# Concentrating on the Fall of the Labor Share

*By* DAVID AUTOR, DAVID DORN, LAWRENCE F. KATZ, CHRISTINA PATTERSON AND JOHN VAN REENEN*

\* Autor: MIT Department of Economics, Cambridge, MA 02142 (email:dautor@mit.edu); Dorn: University of Zurich, Schoenberggasse 1, 8001 Zurich, Switzerland (e-mail: ddorn@econ.uzh.ch); Katz: Department of Economics, Harvard University, Cambridge, MA 02138 (e-mail: lkatz@harvard.edu); Patterson: MIT Department of Economics, Cambridge, MA 02142 (email:cpatt@mit.edu);; Van Reenen: MIT Sloan School and Dept. of Economics, Cambridge, MA 02142 (email:vanreene@mit.edu);. This is a companion paper to Autor et al. (2016). We thank Daron Acemoglu and Jason Furman for helpful discussions. This research was funded by the National Science Foundation, the European Research Council, the Economic and Social Research Council, the MIT Initiative on the Digital Economy, and the Swiss National Science Foundation.

## I. Introduction

There has been an upswing of interest in economics and the media over the decline in the share of GDP going to labor. The stability of the labor share of GDP was one of the famous Kaldor (1961) "stylized facts" of growth. The macro stability of labor's share was always, as Keynes remarked, "something of a miracle" and disguised instability at the industry level (Elsby et al., 2013). Karabarbounis and Neiman (2013) emphasize that the decline in the labor share is not confined to the U.S. and occurs primarily within rather than between industries. Although there is controversy over the degree to which the fall in the labor share is due to

measurement issues such as the treatment of housing (Rognlie, 2015) and intangible capital (Koh et al., 2016), there is consensus that there has been a decline in the U.S. labor share since the 1980s particularly in the 2000s.

Nevertheless, little consensus exits on the causes of the decline in the labor share. Elsby et al. (2013) argue for the importance of international trade and find that the labor share declines the most in U.S. industries strongly affected by import shocks. However, labor shares have also declined in most non-traded sectors such as wholesale, retail and utilities, a pattern not readily explained by rising trade.

Karabarbounis and Neiman (2013) instead emphasize that the cost of capital has fallen relative to the cost of labor, driven especially by rapid declines in quality-adjusted equipment prices of information and communication technologies. A decline in the relative price of capital will lead to a decline in the labor share under CES production functions if the capital-labor elasticity of substitution is greater than unity. Although Karabarbounis and Neiman present evidence

that the elasticity exceeds unity, the bulk of the empirical literature suggests a much lower elasticity (e.g. Lawrence, 2015). Since changes in relative factor prices tend to be similar across firms, lower relative equipment prices should lead to greater capital adoption and falling labor shares in all firms. In Autor et al. (2016) we find the opposite: the unweighted mean labor share across firms is roughly constant since 1982. Thus, the typical firm shows no decline in its labor share. To explain the decline in the aggregate labor share, one must study the reallocation of activity among heterogeneous firms toward firms with low and declining labor shares.

In Autor et al. (2016) we propose a new "superstar firm" model that emphasizes the role of firm heterogeneity in the dynamics of the aggregate labor share. We hypothesize that industries are increasingly characterized by a "winner take most" feature where one firm (or a small number of firms) can gain a very large share of the market. Large firms have lower labor shares if production requires a fixed amount of overhead labor in addition to a size-dependent variable labor input, or if markups in the product market correlate positively with firm size. Possible explanations for growing include the diffusion of new competitive platforms (e.g. easier price/quality comparisons on the Internet), the proliferation of information-intensive goods (e.g., software platforms and online services) that have high fixed and low-marginal costs, or the increase in the international integration of product markets. New technologies may also have strengthened network effects and favored firms that are more adept at adopting and exploiting new modes of production.

This paper exposits and evaluates two core claims of the superstar firm explanation: (1) the concentration of sales among firms within an industry has risen across much of the U.S. private economy; and (2) industries with larger increases in concentration should experience a larger decline in labor's share.

