DRAFT: Not for Citation

Associates Degrees, the Quality of the U.S. Workforce, and the Sources of U.S. Economic Growth

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Abstract

There is substantial evidence on the importance of education as a driver of economic growth and productivity. However, knowledge of the specific role of associate's degrees in U.S. economic development is limited. We analyze the sources of U.S. economic growth from a bottom-up industry perspective and identify the contribution of associate's degree holders to improvements in labor quality, productivity, and overall economic growth. We find strong evidence that workers with associate's degrees have different labor market outcomes and dynamics than workers with some college and with bachelor's degrees. In addition, we find evidence that substitution towards workers with associate's degrees has increased aggregate labor quality and productivity, and that these effects are concentrated in the health care, trade, and government sectors.

Key words: Associate degree, growth, labor quality, productivity.

May 1, 2016

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1 Introduction

This paper undertakes an empirical examination of the economic impact of associate's degree (AD) holders on U.S. economic growth over the last two decades, with a focus on the contributions of AD holders' relative to those with some college but no degree. Our first objective is to provide a set of stylized facts on associate's degree holders in the U.S. labor market. Our second objective is to identify the role of associate's degree holders in the evolution of U.S. labor quality and measure the contribution of workers with an associate degree to economic growth.

The focus on AD holders in current policy discussions and trends in the U.S. labor market provide the motivation for our work. While the average educational attainment in the U.S. workforce has plateaued in recent years, the share of workers with associate's degrees has increased, with the AD shares of the working population increasing broadly among women and men and across all age cohorts. In recognition of and to further this, the Obama administration has provided new levels of support for community colleges -- the colleges that award the large majority of associate's degrees. In the President's proposed federal budget for 2017 this includes funding to support free tuition at public community colleges.[1] The funding for community colleges is increasingly being directed – from the federal government, state governments and private foundations -- to raise completion rates (Lumina, 2014; Complete

[1] https://www.whitehouse.gov/omb/budget

College America, 2015).[2] In other words, a major focus of current education policy is to support completion of an associate's degree.

In 2015, Community colleges enrolled approximately 10 million students, rising from 2.2 million in 1970, and now comprising about 43 percent of all undergraduates in the U.S. (Bailey, Jaggars and Jenkins, 2015).[3] While community college enrollment has grown over recent decades, the percentage of Americans completing bachelor's degrees or higher has not increased significantly from around 30 percent (Stevens, Kulaender and Grosz, 2015). Expectations are that community colleges will be increasingly attractive to students and their families with the average full-time annual tuition cost roughly one-third of the comparable costs at four-year universities.

We attempt to enhance the understanding of the labor market and economic relevance of associate's degree completion, particularly as compared to some college. A related goal is to assess whether associate's degree holders should be differentiated from those with some college in the analysis of education in economic outcomes.[5] For example, Machin (2014) described how "research undertaken by economists on questions to do with education and

[2] The percentage of first time, full-time community college students who graduate from their original institution within three years is below 20 percent, with some colleges having rates in the single digits (Bailey *et al*., p. 5).

[3] According the U.S. Census Bureau, 2013 American Community Survey, among working age 24-65 year olds, 22 percent had some college and 9 percent had an associate's degree, up from 6 percent in 2000. https://www.census.gov/population/www/cen2000/censusatlas/pdf/10_Education.pdf.

[5] Currently, when the U.S. Department of Labor releases its monthly employment reports, the Wall Street Journal, New York Times, and other major outlets present data on employment status of workers by education, but they do not differentiate workers who have completed associate degrees from those who have attended some college.

education policy has been a big growth area in recent years" (p. 13). However, there were no papers cited or mention made differentiating those with associate's degrees.

Associate degree programs have grown as technology change in the economy has led to an increase in the demand for workers with skills that complement the use of new technologies and these skills are thought to account for a significant portion of the increased returns to higher education overall (Oreopoulos and Petronijevic, 2013). The so-called "mid-level" skill job segment which many American community colleges are focused on is one of the nation's largest skill level segments, representing by some reports over 50 percent of all jobs (National Skills Coalition, 2014).[6] In addition, many of the middle-skills jobs are growing and in high wage occupations. A Brookings Institution study, for example, found that 50 percent of science, technology, engineering and mathematics (STEM) jobs do not require a bachelor's degree, with many of these positions requiring associate's degrees (Rothwell, 2013).

The studies that have analyzed the associate's degree have found that the financial returns for individuals are significant. One of the most cited analyses of associate's degree returns drew on a U.S. national sample of individuals 14-to-21 years old in 1979 and identified on average returns of 4 to 7 percent per year compared to about 6 to 9 percent at four-year colleges (Kane and Rouse, 1995). Kane and Rouse estimated that an associate's degree is related to earnings increases over high school graduates of 24 percent for men and 31 percent for women. Leigh and Gill (1997) found similar results and that the returns were similar for continuing students and returning students. Kane and Rouse (1995), furthermore, found that receiving an associate's degree raised earnings even when compared to having completed an

[6] http://www.nationalskillscoalition.org/resources/publications/file/middle-skill-fact-sheets-2014/NSC-United-States-MiddleSkillFS-2014.pdf

equivalent amount of schooling without completing a degree. Marcotte *et al*. (2005) used a more recent national cohort of students and obtained similar results.

Other studies of associate's degree completers have relied on administrative data from single states. Jepsen, Troske and Commes (2009) use detailed administrative data from Kentucky focused on all community college completers, including associate's degrees and certificates. Of students entering Kentucky's community colleges in academic years 2003 and 2004, they find that associate's degree holders experienced returns of 40 percent among women and around half of that for men. Much of the differential in returns for females compared to males was accounted for by female concentration in health programs, which had higher than average wage differential for graduates of Kentucky's community colleges. A study of California community college students in career and technical education programs identified an average earnings increase of 33 percent for associate's degree completers (Stevens, Kulaender and Grosz, 2015).

While the above studies have identified earnings differentials and other features of the associate degree, the current literature has not focused on the contribution of AD workers to aggregate growth and productivity. To analyze the overall economic impact of AD holders, we incorporate AD workers into a model that identifies the sources of growth. We employ the model to document labor market outcomes by level of educational attainment by assembling data on employment, hours worked, and earnings by industry of employment. In particular, we quantify the differences between associate's degree holders relative to some college across industries and assess the contribution of these differences to the overall growth of the economy.

The paper proceeds along the following outline. Section 2 describes the basic role of labor quality in economic growth and discusses the importance of separating AD workers from workers with some college in models of growth. Section 3 presents the industry growth accounting model, while section 4 demonstrates how we aggregate over industries. Section 5 describes our source data and data construction. Section 6 uses the data to provide a set of stylized facts on associate degrees in the U.S. labor market. Section 7 implements the model of U.S. economic growth to identify the role of associate degree holders. Section 8 summarizes the findings of this study.

2 Labor Quality and Economic Growth

Improvements in the quality of the U.S. workforce account for a significant portion of postwar U.S. economic growth. Labor quality refers to the distribution of the workforce across skills valuable to employers, and improvements in labor quality reflect a shift in the distribution towards more productive workers. According to estimates in Jorgenson, Ho and Stiroh (2005), improvements in labor quality account for almost 10 percent of U.S. Gross Domestic Product (GDP) growth and almost 15 percent of labor productivity (ALP) growth between 1948 and 2002. In related work, Mason, O'Leary, and Vecchi (2012) find a positive relationship between human capital effects related to education and productivity growth across countries.

The primary driver of labor quality growth is increased educational attainment of the workforce. The predominant role of educational attainment in the evolution of the quality of the U.S. workforce is evident in the labor quality growth estimates of Jorgenson, Ho and Stiroh (2005). They report that between 1977 and 2000 about 70 percent of the growth in labor quality was due to advancement in the educational attainment of the workforce, with the remainder coming from increases in worker experience. Their measure of educational attainment classifies workers into six categories: i) 0-8 years of grade school, ii) grade 9-12 no diploma, iii) High School graduate, iv) Some College (including associate's degrees), v) bachelor's degree, and vi) more than a bachelor's degree. These are the same basic education categories used in the official estimates of TFP growth produced by the U.S. Bureau of Labor Statistics.

There are several reasons to consider whether (or not) associate's degree holders should be grouped with workers with some college.[7] The some college group includes those who exited four-year colleges and universities and those who completed or did not complete associate degree programs. Therefore, the some college group does not: i) allow for differentiation of associate degree completers from those who exit and do not complete a college degree, ii) make it possible to evaluate the aggregate labor quality effects and outcomes of associate degree holders (including the contributions of associates degree programs that are focused on careers and on applied technology fields such as advanced manufacturing,

[7] According to Zoghi (2010), "[s]ome counter that it may not be the education itself that enhances the skills of the worker, but rather that workers with a certain skill level obtain an education in order to signal their skill to employers (Spence, 1973). In either case, however, educational differentials are likely to be correlated with productivity differentials. This fits in closely with the idea that there are "sheepskin effects", or disproportionate effects to obtaining a particular degree, above and beyond the effect of the number of years of education that it takes to obtain such a degree (Hungerford and Solon, 1987; Belman and Heywood, 1991)." (p. 463-465)

automotive, computer and electrical technology and health care), and iii) allow for understanding how labor quality and outcomes of associate degree holders have changed over time and how they differ by age and gender of the degree holder.

We analyze the economic impact of AD workers by building up from the industry level because the skill mix and economic contributions of workers can differ significantly across industries. The framework we use accounts for heterogeneity in the demand for workers across industries, aggregating over industries to analyze macroeconomic trends in the sources of economic growth.

3 Modeling the Industry Sources of Growth

We employ the growth accounting framework of Jorgenson, Ho and Stiroh (2005) to identify the conribution of associate's degree holders and other workers to economic growth. In this framework, economic impact is viewed through the lens of production. Industries increase output by replicating existing technology and using more or higher quality inputs, or by increasing productivity (specifically total factor productivity). The fundamental equation in this approach is an industry-level growth accounting equation that specifies that industry gross output growth can be decomposed into the contributions of capital, labor, intermediate inputs and total factor productivity (TFP) growth.[8]

$$\Delta \ln Q_j = \overline{w_{Kj}} \Delta \ln Q_{Kj} + \overline{w_{Lj}} \Delta \ln Q_{Lj} + \overline{w_{Xj}} \Delta \ln Q_{Xj} + \Delta \ln TFP_j \qquad (1)$$

[8] This can be derived via a simple application of tornqvist index numbers. For this definition of TFP growth to correspond to technological changes requires additional economic assumptions.

The contribution of capital $\overline{w_{Kj}}\Delta\ln Q_{Kj}$ is the growth rate of capital input, weighted by its income share, and similar for the other inputs. In this framework, industries can increase output by accumulating capital, labor, and intermediate inputs, or by increasing total factor productivity. In practice, total factor productivity is unobserved and is estimated as a residual after accounting for production and the use of other inputs. A key assumption in this approach is that inputs are measured in constant-quality units.

Our focus is on the contribution of labor input: $\overline{w_{Lj}}\Delta\ln Q_{Lj}$. In the Jorgenson, Ho and Stiroh (2005) framework, a key feature of the measure of labor input is that it is constructed to reflect heterogeneity in skills valuable to employers. The economic intuition for allowing for worker heterogeneity is that workers within industries do not have equivalent skills and that substitution towards workers with a higher skill set is an increase in labor input, ceteris paribus. Their measure of labor input is formulated as:

$$\Delta\ln\mathrm{Q}_{Lj,t} = \sum_{i}\overline{w_{Lijt}}\Delta\ln H_{i,j,t}\ , \tag{2}$$

where I indexes worker type and $\overline{w_{Lijt}}$ is each worker's compensation share in total industry labor compensation. Here, we expand the worker groupings used by (Jorgenson, Ho, & Stiroh, 2005) to identify the role of AD holder. In particular, we add the AD holder category to the worker classification and group workers by industry (65), gender (2), age group (7), class of worker (2), and levels of educational attainment (7). The levels of educational attainment are (1) less than high school, (2) some high school, (3) high school degree, (4) some college, (5) associate's degree holder, (6) bachelor's degree holder, (7) more than a bachelor's degree. To identify the substitution (or composition) effect, Jorgenson, Ho and Stiroh (2005) define:

$$\Delta \ln LQ_{j,t} \equiv \Delta \ln \mathrm{Q}_{Lj,t} - \Delta \ln H_{j,t} \tag{3}$$

as the growth in labor quality. The difference between the measure of labor input that accounts for the changing composition of workers within the industry and the simple sum of hours worked in the industry ($H_{j,t}$) represents the change in labor input accounted for by substitution to different types of workers. To identify the role of different worker types within the overall change in labor quality, we restate this definition as:

$$\Delta \ln LQ_{j,t} \equiv \sum_i \overline{w_{Lijt}} (\Delta \ln H_{i,j,t} - \Delta \ln H_{j,t}) \, . \tag{4}$$

With this restated definition, the contribution of workers in group G to the growth in labor quality is $\sum_{i \in \{G\}} \overline{w_{Lijt}} (\Delta \ln H_{i,j,t} - \Delta \ln H_{j,t})$. Again, this effect captures the substitution towards hours worked by specific types of workers.

We are also interested in the role of labor quality in the growth of labor productivity (ALP). Subtracting the growth rate of hours from both sides of equation (1) yields a decomposition of ALP growth:

$$\Delta \ln q_j = \overline{w_{Kj}} \Delta \ln Q_{kj} + \overline{w_{Lj}} \Delta \ln LQ_j + \overline{w_{Xj}} \Delta \ln Q_{xj} + \Delta \ln TFP_j \, , \tag{5}$$

where the lowercase letters indicates the growth rate per hour worked. In words, labor productivity growth can be decomposed into the contributions of capital deepening, labor quality, intermediate input deepening, and TFP growth. Substitution of equation (4) into equation (5) allows us to identify the contribution of individual worker types to industry labor productivity growth:

$$\Delta \ln q_j = \overline{w_{Kj}} \Delta \ln Q_{kj} + \overline{w_{Lj}} \sum_i \overline{w_{Lijt}} (\Delta \ln H_{i,j,t} - \Delta \ln H_{j,t}) + \overline{w_{Xj}} \Delta \ln Q_{xj} + \Delta \ln TFP_j \tag{6}$$

so that summing $\overline{w_{Lj}} \sum_i \overline{w_{Lijt}} (\Delta \ln H_{i,j,t} - \Delta \ln H_{j,t})$ over worker types i $\in \{\text{AD}\}$ gives the contribution of AD workers to the growth rate in industry labor productivity.

4 Aggregate Sources of Growth

We aggregate over industries to measure the economy-wide sources of growth. The advantage of this approach is that it provides a framework that is integrated with the official national economic accounts. Using this method, we can trace changes in the labor market through to aggregate economic growth and productivity.

The starting point to aggregate over industries is the definition of aggregate value added growth as tornqvist index over industry real value growth:[9] [10]

$$\Delta \ln V = \sum_j \overline{w}_j \Delta \ln V_j \, . \tag{7}$$

[9] Tornqvist aggregate allows for value added prices to differ by industry, a key feature of the data.

[10] All value shares are two period averages of period *t* and *t-1*.

Industry real value added growth is not observed, thus is backed out using the decomposition that the growth rate of output (observed) equals the weighted growth rate of value added and intermediate input (observed):

$$\Delta \ln V_j = \frac{1}{\overline{w_{Vj}}}(\Delta \ln Q_j - \overline{w_{Xj}} \Delta \ln Q_{xj}) \tag{8}$$

Combining equations (1), (7), and (8) yields a decomposition of aggregate real value added growth.

$$\Delta \ln V = \sum_j \bar{v}_{Kj} \Delta \ln Q_{Kj} + \sum_j \bar{v}_{Lj} \Delta \ln Q_{Lj} + \sum_j \frac{\overline{w}_j}{\overline{w_{Vj}}} \Delta TFP_j \tag{9}$$

Where $\bar{v}_{Kj}$ is the share of nominal industry capital services in nominal aggregate value added, $\bar{v}_{Lj}$ is the share of industry labor services in aggregate value added, and $\frac{\overline{w}_j}{\overline{w_{Vj}}}$ is often referred to as the "Domar" weight. This weight accounts for the direct effect of TFP growth on aggregate value added, and the indirect effect via industries that use the output as an intermediate input. Equation (9) allows one to trace changes in primary inputs at the industry level through to changes in aggregate output. The contribution of TFP growth at the industry level to aggregate TFP growth is the weighted industry TFP growth rate.

To identify the contributions of hours and labor quality growth at the industry level, we define the aggregate labor contribution as $\mathrm{CTL} \equiv \sum_j \bar{v}_{Lj} \Delta \ln Q_{Lj}$ and decompose this as:

$$\mathrm{CTL} \equiv \sum_j \bar{v}_{Lj} \Delta \ln H_j + \sum_j \bar{v}_{Lj} (\sum_i \overline{w_{Lijt}} (\Delta \ln H_{i,j,t} - \Delta \ln H_{j,t})) \tag{10}$$

While equation (10) identifies the increase in quality due to worker substitution, it does not allow for a direct measure of the total contribution of each worker group because the hours worked measure H_j includes hours worked for all types of workers in the industry. To measure the contributions of the labor input by level of education attainment, we construct indexes of labor input for each educational grouping

$$\Delta \ln \mathrm{Q}_{LEj,t} = \sum_{i \in E} \overline{w_{Lijt}} \Delta \ln H_{i,j,t} \tag{11}$$

and decompose CTL as:

$$\mathrm{CTL} = \sum_j \sum_E \bar{v}_{LEj} \Delta \ln \mathrm{Q}_{LEj,t} + R_H \, , \tag{12}$$

where $\bar{v}_{LEj}$ is the value share of workers in each educational attainment category in aggregate value added, and the reallocation term R captures the second order effect of treating each type of level of educational attainment as a separable labor input.[11]

5 Data and Data Construction

We construct labor input measures by gender, age cohort, educational attainment, and class of worker for workers in 65 industries.[12] The classification yields 2*7*7*2*65=12,740 different

[11] In a certain sense this is due to the lack of consistency in aggregation property of the tornqvist index, in another sense this is a real effect reflecting the how labor input would change if workers were reallocated.

