval (2014) estimates the average plant level elasticity of substitution as 0.5, and the aggregate elasticity of substitution for the Manufacturing sector to be 0.71 in 1987, and 0.75 in 2007. I target an elasticity of substitution of 0.5 at the firm/plant level, and choose $\rho = -1$.

[46] There will be some equilibrium effect on wage due to availability of new technology and associated capital accumulation. As shown in the quantitative analysis section, this equilibrium effect is small.

[47] This is slightly smaller than the value typically used in literature, e.g. 0.85 in Atkeson and Kehoe (2007) and Midrigan and Xu (2014). A relatively larger profit share is targeted since firms are required to pay fixed costs out of profit in the model here.

50 firms typically account for a very small fraction of total number of firms in any given 2 digit sector. The model here does not distinguish between firms and establishments. Large firms typically have multiple establishments. The following adjustment is implemented: BDS (Business Dynamics Statistics) data classify firms into different size bins (with size measured by No. of employees) from the smallest, *1 to 4 employees*, to the largest, *more than 10000 employees*. I use the average number of establishments for firms in the largest size bin to approximate the number of establishments in 50 largest firms, and calculate their fraction in total establishments for each sector. This fraction at the sector level is summed up to obtain the economy wide values. Calculated this way, 50 largest firms account for 1.93% of all establishments in 1987.

In Table 2.6 of Section II, Top-50 firms account for 26% of revenue share in 1987. Concentration in the mode is a combination of two forces: higher productivity (that is governed by the tail parameter λ) and more advanced technology (that is determined by technology γ and conversion costs). Due to lack of apparent ways to disentangle these two forces, I choose a value for the tail parameter as the benchmark, and vary its values for robustness check. In the benchmark and without technological heterogeneity, 50 largest firms (i.e. 1.93%) account for 18% of value added/revenue. This gives the tail parameter of the Pareto distribution, $\lambda = 1.77$.

Research that estimates the elasticity of substitution between capital and labor usually also estimates the rate of factor augmenting technological progress. Define the rate of labor saving technological change as the difference between the rate of labor augmenting technological change and that of capital augmenting technological change[48]. Research before 1980s usually estimate an annual rate of labor saving technological change around 0.5% (e.g. 0.36-0.62% in Brown and DeCani (1963) and 0.51% in Wilkinson (1968)). Estimates that employ more recent data tends to have a higher estimate. The annual rate of labor saving technological change in Antras (2004) is 3.08-3.15%.

In the current vintage capital model, production function in terms of the *general* capital is

$$y_i = z_i^{1-\eta}[(1-\alpha)(\frac{k}{q_\gamma})^\rho + \alpha(\gamma\ell)^\rho]^{\frac{\eta}{\rho}}$$

Under the assumption $q_\gamma = \gamma^\epsilon$, the rate of labor saving technological progress is $(1+\epsilon)\frac{\dot{\gamma}}{\gamma}$. The conversion cost acts like a labor saving technological change. The reason is that a higher conversion cost reduces the demand for the *general* capital. Technological progress that improves the productivity of labor tends to also 'dampen' capital. Therefore, the rate of net labor saving technological progress is amplified by the cost parameter ϵ. I set $(1+\epsilon)\frac{\dot{\gamma}}{\gamma} = 3\%$ as in Antras (2004). The benchmark value of ϵ is chosen to be $\epsilon = 0.8$, which implies $\frac{\dot{\gamma}}{\gamma} = 1.67\%$. In a 25-year span (1987-2012), this translates to a rate of 42%. For technology 1, the level of labor saving technology is normalized to $\gamma_1 = 1$; the second technology corresponds to $\gamma_2 = 1.42$ (i.e. $\gamma_1 \times 42\%$). When a third technology is introduced, it's technology parameter is set to be $\gamma_3 = 2.02$ (i.e. $\gamma_2 \times 42\%$).

The weight of labor in production function, α, and the two fixed costs, ϕ_1 and ϕ_2, are jointly calibrated to match the aggregate labor share in 1987, and a 5% of firms/establishment exit rate[49],

[48] See Table 1 in Leon-Ledesma et al. (2010) for a summary.

[49] The establishment exit rate, based on Business Dynamics Statistics data, is 11.9% in in 1987; the entry rate that year is 15.4%. Since the model does not focus on firm entry and exit, I choose a more conservative target of 5% inactive firms.

Table 3.1: Summary of calibration results

Para.	Meaning	Values	Target/sources
β	discount rate	0.96	4% interest rate
δ	depreciation rate	0.06	6% capital depreciation
η	span-of-control	0.75	25% profit share
ρ	elasticity of substitution, K and L	-1	Oberfield and Raval (2014)
α	labor weight in prod. fun.	0.37	LS in 1987
λ	shape of Pareto distribution	1.77	18% in tail
ϵ	power in conversion cost fun.	0.8	see text
γ_1	technology para. in Tech. 1	1	normalization
γ_2	technology para. in Tech. 1	1.42	rate of L.S.T. (25 yr) in Antras (2004)
ϕ_1	fixed cost of Tech. 1	0.21	5% exit rate
ϕ_2	fixed cost of Tech. 2	0.90	CR-*Top50* in 1987

and a concentration ratio of 26% for Top-50 firms in 1987. Table 3.1 summarizes the calibration results.

Under these parameter values, The aggregate labor share in model is 51.83%, and the revenue share of *Top50* firms is 26.06%. In equilibrium, 5% of firms/establishments stays inactive. Figure 3.2 plots the steady state distribution of firm size and labor share. The equilibrium wage is 1.12. Two productivity cutoffs are 1.03 and 5.91. Equivalently, 5% of firms exit, 90.5% of small firms adopt technology 1 and have a labor share of 53.7%. the remaining 4.5% of large firms adopt technology 2, with a labor share of 48.6%. The relative labor share of *Top50* firms (1.93%) is 93.8%.

Next, a 3*rd* technology is (exogenously) introduced. This third, more advanced technology has a higher value of γ_3. As mentioned earlier, technology is assumed to progress at a constant rate, i.e. $\frac{\gamma_3}{\gamma_2} = \frac{\gamma_2}{\gamma_1}$. This implies $\gamma_3 = 2.02$. The fixed cost ϕ_3 is chosen such that exactly Top-50 firms adopt this new technology[50].

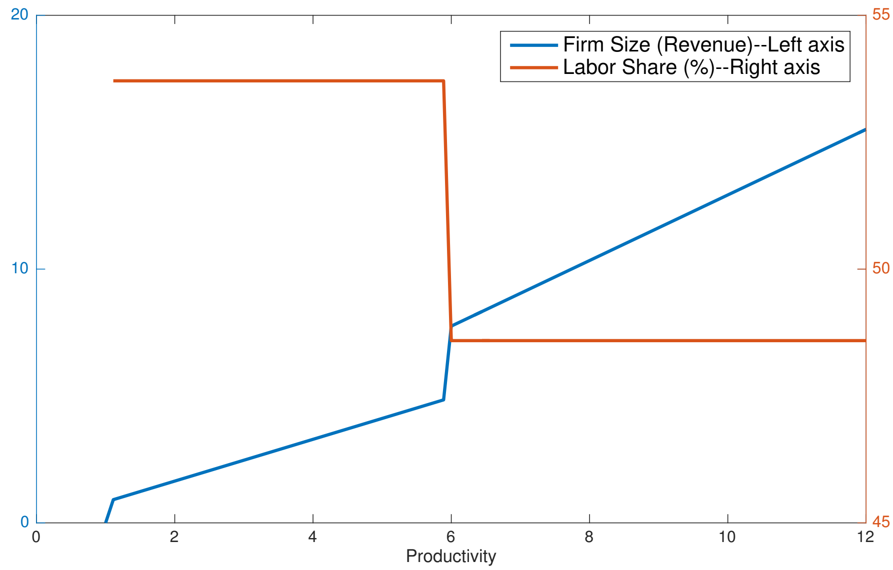
Figure 3.3 presents the distribution of firm size and labor share in the new steady state when a 3*rd* technology becomes available. The most productive firms optimally switch to the new technology. Labor share in these firms declines to 43.2%. Their relative labor share decreases to 86.67%. The concentration ratio, measured as the value added share of *Top50* firms, increases from 26.06% to 33.17%. The aggregate labor share declines from 51.83% to 49.80%. Note that there is an equilibrium effect when a more advanced technology arrives: capital accumulates and absolute level of wage might increase[51]. In the current exercise, wage increases from 1.12 to 1.14. This slight increase in wage explains the decrease in output, and increase in labor shares in small firms in Figure 3.3. The increase in equilibrium wage also pushes more firms to exit. In the new steady state, 9.1% of firms choose to exit, comparing to 5% before the introduction of the new technology.

Robustness In the benchmark, the value of the conversion cost parameter ϵ is assigned as 0.8. Table 3.2 shows results under different values for this parameter. In addition, it presents a couple of exercises with the Pareto tail parameter $\lambda = 1.69$, which corresponds to a concentration ratio

[50]Note that the qualitative result does not depend on this specific choice of target.

[51]The new technology also substitute labor and reduces wage. The change of equilibrium wage depends on which effect dominates.

Figure 3.2: Distribution of firm size and labor share



Note: The vertical axis on the left is firm size (output level); the vertical axis on the right is the labor share; the horizontal axis is the productivity of a firm.

of 20% (18% in benchmark) without technological heterogeneity[52]. While the qualitative results are robust, a lower ϵ tends to increases the concentration more, as firms accumulates more in new capital if it is less costly to employ.

4 Discussions and Further Evidence

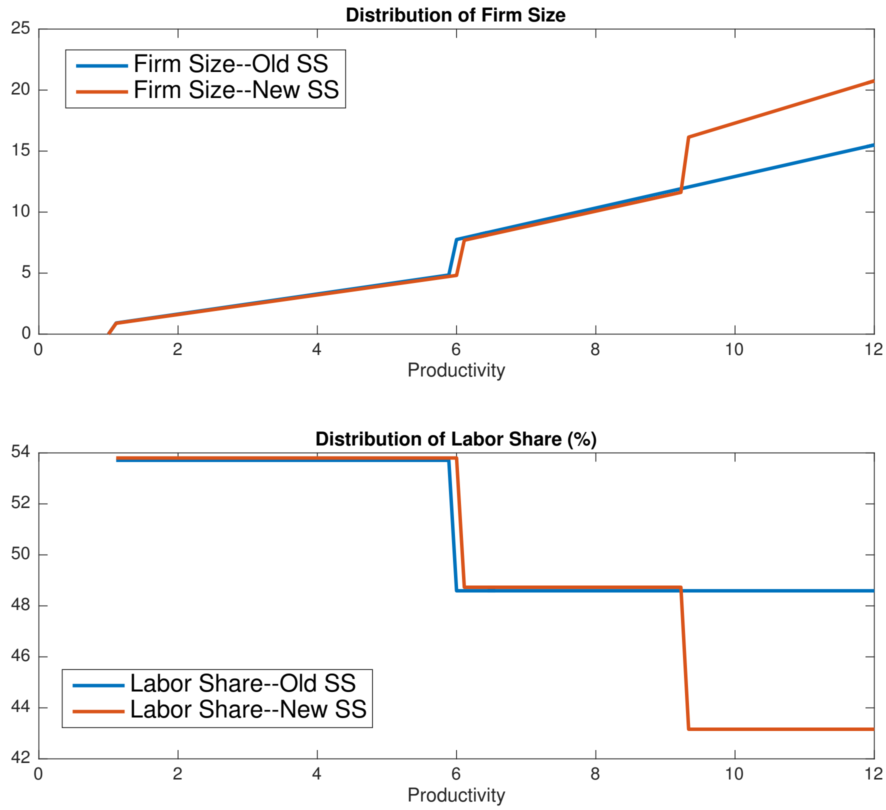
This section addresses three related issues. First, I provide the return to capital that is calculated based on National Income and Product Accounts (NIPA) data and explicitly accounts for changes in relative prices of investment goods. Second, the (labor saving) technological progress that drives down the labor share also increases labor productivity. The evolution of sector labor productivity is presented. Third, one main argument of this paper is technological heterogeneity across firms. I document heterogeneity of capital intensity at the firm level using *Compustat* data.