## II. Model

To see the intuition for a link between the rise of superstar firms and a decline in the labor share, consider a production function $Y = AV^{\alpha_L}K^{1-\alpha_L}$ where $Y$ is value-added, $V$ is variable labor, $K$ is capital and $A$ is Hicks-neutral efficiency ("TFPQ"), which we assume is heterogeneous across firms. There is a fixed amount of overhead labor $F$ needed for production, so total labor is $L = V + F$. We assume that factor markets are competitive with wage $w$ and cost of capital $r$ being equal to the input factors' marginal products, while there is imperfect competition in the product

market. From the static first order condition for labor, we can write the share of labor costs $(wL)$ in nominal value added $(PY)$ as:

$$(1) \qquad S_i = \left(\frac{wL}{PY}\right)_i = \frac{\alpha_L}{\mu_i} + \frac{wF}{(PY)_i}$$

where $\mu$ is the mark-up, the ratio of product price $(P)$ to marginal cost $(c)$, and $F$ is fixed cost (assumed to be in terms of overhead labor). The firm sub-scripts $i$ indicate that for given economy-wide values of $(\alpha_L, w, F)$ a firm would have a lower labor share if (i) its share of fixed costs in total revenues are lower or (ii) its mark-up is higher. Superstar firms (firms with high $A_i$) will be larger because they produce more efficiently and capture a higher share of industry output. Superstar firms therefore will have a lower share of fixed costs in total revenues, and thus a lower labor share. In monopolistically competitive models, the mark-up is the same across firms in an industry: $\mu = \rho/(\rho - 1)$, where $\rho$ is the price elasticity of demand. However, in other models of imperfect competition, firms with larger market shares will be able to set higher mark-ups (e.g. Cournot competition), also leading to a negative relationship between firm size and labor shares. In either case, when there is an exogenous change that allocates more market share to a small number of large superstar firms, the aggregate labor share will fall as the economy shifts towards these low labor share firms. Autor et al (2016) formalize this idea in a simple a superstar firm model for a monopolistically competitive setting. Distinct from the prior literature, the superstar firm model emphasizes the changing heterogeneity of firms within industries as being critical for understanding the fall in the labor share. We next show that, in line with the model's mechanism, the concentration of sales across firms within industries has grown in most U.S. sectors.

### III. Data and Empirical Findings

We use data from the U.S. Economic Census, conducted every five years to enumerate all establishments in select sectors on current economic activity. We focus on the Economic Census from 1982 to 2012 for six large sectors: manufacturing, retail trade, wholesale trade, services, finance, and utilities and transportation. The covered establishments in these six sectors account for four-fifths of total private sector employment.

For the six sectors, the Census reports each establishment's annual payroll, output, employment, and an identifier for the firm to which the establishment belongs. To measure the concentration of sales within an industry, we use an output measure capturing total sales

by the establishment during the survey year. To measure sales at the firm level, we aggregate the sales of all establishments that belong to the same firm and the same industry. If a firm operates establishments in several industries, each combination of firm and industry is counted as a separate firm, capturing the firm's separate contributions to sales concentration in several industries.

To implement our industry-level analysis, we assign each establishment in a given year to a 1987 SIC-based time-consistent industry code as described in Autor et al. (2016). Our methodology yields 676 industries, 388 in manufacturing. All of our measures use these time-consistent industry definitions leading to measures of industry concentration that differ slightly from published statistics. The correlation between our calculated measures and those based on the published data is close to one, however, for periods without changes in industry definitions.

We measure the concentration of sales within an industry as the fraction of total sales accruing to its four largest firms (denoted CR4). Figure 1 plots the average CR4 across four-digit industries for the six sectors from 1982 to 2012.. The level of sales concentration varies considerably across sectors. In each year, the top four firms in an average manufacturing industry capture more than a third of the industry's total sales, while the top four firms in the average service industry combine for less than a sixth of total sales.

There is a remarkably consistent upward trend in concentration in each sector. In manufacturing, the sales-concentration ratio increases from 38% to 43%; in finance it rises from 24% to 35%; in services from 11% to 15%; in utilities from 29% to 27%; in retail trade from 15% to 30% and in wholesale trade from 22% to 28%.

To further characterize the emergence of superstar firms, Figure 1 also plots CR4 concentration measures based on firm employment rather than sales. Again, we observe a rising concentration in all six sectors for 1982 to 2012, although employment concentration has grown notably more slowly than sales concentration in finance, services, and especially in manufacturing. The pattern suggests that firms may attain large market shares with a relatively small workforce, as illustrated by Facebook and Google.