[12] We use the following groups for age cohorts: 16 to 17 years old, 18 to 24 years old, 25 to 34 years old, 35 to 44 years old, 45 to 54 years old, 55 to 64 years old, and 65 plus. For educational attainment we use: 0 - 8 years grade school; 9 - 12 years - no high school diploma; High school diploma; Some College, but no degree; Associate's degree; Bachelor's degree; and Graduate degree. For class of workers we consider two categories: employees (public and private) and unpaid and self-employed.

types of workers[13]. The hours and compensation data required to build the labor input metrics are from the U.S. Census 2000 and the U.S. Current Population Survey (CPS). The first step involves building a matrix with 12,740 rows using data from the 1 percent sample of the population from the U.S. Census 2000. This matrix provides a robust estimate of the distribution of workers across different dimensions. We construct matrices of employment, weekly hours, weeks per year, and compensation per hour.[14] All metrics are weighted using census population weights, thus we obtain national employment and average hours, weeks and compensation.

The U.S. census data does not allow for an analysis of year-to-year changes in labor inputs. We use the matrices produced using the Census 2000 microdata to initialize a time series generated using microdata from the March Supplement of the Current Population Survey (CPS) and the method of iterative proportional fitting (RAS). The CPS is a monthly survey of over 60,000 households representing over 90,000 people who are in the labor force and 100,000 people who are out of the labor force[15]. Thus, the CPS collects data from a much smaller sample (compared to the Census), which prevents estimating the full-dimensioned matrices (12,740 rows) of employment, weekly hours, weeks per year, and compensation required in this study. We follow Jorgenson, Ho and Stiroh (2005) and use the CPS microdata to generate

[13] Jorgenson, Ho and Stiroh (2005) use a total of 2*2*7*6*44=7,392 different types of workers in their work.

[14] We do not have data on the labor compensation of the self-employed so that we assume that wages of the self-employed equal that of the same employed worker by industry, sex, age and education

[15] The CPS increased its sample by 10,000 households in 2001. Prior to 2001, the numbers of people in the labor force was under 80,000.

marginal matrices of smaller dimensions[16] that in certain cases use less industry detail. For employment, we build three *marginal* matrices: 1) E^{M}_{sacj}, matrix with sex, age cohort, educational attainment, and class of workers (2*7*7*2=196 cells); ii) E^{M}_{jc}, matrix with 65 industries and class of workers (65*2=130 cells); and iii) E^{M}_{ej}, matrix with educational attainment and 20 industries (7*20=140 cells). The three marginal matrices for employment add up to the same totals for each dimension.[17] For total hours and annual weeks we generate a marginal matrix with sex, age cohort, class and 11 industries (2*7*2*11=308 cells) denoted h^{M}_{sacj} and w^{M}_{sacj}, respectively. For hourly compensation of workers whose employment status is "employed" we generated two matrices: i) c^{M}_{sae}, matrix with sex, age cohort, and educational attainment (2*7*7=96 cells); ii) c^{M}_{ej}, a matrix with educational attainment and 20 industries (7*20=140 cells). The different industry groups (65, 20 and 11) are provided in Table A1 in the appendix. For the marginal matrices that do not use the full 65 industries, the industries are chosen to group industries with similar characteristics. It is worth emphasizing that these are the same industry groupings used by Jorgenson, Ho and Samuels (2014)

[16] We adjusted the CPS microdata during the process used to generate the marginal matrices. First, the CPS wage and salary income variable is subject to "top coding". We adjust the top codes by using the method proposed by Larrimote *et al.* (2008). Second, we re-coded all workers who answered that they their *class* was "government" to *industry* "government" regardless of the industry at which they were working. For instance, a worker could have answered that she worked in "educational services" while also answering that her class of work was "local government". In this case, we re-coded such an observation to industry "Local Government". Third, from 1992 to 2014, the CPS microdata contain 65 observations for individuals 16 to 17 years old who hold BA or graduate degrees. These worker categories are not present in the Census 2000, thus these observations were deleted from our analysis. We also deleted 24 observations whose class was "self-employed or unpaid" and the industry was "government". Finally, the CPS variables "weeks worked," "usual hours worked," and "wage and salary income all refer to "last year" while employment is contemporaneous. All marginal matrices are calculated for the year at which the information refers to. For example, we use the 2014 CPS data to calculate total hours, total weeks worked, and total compensation for 2013 and total employment for 2014.

[17] For instance, $\sum_{sae} E^{M}_{saec} = \sum_{j} E^{M}_{jc}$.

We build annual marginal matrices from 1992 to 2014. The analysis start date is restricted to 1992. That was the date of a major change in the CPS sample design that expanded information about educational attainment and included data about associate degree attainment. Using the full-dimensioned Census 2000 benchmark matrix, the annual marginal matrices described above and RAS, the full-dimensioned matrices for employment, weekly hours, weeks per year, and compensation for all years between 1992 and 2014 are estimated. The RAS procedure used is from Jorgenson, Ho and Stiroh (2005).

The final step in constructing the data comprised re-scaling the full-dimensioned matrices to ensure that aggregate estimates match official data published by the U.S. Bureau of Economic Analysis. More precisely, the estimates were re-scaled to match i) total hours by industry, ii) total labor compensation by industry, iii) total employment by industry; and iv) self-employment by industry.

The labor data described above provides one piece of the industry-level production account required to implement the sources of growth model. We combine the labor data described above with data on industry output, capital, and intermediate inputs provided by Dale Jorgenson and used in a recent analysis of U.S. economic growth by Jorgenson, Ho and Samuels (2015). The data for capital and intermediate inputs are constructed in an analogous way to the measure of labor services: capital service flows and intermediate purchases are weighted by their nominal cost shares to construct an input measure that captures substitution towards more productive inputs over time. Since the data provided by Jorgenson ends in 2012, we extend this for one year using the series on output, capital and intermediate inputs available in the BEA-BLS Integrated Industry level production account. Since the series in the BEA-BLS account overlap in concept and coverage, this is a simple extrapolation.[18] Thus, our labor data covers 1992-2014 and our industry production account covers 1992-2013.

6 AD Holders and the U.S. Labor Market: Stylized Facts

The share of AD holders in total employment has increased significantly across all industries, except for information and data processing services. This growth took place while the average educational attainment in the U.S. plateaued (see Table A2 in the Appendix). ***S***The health care industry, in particular, has employed a significant share of AD holders (see Figure 1). In 2014, about one fifth of the workers employed in hospitals nursing and residential care services and in ambulatory health care services were AD holders. All these sectors within the health care industry have experienced significant increases in the share of workers with AD over the last two decades. For example, the share of AD holders employed in hospitals nursing and residential care services increased from 14.9 percent in 1992 to 19.6 percent in 2014. It is also noteworthy that utilities, transportation (air transportation and other transportation and support activities), manufacturing (computer and related products and machinery) and government enterprises (Federal and S&L) also experienced significant increases in their share of AD employees and rank among the top ten industries in terms of AD holders concentration.

Since 1992 the percentages of all workers with ADs have been increasing in the United States for each of the age groups considered, see Figure 2. The dynamics of changes in the older (45 – 54 years and 55 – 64 years) worker cohorts are, however, strikingly different from

[18] The BEA-BLS account data are available at: http://www.bea.gov/industry/

the other age cohorts. In particular, the share of AD holders for these two age cohorts increased sharply in the early 1990s, early 2000s, and then in the late 2000s. While no causation can be implied, it is worthwhile to note that these spikes happened all after recessions.[19] The biggest increase in the share of AD employment for the 45 – 54 years cohort happened in the early 1990s while for the 55 – 64 years cohort it took place in the early 2000s. It is also important to highlight that people in these two age cohorts are pre baby-boomers born between 1925 and 1945. These major shifts might be related to generational changes as the pre baby-boom generation, which had lower educational attainment compared to baby-boomers, were motivated to acquire new skills to meet shifts in labor market demand. Unfortunately, the data do not allow discerning at what point in the life cycle these workers attained the observed level of education.

Figure 3 and 4 provide the distribution of the change in employment shares by educational attainment, age cohorts, and gender from 1992 to 2014. Figure 3 shows that the employment share of female AD holders increased across all age cohorts. The increase in the AD share of employment, however, is relatively smaller for young females (18 to 34 years old) compared to older women.

Figure 4 depicts the changes in employment share for males. For men, the share of AD holders in employment increased at the about same pace as that of bachelor's degree holders for men in the 45 – 54 years and in the 55 – 64 years cohorts. This coincided with a significant

[19] According to the National Bureau of Economic Analysis (NBER), the U.S. was in recession from July 1990 to March 1991, from March 2001 to November 2001, and from December 2007 to June 2009.

decline in the employment share of males with some college in the 25 to 34, 35 to 44, and 45 to 54 age cohorts.

Figure 5 reports the employment participation rate of AD workers compared to other degree holder. It shows that the decline in the employment participation rate began before 2008, and then declined sharply during the 2008 recession. It also shows that the employment participation rate of AD workers is significantly higher than that of workers with some college. In addition, Figure 6 shows this result persists across gender and age cohorts. Moreover, for the 35 - 44 year old females, the employment participation rate of AD exceeds that of BA workers, and for older female workers the employment participation rate is very similar with that of BA workers over the time series, although there was a sudden drop in 2014. For young males (25-34 years old), the employment participation rate of AD workers matches that of BA workers in 2014, yet for older male workers the employment participation rate of AD workers significantly exceeded that of workers with bachelor degrees.

Wage Differential for AD Holders[20]

The associate's degree to some college wage differential is statistically significant (see Figure 7). While point-estimates for the AD to some college wage difference have slightly declined from 1992 to 2014, there is no evidence that this reduction is statistically significant. The BA compared to some college wage differential, in contrast, increased from about 29 percent in the early 1990s to just below 35 percent in 2014. This increase is statistically significant.

[20] This section provides an overview of wage differences between AD, some college, and BA degree holders. We do not test an underlying theory of the reason for these differences or offer a causal interpretation. What matters for our analysis is that AD workers are not perfect substitutes for some college workers.

The BA compared to some college differential has been hovering around 35 percent since 2002, indicating that the changes in the labor market in the late 1990s leading to an increasing wage differential for a four-year college education may have stabilized and that now the AD and BA compared to some college labor market dynamics have both stabilized and are more similar than in the late 1990s.

The average wage differential varies by age cohort (see Figure 8). The positive wage differential for AD holder is relatively larger for younger individuals (18 – 44 years old), then it diminishes significantly for individuals who are 45-to-54 years old and turns negligible for individuals 55 years or older. In addition, the reduction in the wage differential for AD holder that took place during the last two decades affects all age cohorts, except individuals in the 24 – 34 years old cohort for whom the wage differential stayed roughly constant from 1992 to 2014. This finding suggests that an area of distinction of AD education – labor market and applied mid-level skills focus – may also be a weakness because the learning in completing an associate's degree program may be prone to obsolesce or can be replicated by on the job experience. It is worth noting that the wage differential for BA holders also shrinks over a person's lifetime, however, it stays quite large at the end of a person's life cycle. This implies that the skills acquired through a bachelor's degree education are not subject to the same degree of obsolescence or substation by learning on the job as those acquired through associate degree programs.

Wage Differential for AD Holders by Industry

AD to some college wage differentials vary significantly by industry (see Figure 9). The wage differential for associate degrees compared to some college is largest for hospital nursing and residential facilities (38 percent), legal services (28 percent), computer system designs and related services (23 percent), water and other transportation equipment (23 percent), educational services (20 percent), and ambulatory health care services (17 percent). Wage differentials for associate's degree is substantial in many industries that require focused and applied mid-level skills that are the hallmark of a large number of associate degree programs.

The wage differential for associate degrees relative to some college is negative for several industries including financial-related industries, mining, farming, wholesale trade, and real estate. It is negligible in leisure and hospitality-related industries, truck and pipeline transportation, federal government enterprises, and in some manufacturing sectors. In these industries, learning on the job, after some college, might provide workers with skills as or more appropriate than the skills gained completing an associate's degree.

7 Associates Degrees and the Sources of U.S. Economic Growth

We now use the sources of growth model described in sections 4 and 5 to quantify the contribution to AD holders to U.S. economic growth. We provide Information from "the top down," starting with broad trends and then narrowing down to the sources of these trends at the industry level.

Table 1 presents the decomposition of aggregate output growth into its sources based on equation (9). In this model, aggregate output is gross domestic product (GDP), measured by aggregating real value added across producing industries. Industry output growth occurs via the accumulation of inputs and the growth in total factor productivity, modeled in equation (1).

In the period that the dataset covers, 1992-2013, the accumulation of inputs was the predominant source of growth. Over this period, investments in capital inputs accounted for about 53 percent of growth, labor input accounted for about 28 percent, and TFP growth accounted for about 18 percent of growth.[21]

Table 2 decomposes the aggregate labor contribution into the growth of hours worked and labor quality using equation (10). For the period as a whole, labor quality accounted for 0.25 percentage points (pp) of the 0.69 pp contribution of aggregate labor input. That is, within this period, substitution towards workers with higher wages (and higher marginal products under the assumptions of the neoclassical growth model) buoyed the contribution of labor to aggregate growth. Taken another way, if this substitution effect was ignored, TFP growth would be estimated to have grown by 0.70 percent per year instead of 0.44 percent per year.

The difference between the growth in hours worked by a given type of worker and hours worked in the industry as a whole (weighted by the income share of the worker) yields a measure of the contribution of worker by type to the overall increase in aggregate labor quality (equation (10) with each type of worker *i* grouped by educational attainment). This tabulation, presented in Table 2, demonstrates that substitution towards relatively educated workers was

[21] These results are broadly consistent with (Jorgenson, Ho, & Samuels, forthcoming) covering the postwar period: 1947-2012.

a significant driver of aggregate labor quality growth. Furthermore, there is a clear distinction between workers with some college and AD workers. For the period as a whole, substitution towards AD workers accounted for 0.10pp of the 0.25pp contribution of aggregate labor quality growth. Substitution towards BA and MA+ workers contributed 0.21pp and 0.17pp respectively, while the declines in hours worked from workers without a post-secondary degree relative to total hours worked in the industry manifests as a drag on aggregate labor quality growth.

While the employment share of AD holders has increased over time, the bottom panel of Table 2 shows that the aggregate nominal value share of AD workers has been stable over time. In comparison, the value share of output paid to workers with below an AD degree declined slightly over the period, with the difference coinciding with an increase in the share of output distributed to workers with a BA degree or above. It is worth reiterating that these shares by level of educational attainment obscure the underlying detail on the wage structure by gender and age. In other words, the stability of the AD labor share taken together with an increasing number of workers does not necessarily imply a decline in the compensation rates for AD workers relative to other workers over this period because the stability of the income share may simply reflect an aging of the BA and MA workers, for example. On the other hand, Figure 7 does suggest a small decline in the relative wages of AD workers over this period.

Table 3 gives the contribution of labor input to aggregate output growth by level of educational attainment (based on equation (12)). Of the 0.69pp contribution of labor input over the 1992-2013 period, AD workers accounted for 0.14pp compared to 0.05pp for some college workers, 0.32pp for BA workers, and 0.26pp for MA+ workers. These results indicate the importance of identifying the contribution of AD workers separately from some college workers in sources of growth analyses. While the contribution of some college and AD were comparable between 1992 and 2000, after 2000 the contribution of workers with some college fell, while that from AD workers continued to rise. Notably, during the Great Recession, the contribution of workers with some college and BA workers was -0.23pp and -0.29pp, while the contribution of AD workers declined, but only by -0.05pp. This suggests that the jobs held by AD workers may be more resilient than jobs held by other types of workers during the type of macroeconomic fluctuation that occurred in the Great Recession. In the bottom-up industry analysis presented below, we provide an analysis of which industries are driving these aggregate trends.

The falling employment participation rate discussed in the previous section was a drag on aggregate growth between 1992 and 2013 (see Table 4), but the negative effect on growth was particularly strong between 2007 and 2009. It is noteworthy that the decline in the employment participation rate from workers with less than some college accounted for a significantly larger drag on growth. In addition, the drag on growth from declining employment participation rate was slightly less for AD workers compared to BA and MA workers.

Previous work has demonstrated the importance of incorporating industries into aggregate sources of growth analysis. For example, Jorgenson, Ho and Stiroh (2005) demonstrate with the onset of the IT-revolution, the large majority of aggregate TFP growth was accounted for by just a few industries, in particular the IT-producing industries. In the remainder of this section, we decompose the aggregate labor contributions to industries.

Figure 12 shows that AD holders contributed positively across a broad set of industries, with health and trade industries, along with professional and support services having relatively large contributions to aggregate output growth. Towards the bottom of the industry economic contribution distribution, growth in the labor input of AD workers was negative in apparel, funds trusts and other financial vehicles, the federal government, textile mills, other transportation equipment, and the printing industry. Compared to workers with less than a college degree and workers with some college (Figures 10 and 11), there were only a few industries where labor input from AD workers declined over the period. Note that in many of the industries where AD workers contributed significantly, workers with other levels of educational attainment showed significant changes as well, indicative of the large influence of macroeconomic trends.

To strip out the broad macro effects affecting all education groupings, Figures 15 and 16 present the contribution of AD holders less the contribution of some college workers and BA workers, respectively. These figures give a sense of how the contribution of and demand for AD holders is changing relative to other workers. Figure 15 suggests that the demand for AD workers relative to some college workers increased broadly across industries over the period. For only the food services, computer systems design, social assistance, amusements and gambling, and a couple other industries did the contribution of workers with some college exceed that from AD workers. Figure 16 suggests that the increase in demand for BA workers outpaced that for AD workers, in general, but for a small subset of industries, demand for AD workers was particularly strong relative to BA workers. For example, funds, trusts, and other financial vehicles, computer and electronic products, apparel and leather, utilities, chemicals, printing, and machinery were industries where the contribution of AD workers increased relative to BA workers.