4.1 The return to capital

With a production function where capital and labor are complementary, a declining rate of return to capital would encourage capital accumulation and increase the labor share. It has been well documented that the relative price of investment goods, measured as the ratio of price of investment goods to the price of consumption goods, has declined since 1980 (Karabarbounis and Neiman (2014b)). However, changes in the price of investment goods only reflects the capital gain

[52]For each case, the rate of technological progress is adjusted accordingly, and values of some parameters (α, ϕ_1, and ϕ_2) are re-calibrated since these parameters are targeted equilibrium outcomes which would be changed under different values of λ and ϵ.

Figure 3.3: The effect of new technology on size and LS Distribution

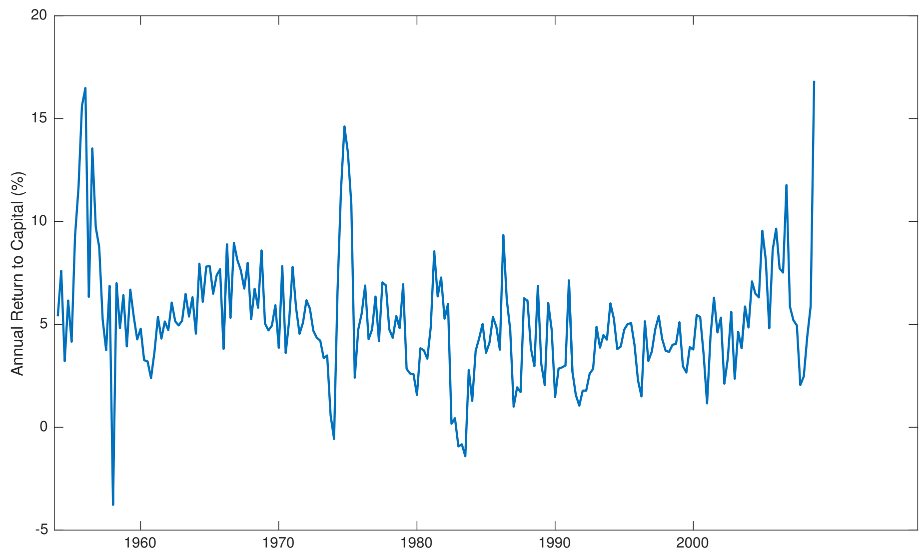


Note: The vertical axis on the left is firm size (output level); the vertical axis on the right is the labor share; the horizontal axis is the productivity of a firm. Blue lines are results in old steady state. Red lines are results in new steady state where a new and more advanced technology is available.

Table 3.2: Results under alternative parameter values

	LS	CR-*Top50*	RLS-*Top50*	LS-*largest firms*
$\lambda = 1.77, \epsilon = 0.8$				
N=2	51.83%	26.06%	93.80%	48.59%
N=3	49.80%	33.17%	86.67%	43.16%
$\lambda = 1.77, \epsilon = 0.6$				
N=2	51.78%	26.01%	94.99%	49.19%
N=3	49.59%	36.87%	88.64%	43.96%
$\lambda = 1.69, \epsilon = 1$				
N=2	51.84%	25.92%	93.52%	48.48%
N=3	49.96%	30.34%	87.70%	42.84%
$\lambda = 1.69, \epsilon = 0.8$				
N=2	51.86%	26.03%	95.62%	49.59%
N=3	50.13%	30.35%	87.82%	44.03%
$\lambda = 1.69, \epsilon = 0.6$				
N=2	51.87%	26.04%	96.94%	50.28%
N=3	49.82%	37.62%	90.67%	45.17%

Figure 4.1: The return to capital, 1954-2008



Note: The return to capital is equal to the real return, measured from NIPA, plus capita gains. Data Source: Table 2 in Gomme et al. (2011).

component of investment. The return to capital equals the capital gain pus the real return. Gomme et al. (2011) measures the return to capital as

$$R_t = \frac{\text{After-tax capital income at t}}{\text{capital stock at t}} + \frac{\text{relative price of investment goods at t}}{\text{relative price of investment goods at t-1}} - 1$$

where capital stock excludes housing, and capital income, calculated from NIPA, equals after-tax non-labor income. The second term explicitly captures the capital gain of investment, i.e. changes in relative prices of investment goods over time. Figure 4.1 presents the (annualized) results from Gomme et al. (2011). The return to capital fluctuates around 5.16% and shows no declining trend since 1980s.

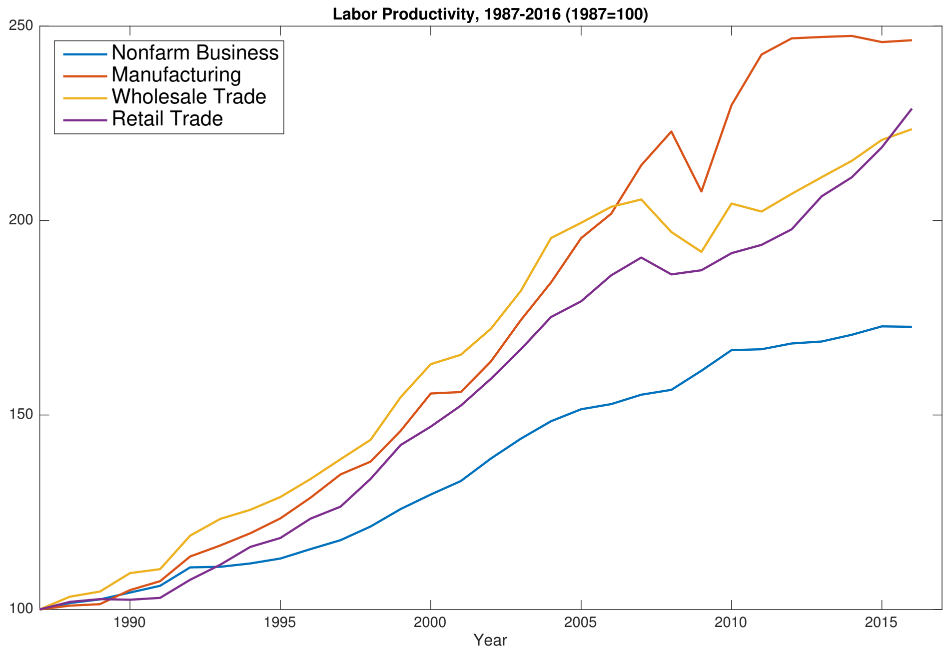
4.2 Labor productivity

According to the model, new (labor saving) technologies that decrease the labor share also increase labor productivity[53]. Declines of labor share concentrate in Manufacturing, Trade and Transportation. A larger increase in labor productivity should also be observed in these sectors. Note that ex ante, there is not nessarily any relation between labor share ($\frac{WL}{PY}$) and labor productivity ($\frac{Y}{L}$). For example, with a Cobb-Douglas production function, independent of changes in labor productivity, the labor share is a constant. On the empirical side, labor productivity has been increasing for hundreds of years, while the decline of labor share is a recent phenomenon.

The 'Labor Productivity and Costs' program of Bureau of Labor Statistics provides data on labor productivity for different sectors. Labor productivity is the ratio of real output to hours of labor in-

[53] Thanks Yongs Shin for pointing out the model's implication on labor productivity.

Figure 4.2: Labor Productivity, 1987-2016 (1987=100)



Note: Labor productivity is the ratio of real value added to total working hours. Data Source: The 'Labor Productivity and Costs' program of Bureau of Labor Statistics.

put. Output (real output) is measured net of price change and inter-industry transactions. Figure 4.2 presents labor productivity for the economy (non-farm business sector), and Manufacturing, Wholesale Trade and Retail Trade from 1987 to 2016, with 1987 values normalized to 100[54].

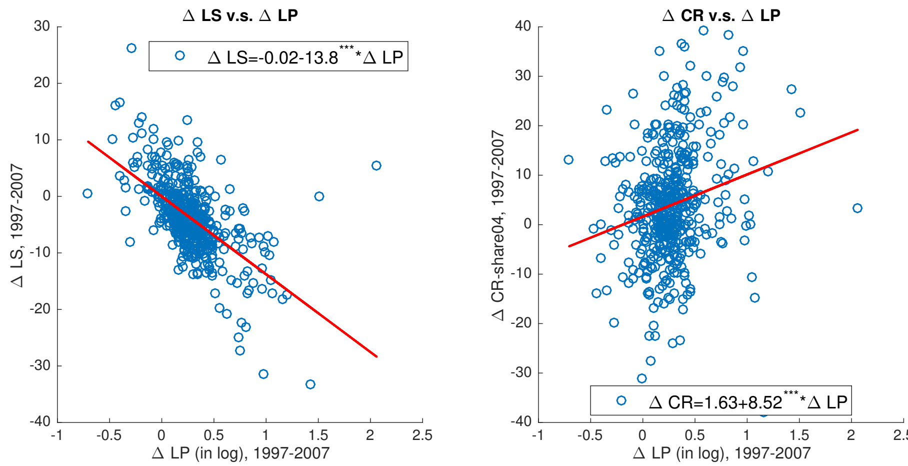
From 1987 to 2016, the economy wide labor productivity has increased 72.7%, from 100 in 1987 to 172.7 in 2016. The increases for the same period in Manufacturing, Wholesale Trade and Retail Trade are 146.4%, 123.5%, and 128.8% respectively. It is clear that over the last 3 decades, the labor productivity in Manufacturing and Trade increases much faster than the rest of economy[55]. This piece of evidence also supports the technological channel, instead of monopoly power, to explain the negative correlation between changes in concentration and changes in labor share. The measured labor productivity is real output (net of price changes) per hour, while increasing monopoly power drives up the price, but does not increase labor productivity[56].

[54] 1987 is the earliest year with labor productivity data available for different industries. The 'Labor Productivity and Cost by Industry Tables' of BLS does not provide labor productivity data for the Transportation and Warehousing (NAICS 48-49) sector. The message from sub-sectors is mixed: labor productivity in Air transportation (NAICS 481) increases 134% from 1987 to 2016, the increase in Line-haul railroads (NAICS 482111) is 196% for the same period. In Postal Service (NAICS 491), labor productivity increases 16%, while in Couriers and messengers (NAICS 492), labor productivity decreases by 43% from 1987 to 2016.

[55] One example of technological progress in retail trade is information technology and online retailers, such as Amazon. From 1987 to 2016, labor productivity in retail trade increases 128.8%, while the increase in Nonstore retailers and Electronic shopping & mail-order houses are 860% and 1486%. In 2012, the share of payroll in total revenue in Retail Trade (NAICS 44-45) is 8.74%, while the same share in Nonstore retailers (NAICS 454) and Electronic shopping & mail-order houses (NAICS 4541) is 7.03% and 6.12% respectively.