In Autor et al. (2016) we show that the two main qualitative findings of Figure 1 are robust to the use of alternative measures of industry concentration including the fraction of sales accruing to the 20 largest firms in an

industry (CR20) and an industry's Herfindahl-Hirschman Index (HHI). Sales have become more concentrated in each of the six broad sectors of the U.S. economy; employment also has concentrated in most sectors, but at a slower rate than sales concentration.

A measurement challenge for our conclusion of rising concentration for broad U.S. sectors is that our concentration measures are calculated exclusively using establishments producing in the U.S. Thus, our measures include production by foreign multinationals operating in the U.S., but they exclude imports. A measure only for the market shares of U.S. producers may mischaracterize concentration trends given rising import shares, particularly for manufacturing.

We assess the importance of trade in the competitive structure of manufacturing by calculating import-adjusted concentration ratios that treat imports from major country groups as if they belong to a single firm. Figure 2 plots the import-adjusted CR4 and CR20 measures along with the original measures only for U.S.-based establishments. The series with and without trade adjustment track each other closely, reaffirming our main finding of rising sales concentration. The slightly higher level of the adjusted concentration ratios implies that foreign producers (such as China) account for a sizable fraction of sales in some manufacturing industries. Imports in such industries likely originate from a small number of major foreign firms, but our data do not permit a firm-level breakdown of imports.

A further implication of our superstar firm model is that the labor share should fall differentially in industries that are experiencing larger increases in concentration. Intuitively, the causal force in our model is the shift in competitive conditions (fall in $\rho$), which reallocates market share to larger and more productive firms. Thus, rising concentration and falling labor shares should move in tandem, both in aggregate and between industries (assuming plausibly that competitive conditions have not shifted uniformly across all sectors).

Autor et al. (2016) test this implication by estimating bivariate regressions of five-year changes in the payroll share of value-added on the contemporaneous change in the C20 for the 388 manufacturing industries for the years 1987 – 2012. Figure 3, sourced from Autor et al. (2016), summarizes these regressions. In the *initial* five years of our sample, we detect no significant cross-industry relationship between rising concentration and falling labor share. But the cross-industry relationship

between rising concentration and falling labor share becomes negative and significant in the next five-year interval, and grows in absolute magnitude across each subsequent interval. In the final period from 2007 to 2012, we estimate that each percentage point rise in an industry's C20 concentration index predicts a 0.4 percentage point fall in its labor share.

Why has industry sales concentration increased? One set of explanations involves a technological change that has made markets increasingly "winner take most" so that superstar firms with higher productivity increasingly capture a larger slice of the market. Or if incumbents are more likely to innovate and the persistence of incumbent's innovative advantage has risen (Acemoglu and Hildebrand, 2017), the incumbent advantage would increase and so would incumbents' market shares.

An alternative set of explanations posits that higher concentration could arise from anti-competitive forces whereby dominant firms are increasingly able to prevent actual and potential rivals from entering and expanding. For instance, firms may lobby for regulatory barriers that complicate market entry for new firms. Higher entry barriers would enable incumbents to have higher monopolistic rents and therefore lower the labor share.

In the first set of explanations, the industries becoming increasingly concentrated will tend to be more dynamic with higher productivity and technical change. By contrast in the second set of explanations, the concentrating industries are likely to be dominated by less productive and less dynamic incumbents.

To adjudicate among these alternatives, we explored the relationship between changes in concentration and changes in other industry characteristics. Data limitations restrict this analysis to manufacturing. We find that the industries that became more concentrated over our sample period were also the industries in which productivity—measured by either output per worker, value-added per worker, TFP, or patents per worker—increased the most. Interestingly, there is no strong relationship between the change in concentration and the change in average wages. The findings suggest that a positive productivity-concentration relationship will most likely feature in any plausible explanation of rising industry concentration.