As noted above, for the macro economy as a whole there were large declines in the labor input from workers with some college and BA degreed during the Great Recession, while the contribution of AD workers was relatively stable. Figure 17 shows the contribution of AD holders compared to some college workers during the Great Recession. During the period, the demand for AD workers held up relatively well compared to some college workers, and this was led by relatively strong demand for AD workers in the construction, health care, retail trade, federal reserve and credit intermediation, and real estate. Figure 17 shows the industries where the contribution from AD workers exceeded that from BA workers for this period. Comparing these two levels of educational attainment, changing demand for AD workers in the health industries, miscellaneous professional and technical services, federal government, admin support, and broadcasting and telecom led to contributions to growth that exceeded that from BA workers during this period.

Finally, in Figures 19-23 we provide detail on the industry contributions to aggregate labor quality growth by level of educational attainment. Figure 19 is consistent with the broad substitution of hours worked away from workers with minimal education. For workers with some college (Figure 20), the aggregate contribution to labor quality growth was slightly negative, but there was significant variation across industries. In comparison, in nearly all of the industries, substitution towards workers with an AD degree elevated aggregate labor quality (Figure 21). Relatively strong growth in the hours worked by AD holders in trade, health care, and construction was a contributor to the increase on aggregate labor quality growth over the period. Figures 22 and 23 show that while increases on the hours worked by BA workers and MA+ workers were broad contributors to aggregate labor quality growth, the largest contributions were from a significantly different set of industries. Growth of BA workers in the trade, banking, other services, and construction topped the industry contributions, while for MA+ industries, the contributions from the government, health, and legal services had the highest impact on aggregate labor quality.

8 Final Remarks and Conclusions

This study has undertaken an empirical assessment of a relatively under-examined educational contribution to economic growth: the associate degree's contribution to the U.S. economy and earnings. Our findings indicate the virtue of distinguishing the contributions of AD workers from those with some college, but no degree, and differentiating degree holder contributions by program area. The constructed industry dataset used allowed for quantifying the sources of economic growth from the bottom up and for comparing the economic impact of changes in the workforce across levels of educational attainment and industry. We have documented the AD holders' presence in and contributions to the U.S. economy and how both have been increasing since the early 1990s and accounting for a significant portion of U.S. economic growth, especially compared to workers without a post-secondary degree.

This study shows that the share of AD holders in total employment has increased significantly across most industries. However, the dynamics of changes in the older (45 – 54 years and 55 – 64 years) worker cohorts are sharply different from the other age cohorts. This study also shows that the employment participation rate of AD workers is significantly higher than that of workers with some college. There is, however, a notable gender difference: for females, the employment participation rate of AD workers is very similar with that of BA workers. For older male workers the employment participation rate of AD workers significantly exceeded that of AD workers. The data also show significant wage differences between AD holders and those with some college. The wage differentials hold strongly for women and men and across all age cohorts, *albeit* with some noteworthy variation.

Substitution towards workers with associate's degrees accounts for a significant portion of the growth of U.S. labor quality since 1992. In contrast, the relative decrease in hours worked by those in the some college grouping represents a negative contribution to aggregate labor quality growth. In addition, the decline in the employment participation rate from workers with less than some college accounted for a significantly larger drag on growth than that from AD workers. In nearly all of the industries, substitution towards workers with an AD degree elevated aggregate labor quality. We find the increasing demand for AD workers relative to some college workers in the health care, trade, and government sectors to be particularly important in the evolution of aggregate labor input and labor quality since 1992.

Over the period we analyzed the contribution of some college and AD workers was comparable between 1992 and 2000, but after 2000 the contribution of workers with only some college fell, while that from AD workers continued to rise. Notably, during the Great Recession, the contribution of workers with some college and BA workers declined more sharply that AD workers. This suggests that the AD workers were more resilient in their jobs. AD workers accounted for about 5 percent of aggregate labor compensation over the period studied, yet 0.21pp of aggregate labor quality growth. For comparison, the value share of BA workers was over triple that, but only double in the contribution to labor quality growth.

The findings suggest that the AD degree should be considered a distinctive level of higher education attainment. Some important information on educational contributions and outcomes could be lost when those with some college and associate's degree holders are combined or when associate's degree are not differentiated from bachelor's degree holders or when different degree program areas are not considered. When the some college and associate's degree categories are combined, the underlying economic assumption is that workers with some college are perfect substitutes for workers with an associate degree. For a class of macro models, this is probably an innocuous assumption. For detailed studies of the labor markets and education's impact on labor markets, however, our analysis suggests that combining associate's degrees with other educational attainment categories obscures important economic information. For efforts to align education more in support of economic growth, our analysis indicates that it is important to recognize that AD workers have different labor market outcomes and dynamics than workers with some college and BA degrees.

While we argue that AD workers should be differentiated from workers with some college when studying the economic impact of education, the underlying reasons for these differences remain an open question. For example: (a) do workers of different skills and interests self-select into AD programs and (b) how are degree holder wage differentials and economic growth contributions affected by program alignment with the needs of employers, or is it something in the industries production that better aligns with the AD skill-level of graduates more generally? While the answers to these questions are crucial for future labor and education policy, the evidence we present indicates that policies should account for the particular skill set of AD workers and how these align with demands for skill across industries.

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Table 1: Contributions to Aggregate Value Added Growth

	1992-2013	1992-1995	1995-2000	2000-2007	2007-2013	2007-2009	2009-2013
Contributions							
Aggregate Value Added Growth	2.42	2.82	4.26	2.26	0.87	-1.46	2.03
Capital	1.29	1.49	2.06	1.28	0.56	0.83	0.42
Labor	0.69	1.54	1.30	0.39	0.10	-1.40	0.84
TFP	0.44	-0.21	0.89	0.59	0.21	-0.89	0.77
Share of Growth (%)							
Capital	53.3	52.8	48.5	56.5	64.3	-57.2	20.8
Labor	28.4	54.5	30.6	17.2	11.1	96.1	41.5
TFP	18.3	-7.3	21.0	26.2	24.6	61.1	37.7

Notes: Average annual percentages.

Table 2: Labor Quality and Contributions to Aggregate Value Added Growth

	1992-2013	1992-1995	1995-2000	2000-2007	2007-2013	2007-2009	2009-2013
Contributions							
Aggregate Value Added Growth	2.42	2.82	4.26	2.26	0.87	-1.46	2.03
Capital	1.29	1.49	2.06	1.28	0.56	0.83	0.42
Labor	0.69	1.54	1.30	0.39	0.10	-1.40	0.84
Hours	0.43	1.17	1.10	0.18	-0.19	-1.80	0.62
Quality	0.25	0.37	0.20	0.21	0.29	0.41	0.23
Less than Some College	-0.20	-0.55	-0.09	-0.11	-0.23	-0.34	-0.18
Some College	-0.02	0.15	-0.02	-0.11	0.00	0.10	-0.05
AD	0.10	0.29	0.04	0.08	0.09	0.09	0.09
BA	0.21	0.30	0.21	0.21	0.18	0.18	0.19
MA+	0.17	0.19	0.07	0.15	0.25	0.38	0.18
TFP	0.44	-0.21	0.89	0.59	0.21	-0.89	0.77
Nominal Value Share (%)							
Capital	42.7	42.1	40.9	42.0	45.3	44.2	45.9
Labor	57.3	57.9	59.1	58.0	54.7	55.8	54.1
Less than Some College	16.7	20.2	18.9	16.5	13.4	14.1	13.1
Some College	9.6	10.9	10.5	9.6	8.3	8.8	8.0
AD	5.0	4.8	5.0	5.1	5.0	5.0	5.0
BA	15.6	13.6	15.2	16.2	16.1	16.1	16.2
MA+	10.4	8.4	9.5	10.8	11.8	11.8	11.8

Notes: Average annual percentages.

Table 3: Educational Attainment and Contributions to Aggregate Value Added Growth

	1992-2013	1992-1995	1995-2000	2000-2007	2007-2013	2007-2009	2009-2013
Contributions							
Aggregate Value Added Growth	2.42	2.82	4.26	2.26	0.87	-1.46	2.03
Capital	1.29	1.49	2.06	1.28	0.56	0.83	0.42
Labor Input	0.69	1.54	1.30	0.39	0.10	-1.40	0.84
Less than Some College	-0.09	-0.07	0.23	-0.10	-0.36	-1.04	-0.02
Some College	0.05	0.37	0.17	-0.10	-0.05	-0.23	0.04
AD	0.14	0.38	0.14	0.10	0.08	-0.05	0.15
BA	0.32	0.54	0.52	0.25	0.15	-0.29	0.36
MA+	0.26	0.31	0.25	0.24	0.27	0.21	0.30
Reallocation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TFP	0.44	-0.21	0.89	0.59	0.21	-0.89	0.77
Share of Growth attributed to each Factor (%)							
Aggregate Value Added Growth	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital	53.3	52.8	48.5	56.5	64.3	-57.2	20.8
Labor	28.4	54.5	30.6	17.2	11.1	96.1	41.5
Less than Some College	-3.7	-2.5	5.4	-4.3	-41.1	71.7	-0.8
Some College	2.0	13.2	4.0	-4.2	-5.5	15.8	2.1
AD	5.9	13.5	3.2	4.2	9.3	3.6	7.2
BA	13.4	19.1	12.1	10.8	16.9	19.7	17.9
MA+	10.9	11.0	5.9	10.7	31.4	-14.5	15.0
Within Labor Reallocation	0.0	0.0	0.0	0.0	0.1	-0.1	0.0
TFP	18.3	-7.3	21.0	26.2	24.6	61.1	37.7

Notes: Average annual percentages.

Table 4: Contributions to Aggregate Labor Input Growth

	1992-2013	1992-1995	1995-2000	2000-2007	2007-2013	2007-2009	2009-2013
Total Labor Input	1.29	2.74	2.27	0.83	0.30	-2.32	1.61
Contributions							
Population	1.76	2.35	1.91	1.85	1.24	1.23	1.24
Participation	-0.15	0.38	0.41	-0.23	-0.81	-1.98	-0.22
Hours per week	-0.31	0.01	-0.05	-0.80	-0.13	-1.57	0.59
Less than Some College	-0.11	-0.06	0.43	-0.12	-0.58	-1.73	0.00
Population	-0.10	-0.45	0.02	0.06	-0.23	-0.27	-0.21
Participation	-0.07	0.15	0.26	-0.12	-0.39	-0.90	-0.14
Hours per week	0.06	0.23	0.15	-0.06	0.05	-0.56	0.35
Some College	0.11	0.70	0.29	-0.13	-0.06	-0.37	0.10
Population	0.19	0.66	0.18	0.09	0.09	0.21	0.03
Participation	-0.04	0.15	0.09	-0.08	-0.19	-0.42	-0.07
Hours per week	-0.05	-0.11	0.02	-0.14	0.03	-0.16	0.13
AD	0.25	0.65	0.23	0.17	0.16	-0.07	0.28
Population	0.29	0.64	0.23	0.23	0.24	0.26	0.22
Participation	-0.01	0.03	0.00	0.01	-0.07	-0.19	0.00
Hours per week	-0.03	-0.02	0.01	-0.07	-0.01	-0.14	0.06
BA	0.58	0.94	0.85	0.48	0.27	-0.49	0.66
Population	0.74	0.87	0.91	0.83	0.43	0.10	0.59
Participation	-0.02	0.09	0.05	-0.05	-0.10	-0.22	-0.04
Hours per week	-0.14	-0.02	-0.11	-0.30	-0.05	-0.38	0.11
MA+	0.47	0.51	0.47	0.42	0.50	0.34	0.58
Population	0.64	0.63	0.57	0.64	0.71	0.93	0.60
Participation	-0.02	-0.05	0.01	0.01	-0.06	-0.25	0.03
Hours per week	-0.15	-0.08	-0.10	-0.23	-0.15	-0.33	-0.06

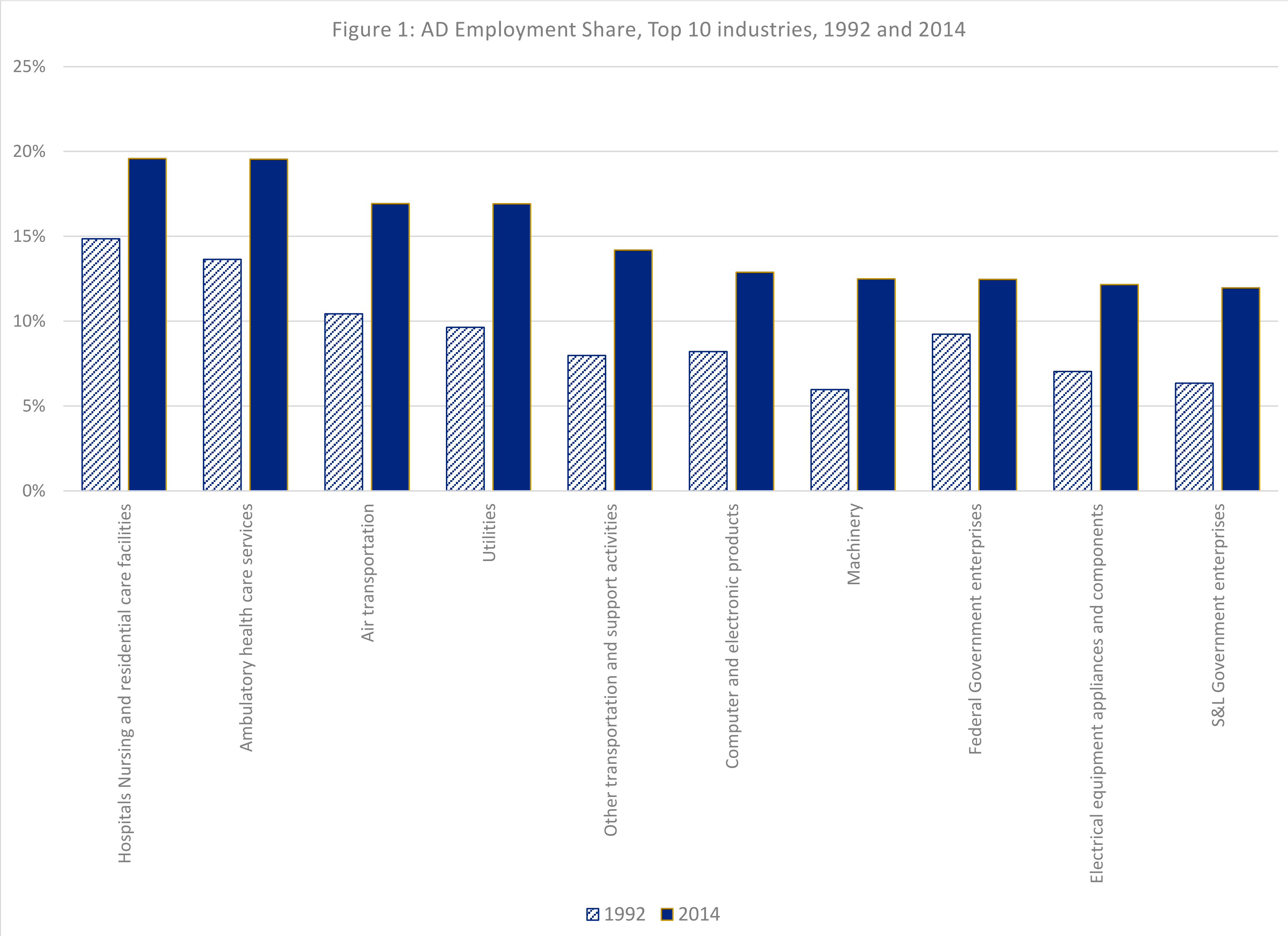


Figure 1: AD Employment Share, Top 10 industries, 1992 and 2014
25%
20%
15%
10%
5%
0%
Hospitals Nursing and residential care facilities
Ambulatory health care services
Air transportation
Utilities
Other transportation and support activities
Computer and electronic products
Machinery
Federal Government enterprises
Electrical equipment appliances and components
S&L Government enterprises
1992
2014