[56] Another evidence that does not support monopoly power is the Finance sector. The concentration ratio, measured

Figure 4.3: LP, LS and Concentration, MFG change from 1997 to 2007



Note: LS is the fraction of payroll in value added; LP is the ratio of real value added to total working hours; Concentration is the value added share of 4 largest firms. Each circle is a 6 digit NAICS sector.

Figure 6.11 plots the labor productivity and labor share in Manufacturing from 1987 to 2014. From 1987 to 1997, labor productivity increases 34.7%, and the labor share declines 10.3%. Since late1990s, both increases in labor productivity and declines in labor share speed up. From 1997 to 2007, labor productivity increases 59.0%, and the labor share declines 20.2%.

Labor productivity in more dis-aggregated Manufacturing sectors can be measured using the Census of Manufacture data. The census data provides value added, employment, No. of production workers, hours of production workers, deflator for value of shipment (1997=1) for each 6 digit Manufacturing sector. we construct total hours by assuming average working hours of non-production workers are the same as production workers. Labor productivity is calculated as the ratio of value added to total working hours.The deflator for value of shipments (1997=1) is used for each sector to obtain the real value added. Figure 4.3 plots the change in labor share and concentration against labor productivity across 6 digit Manufacturing sectors. From 1997 to 2007, the more labor productivity increases in a sector, the more labor share declines, and the more concentration increases.

Congress (1995) provides a detailed description on how progress in information technology since 1980s has transformed the transportation and distribution sectors. the use of sophisticated in-

by revenue share of 50 largest firms, in Finance and Insurance (NAICS 52) has increased from 38.6% in 1997 to 46% in 2007, and 48.5% in 2012 (A similar pattern is observed for other concentration measures. For example, revenue share of 20 largest firms increases from 22.6% in 1997 to 28.5% in 2007, and 31.6% in 2012; the average revenue share of 4 largest firms across 6 digit NAICS Finance sectors increases from 26.0% in 1997, to 36.1% in 2007 and 35.4% in 2012.). The sector labor share, measured as the fraction of compensation in value added, in Finance actually slightly increases from 23.2% in 1997 to 25.4% in 2007 (and declines slightly during the financial crisis). This suggests concentration alone can not fully explain the behavior of labor share. The *Compustat* data provides information for labor shares, measured as the fraction of compensation in revenue, in large financial firms, as shown in Figure 6.10 in Appendix. In most large financial firms, the labor share actually increases, at a nontrivial magnitude in many firms. This shows the importance of combing concentration and changes of labor shares within firms, especially large ones to understand the behavior of aggregate labor share. The reason why large financial firms have a larger market share and larger labor share over time seems non-technological, and is beyond the scope of this paper.

Table 4.1: Dependent Var.: RC_EMP, 2007-2012

	(1) Large	(2) Small	(3) All	(4)-WLS All
RC_REV	0.62***	0.84***	0.84***	0.79***
	(0.04)	(0.03)	(0.05)	(0.05)
Large			0.02	0.04**
			(0.02)	(0.02)
RC_REV*Large			-0.22***	-0.26***
			(0.06)	(0.06)
R^2	0.29	0.69	0.38	0.35
NO.	489	488	977	977

Note: RC_EMP (RC_REV) is the percentage change of employment (revenue) from 2007 to 2012. 'Large' is a dummy and denotes 4 largest firms in the 6 digit NAICS sector. Column (4) uses sector employment in 2007 as weights.

formation systems and automation (e.g. bar-coding) contributes to the rise of express carriers such as UPS (United Parcel Service) and Federal Express. Due to information technology, the wholesale trade sector has changed from a system of stocked warehouses to one of fewer larger-scale distribution centers. Prominent technologies include: Electronic data interchange (EDI, or computer-to-computer information interchange) which facilitates communications of inventory and demand information; bar coding which has largely improved logistics and inventory control and made possible accurate deliveries; and automation of distribution facilities (e.g. a conveyor system). These new technologies replace certain tasks performed by labor before, increases productivity, and leads to concentration since facilities must be large enough to support dedicated automated equipment and achieve economies of scale.

At the firm level, one implication of the model is that large firms expand by adopting more advanced technologies which improve their labor productivity. It is possible to investigate the heterogeneity between large and small firms using the census data. I did the following exercise: calculate the percentage increase of employment if revenue increases for 1%, for different firm groups. The benchmark period is from 2007 to 2012. Large firms are defined as 4 firms that have the highest level of revenue in a 6 digit Non-Manufacturing sector, with small firms the rest. Table 4.1 shows the results. A 1% increase in revenue is associated with 0.84% increase in employment in small firms; and only 0.62% for large ones. The difference is statistically significant and economically large. In addition, the pattern is robust for different cutoffs of large firms, various digit levels and different years. It suggests that growth in small firms heavily rely on more hiring, while a large fraction of growth in large firms comes from improvement in labor productivity.This is further confirmed by the fact that R^2 in column (2) (for small firms) is much larger than column (1) (for large firms).

4.3 Firm size, concentration and capital intensity

My model implies that large firms adopt advanced technologies which are more K/L intensive[57]. Firm level capital intensity can be measured using data from *Compustat*. The data I use ranges

[57] Abow et al. (1999) shows that high paid firms in French are more productive and also more capital intensive.

Table 4.2: Dependent var.: Capital Intensity (in log)

	(1)	(2)	(3)	(4)	(5)	(6)
log-assets	0.18***			0.21***		
	(0.001)			(0.001)		
log-sales		0.10***			0.14***	
		(0.001)			(0.001)	
log-emp.			0.03***			0.07***
			(0.001)			(0.002)
Year D.	Yes	Yes	Yes	Yes	Yes	Yes
Sector D.	Yes	Yes	Yes	Yes	Yes	Yes
Sample	1980-	1980-	1980-	2000-	2000-	2000-
R^2	0.62	0.62	0.57	0.58	0.58	0.50
Obs.	225,798	212,927	225,811	107,875	98,103	107,885

Note: Capital intensity is measured as the ratio of Capital to the NO. of Employees (in log). Sector Dummies are each 4 digit SIC sector. Data Source: *Compustat*, 1980-2016.

from 1980 to 2016. In total, there are 421,501 *firm*×*year* observations. Firm size is measured as assets (and employment and sales for robustness check). Capital is defined as the sum of two items, *PPEGT*, 'Property, Plant and Equipment-Total (Gross)', and *INTAN*, 'Intangible Assets-Total'. Capital intensity is defined as the ratio of Capital to No. of Employees (in log).

Table 4.2 shows the results of OLS regressions, with Capital intensity (in log) as the dependent variable, and firm size as one independent variable. Dummies for each year and each 4 digit SIC sector are added as controls. The capital intensity is positively and significantly correlated with the firm size.

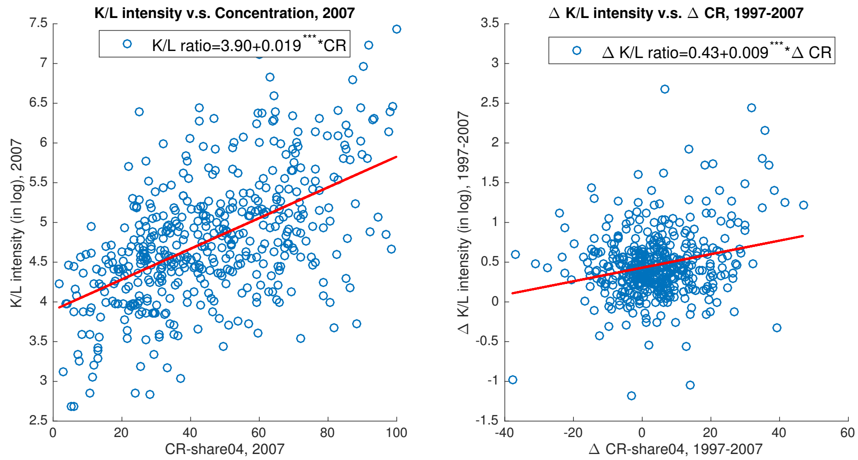
Census of Manufactures also provides values of capital stock for Manufacturing sub-sectors. The measured capital stock contains equipment and structures and both are in real terms[58]. Capital intensity is defined as the ratio of real capital to No. of employees. Figure 4.4 presents capital intensity against concentration ratio (measured as value added share of 4 largest firms) in Manufacturing 6 digit sectors. Sectors that are more capital intensive tend to be more concentrated. Over time, sectors where concentration increases also becomes more capital intensive.

5 Conclusion

This paper documents firm heterogeneity of labor share, i.e. large firms tend to have a lower labor share, and finds that declines of labor share in large firms and their rising market share (rising concentration) jointly leads to declines of aggregate labor share. Declines of labor share concentrate in Manufacturing, Trade and Transportation. These are also sectors where concentration increases the most, and the relative labor share of large firms declines the most. Increases in labor productivity of large firms in these sectors are not matched by comparable increases in wage.

[58] The recently capitalized Intellectual Properties and Products (IPP) are not included in Census of Manufactures data.

Figure 4.4: Concentration and K/L intensity, Manufacturing



Note: K/L intensity in the vertical axis is the ratio of capital (equipment+structure) to NO. of employees. Concentration in the horizontal axis is the value added share of 4 largest firms. A circle represents a 6 digit NAICS sector.

I provide a rationale for these empirical facts by assuming that capital and labor are complementary inputs and technological progress is labor saving. Under these assumptions, my model predicts a negative correlation between firm size and labor share. With complementarity between capital and labor, (labor saving) technology increases the productivity of capital and the demand for effective labor, and increases output; On the other hand, technology substitutes raw labor and reduces its share of income. Further, the adoption of new technologies diminishes the labor shares in large firms and increases their market share. As a consequence, the aggregate labor share declines.

This technological channel is consistent with the evolution of labor pruductivity across sectors during the last 30 years. From 1987 to 2016, the economy wide labor productivity has increased 72.7%. For the same period, the increases in labor productivity in Manufacturing, Wholesale Trade and Retail Trade are 146.4%, 123.5%, and 128.8%, respectively.

The model does not address sector heterogeneity. A future extension would be to embed that heterogeneity into the model for quantitative analysis. Further, in some sectors, new technologies are adopted by small firms and they grow large over time (e.g. Amazon in retail trade). A second extension is to add a richer firm dynamics and incorporate firm creation and death of incumbents, into the current model.

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6 Appendix

K/L intensity under different technologies in Static Case. The marginal condition of labor market is

$$w = MPL_j = [(1-\alpha)(\frac{k_j}{\ell_j})^\rho + \alpha\gamma_j^\rho]^{\frac{1}{\rho}-1}\alpha\gamma_j^\rho$$

Note that there are two $\gamma_j's$ in the equation above. The second (last) γ_j^ρ captures the direct effect that a technology with a higher γ_j increases the labor productivity and requires less labor to produce. The first γ_j^ρ represents the opposite effect that this technology allows firms to operate at a larger scale, which increases labor demand.

Rewrite the labor market marginal condition as

$$(1-\alpha)(\frac{k}{\ell})^\rho = (\frac{w}{\alpha\gamma^\rho})^{\frac{\rho}{1-\rho}} - \alpha\gamma^\rho \equiv f(\gamma)$$

A sufficient condition for a positive correlation between γ and $\frac{k}{\ell}$ is $f'(\gamma) < 0$. Note that

$$f'(\gamma) = (\frac{w}{\alpha})^{\frac{\rho}{1-\rho}}(-\frac{\rho^2}{1-\rho})\gamma^{\frac{-\rho^2}{1-\rho}-1} - \alpha\rho\gamma^{\rho-1}$$

$f'(\gamma) < 0$ is equivalent to

$$\gamma > (\frac{w}{\alpha})^{\frac{1}{1-\rho}}(\frac{-\rho}{1-\rho}\frac{1}{\alpha})^{\frac{1}{\rho}}$$

Therefore, this condition is satisfied if γ is large enough[59].