## IV. Conclusions

We consider a "superstar firm" explanation for the much-discussed fall in labor share of GDP. Our hypothesis is that technology or market conditions—or their interaction—have

evolved to increasingly concentrate rewards among firms with superior products or higher productivity—leading to better quality or lower costs—thereby enabling the most successful firms to control a larger market share. Because these superstar firms are more profitable, they will have a smaller share of their labor in total sales or value added. Consequently, the aggregate share of labor falls as the weight of superstar firms in the economy grows. The model yields many predictions that are elaborated and tested in Autor et al. (2016). A key underpinning of the superstar firm explanation for declining labor share is that sales should become increasingly concentrated in a small number of superstar firms across a wide range of industries. Consistent with the model, we find that the concentration of sales (and of employment) has indeed risen from 1982 to 2012 in each of the six major sectors covered by U.S. Economic Census. In Autor et al. (2016), we further show that those industries where concentration rises the most have the sharpest falls in the labor share, and that the fall in the labor share is mainly due to a reallocation of labor towards firms with lower (and declining) labor shares, rather than due to declining labor shares within most firms

## REFERENCES

Acemoglu, Daron and Nikolaus Hildebrand. 2017. "Increasing Concentration and Persistence of Innovation: Facts and Theory," mimeo.

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. 2016. "The Fall of the Labor Share and the Rise of Superstar Firms." Working Paper, Massachusetts Institute of Technology.

Elsby, Mike., Bart Hobijn, and Aysegul Sahin. 2013. "The Decline of the U.S. Labor Share." *Brookings Papers on Economic Activity*. 1-42

Kaldor, Nicholas. 1961. "Capital Accumulation and Economic Growth" in The Theory of Capital, ed. F. A. Lutz and D. C. Hague, New York: St. Martin's Press: 177-222.

Karabarbounis, Loukas and Brent Neiman. 2013. "The Global Decline of the Labor Share." *Quarterly Journal of Economics*, 129(1), 61-103.

Koh, Dongya, Raul Santaeulalia-Lopis, and Yu Zheng. 2016. "Labor Share Decline and the Capitalization of Intellectual Property Products". Barcelona Graduate School of Economics Working Papers 927.

Lawrence, Robert. 2015. "Recent Declines in Labor's Share in Us Income: A Preliminary Neoclassical Account" NBER Working Paper No. 21296.

Rognlie, Matthew. 2015. "Deciphering the Fall and Rise in the Net Capital Share: Accumulation or Scarcity?" *Brookings Papers on Economic Activity* (Spring): 1-69.
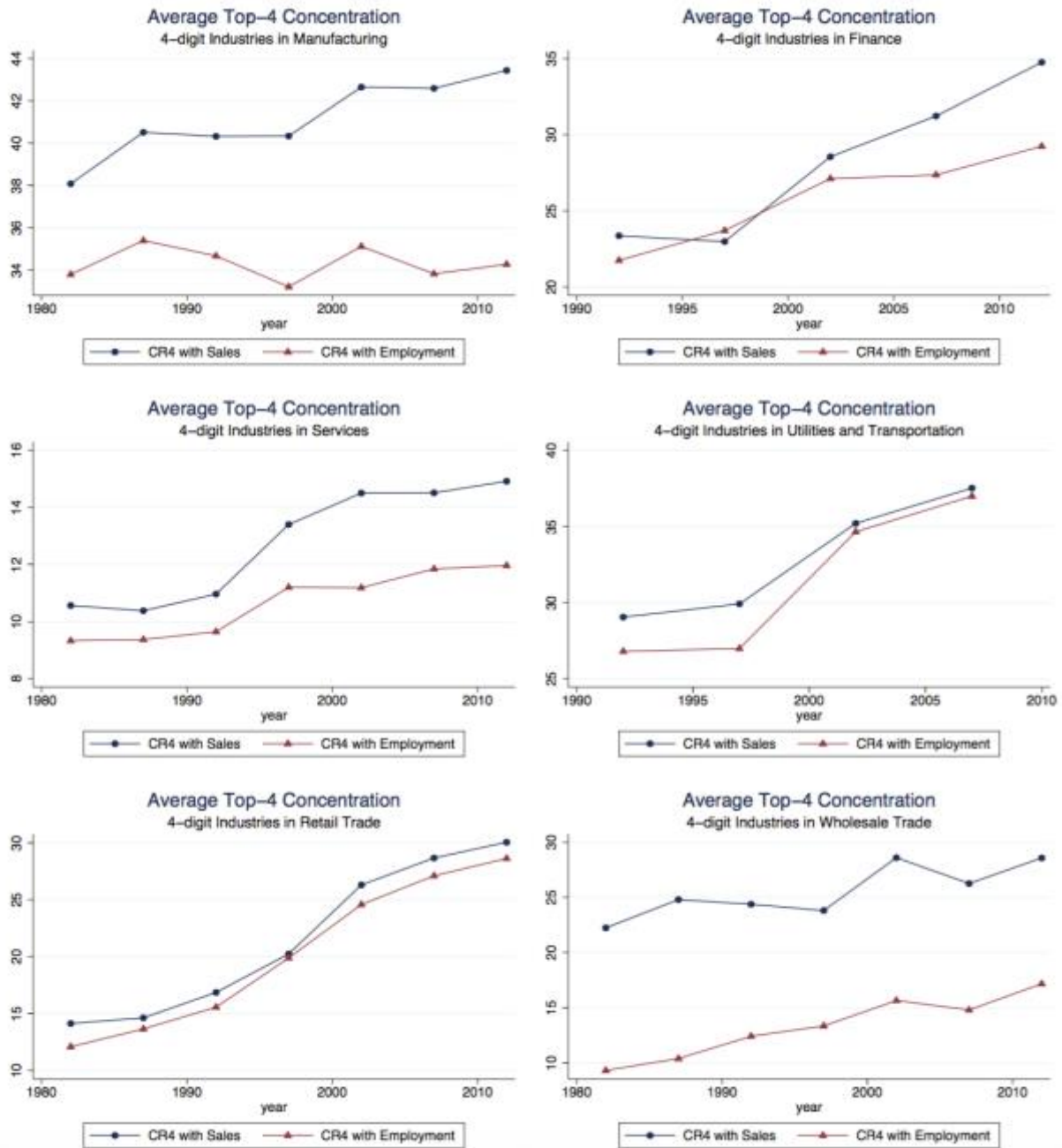
FIGURE 1. AVERAGE TOP-4 INDUSTRY CONCENTRATION BY MAJOR INDUSTRY GROUP