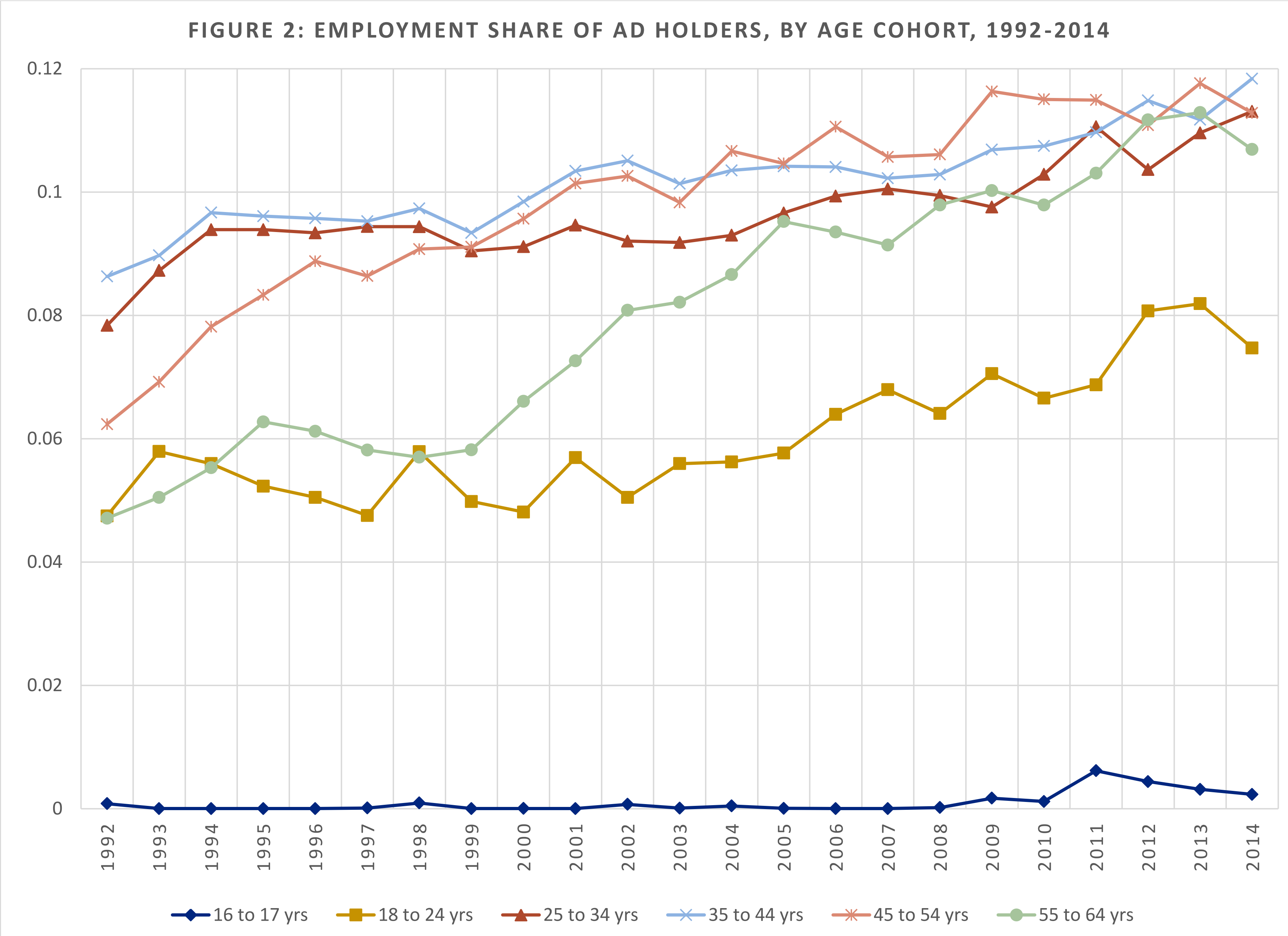


FIGURE 2: EMPLOYMENT SHARE OF AD HOLDERS, BY AGE COHORT, 1992-2014
0.12
0.1
0.08
0.06
0.04
0.02
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
16 to 17 yrs
18 to 24 yrs
25 to 34 yrs
35 to 44 yrs
45 to 54 yrs
55 to 64 yrs

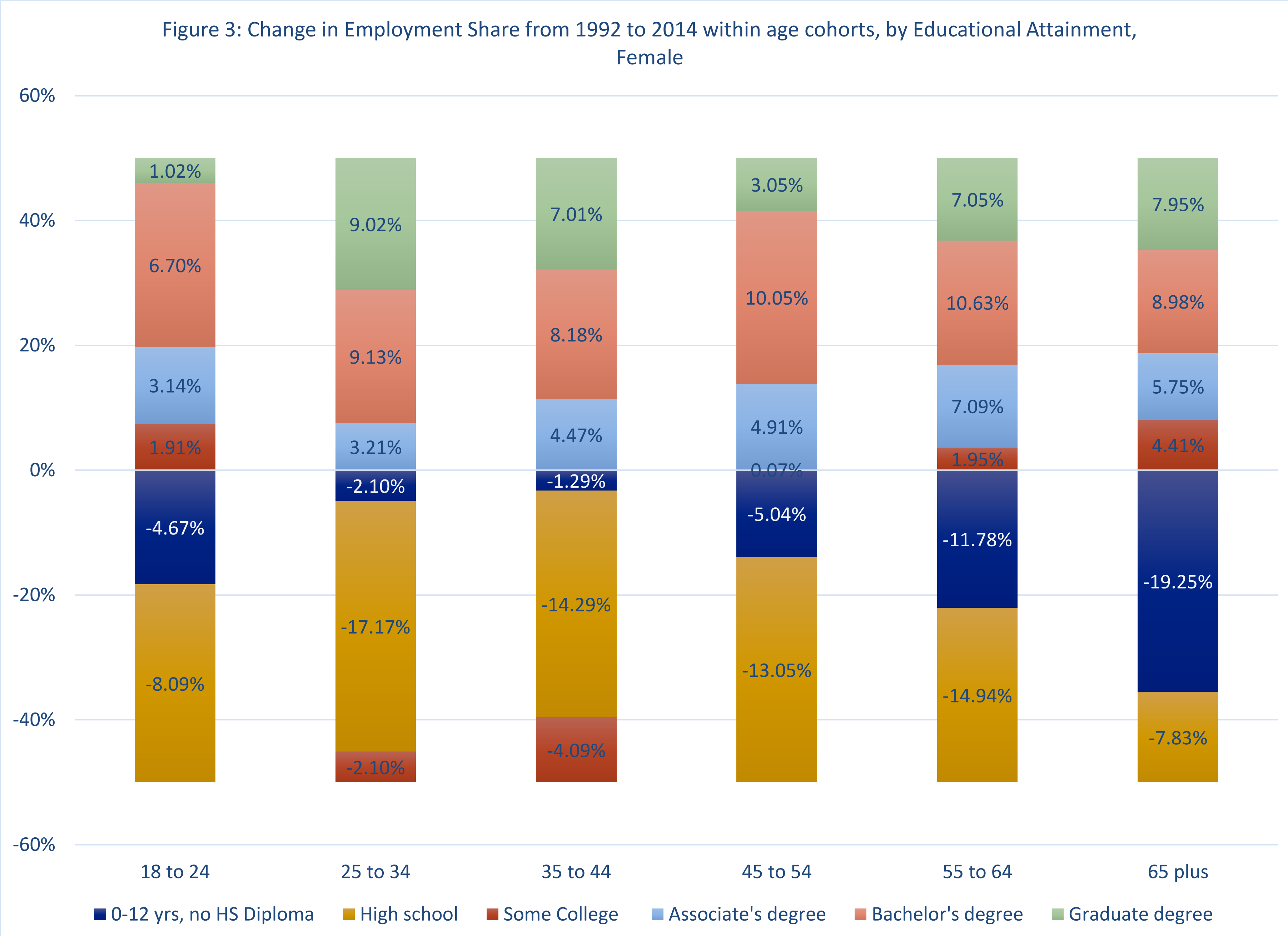


Figure 3: Change in Employment Share from 1992 to 2014 within age cohorts, by Educational Attainment, Female
60%
40%
20%
0%
-20%
-40%
-60%
1.02%
6.70%
3.14%
1.91%
-4.67%
-8.09%
9.02%
9.13%
3.21%
-2.10%
-17.17%
-2.10%
7.01%
8.18%
4.47%
-1.29%
-14.29%
-4.09%
3.05%
10.05%
4.91%
0.07%
-5.04%
-13.05%
7.05%
10.63%
7.09%
1.95%
-11.78%
-14.94%
7.95%
8.98%
5.75%
4.41%
-19.25%
-7.83%
18 to 24
25 to 34
35 to 44
45 to 54
55 to 64
65 plus
0-12 yrs, no HS Diploma
High school
Some College
Associate's degree
Bachelor's degree
Graduate degree

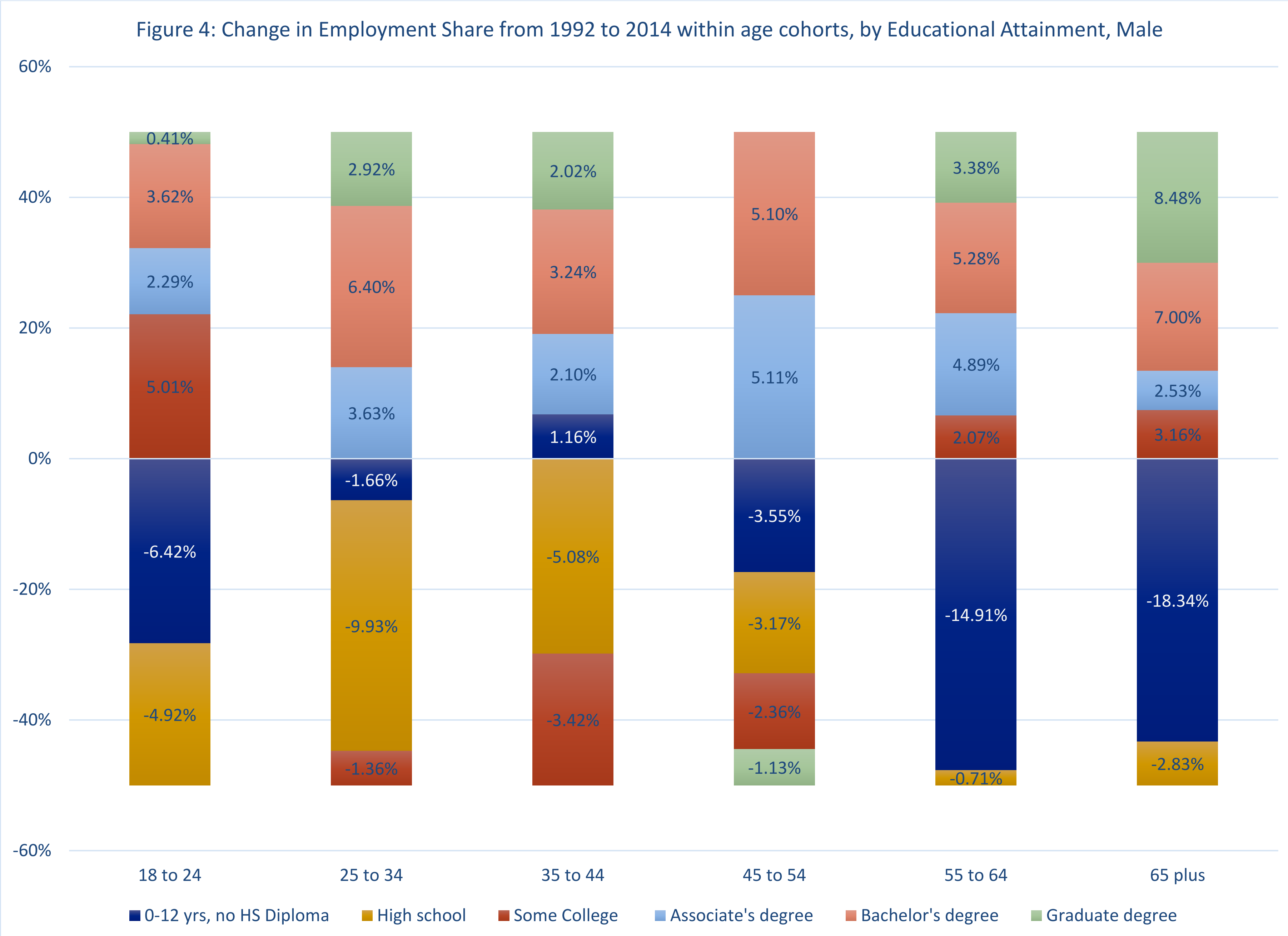


Figure 4: Change in Employment Share from 1992 to 2014 within age cohorts, by Educational Attainment, Male
60%
40%
20%
0%
-20%
-40%
-60%
0.41%
3.62%
2.29%
5.01%
-6.42%
-4.92%
2.92%
6.40%
3.63%
-1.66%
-9.93%
-1.36%
2.02%
3.24%
2.10%
1.16%
-5.08%
-3.42%
5.10%
5.11%
-3.55%
-3.17%
-2.36%
-1.13%
3.38%
5.28%
4.89%
2.07%
-14.91%
-0.71%
8.48%
7.00%
2.53%
3.16%
-18.34%
-2.83%
18 to 24
25 to 34
35 to 44
45 to 54
55 to 64
65 plus
0-12 yrs, no HS Diploma
High school
Some College
Associate's degree
Bachelor's degree
Graduate degree

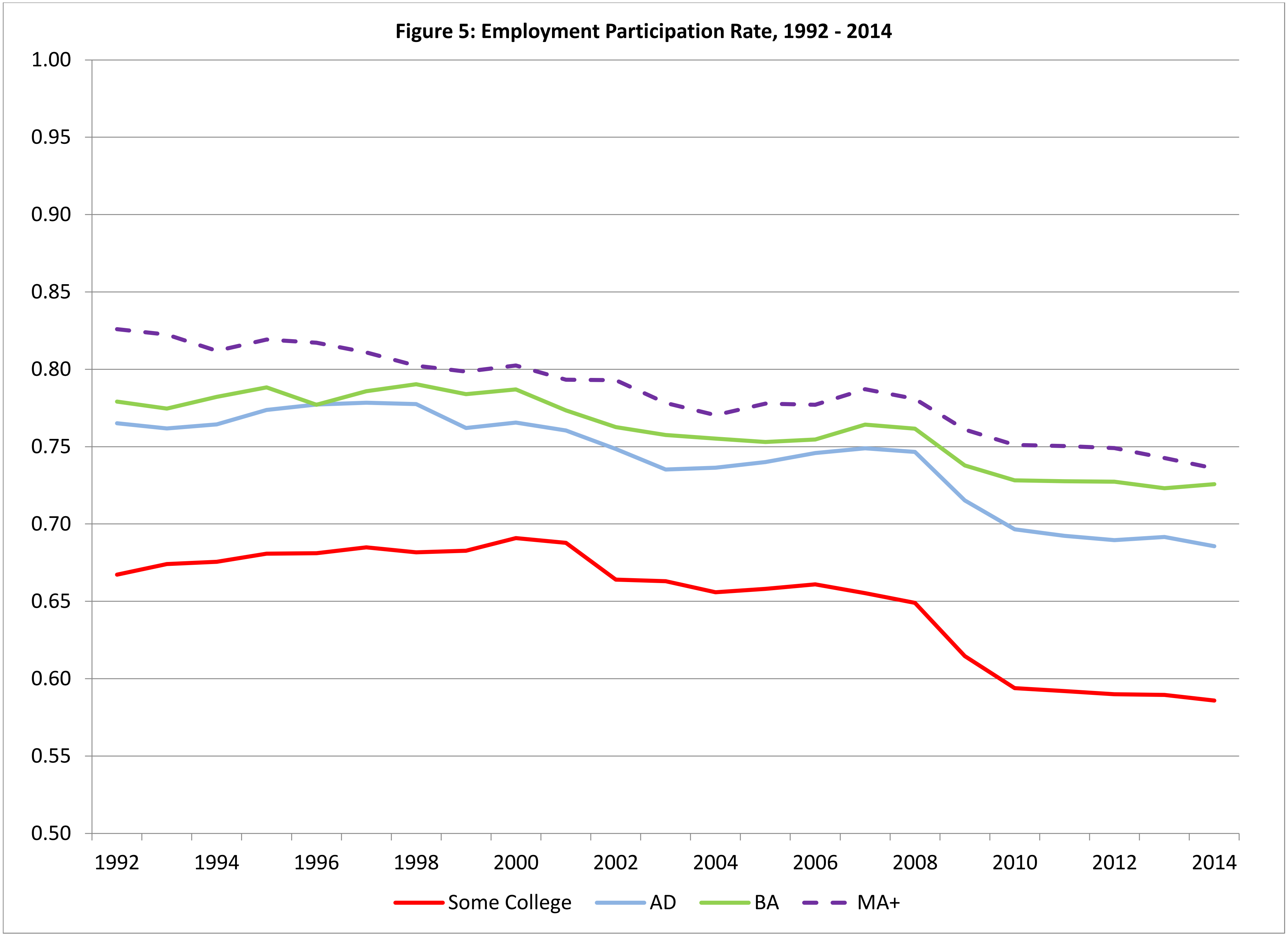


Figure 5: Employment Participation Rate, 1992 - 2014
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Some College
AD
BA
MA+