Firm size and employment in general equilibrium Optimal Conditions in Competitive Equilibrium

$$MPK_i = \eta z_i^{1-\eta}[(1-\alpha)(\frac{k_i}{q_\gamma})^\rho + \alpha(\gamma\ell_i)^\rho]^{\frac{\eta}{\rho}-1}(1-\alpha)q_\gamma^{-\rho}k_i^{\rho-1} = r$$
$$MPL_i = \eta z_i^{1-\eta}[(1-\alpha)(\frac{k_i}{q_\gamma})^\rho + \alpha(\gamma\ell_i)^\rho]^{\frac{\eta}{\rho}-1}\alpha\gamma^\rho\ell_i^{\rho-1} = w$$

Demand of labor and capital in firm i

$$k_i = z_i(\frac{\eta(1-\alpha)}{r})^{\frac{1}{1-\eta}}q_\gamma^{\frac{-\eta}{1-\eta}}[(1-\alpha) + \alpha(\frac{r}{w}\frac{\alpha\gamma q_\gamma}{1-\alpha})^{\frac{\rho}{1-\rho}}]^{\frac{\eta-\rho}{\rho(1-\eta)}}$$
$$\ell_i = z_i(\frac{\eta\alpha}{w})^{\frac{1}{1-\eta}}\gamma^{\frac{\eta}{1-\eta}}[(1-\alpha)(\frac{1-\alpha}{\alpha\gamma q_\gamma}\frac{w}{r})^{\frac{\rho}{1-\rho}} + \alpha]^{\frac{\eta-\rho}{\rho(1-\eta)}}$$

Therefore, the net effect of technology on employment size is unclear. The reason is that technology has two effects on employment, as illustrated in the static case above.

[59] Note that it follow from the marginal condition of labor market, $(1-\alpha)(\frac{k}{\ell})^\rho = (\frac{w}{\alpha\gamma^\rho})^{\frac{\rho}{1-\rho}} - \alpha\gamma^\rho$, that $(\frac{w}{\alpha\gamma^\rho})^{\frac{\rho}{1-\rho}} - \alpha\gamma^\rho > 0$, or equivalently, $\gamma > \frac{w}{\alpha}(\frac{1}{\alpha})^{\frac{1-\rho}{\rho}}$.

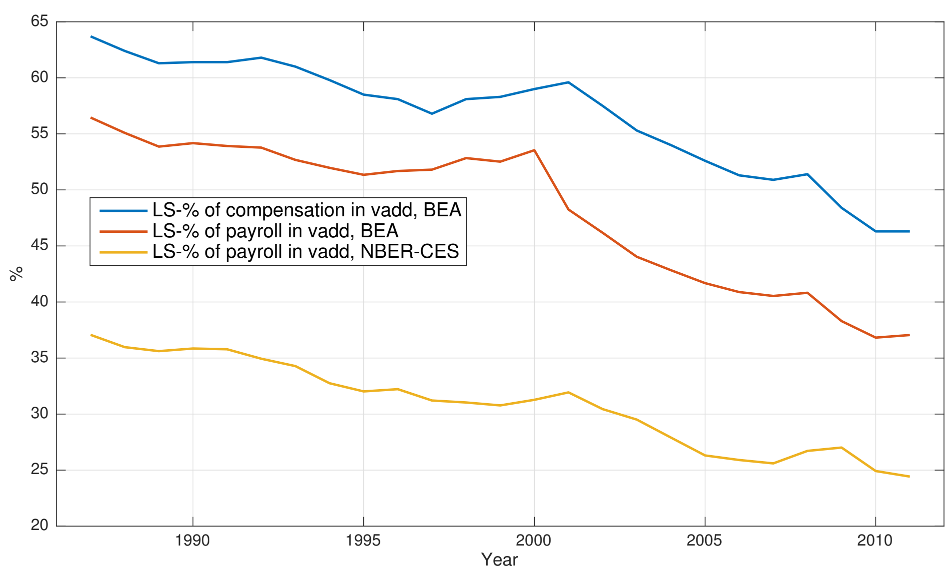
Data Source

- Data used to calculate labor share for 2 digit sectors is from the industry accounts of Bureau of Economic Analysis. labor share for detailed manufacturing sectors is calculated using *Annual Survey of Manufacturing (ASM)* data. A simplified version of *ASM*, for 6-digit sector, is summarized in the *NBER-CES* dataset. *NBER-CES* data is available for 6 digit manufacturing sectors from 1958 to 2011.

- Concentration ratio for 2002, 2007 and 2012 is from the 'American FactFinder' website, and various publications by the Census Bureau before 1997. The measure provides shares of 4, 8, 20, and 50 largest firms in total sales (receipts, value of shipments). For manufacturing, concentration ratios in value added is also available.

Classification of multi-establishment enterprises NAICS is designed to facilitate the collection, tabulation, presentation, and analysis of data relating to establishments[60]. For industry classification of multi-unit firms[61] with diverse production activities, a multiple stage "hierarchical" approach is employed. In the first stage, the firm is assigned to a major sector based on highest share of payroll. Within that major sector, the firm is then assigned to a subsector, based on the highest share across the sub-sectors within the major sector (Awuku-Budu and Robbins (2014)). This process continues to the most disaggregated level of industry classifications.

Figure 6.1: MFG LS in ASM/NBER-CES and BEA-NIPA



[60]See Parker (2012),"Restoring the Enterprise Statistics Program (ESP) For the 2012 Economic Census".
[61]*unit* and *establishment* are used interchangeably; while *firms*, *enterprises* and *companies* are the same in this context

Offshoring index

Following Feenstra and Hansen (1996), Feenstra and Hansen (1998), the offshoring intensity for sector i is measured as

$$OS_i = \Sigma_j \frac{\text{input from sector j}}{\text{total intermediate input in i}} * \text{import intensity of j}$$

and *import intensity of j* is measured as the fraction of import in expenditure, which equals value of shipment plus import and minus export, in sector j. The offshoring intensity is calculated using input-output tables of 1997 and 2015 for 66 private industries. Figure 6.2 presents the result. The measured offshoring intensity increases in most industries, and the increases is more prominent in Manufacturing than Non-Manufacturing sectors.

Figure 6.2: Offshoring intensity, 1997-2015

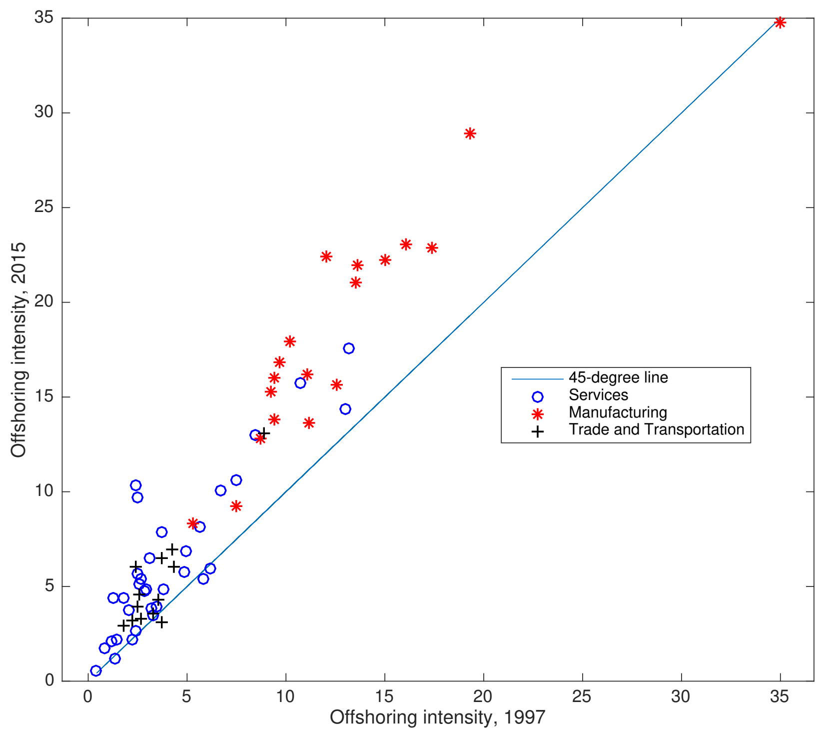
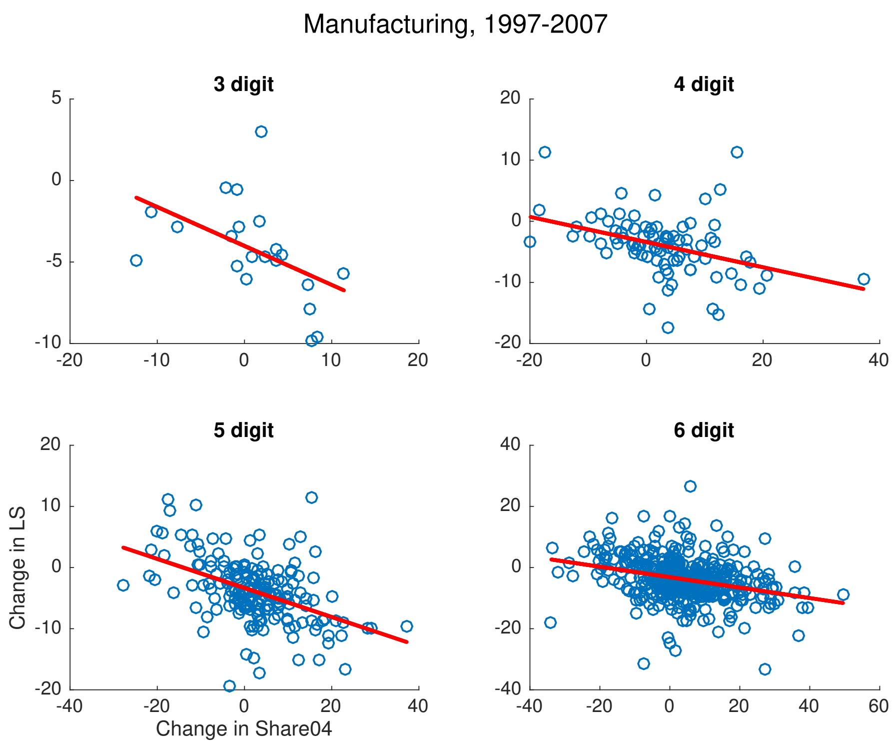


Table 6.1: Concentration and Labor Share. Depend. var.: ΔLS, 1997-2007

	OLS				WLS			
	3 digit	4 digit	5 digit	6 digit	3 digit	4 digit	5 digit	6 digit
$\Delta CR04$	-0.239**	-0.206***	-0.237***	-0.171***	-0.117	-0.175***	-0.191***	-0.156***
	(0.099)	(0.054)	(0.033)	(0.024)	(0.084)	(0.043)	(0.032)	(0.024)
R^2	0.23	0.16	0.22	0.10	0.09	0.16	0.16	0.08
$\Delta CR08$	-0.213***	-0.126**	-0.175***	-0.146***	-0.125**	-0.132***	-0.147***	-0.125***
	(0.073)	(0.062)	(0.041)	(0.029)	(0.057)	(0.046)	(0.037)	(0.029)
R^2	0.31	0.05	0.09	0.05	0.20	0.09	0.08	0.04
$\Delta CR20$	-0.318***	-0.149*	-0.210***	-0.157***	-0.132	-0.203***	-0.247***	-0.169***
	(0.115)	(0.077)	(0.049)	(0.036)	(0.084)	(0.063)	(0.053)	(0.040)
R^2	0.29	0.04	0.09	0.04	0.11	0.11	0.11	0.04
$\Delta CR50$	-0.347*	-0.137	-0.211***	-0.124***	-0.168	-0.226***	-0.260***	-0.176***
	(0.167)	(0.100)	(0.062)	(0.048)	(0.113)	(0.084)	(0.067)	(0.054)
R^2	0.19	0.02	0.06	0.01	0.11	0.08	0.08	0.02
Obs.	21	86	183	464	21	86	183	464

Note: The single variable regression results are based on manufacturing sectors, at various digit levels. The dependent and independent variables are the change in labor share and concentration, both from 1997 to 2007. $\Delta CR04$ refers to the change in *Share04*, which itself measure the share of value added by the largest 4 firms in a sector. WLS regressions are weighted by the average value added in 1997 and 2007.