This figure plots the average concentration ratio in each of the six major sectors. Industry concentration is calculated for each 4-digit 1987 SIC-based time-consistent industry code as described in Autor et al. (2016), and then averaged within the sector. The blue line shows average fraction of total industry sales that is accounted for by the largest 4 firms in that industry, and the red line shows the average fraction of industry employment utilized in the 4 largest firms in the industry.
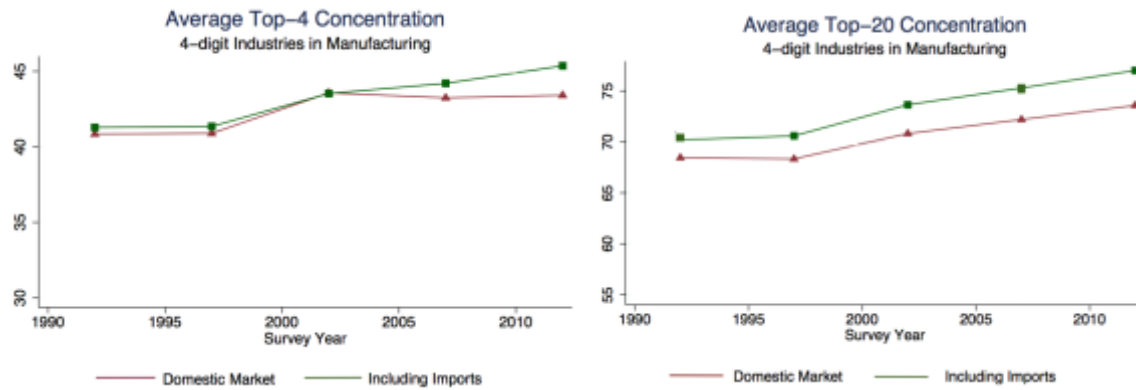
FIGURE 2. INDUSTRY CONCENTRATION ADDING IMPORTS