Figure 6: Employment Participation Rate, by Gender and Age Cohort, 1992-2014

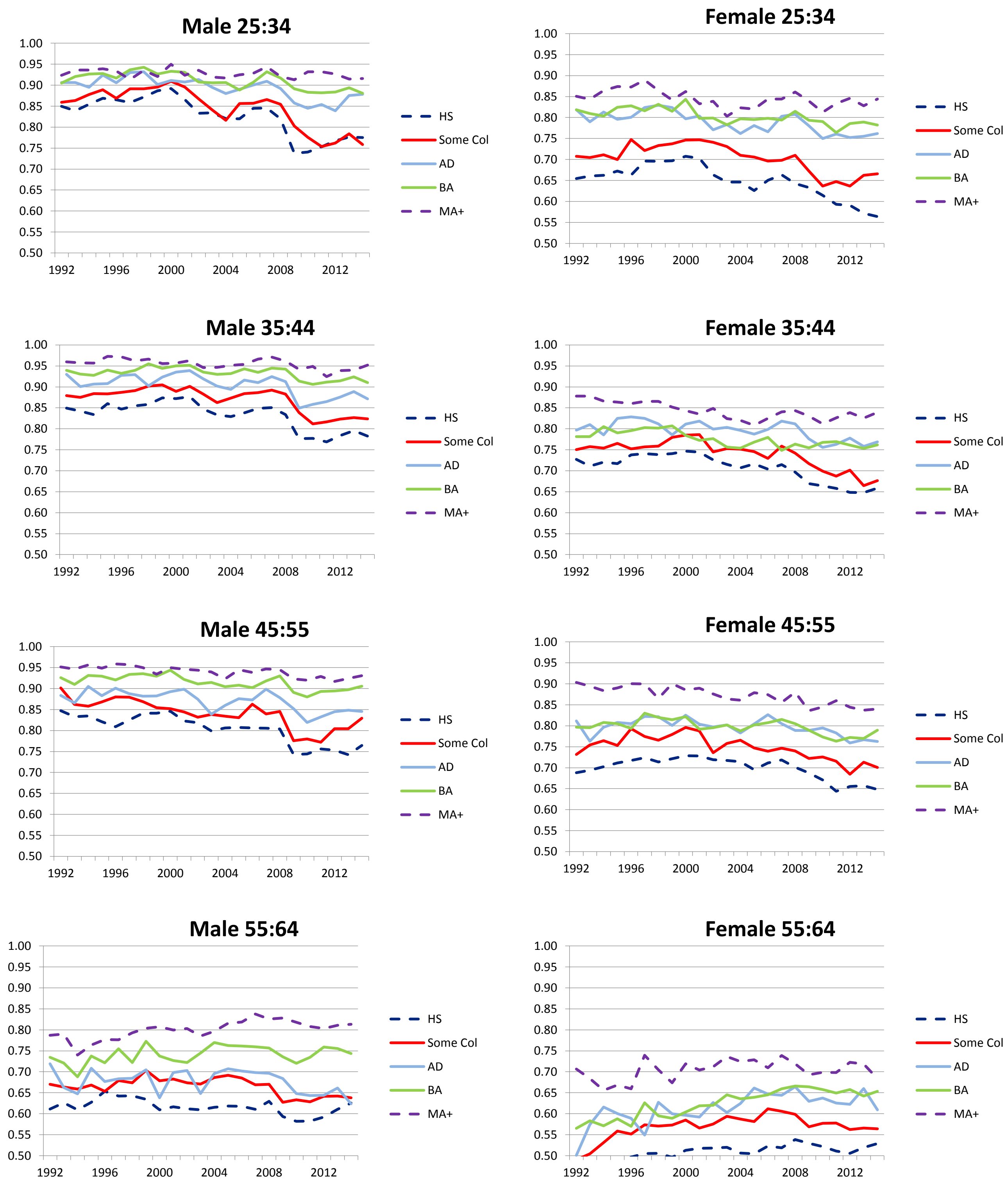
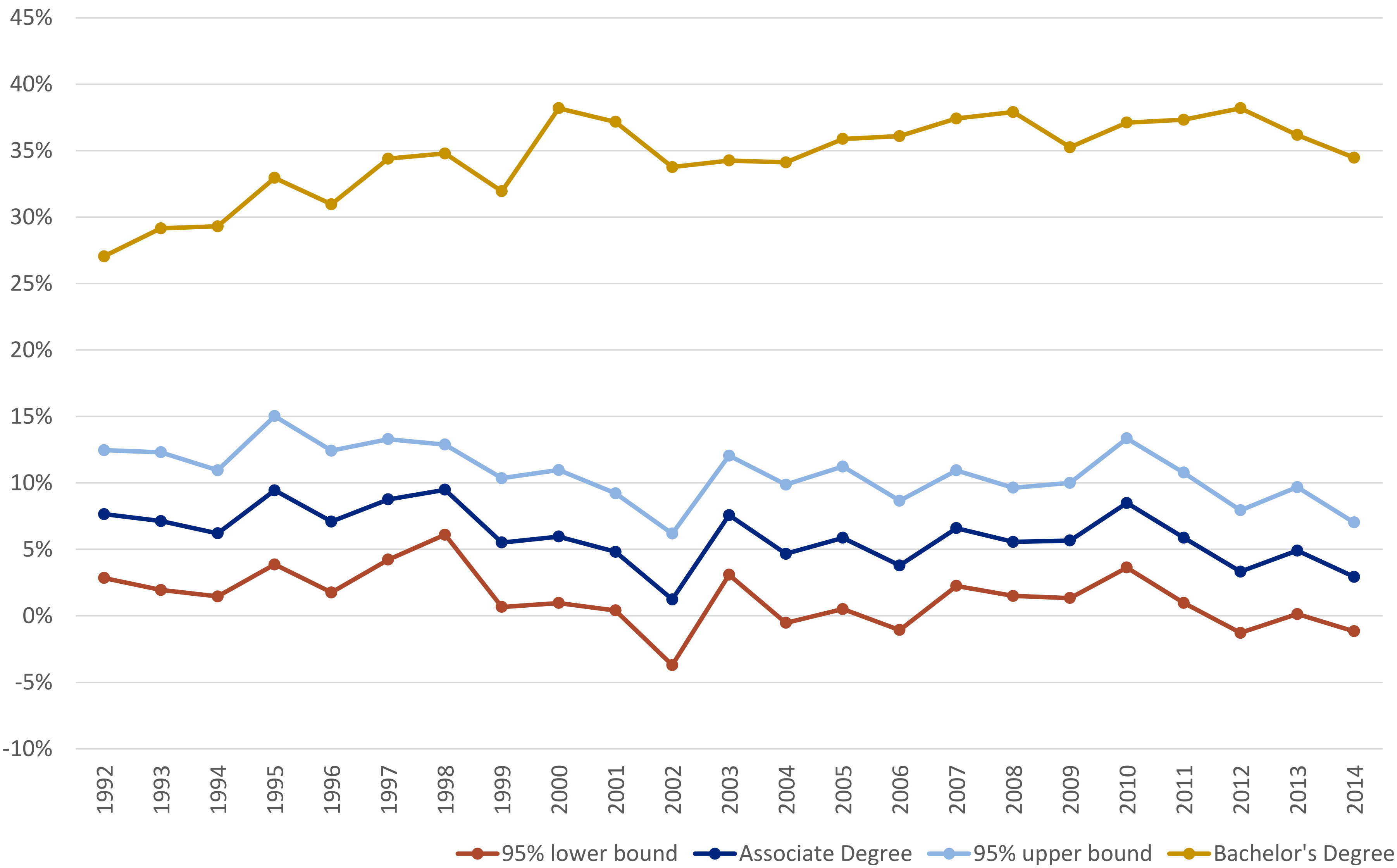
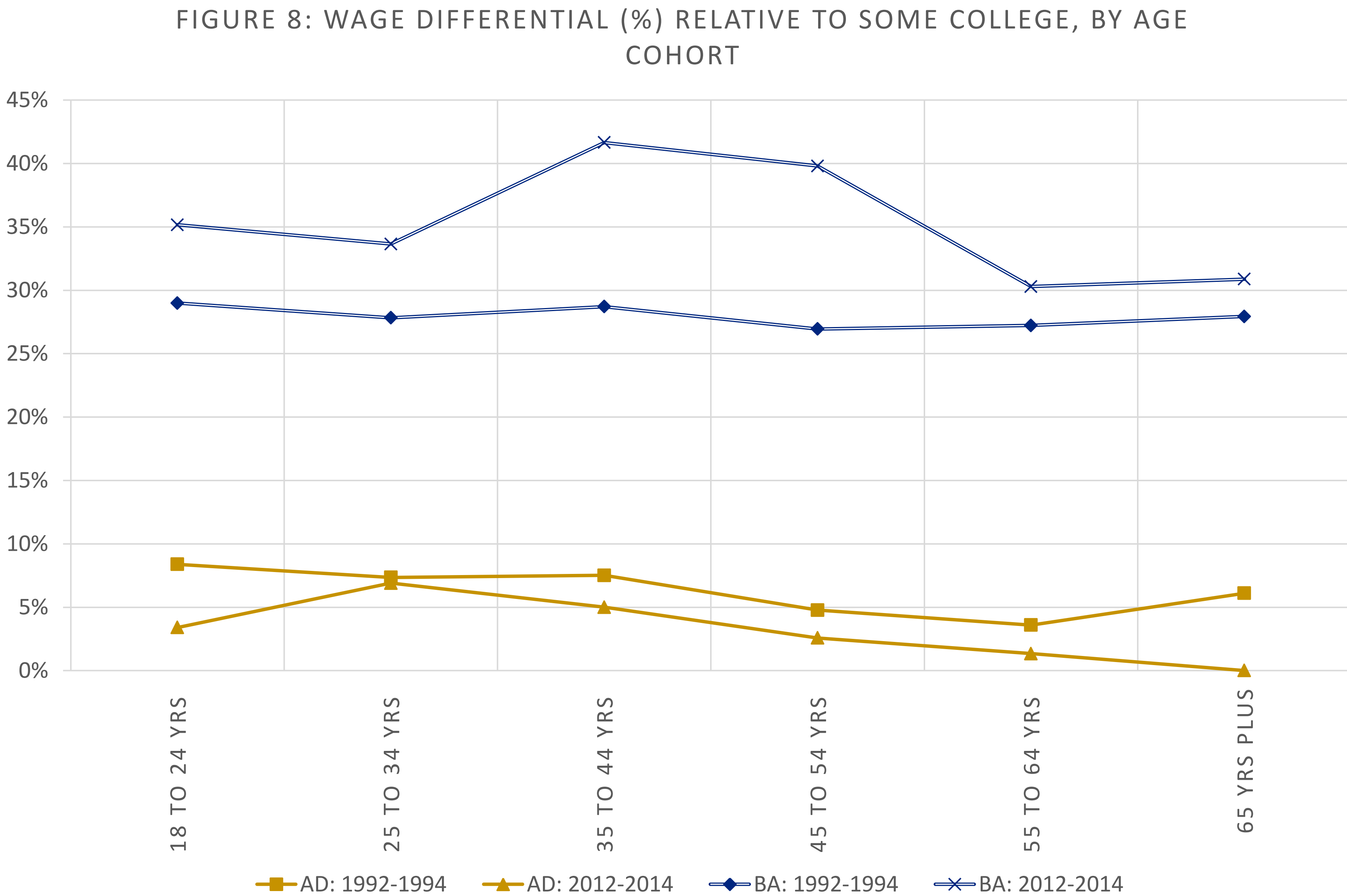


Figure 7: Wage Difference (%) Relative to Some College, 1992-2014



Note: The annual wage difference is estimated using a *log-lin* regression where hourly compensation is regressed against sex, age cohorts, and control for 65 industries. Total employment in each industry is used as weights and the standard errors were clustered by industry



Note: The annual wage difference is estimated using a *log-lin* regression where hourly compensation is regressed against sex and control for 65 industries for each age cohort. Total employment in each industry is used as weights and the standard errors were clustered by industry.

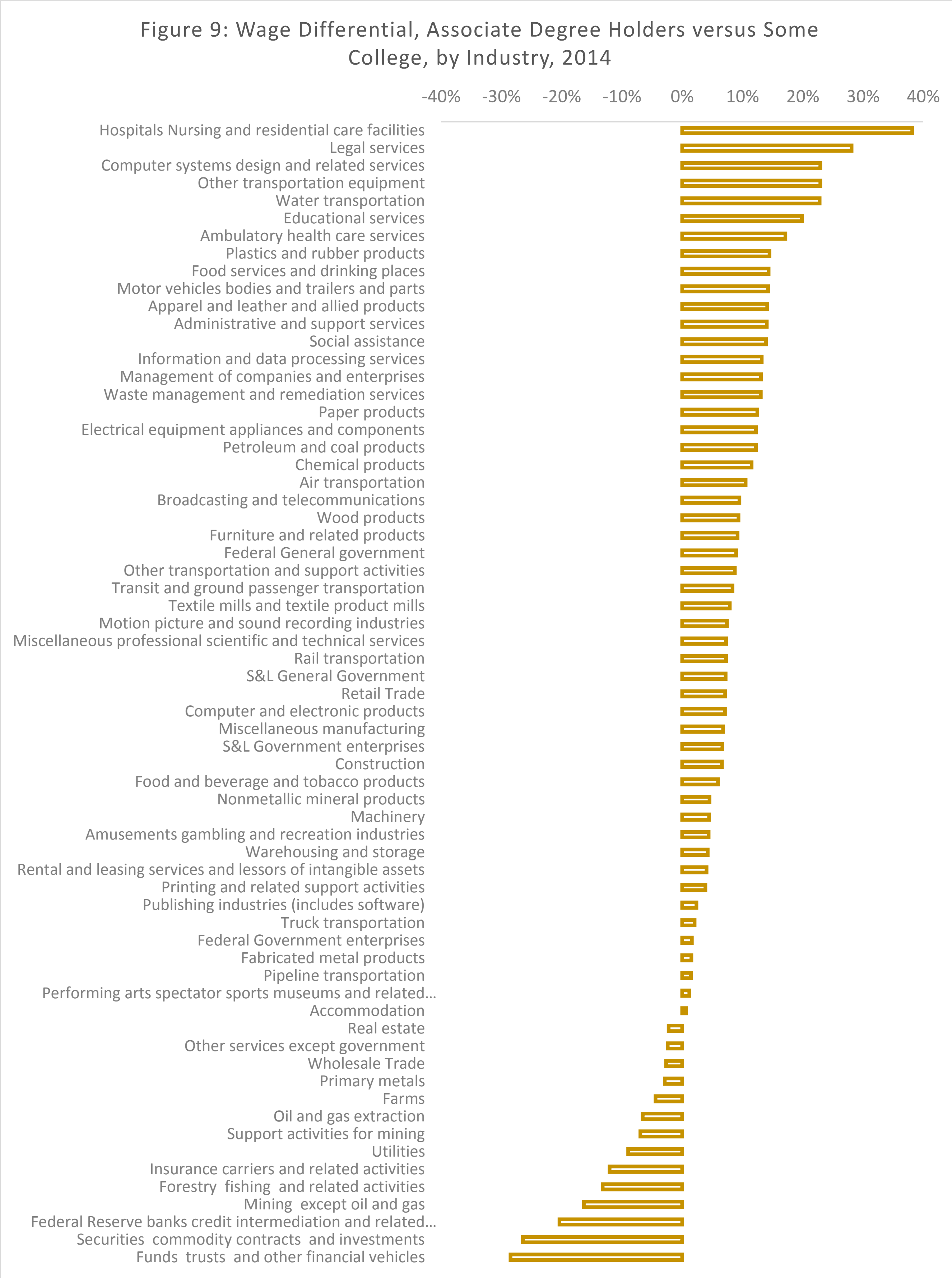


Figure 9: Wage Differential, Associate Degree Holders versus Some College, by Industry, 2014
-40%
-30%
-20%
-10%
0%
10%
20%
30%
40%
Hospitals Nursing and residential care facilities
Legal services
Computer systems design and related services
Other transportation equipment
Water transportation
Educational services
Ambulatory health care services
Plastics and rubber products
Food services and drinking places
Motor vehicles bodies and trailers and parts
Apparel and leather and allied products
Administrative and support services
Social assistance
Information and data processing services
Management of companies and enterprises
Waste management and remediation services
Paper products
Electrical equipment appliances and components
Petroleum and coal products
Chemical products
Air transportation
Broadcasting and telecommunications
Wood products
Furniture and related products
Federal General government
Other transportation and support activities
Transit and ground passenger transportation
Textile mills and textile product mills
Motion picture and sound recording industries
Miscellaneous professional scientific and technical services
Rail transportation
S&L General Government
Retail Trade
Computer and electronic products
Miscellaneous manufacturing
S&L Government enterprises
Construction
Food and beverage and tobacco products
Nonmetallic mineral products
Machinery
Amusements gambling and recreation industries
Warehousing and storage
Rental and leasing services and lessors of intangible assets
Printing and related support activities
Publishing industries (includes software)
Truck transportation
Federal Government enterprises
Fabricated metal products
Pipeline transportation
Performing arts spectator sports museums and related...
Accommodation
Real estate
Other services except government
Wholesale Trade
Primary metals
Farms
Oil and gas extraction
Support activities for mining
Utilities
Insurance carriers and related activities
Forestry fishing and related activities
Mining except oil and gas
Federal Reserve banks credit intermediation and related...
Securities commodity contracts and investments
Funds trusts and other financial vehicles