Figure 6.3: ΔLS v.s. $\Delta Share04$, MFG



Note: LS in the vertical axis is the fraction of payroll in value added. Concentration in the horizontal axis is the value added share of 4 largest firms.

Table 6.2: Depend. var.:ΔLS

	1963-1967		1972-1977		1977-1982		1987-1992	
	OLS	WLS	OLS	WLS	OLS	WLS	OLS	WLS
$\Delta CR04$	-0.101**	-0.059**	-0.118***	-0.023	-0.190***	-0.240***	-0.174***	-0.128***
	(0.039)	(0.030)	(0.040)	(0.044)	(0.057)	(0.062)	(0.036)	(0.032)
R^2	0.02	0.01	0.02	0.001	0.03	0.03	0.05	0.03
$\Delta CR08$	-0.117***	-0.079***	-0.108***	-0.011	-0.164**	-0.147**	-0.195***	-0.121***
	(0.035)	(0.030)	(0.040)	(0.036)	(0.058)	(0.064)	(0.040)	(0.036)
R^2	0.02	0.02	0.02	0.03	0.02	0.001	0.05	0.03
$\Delta CR20$	-0.187***	-0.103***	-0.113**	-0.067	-0.105	-0.180**	-0.207***	-0.171***
	(0.046)	(0.036)	(0.045)	(0.053)	(0.067)	(0.073)	(0.049)	(0.044)
R^2	0.04	0.02	0.01	0.004	0.006	0.01	0.04	0.03
$\Delta CR50$	-0.167***	-0.076	-0.101*	-0.075	-0.134*	-0.274***	-0.229***	-0.141**
	(0.059)	(0.048)	(0.053)	(0.057)	(0.080)	(0.068)	(0.069)	(0.059)
R^2	0.02	0.007	0.001	0.004	0.007	0.03	0.02	0.01
Obs.	400	400	442	442	437	437	448	448

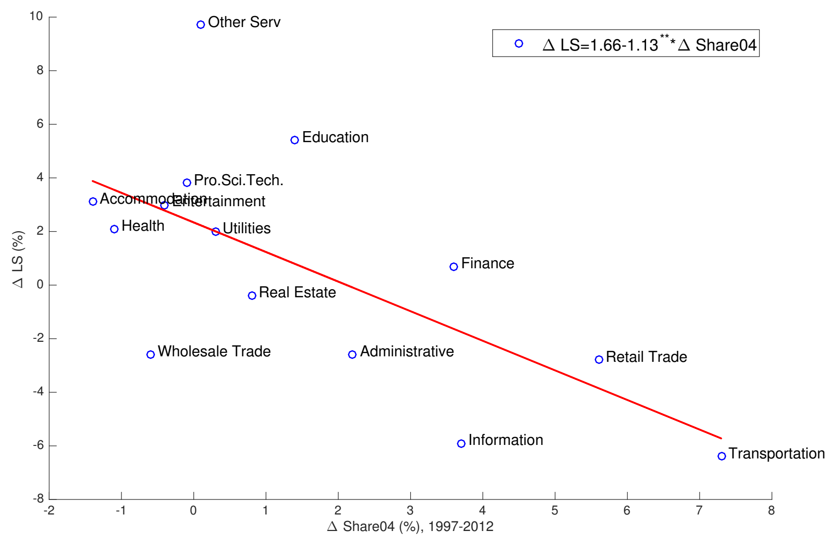
Note: The single variable regression results are based on 4 digit SIC manufacturing sectors. The dependent and independent variables are the change in labor share and concentration, from 1963 to 1967 in the first two columns, and from 1972 to 1977 in the last two columns. $\Delta CR04$ refers to the change in *Share04*, which itself measure the share of value of shipment by the largest 4 firms in a sector. The weights used in WLS are the average value added of beginning and end years for each period.

Table 6.3: Depend. var.: ΔLS, 2007-2012

	LS1-OLS	LS2-OLS	LS1-WLS	LS2-WLS
$\Delta CR04$	-0.292**	-0.386***	-0.267***	-0.348***
	(0.041)	(0.051)	(0.032)	(0.043)
R^2	0.23	0.25	0.29	0.28
$\Delta CR08$	-0.352***	-0.475***	-0.363***	-0.476***
	(0.049)	(0.061)	(0.038)	(0.051)
R^2	0.23	0.26	0.34	0.33
$\Delta CR20$	-0.400***	-0.558***	-0.442***	-0.581***
	(0.065)	(0.081)	(0.050)	(0.067)
R^2	0.18	0.22	0.31	0.30
$\Delta CR50$	-0.357***	-0.558***	-0.442***	-0.714***
	(0.092)	(0.115)	(0.050)	(0.096)
R^2	0.08	0.12	0.31	0.24
Obs.	175	175	175	175

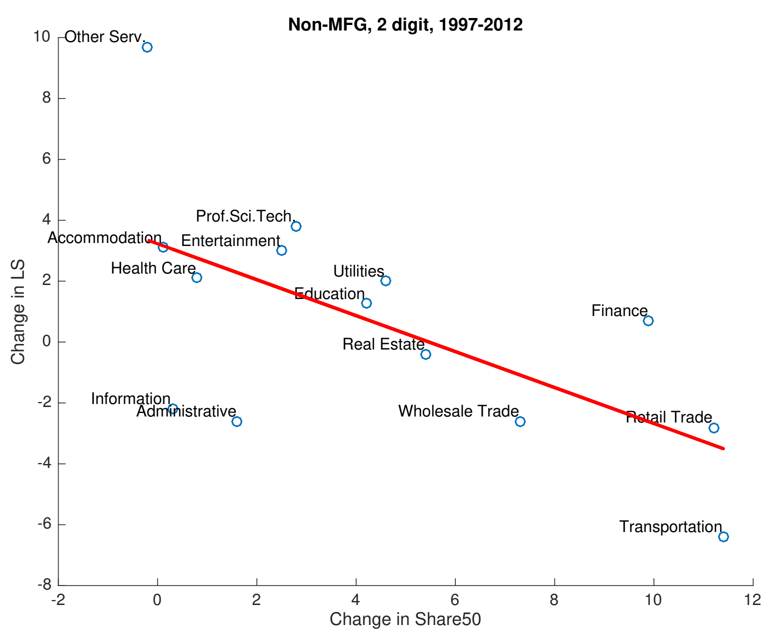
Note: The single variable regression results are based on manufacturing sectors, at the 5 digit level. LS1 is the ratio of payroll to value added, and LS2 the ratio of compensation (=payroll+benefit) to value added. The average value added between 2007 and 2012 is used as weight in WLS.

Figure 6.4: ΔLS v.s. $\Delta Share04$, NON-MFG, 1997-2012



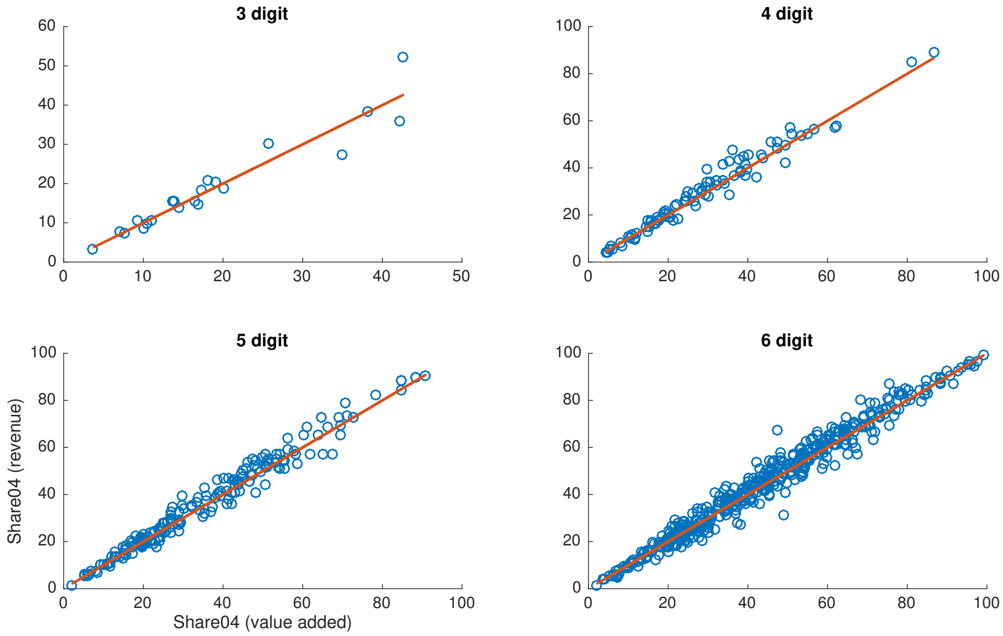
Note: LS in the vertical axis is the fraction of compensation of employees to value added. Concentration in the horizontal axis is the revenue share of 4 largest firms.

Figure 6.5: ΔLS v.s. $\Delta Share50$, NON-MFG, 1997-2012



Note: LS in the vertical axis is the fraction of compensation of employees to value added. Concentration in the horizontal axis is the revenue share of 50 largest firms. In this graph, I made minimum adjustments to LS in 1997 based on data in Table 6.9. In particular LS for *Information* in 1996, instead of 1997, and the average LS for *Education*, between 1996 and 1998, instead of 1997, are employed.

Figure 6.6: Share of 4 largest firms: value added v.s. revenue, MFG 2002



Note: The vertical axis is the revenue share of 4 largest firms (in terms of revenue); the horizontal axis is the value added share of 4 largest firms (in terms of value added).

Table 6.4: Depend. var.: Share04_rev, MFG 2002

	3 digit	4 digit	5 digit	6 digit
Share04_vadd	0.917***	0.948***	0.959***	0.956***
	(0.043)	(0.014)	(0.008)	(0.007)
R^2	0.92	0.97	0.97	0.97
Obs.	21	86	183	467

Note: The dependent var. is the revenue share of the 4 largest firms (in terms of revenue); the independent var. is the value added share for the 4 largest firms (in terms of value added).