This figure plots the average 4-digit concentration in U.S. manufacturing industries from 1992-2012. The red line plots the average fraction of U.S. sales produced by the 4 largest firms in the U.S. (analogous to figure 1). The green line plots the fraction of the total U.S. market, defined as domestic sales plus industry imports, which is produced by the 4 largest ``firms'', where each country group is counted as an individual firm. Imports are based on UN Comtrade data, as described in Autor et al. (2016) and the 6 country groups are: Canada, Mexico/CAFTA, China, low income countries except China, 8 developed countries (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland), and the rest of the world. On average, 0.94 country groups are among the top 4 ``firms'', and 2.7 country groups are among the top 20 ``firms''.
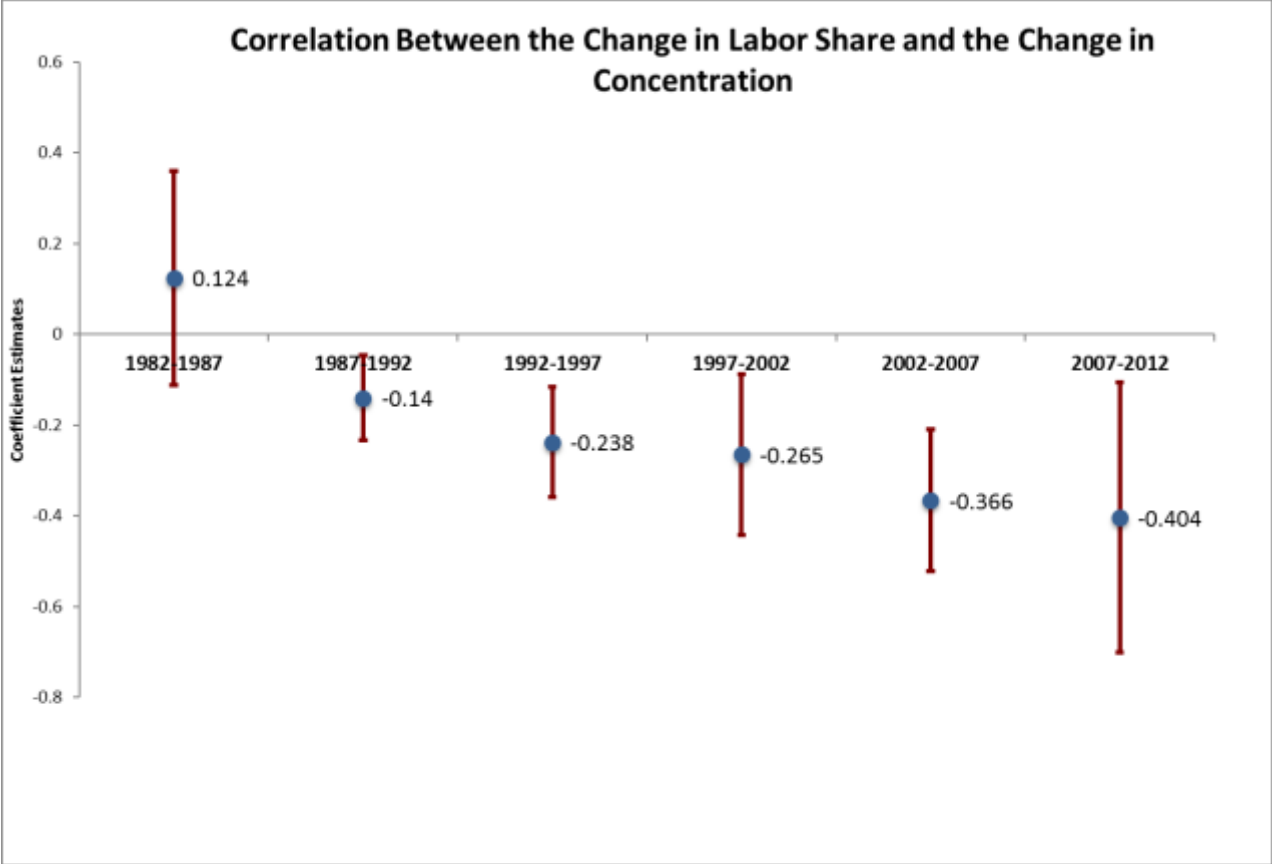
FIGURE 3. CORRELATION BETWEEN CHANGES IN LABOR SHARE AND CHANGES IN INDUSTRY CONCENTRATION IN THE U.S. MANUFACTURING SECTOR AT FIVE-YEAR INTERVALS, 1982/87 – 2007/12

This figure plots point estimates and 95% confidence intervals from Autor et al. (2016) for OLS bivariate regressions of the change in the payroll to value-added share on the change in the CR20 index in U.S. manufacturing industries and a constant for the indicated five-year intervals. Regressions are weighted by industries' 1982 shares of value-added.