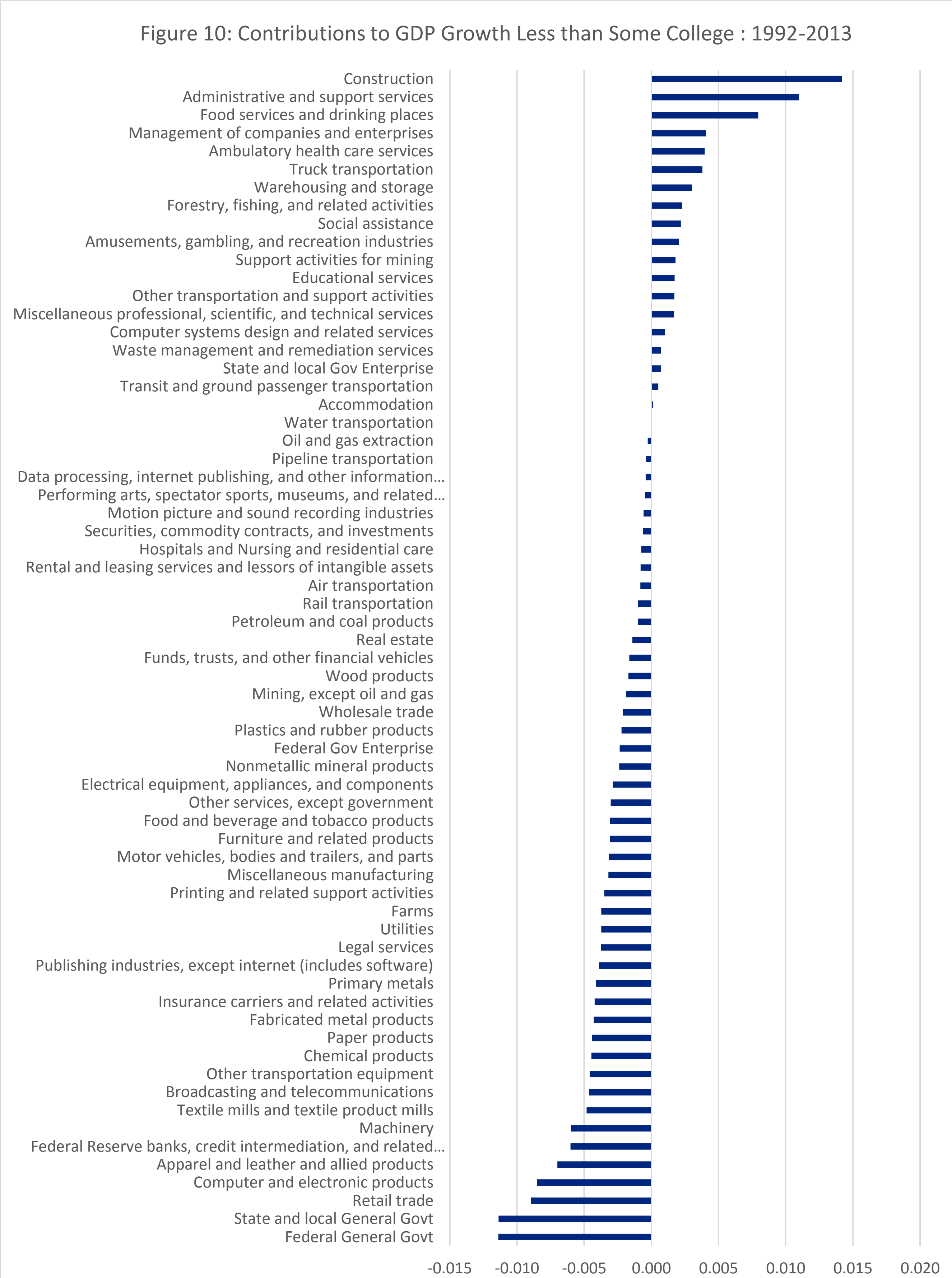


Figure 10: Contributions to GDP Growth Less than Some College : 1992-2013
Construction
Administrative and support services
Food services and drinking places
Management of companies and enterprises
Ambulatory health care services
Truck transportation
Warehousing and storage
Forestry, fishing, and related activities
Social assistance
Amusements, gambling, and recreation industries
Support activities for mining
Educational services
Other transportation and support activities
Miscellaneous professional, scientific, and technical services
Computer systems design and related services
Waste management and remediation services
State and local Gov Enterprise
Transit and ground passenger transportation
Accommodation
Water transportation
Oil and gas extraction
Pipeline transportation
Data processing, internet publishing, and other information…
Performing arts, spectator sports, museums, and related…
Motion picture and sound recording industries
Securities, commodity contracts, and investments
Hospitals and Nursing and residential care
Rental and leasing services and lessors of intangible assets
Air transportation
Rail transportation
Petroleum and coal products
Real estate
Funds, trusts, and other financial vehicles
Wood products
Mining, except oil and gas
Wholesale trade
Plastics and rubber products
Federal Gov Enterprise
Nonmetallic mineral products
Electrical equipment, appliances, and components
Other services, except government
Food and beverage and tobacco products
Furniture and related products
Motor vehicles, bodies and trailers, and parts
Miscellaneous manufacturing
Printing and related support activities
Farms
Utilities
Legal services
Publishing industries, except internet (includes software)
Primary metals
Insurance carriers and related activities
Fabricated metal products
Paper products
Chemical products
Other transportation equipment
Broadcasting and telecommunications
Textile mills and textile product mills
Machinery
Federal Reserve banks, credit intermediation, and related…
Apparel and leather and allied products
Computer and electronic products
Retail trade
State and local General Govt
Federal General Govt
-0.015
-0.010
-0.005
0.000
0.005
0.010
0.015
0.020

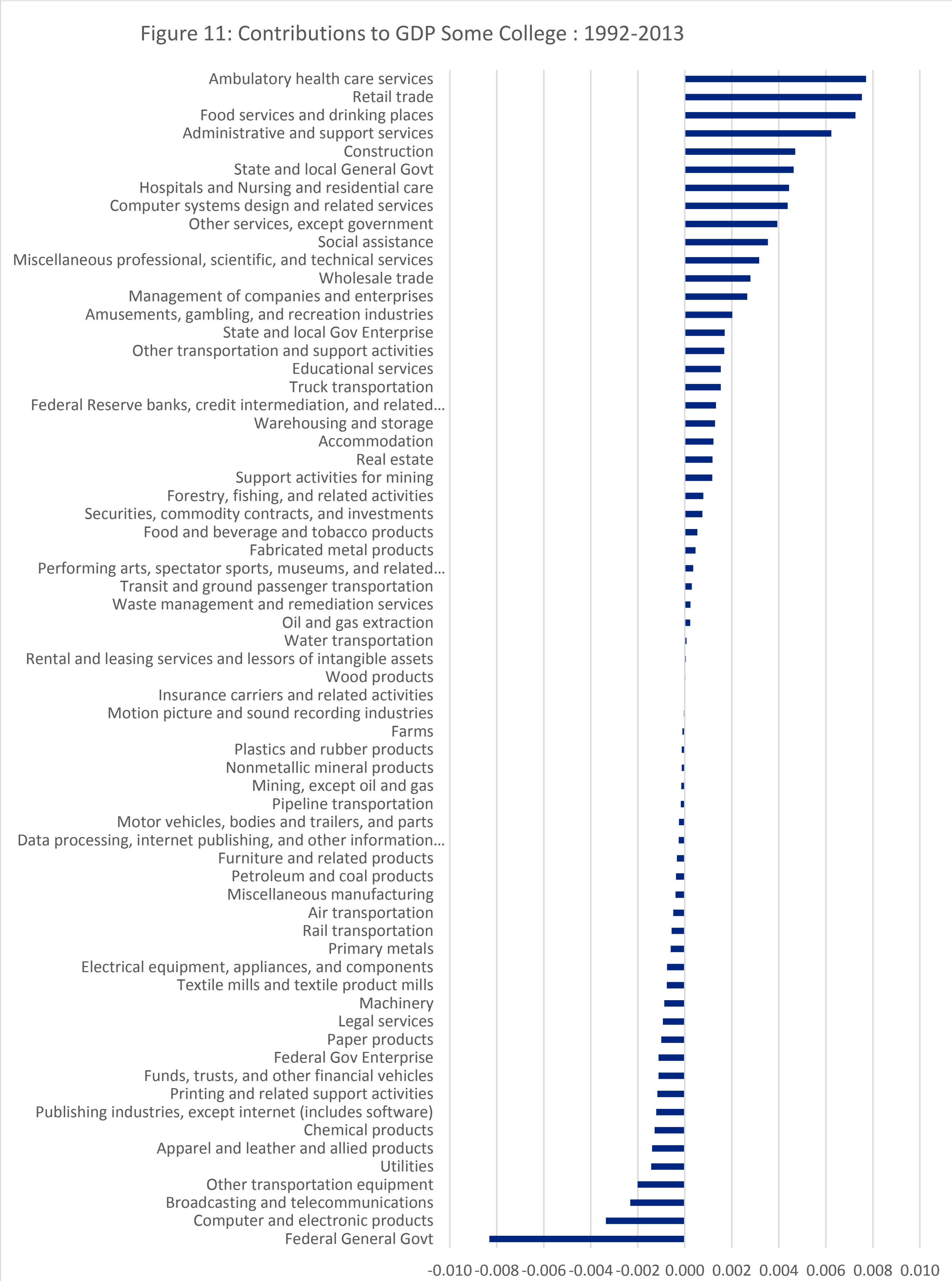
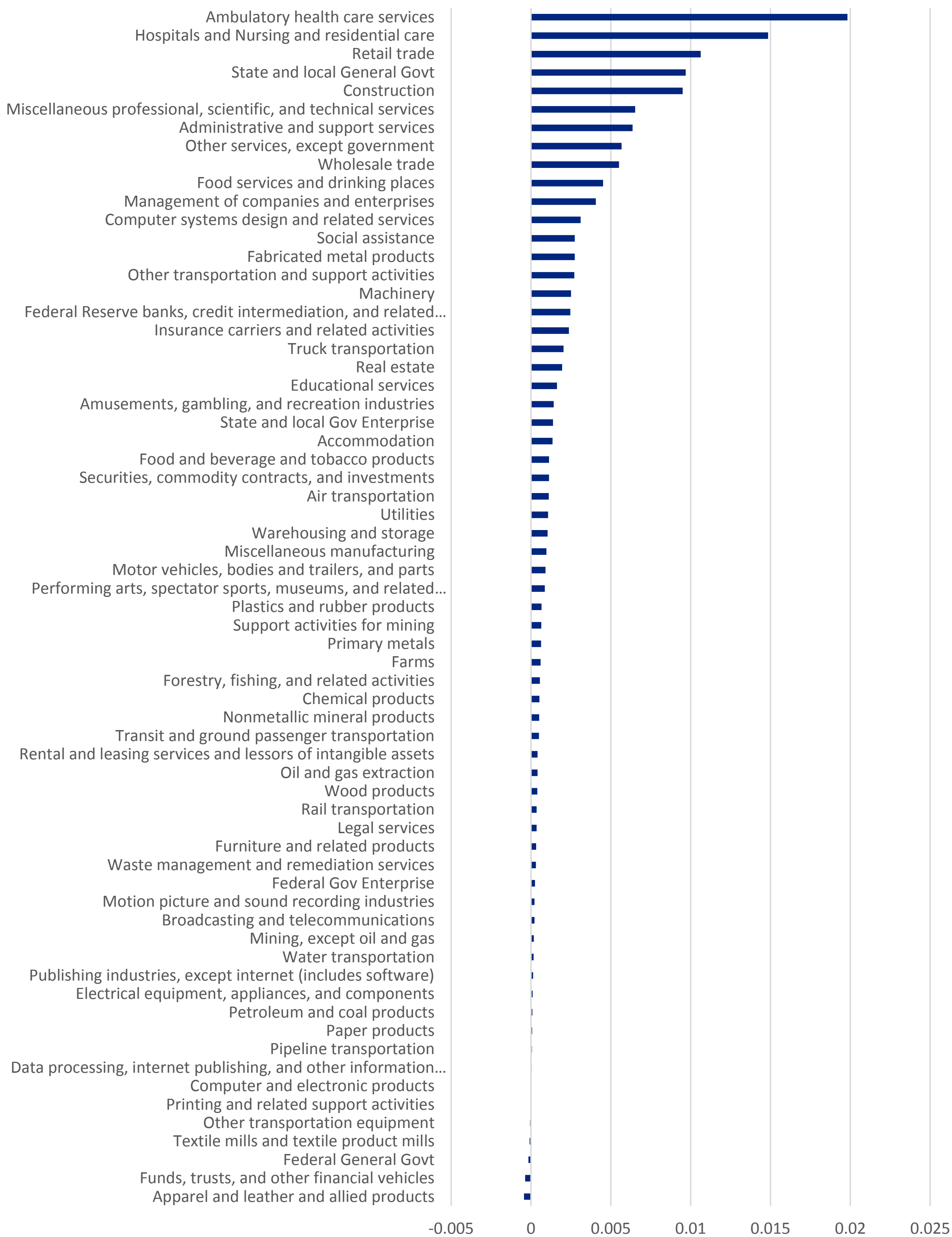


Figure 11: Contributions to GDP Some College : 1992-2013
Ambulatory health care services
Retail trade
Food services and drinking places
Administrative and support services
Construction
State and local General Govt
Hospitals and Nursing and residential care
Computer systems design and related services
Other services, except government
Social assistance
Miscellaneous professional, scientific, and technical services
Wholesale trade
Management of companies and enterprises
Amusements, gambling, and recreation industries
State and local Gov Enterprise
Other transportation and support activities
Educational services
Truck transportation
Federal Reserve banks, credit intermediation, and related…
Warehousing and storage
Accommodation
Real estate
Support activities for mining
Forestry, fishing, and related activities
Securities, commodity contracts, and investments
Food and beverage and tobacco products
Fabricated metal products
Performing arts, spectator sports, museums, and related…
Transit and ground passenger transportation
Waste management and remediation services
Oil and gas extraction
Water transportation
Rental and leasing services and lessors of intangible assets
Wood products
Insurance carriers and related activities
Motion picture and sound recording industries
Farms
Plastics and rubber products
Nonmetallic mineral products
Mining, except oil and gas
Pipeline transportation
Motor vehicles, bodies and trailers, and parts
Data processing, internet publishing, and other information…
Furniture and related products
Petroleum and coal products
Miscellaneous manufacturing
Air transportation
Rail transportation
Primary metals
Electrical equipment, appliances, and components
Textile mills and textile product mills
Machinery
Legal services
Paper products
Federal Gov Enterprise
Funds, trusts, and other financial vehicles
Printing and related support activities
Publishing industries, except internet (includes software)
Chemical products
Apparel and leather and allied products
Utilities
Other transportation equipment
Broadcasting and telecommunications
Computer and electronic products
Federal General Govt
-0.010 -0.008 -0.006 -0.004 -0.002 0.000 0.002 0.004 0.006 0.008 0.010

Figure 12: Contributions to GDP AD Holders : 1992-2013



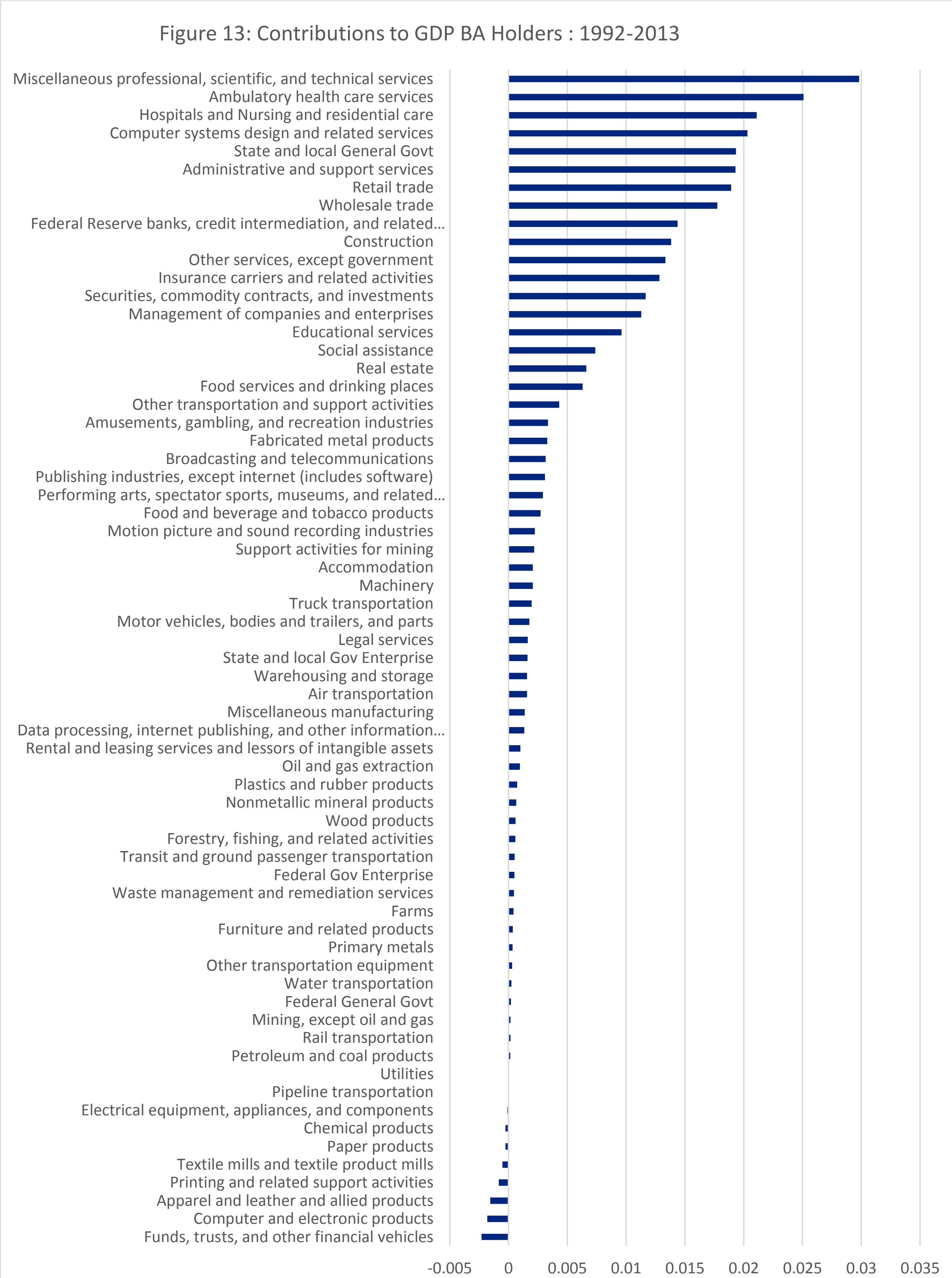
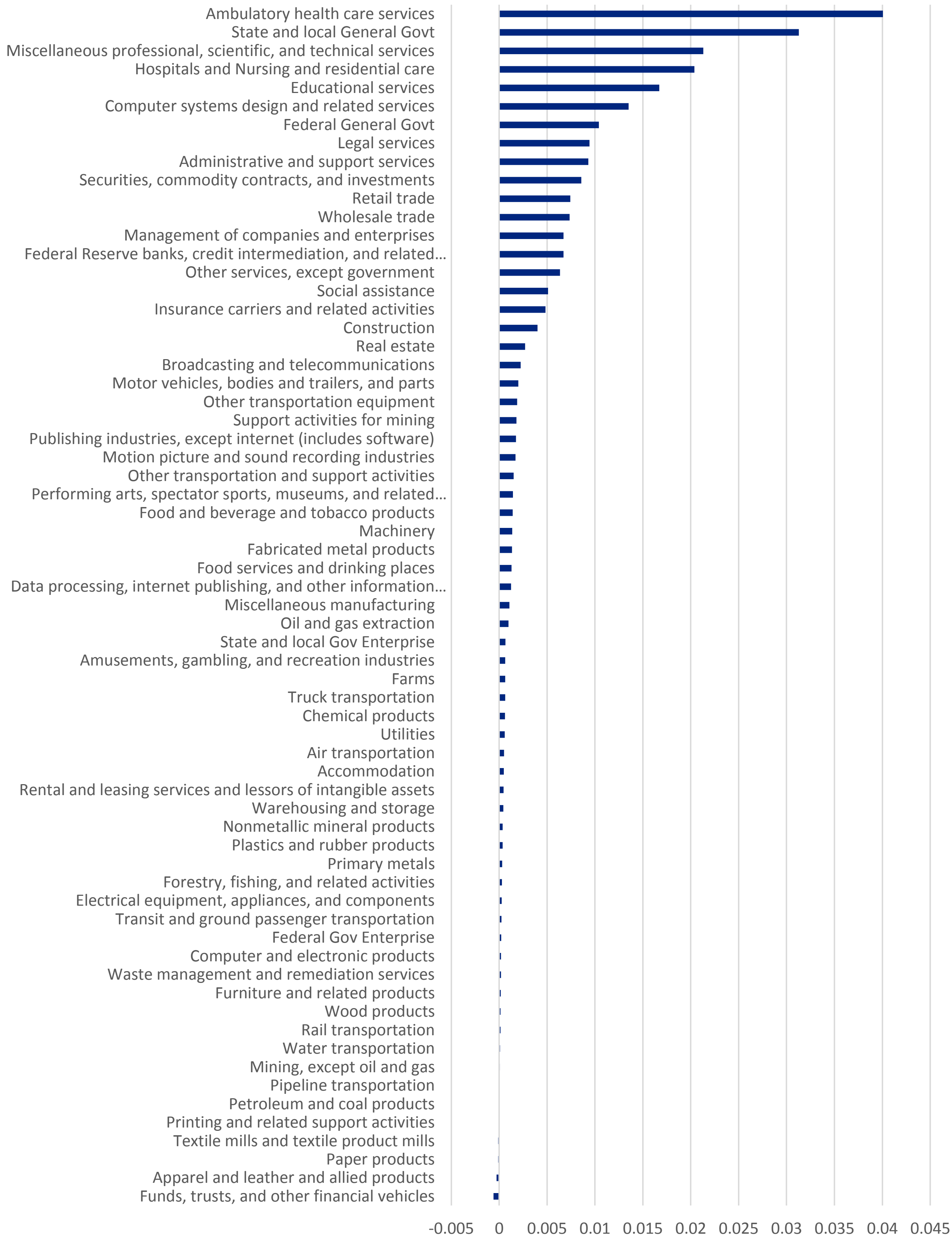