Table 6.5: Concentration in Manufacturing-I

	Share04				Share08			
Year	3-D	4-D	5-D	6-D	3-D	4-D	5-D	6-D
1997	19.82	29.99	35.12	42.37	27.43	40.29	46.53	54.04
2002	20.81	32.19	37.52	44.84	29.38	43.01	49.05	57.40
2007	20.88	32.18	37.48	44.93	30.92	44.38	50.68	59.03
2012	21.64	32.63	38.26	44.47	32.56	45.20	51.90	59.20
	Share20				Share50			
Year	3-D	4-D	5-D	6-D	3-D	4-D	5-D	6-D
1997	39.82	54.59	60.98	69.59	52.61	67.00	73.23	79.15
2002	42.21	56.63	63.07	71.20	54.81	68.44	74.56	80.07
2007	44.27	58.65	65.29	73.22	56.53	70.60	76.77	83.61
2012	46.16	60.27	67.06	74.28	58.28	72.30	78.61	84.97

Note: *Share04* refers to the weighted average of share of revenue for the 4 largest firms, with revenue as weights. 3-D means 3 digit NAICS sectors. Total numbers of 6 digit sectors decrease from 467 in 2007 to 362 in 2012. Industrial classification is consistent over time at other digit levels.

Table 6.6: Concentration in Manufacturing-II

Year	Share04	Share08	Share20	Share50	Obs.
1963	39.19%	51.22	65.28	76.63	410
1967	38.97	51.42	65.51	77.47	408
1972	39.65	51.83	67.23	79.15	449
1977	39.13	52.64	67.96	79.86	444
1982	36.83	49.82	65.39	78.96	441
1987	40.11	52.23	67.23	79.23	451
1992	40.34	52.25	67.82	79.81	455
1997	42.37	54.04	69.59	79.15	470
2002	44.84	57.40	71.20	80.07	471
2007	44.93	59.03	73.22	83.61	467
2012	44.47	59.20	74.28	84.97	362

Note: *Share04* refers to the share of revenue for the 4 largest firms. The indices are weighted average across 4 digit SIC sector before 1992 and 6 digit NAICS sectors after 1997, weighted by revenue. The last column shows total numbers of sectors.

Relative Labor Share in Manufacturing

Table 6.7: Share of industry statistics (%), Manufacturing

Firm groups	Emp.	Payroll	Val. add.	Rel. LP	Rel. Wage	Rel. LS
1997						
50 largest	11.7%	17.3	24.5	205	148	72
50th to 100th largest	4.4	5.3	7.7	175	120	69
101st to 150th largest	3.6	4.2	5.2	144	117	81
151st to 200th largest	2.8	3.0	3.8	136	107	79
201st and smaller	77.5	70.2	59.3	73	91	118
2007						
50 largest	9.9%	14.5	25.5	258	146	57
50th to 100th largest	5.3	6.3	9.1	141	120	85
101st to 150th largest	4.3	4.7	5.3	130	108	83
151st to 200th largest	2.3	2.8	3.6	185	107	65
201st and smaller	78.3	71.8	56.5	73	91	125
2012						
50 largest	10.8%	15.5	26.1	242	144	59
50th to 100th largest	6.1	7.3	8.6	172	119	69
101st to 150th largest	4.0	4.3	5.2	123	109	89
151st to 200th largest	2.0	2.4	3.7	157	122	78
201st and smaller	77.2	70.5	56.4	72	92	127

Note: Data source: *Census of Manufacturers*. Relative labor productivity is defined as the ratio of the share of value added to the share of employment. Relative Wage is the ratio of the share of payroll to the share of employment. Relative Labor Share is the ratio of the share of payroll to the share of value added.

Table 6.8: Relative LS, LP and Wage for 100 and 200 largest MFG firms

	1967	1972	1977	1982	1987	1992	1997	2002	2007	2012
50 largest										
Rel. LS	98%	98	97	92	92	83	72	67	57	59
Rel. LP	128	134	143	150	158	169	205	209	258	242
Rel. Wage	126	131	139	138	144	141	148	140	146	144
100 largest										
Rel. LS	94	93	94	90	87	79	71	68	60	66
Rel. LP	132	136	140	147	158	171	200	194	228	205
Rel. Wage	123	127	132	133	138	136	140	132	137	135
200 largest										
Rel. LS	93	92	92	90	87	81	73	72	65	68
Rel. LP	131	132	137	141	150	160	181	174	200	191
Rel. Wage	120	122	125	126	130	129	132	125	130	129

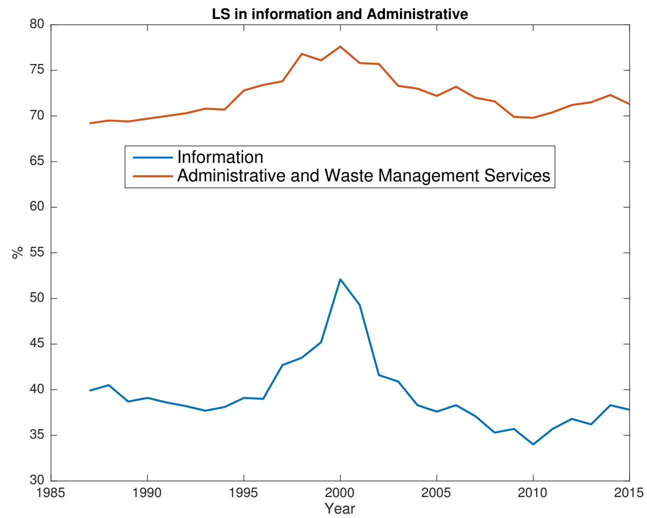
Note: Data source: *Census of Manufacturers*.

Table 6.9: Labor Share (%), 2 digit sectors

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1987	24.6	63.7	54.1	60.5	68.8	39.9	23	6.5	60.9	69.2	86.9	78.8	50.7	64.4	60.9
1988	24.9	62.4	53.9	60.5	67.5	40.5	23.1	6.7	61.4	69.5	86.5	79.8	51.6	65.2	61.4
1989	23.7	61.3	54.3	59.9	68.7	38.7	22.4	6.5	60.9	69.4	86.4	78.9	49.5	64.8	61.2
1990	23.9	61.4	54.9	60.6	69.9	39.1	22.2	6.4	60.8	69.7	87.5	79.2	48.9	65.7	62.2
1991	24.1	61.4	53.7	60.7	68.7	38.6	21.8	6.2	61.1	70	86	79.4	50	65.5	62.3
1992	24.6	61.8	54.4	60.9	69.2	38.2	22.5	6	61.5	70.3	87	79.9	49	65.7	62
1993	24.3	61	52.2	58.6	66.6	37.7	22.6	5.9	61.3	70.8	86.9	79.7	51.9	63.7	61.3
1994	23.3	59.8	50.2	58.2	65.1	38.1	22.1	5.9	61	70.7	86.1	79.6	52.1	63	60.2
1995	22.5	58.5	51.3	58.4	65.3	39.1	21.9	5.8	62.2	72.8	86.4	80.3	52.9	62.9	61.1
1996	22.9	58.1	50.7	57.7	65.9	39	22.4	5.9	62.8	73.4	86.9	81	53.6	62	61.7
1997	24.5	56.8	50.2	57.6	65.2	42.7	23.2	5.9	65	73.8	82.5	81.5	51.9	61.2	61.2
1998	26.3	58.1	51.1	57.1	64.9	43.5	24.3	6.3	67.1	76.8	86.4	82.1	55.3	62.8	61.5
1999	26.2	58.3	51.6	57.5	66.5	45.2	24.2	6.2	67.4	76.1	86.4	82.1	55.1	62.5	61.1
2000	27.9	59	52.5	58.3	66.8	52.1	24.6	6.4	70.5	77.6	86.5	82.1	55.8	61.1	61.4
2001	29.3	59.6	53.4	58.4	67.6	49.3	24.4	6.1	69	75.8	86.9	81.8	60	62.6	66.5
2002	30.3	57.5	53.3	58	67.6	41.6	23.6	6.1	65.2	75.7	89.9	81.7	59.27	60.9	66.1
2003	28.3	55.3	52.1	57.3	65.3	40.9	23.5	6	64.5	73.3	88.4	82.2	57.7	61.9	68.9
2004	27.4	54	50.8	57.2	63.2	38.3	24.5	6.2	64.2	73	87.2	82.4	56.9	62	69
2005	27.9	52.6	49.9	56.3	61.7	37.6	24.1	6.1	65.6	72.2	87.2	82.9	56	62.1	67.2
2006	26.5	51.3	49.6	56.1	59.1	38.3	24.8	6.3	67.1	73.2	86.8	83.1	56.1	61.5	67.2
2007	26.8	50.9	49.9	57.7	62.5	37.1	25.4	6.1	67.6	72	87	83.7	55.9	62.8	69.9
2008	27.9	51.4	49.6	58.5	60.5	35.3	25.8	5.8	65.7	71.6	86.5	82.8	57.5	63.9	72.5
2009	26.7	48.4	49.3	56.3	60.5	35.7	22.7	5.4	66.9	69.9	85.6	82.1	56.6	63.3	71.6
2010	25.3	46.3	47.5	55.2	57.8	34	23	5.3	66.8	69.8	85.8	82.4	55.1	62.7	70
2011	26.2	46.3	48.1	55.7	58.2	35.7	23.4	5.3	67.7	70.4	86.8	83	55.4	63.5	71
2012	26.5	46.3	47.6	54.8	58.8	36.8	23.1	5.5	68.8	71.2	87.9	83.6	54.9	64.3	70.9
2013	26.8	45.7	46.7	54.4	58	36.2	23.1	5.5	69.8	71.5	88.6	84	54.7	63.9	71.1
2014	26.3	46.2	46.9	54.5	57.7	38.3	23.1	5.7	70.4	72.3	89.1	84.1	54.8	64.6	71.7
2015	27	46.2	46.8	54.2	58.1	37.8	23.3	5.8	70.4	71.3	89	83.6	54	64.4	71.2

Note: LS is the share of compensation in value added. (1)-Utilities; (2)-Manufacturing; (3)-Wholesale Trade; (4)-Retail Trade; (5)-Transportation and Warehousing; (6)-Information; (7)-Finance and Insurance; (8)-Real Estate, rental and leasing; (9)-Professional, Scientific and Technical Services; (10)-Administrative and Waste Management Services; (11)-Educational Services; (12)-Health Care and Social Assistance; (13)-Arts, Entertainment, and Recreation; (14)-Accommodation and Food Services; (15)-Other Services. Data Source: NIPA Value-added-by-Industry.

Figure 6.7: LS in *Information* and *Administrative*



There are surges in LS both in Information and Administrative (i.e. Administrative and Support and Waste Management and Remediation Services) sectors . This is partly caused by the realization of stock options, which is counted as labor compensation, during the internet bubble (Moylan (2008)). In 1998, labor compensation in the Administrative sector increased 11.7%, while the increase in value added is 7.4%, which results in an increase in labor share by 3% in that single year.

Information sector (NAICS 51) contains 6 sub-sectors: Publishing industries (except internet) (NAICS 511); Motion Picture and Sound Recording Industries (NAICS 512); Broadcasting (except internet) (NAICS 515); Telecommunications (NAICS 517); Data Processing, Hosting, and Related Services (NAICS 518); Other Information Services (NAICS 519). In 2012, the first and second sub-sectors account for 26%, and 15% of value added in the aggregate *Information* sector. Broadcasting and Telecommunication accounts for 52%, and the remaining 7% goes to the last two sub-sectors combined. Table 6.10 lists labor share, measured as share of compensation in valued added in each sub-sectors around 2000.

Table 6.10: LS in Information sub-sectors

	1998	1999	2000	2001	2002
Publishing industries, except internet	56.4%	50.6	65.6	65.7	51.0
Motion Pictures and sound recording industries	39.2	32.1	37.6	35.2	31.1
Broadcasting and telecommunications	35.2	38.5	39.1	38.3	36.7
Data processing, internet publishing, and other info. serv.	66.7	105.1	170.6	103.3	54.8

Table 6.11: Relative LS in Non-Manufacturing sectors, 2002

NAICS	(1)-Average 1-4	5-20	21-50	≥ 51	(2)-Weight=revenue 1-4	5-20	21-50	≥51	(3)-Weight=employment 1-4	5-20	21-50	≥51
1997												
2 digit	79.4%	88.0	84.3	104.9	56.3	86.9	67.9	109.0	79.8	93.2	85.7	104.0
3 digit	86.2	90.6	92.4	115.1	71.1	80.6	76.8	115.9	90.5	91.8	90.7	108.1
4 digit	83.4	91.8	99.4	113.5	80.8	83.4	90.1	118.3	90.0	92.7	97.4	109.1
5 digit	82.7	92.9	102.8	114.3	83.6	86.5	94.4	119.0	90.3	93.9	99.9	109.5
6 digit	84.4	95.3	103.9	113.8	83.7	86.3	94.8	120.3	90.8	94.0	100.0	110.0
2002												
2 digit	79.1%	83.4	84.4	107.2	65.6	72.5	78.4	113.0	79.2	89.8	86.9	106.1
3 digit	76.7	86.3	96.4	118.5	64.8	80.5	87.1	118.9	84.2	90.5	92.7	109.3
4 digit	81.7	90.4	99.7	113.7	81.3	85.8	91.9	116.8	87.4	92.3	96.4	108.9
5 digit	81.5	92.6	102.2	115.7	82.1	89.4	95.8	116.6	87.5	94.3	98.1	108.6
6 digit	83.3	94.5	102.7	115.3	83.2	88.4	96.6	118.6	88.5	94.1	98.3	109.7
2007												
2 digit	81.6%	84.4	79.2	108.0	66.1	72.3	70.7	112.8	87.0	89.8	82.4	105.9
3 digit	81.6	86.2	88.7	116.7	64.5	78.3	83.2	119.0	89.5	89.6	89.6	109.1
4 digit	83.4	89.6	97.8	112.7	82.0	84.6	87.4	116.0	89.0	92.4	93.6	108.7
5 digit	81.6	91.7	102.2	117.6	82.3	87.6	94.0	118.9	88.7	93.6	96.7	109.5
6 digit	83.0	93.6	103.4	117.1	82.6	87.8	94.5	120.6	89.8	93.5	96.9	110.4
2012												
2 digit	83.8%	80.8	87.2	107.7	59.6	63.1	78.2	115.7	87.0	87.5	89.5	106.1
3 digit	83.3	88.5	89.9	117.2	62.6	77.1	84.2	122.1	90.1	93.8	91.4	109.1
4 digit	82.8	91.6	95.6	114.3	83.5	85.5	88.8	117.3	89.9	94.2	94.2	108.5
5 digit	80.6	93.6	101.7	118.0	82.6	87.7	95.3	118.6	89.5	95.8	96.1	108.2
6 digit	82.3	95.1	103.1	116.7	82.0	87.5	96.4	119.7	89.6	95.2	96.8	108.9

1-4 denotes the 4 largest firms. For Services sectors in 1997, the indices are for establishments subject to federal taxes, due to data availability.

Table 6.12: Relative LS, 2 digit Non-Manufacturing sectors, 2002

NAICS	Sector	Rel. LS				Rel. LP				Rel. Wage			
		1-4	5-20	21-50	≥51	1-4	5-20	21-50	≥51	1-4	5-20	21-50	≥51
22	Utilities	116.5%	98.0	105.3	90.7	105.4	108.2	97.8	92.5	122.4	106.1	103.0	84.0
42	Wholesale trade	10.4	35.0	61.2	123.8	834.1	343.2	210.8	79.3	87.1	120.2	128.9	98.1
44-45	Retail trade	95.7	97.9	90.1	102.2	96.2	92.7	89.0	103.7	92.0	90.7	80.2	106.0
48-49	Transportation	94.6	81.5	78.2	106.6	107.8	141.3	155.1	90.7	101.7	115.2	121.2	96.7
51	Information	84.6	74.0	88.9	130.7	125.9	165.2	107.5	70.7	106.5	122.3	95.6	92.4
52	Finance	91.0	76.1	70.9	118.4	124.2	128.0	159.1	82.0	113.1	97.4	112.8	97.0
53	Real Estate	93.9	64.1	86.4	106.9	87.4	163.2	165.3	92.6	82.0	104.6	142.8	99.0
54	Prof. Sci. Tech.	74.6	90.2	88.4	102.8	167.0	117.0	99.3	97.0	126.0	104.7	86.4	100.0
56	Administrative	68.9	124.8	100.8	99.5	281.7	80.2	121.1	96.4	195.0	100.1	122.1	95.9
61	Education	91.1	85.5	96.7	102.8	172.8	178.3	210.0	88.9	141.0	142.1	181.5	93.3
62	Health Care	73.1	91.2	91.0	103.3	139.9	138.0	111.8	96.5	108.6	126.0	102.6	98.5
71	Entertainment	53.1	69.6	69.7	99.8	218.9	102.0	142.6	93.9	95.8	70.0	97.4	102.7
72	Accommodation	94.0	104.1	99.9	99.8	121.0	126.5	127.4	94.3	113.7	131.7	127.3	94.1
81	Other Services			93.5	101.9			163.4	96.8			109.1	100.0

Note: Relative LS for a subset of firms in a sector is defined as the ratio of the share of payroll for these firms to their share of value added. $1-4$ denotes the 4 largest firms.

Table 6.13: Between-Within decomposition of LS, 1987-2013

Sector	(1)-vadd share, %			(2)-labor share, %			(3)-decompstion	
	1987	2013	change	1987	2013	change	between	within
Nonfarm Private	–	–	–	51.82	48.90	-2.92	0.84	-3.62
Utilities	3.38	2.09	-1.29	24.59	26.84	2.25	-0.33	0.06
Manufacturing	23.58	15.83	-7.75	63.69	45.67	-18.02	-4.32	-3.43
Wholesale Trd.	7.67	7.79	0.12	54.06	46.70	-7.36	0.06	-0.56
Retail Trade	9.28	7.54	-1.74	60.48	54.41	-6.07	-1.01	-0.51
Transportation	4.11	3.79	-0.32	68.80	58.02	-10.00	-0.21	-0.38
Information	5.98	6.16	0.18	39.94	36.15	-3.79	0.07	-0.23
Finance	7.58	8.84	1.26	56.12	56.35	0.22	0.70	0.02
Real Estate	15.21	16.79	1.58	6.51	5.52	-0.99	0.09	-0.16
Prof. Sci. Tech.	6.01	8.93	2.92	60.93	69.8	8.88	1.90	0.70
Administrative	2.35	3.85	1.50	69.18	71.54	2.36	1.08	0.08
Education	0.90	1.44	0.54	86.91	88.63	1.72	0.47	0.02
Health Care	6.58	9.24	2.66	78.75	84.00	5.25	2.17	0.42
Entertainment	0.90	1.28	0.33	50.69	54.66	3.97	0.21	0.05
Accommodation	3.21	3.60	0.39	64.38	63.93	-0.45	0.25	-0.02
Other Serv.	3.25	2.83	-0.42	60.87	71.08	10.21	-0.27	0.33

Note: Labor Share is measured as the share of *Compensation of employees* in *Value added*. Data source: BEA's *Value Added by Industry* Data.

Table 6.14: Between-Within decomposition of LS (adjusted for capital depreciation), 1987-2013

Sector	(1)-vadd share, %			(2)-labor share, %			(3)-decompstion	
	1987	2013	change	1987	2013	change	between	within
Nonfarm Private	–	–	–	59.81	57.20	-2.61	0.45	-2.95
Utilities	2.98	1.73	-1.25	32.19	37.98	5.79	-0.43	0.13
Manufacturing	23.25	14.97	-8.28	74.54	56.51	-18.03	-5.56	-3.32
Wholesale Trade	8.15	8.49	0.34	58.74	50.13	-8.61	0.19	-0.71
Retail Trade	10.19	8.11	-2.08	63.58	59.15	-4.43	-1.29	-0.40
Transportation	3.85	3.75	-0.10	84.71	68.53	-16.18	-0.08	-0.59
Information	5.43	5.39	-0.04	50.71	48.28	-2.43	-0.02	-0.13
Finance	7.82	9.07	1.25	62.85	64.28	1.43	0.79	0.13
Real Estate	13.54	15.14	1.60	8.44	7.16	-1.28	0.13	-0.18
Prof. Sci. Tech.	6.53	9.52	2.99	64.68	76.62	11.94	2.11	1.00
Administrative	2.56	4.16	1.60	73.36	77.50	4.14	1.23	0.15
Edu. & Health Care	7.96	11.41	3.45	86.54	92.63	6.09	3.08	0.60
Entertainment	0.87	1.29	0.42	60.37	63.20	2.83	0.27	0.03
Accommodation	3.38	3.93	0.55	70.56	68.54	-2.02	0.38	-0.07
Other Services	3.50	3.04	-0.46	65.21	77.40	12.19	-0.32	0.42

Note: value added is adjusted for consumption of fixed capital (depreciation). Education and health care are merged since labor share in *Educational Services*, adjusted this way, exceeds 100% in some years. Data source: BEA GDP-by-Industry-Data, NIPA *Table 3.4 ESI Current-Cost Depreciation of Private Fixed Assets*.

Table 6.15: Share (%) of proprietors' income in value added

Sector	1998	2013	change	Sector	1998	2013	change
Nonfarm Private	6.53	6.14	-0.39	Real Estate	3.84	2.43	-1.39
Utilities	0.50	-4.49	-5.99	Prof. Sci. Tech.	19.63	16.52	-3.09
Manufacturing	1.20	1.35	0.15	Admin. & Manage.	4.10	5.12	1.02
Wholesale Trade	3.87	3.82	-0.05	Education	3.16	3.25	0.09
Retail Trade	7.34	7.91	0.57	Health Care	11.67	9.55	-2.12
Transportation	9.43	7.43	-2.00	Entertainment	15.16	14.85	-0.31
Information	1.67	2.62	0.95	Accommodation	6.21	4.49	-1.72
Finance	4.35	4.18	-0.17	Other Services	30.14	31.13	0.99

Note: Average share from 2010 to 2013, instead of 2013, for *Information* is used. Data for proprietors's income in *Administrative and Waste Management Services* and *Management of Companies and Enterprises* are merged. Data source: BEA GDP-by-Industry-Data, NIPA *Table 6.12D Nonfarm Proprietors' Income by Industry*

Table 6.16: Concentration and Relative LS, Top-50 firms

	CR (Share50)				RLS-Top50			
	1997	2002	2007	2012	1997	2002	2007	2012
Wholesale Trade	20.3	27.2	24.9	27.6	39.9	36.4	30.8	26.9
Retail Trade	25.7	31.7	33.3	36.9	96.4	95.2	95.4	92.9
Transportation	30.7	33.0	42.7	42.1	103.7	86.6	81.9	80.1
Utilities	64.5	69	70.1	69.1	94.9	104.2	102.4	107.3
Information		62	62	62.3		81.2	81.2	80.7
Finance	38.6	44.9	46	48.5	77.9	77.5	78.7	72.1
Real Estate	19.5	24.4	26.1	24.9	73.4	78.7	69.1	74.2
Prof. Sci. Tech.	16.2	16.5	18.6	19.0	84.6	85.8	84.7	93.8
Administrative	22.1	21.9	23.0	23.7	96.4	101.8	109.2	125.2
Education	19.6	23.2	23.5	23.8	79.7	90.8	87.7	90.6
Health Care	18.8	17.2	17.4	19.6	86.5	84.0	86.8	86.9
Entertainment	21.8	23.5	24.1	24.3	75.3	65.2	65.8	70.2
Accommodation	21.1	23.1	23.7	21.2	100.3	100.7	100.9	102.2
Other Services	12.8	14	13.8	12.6	94.9	88.3	91.4	100.4

Note: For most services sectors in 1997, statistics are only available for establishments subject to federal income taxes (instead of all establishments) in Service sectors. To be consistent, the same criteria is applied to 2002, 2007, and 2012.