Figure 13: Contributions to GDP BA Holders : 1992-2013
Miscellaneous professional, scientific, and technical services
Ambulatory health care services
Hospitals and Nursing and residential care
Computer systems design and related services
State and local General Govt
Administrative and support services
Retail trade
Wholesale trade
Federal Reserve banks, credit intermediation, and related…
Construction
Other services, except government
Insurance carriers and related activities
Securities, commodity contracts, and investments
Management of companies and enterprises
Educational services
Social assistance
Real estate
Food services and drinking places
Other transportation and support activities
Amusements, gambling, and recreation industries
Fabricated metal products
Broadcasting and telecommunications
Publishing industries, except internet (includes software)
Performing arts, spectator sports, museums, and related…
Food and beverage and tobacco products
Motion picture and sound recording industries
Support activities for mining
Accommodation
Machinery
Truck transportation
Motor vehicles, bodies and trailers, and parts
Legal services
State and local Gov Enterprise
Warehousing and storage
Air transportation
Miscellaneous manufacturing
Data processing, internet publishing, and other information…
Rental and leasing services and lessors of intangible assets
Oil and gas extraction
Plastics and rubber products
Nonmetallic mineral products
Wood products
Forestry, fishing, and related activities
Transit and ground passenger transportation
Federal Gov Enterprise
Waste management and remediation services
Farms
Furniture and related products
Primary metals
Other transportation equipment
Water transportation
Federal General Govt
Mining, except oil and gas
Rail transportation
Petroleum and coal products
Utilities
Pipeline transportation
Electrical equipment, appliances, and components
Chemical products
Paper products
Textile mills and textile product mills
Printing and related support activities
Apparel and leather and allied products
Computer and electronic products
Funds, trusts, and other financial vehicles
-0.005
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035

Figure 14: Contributions to GDP MA+: 1992-2013



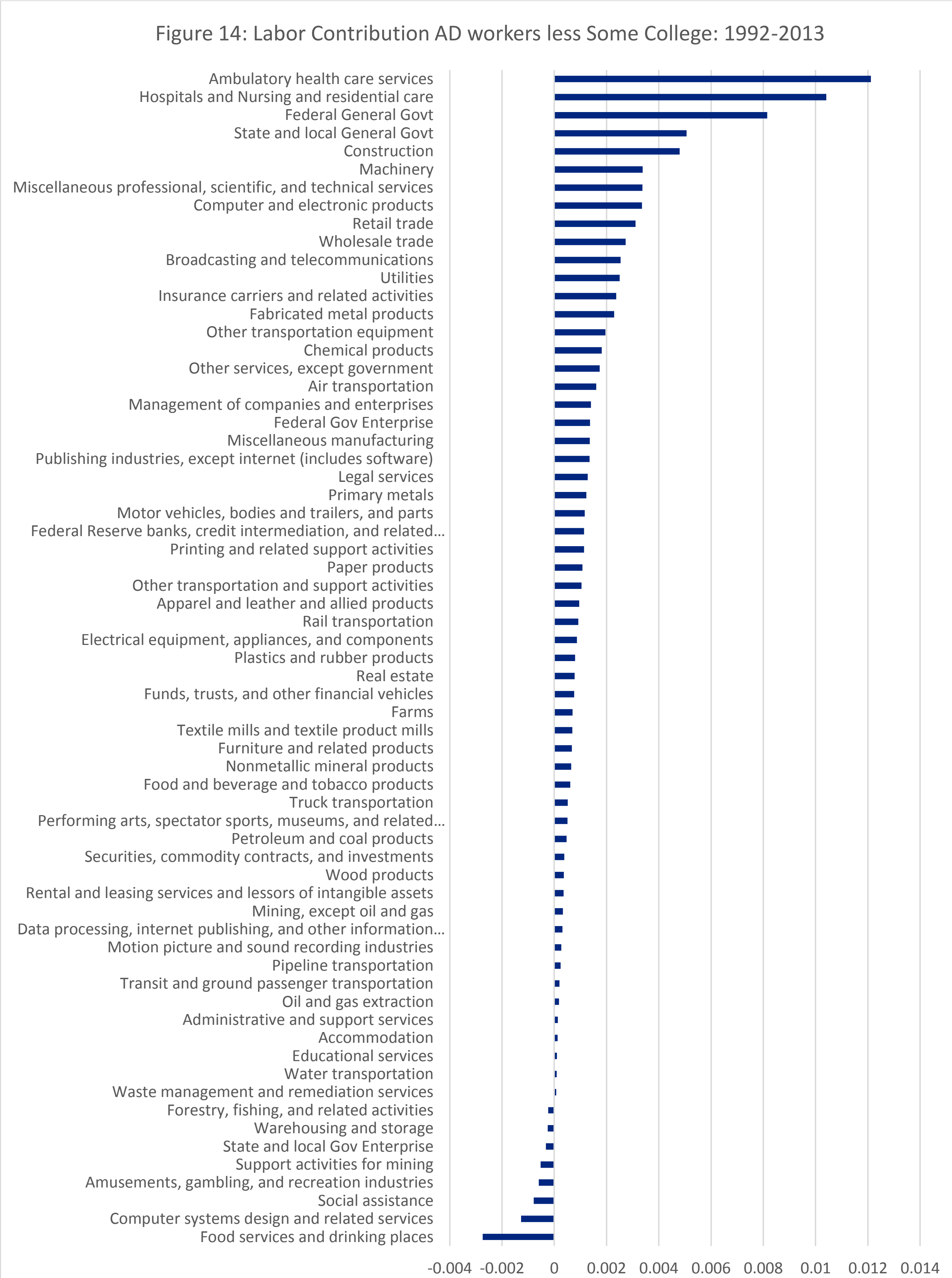


Figure 14: Labor Contribution AD workers less Some College: 1992-2013
Ambulatory health care services
Hospitals and Nursing and residential care
Federal General Govt
State and local General Govt
Construction
Machinery
Miscellaneous professional, scientific, and technical services
Computer and electronic products
Retail trade
Wholesale trade
Broadcasting and telecommunications
Utilities
Insurance carriers and related activities
Fabricated metal products
Other transportation equipment
Chemical products
Other services, except government
Air transportation
Management of companies and enterprises
Federal Gov Enterprise
Miscellaneous manufacturing
Publishing industries, except internet (includes software)
Legal services
Primary metals
Motor vehicles, bodies and trailers, and parts
Federal Reserve banks, credit intermediation, and related…
Printing and related support activities
Paper products
Other transportation and support activities
Apparel and leather and allied products
Rail transportation
Electrical equipment, appliances, and components
Plastics and rubber products
Real estate
Funds, trusts, and other financial vehicles
Farms
Textile mills and textile product mills
Furniture and related products
Nonmetallic mineral products
Food and beverage and tobacco products
Truck transportation
Performing arts, spectator sports, museums, and related…
Petroleum and coal products
Securities, commodity contracts, and investments
Wood products
Rental and leasing services and lessors of intangible assets
Mining, except oil and gas
Data processing, internet publishing, and other information…
Motion picture and sound recording industries
Pipeline transportation
Transit and ground passenger transportation
Oil and gas extraction
Administrative and support services
Accommodation
Educational services
Water transportation
Waste management and remediation services
Forestry, fishing, and related activities
Warehousing and storage
State and local Gov Enterprise
Support activities for mining
Amusements, gambling, and recreation industries
Social assistance
Computer systems design and related services
Food services and drinking places
-0.004
-0.002
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014

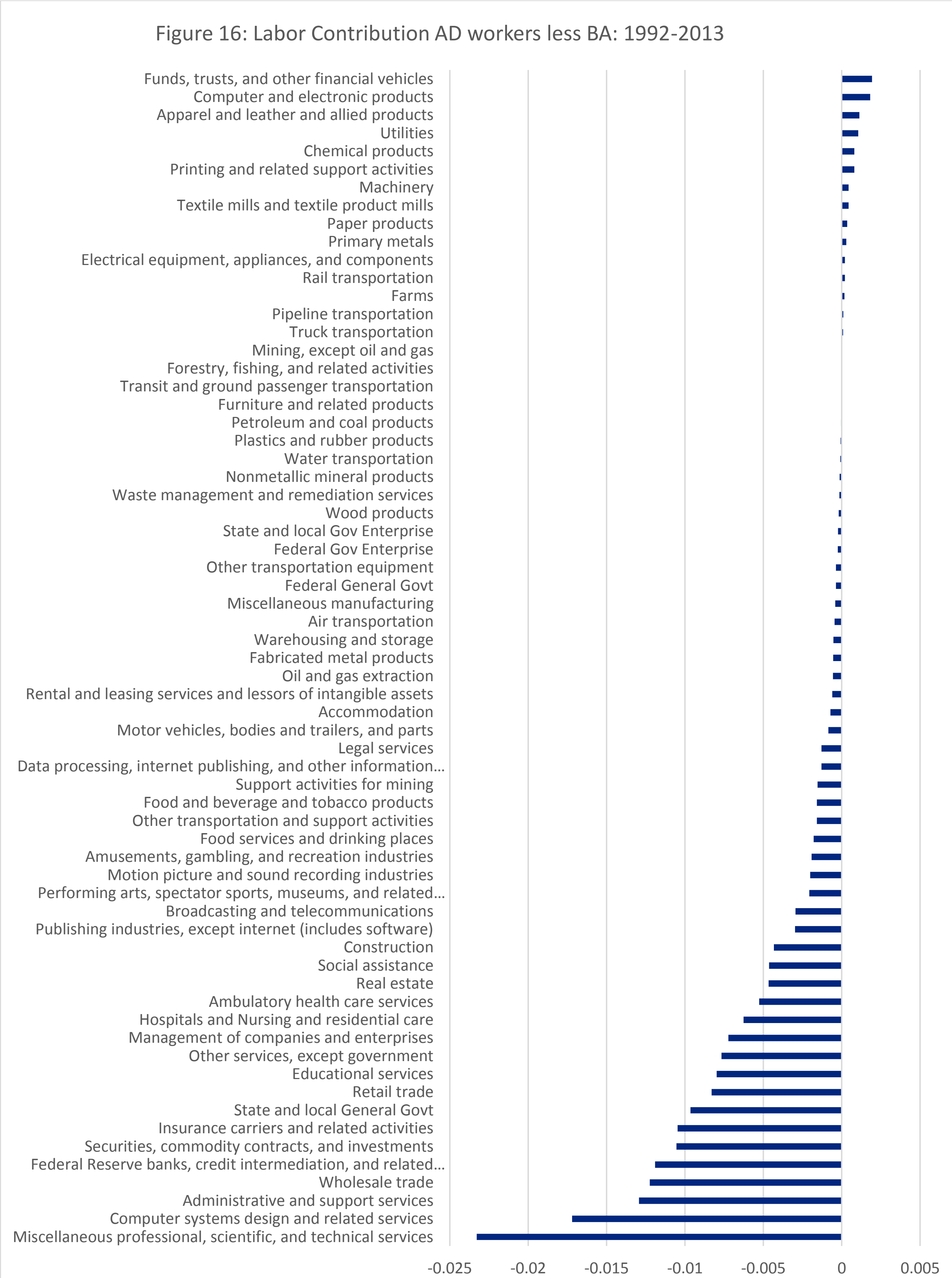


Figure 16: Labor Contribution AD workers less BA: 1992-2013
Funds, trusts, and other financial vehicles
Computer and electronic products
Apparel and leather and allied products
Utilities
Chemical products
Printing and related support activities
Machinery
Textile mills and textile product mills
Paper products
Primary metals
Electrical equipment, appliances, and components
Rail transportation
Farms
Pipeline transportation
Truck transportation
Mining, except oil and gas
Forestry, fishing, and related activities
Transit and ground passenger transportation
Furniture and related products
Petroleum and coal products
Plastics and rubber products
Water transportation
Nonmetallic mineral products
Waste management and remediation services
Wood products
State and local Gov Enterprise
Federal Gov Enterprise
Other transportation equipment
Federal General Govt
Miscellaneous manufacturing
Air transportation
Warehousing and storage
Fabricated metal products
Oil and gas extraction
Rental and leasing services and lessors of intangible assets
Accommodation
Motor vehicles, bodies and trailers, and parts
Legal services
Data processing, internet publishing, and other information…
Support activities for mining
Food and beverage and tobacco products
Other transportation and support activities
Food services and drinking places
Amusements, gambling, and recreation industries
Motion picture and sound recording industries
Performing arts, spectator sports, museums, and related…
Broadcasting and telecommunications
Publishing industries, except internet (includes software)
Construction
Social assistance
Real estate
Ambulatory health care services
Hospitals and Nursing and residential care
Management of companies and enterprises
Other services, except government
Educational services
Retail trade
State and local General Govt
Insurance carriers and related activities
Securities, commodity contracts, and investments
Federal Reserve banks, credit intermediation, and related…
Wholesale trade
Administrative and support services
Computer systems design and related services
Miscellaneous professional, scientific, and technical services
-0.025
-0.02
-0.015
-0.01
-0.005
0
0.005