Table 6.17: Revenue share and relative LS of 20 largest firms

	CR (Share20)				RLS-Top20			
	1997	2002	2007	2012	1997	2002	2007	2012
Manufacturing	–	–	–	–	–	–	–	–
Wholesale Trade	12.9	18.7	16.6	18.1.6	42.1	25.2	22.4	11.1
Retail Trade	18.5	23.9	25.4	27.8	99.9	96.9	102.4	97.2
Transportation	21.8	25.2	34.9	33.7	111.3	89.2	85.3	81.1
Utilities	40.6	44.9	44.5	48	85.7	103.5	110.8	116.0
Information		48.5	49.9	50.7		79.1	77.5	69.21
Finance	22.6	28.2	28.5	31.6	80.9	81.4	81.3	68.6
Real Estate	14.1	17.1	16.3	15.8	80.9	75.4	76.7	78.8
Prof. Sci. Tech.	11.6	11.3	12.7	12.6	84.1	84.7	80.3	91.5
Administrative	14.2	14.9	15.2	16.7	88.6	102.3	117.5	133.9
Education	13.3	16	16.1	16.7	76.6	88.2	85.2	95.1
Health Care	14.2	13.3	13.1	14.9	85.9	81.9	82.3	82.3
Entertainment	15.1	14.7	15.6	15.9	70.6	62.4	62.5	63.6
Accommodation	14.8	16.5	17.4	15.1	99.3	101.1	102.5	103.4
Other Services	8.5	10	10	8.3	97.3	86.2	92.9	104.5

Note: For most services sectors in 1997, statistics are only available for establishments subject to federal income taxes (instead of all establishments), and thus omitted from this table.

Table 6.18: Revenue share and relative LS for 4 largest firms, 6-digit average

	Share04				Relative LS			
	1997	2002	2007	2012	1997	2002	2007	2012
Wholesale Trade	24.3%	31.4	29.1	30.8	55.4%	51.3	51.2	47.0
Retail Trade	18.5	26.8	31.0	34.6	89.8	89.4	90.4	84.6
Transportation	23.6	24.5	30.8	35.2	94.7	89.6	92.5	89.7
Utilities	25.8	23.2	23.0	24.2	86.1	90.8	86.5	111.7
Information		49.83	52.4	52.0		87.1	92.7	92.5
Finance	26.0	32.0	36.1	35.4	94.1	96.2	92.5	97.8
Real Estate	18.8	24.0	25.1	23.3	92.9	76.4	72.8	83.2
Prof. Sci. Tech.	15.0	15.1	17.9	18.3	82.1	78.6	80.6	81.8
Administrative	21.8	23.1	24.4	24.4	94.3	94.5	95.5	99.3
Education	16.6	19.4	19.4	19.4	80.1	90.2	92.5	91.1
Health Care	16.2	15.1	15.1	17.0	92.0	90.1	97.6	97.4
Entertainment	19.2	20.5	21.5	21.6	86.1	79.6	87.8	80.0
Accommodation	13.8	17.4	18.5	16.0	103.4	103.5	107.9	105.7
Other Services	13.8	14.7	15.0	14.1	100.3	94.0	94.8	97.2

Note: Both concentration and Relative LS are weighted average across 6 digit NAICS sectors, with revenue as weights.

Labor share (measured as the share of compensation in revenue). Data Source: Compustat

Figure 6.8: LS in selected MFG firms, 1970-2016

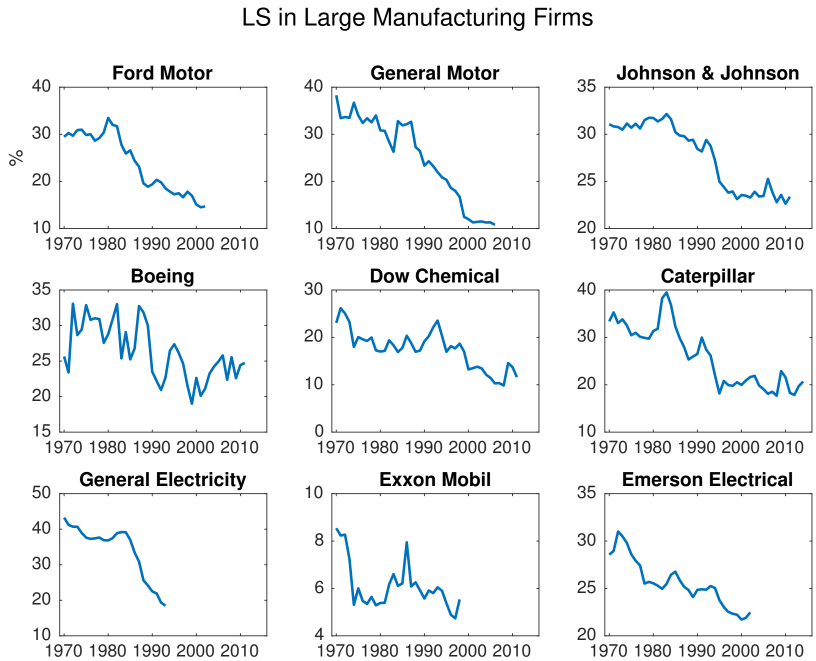


Figure 6.9: LS in selected Transportation firms, 1970-2016

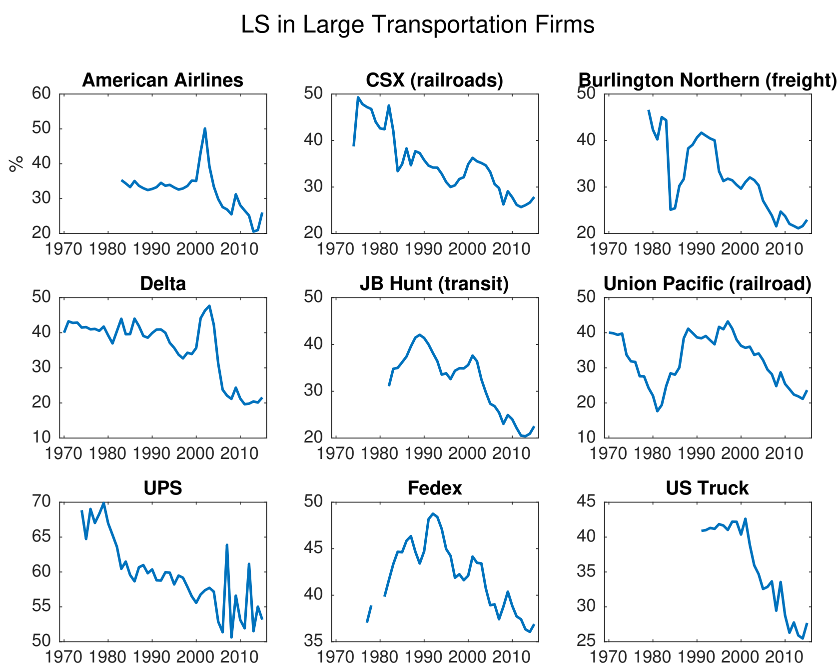


Figure 6.10: LS in selected Finance firms, 1970-2016

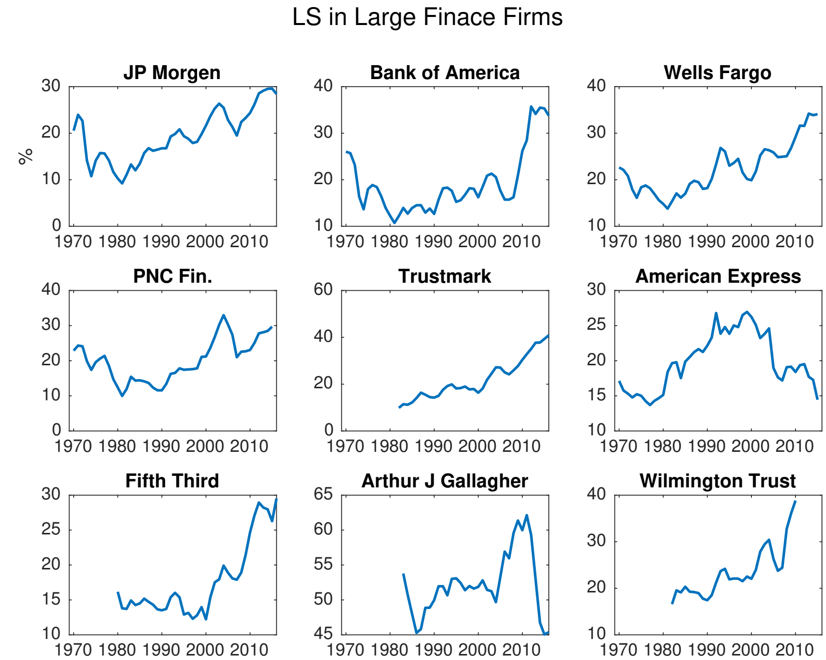
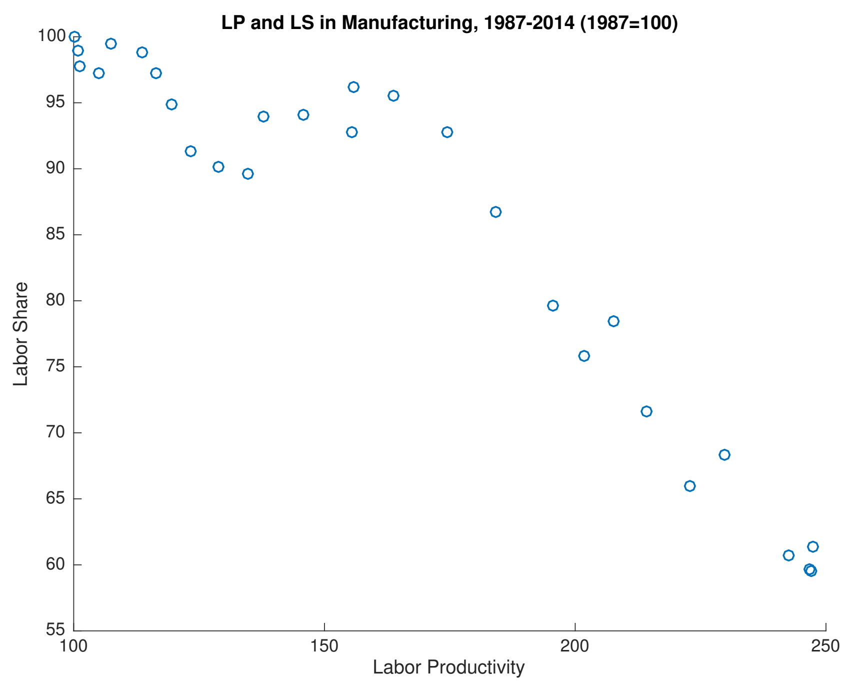


Figure 6.11: LP and LS, Manufacturing 1987-2014 (1987=100)



Note: A circle represents a year. Data Source: The 'Labor Productivity and Costs' program of Bureau of Labor Statistics.