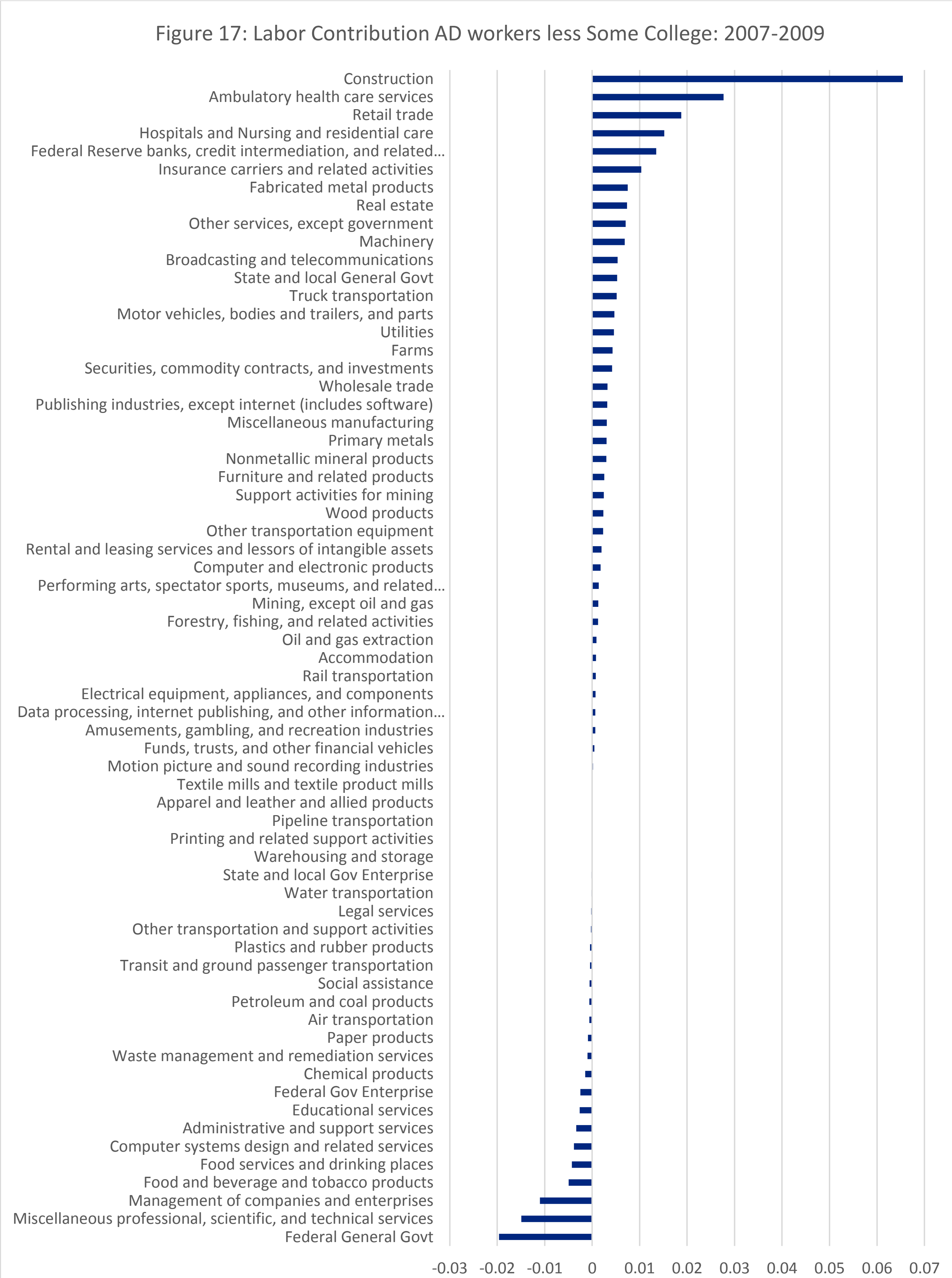


Figure 17: Labor Contribution AD workers less Some College: 2007-2009
Construction
Ambulatory health care services
Retail trade
Hospitals and Nursing and residential care
Federal Reserve banks, credit intermediation, and related…
Insurance carriers and related activities
Fabricated metal products
Real estate
Other services, except government
Machinery
Broadcasting and telecommunications
State and local General Govt
Truck transportation
Motor vehicles, bodies and trailers, and parts
Utilities
Farms
Securities, commodity contracts, and investments
Wholesale trade
Publishing industries, except internet (includes software)
Miscellaneous manufacturing
Primary metals
Nonmetallic mineral products
Furniture and related products
Support activities for mining
Wood products
Other transportation equipment
Rental and leasing services and lessors of intangible assets
Computer and electronic products
Performing arts, spectator sports, museums, and related…
Mining, except oil and gas
Forestry, fishing, and related activities
Oil and gas extraction
Accommodation
Rail transportation
Electrical equipment, appliances, and components
Data processing, internet publishing, and other information…
Amusements, gambling, and recreation industries
Funds, trusts, and other financial vehicles
Motion picture and sound recording industries
Textile mills and textile product mills
Apparel and leather and allied products
Pipeline transportation
Printing and related support activities
Warehousing and storage
State and local Gov Enterprise
Water transportation
Legal services
Other transportation and support activities
Plastics and rubber products
Transit and ground passenger transportation
Social assistance
Petroleum and coal products
Air transportation
Paper products
Waste management and remediation services
Chemical products
Federal Gov Enterprise
Educational services
Administrative and support services
Computer systems design and related services
Food services and drinking places
Food and beverage and tobacco products
Management of companies and enterprises
Miscellaneous professional, scientific, and technical services
Federal General Govt
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07

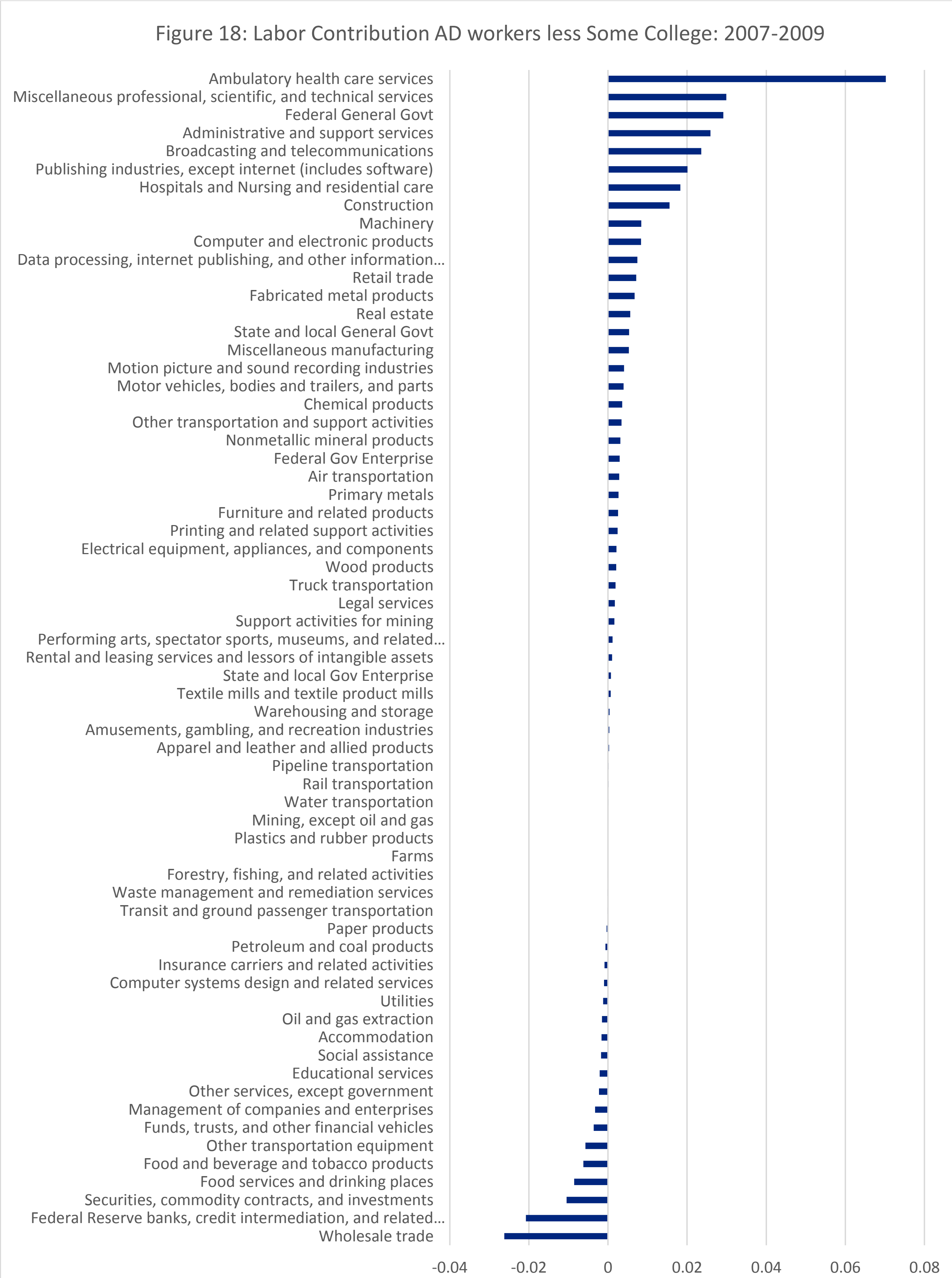
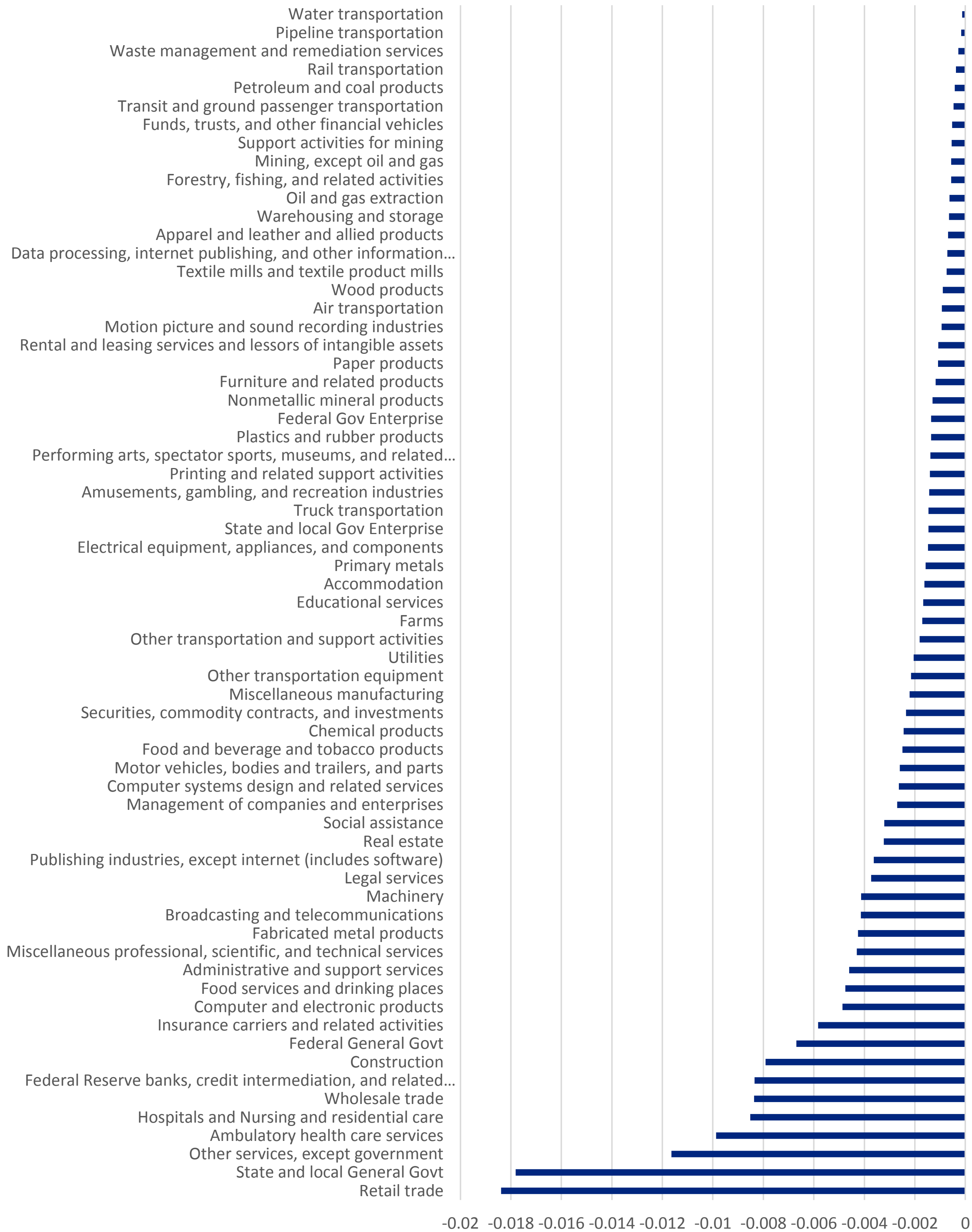


Figure 18: Labor Contribution AD workers less Some College: 2007-2009
Ambulatory health care services
Miscellaneous professional, scientific, and technical services
Federal General Govt
Administrative and support services
Broadcasting and telecommunications
Publishing industries, except internet (includes software)
Hospitals and Nursing and residential care
Construction
Machinery
Computer and electronic products
Data processing, internet publishing, and other information…
Retail trade
Fabricated metal products
Real estate
State and local General Govt
Miscellaneous manufacturing
Motion picture and sound recording industries
Motor vehicles, bodies and trailers, and parts
Chemical products
Other transportation and support activities
Nonmetallic mineral products
Federal Gov Enterprise
Air transportation
Primary metals
Furniture and related products
Printing and related support activities
Electrical equipment, appliances, and components
Wood products
Truck transportation
Legal services
Support activities for mining
Performing arts, spectator sports, museums, and related…
Rental and leasing services and lessors of intangible assets
State and local Gov Enterprise
Textile mills and textile product mills
Warehousing and storage
Amusements, gambling, and recreation industries
Apparel and leather and allied products
Pipeline transportation
Rail transportation
Water transportation
Mining, except oil and gas
Plastics and rubber products
Farms
Forestry, fishing, and related activities
Waste management and remediation services
Transit and ground passenger transportation
Paper products
Petroleum and coal products
Insurance carriers and related activities
Computer systems design and related services
Utilities
Oil and gas extraction
Accommodation
Social assistance
Educational services
Other services, except government
Management of companies and enterprises
Funds, trusts, and other financial vehicles
Other transportation equipment
Food and beverage and tobacco products
Food services and drinking places
Securities, commodity contracts, and investments
Federal Reserve banks, credit intermediation, and related…
Wholesale trade
-0.04
-0.02
0
0.02
0.04
0.06
0.08

Figure 19: Contributions to Aggregate Labor Quallity (Less than Some College) : 1992-2013



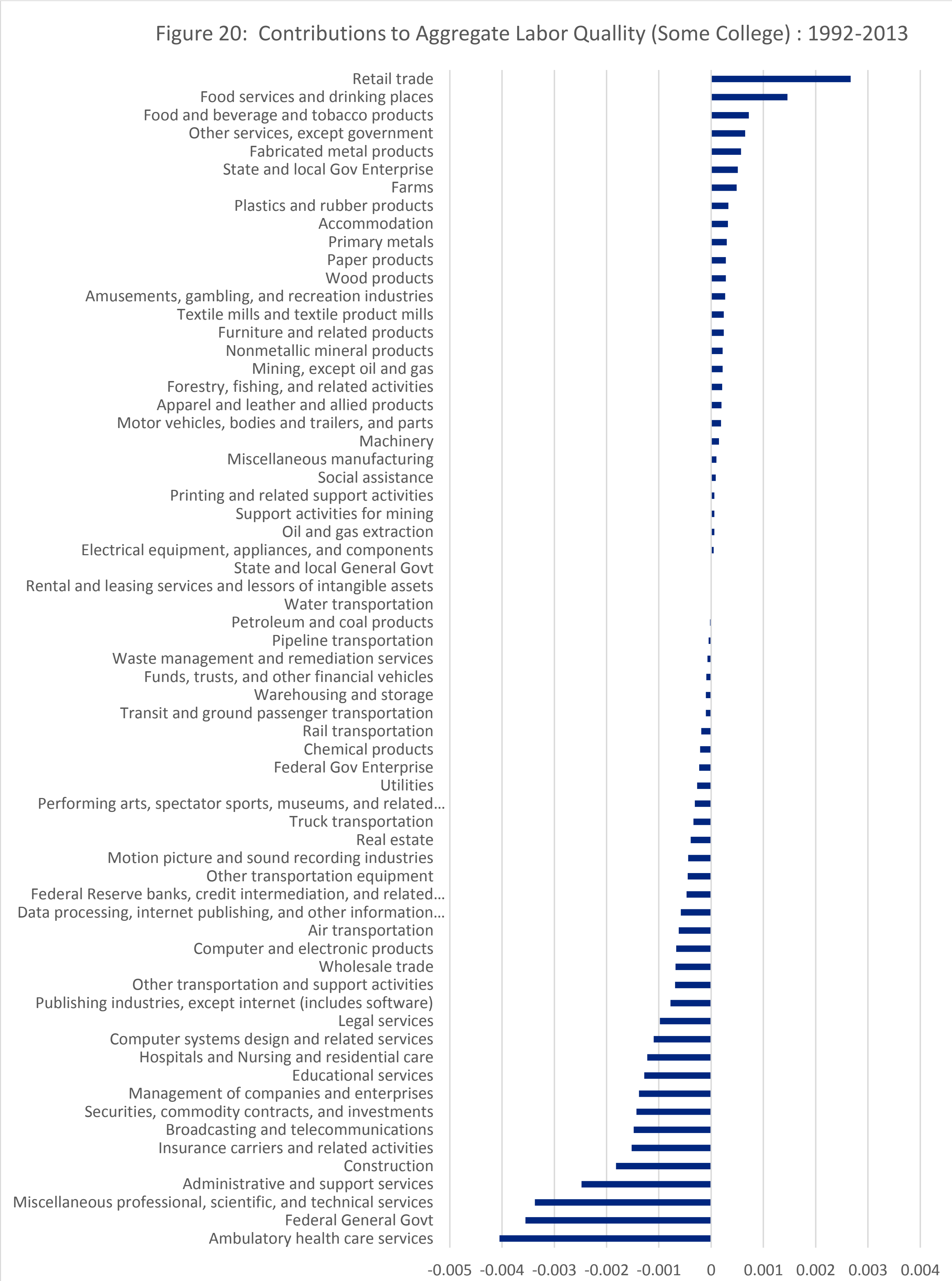


Figure 20: Contributions to Aggregate Labor Quallity (Some College) : 1992-2013
Retail trade
Food services and drinking places
Food and beverage and tobacco products
Other services, except government
Fabricated metal products
State and local Gov Enterprise
Farms
Plastics and rubber products
Accommodation
Primary metals
Paper products
Wood products
Amusements, gambling, and recreation industries
Textile mills and textile product mills
Furniture and related products
Nonmetallic mineral products
Mining, except oil and gas
Forestry, fishing, and related activities
Apparel and leather and allied products
Motor vehicles, bodies and trailers, and parts
Machinery
Miscellaneous manufacturing
Social assistance
Printing and related support activities
Support activities for mining
Oil and gas extraction
Electrical equipment, appliances, and components
State and local General Govt
Rental and leasing services and lessors of intangible assets
Water transportation
Petroleum and coal products
Pipeline transportation
Waste management and remediation services
Funds, trusts, and other financial vehicles
Warehousing and storage
Transit and ground passenger transportation
Rail transportation
Chemical products
Federal Gov Enterprise
Utilities
Performing arts, spectator sports, museums, and related…
Truck transportation
Real estate
Motion picture and sound recording industries
Other transportation equipment
Federal Reserve banks, credit intermediation, and related…
Data processing, internet publishing, and other information…
Air transportation
Computer and electronic products
Wholesale trade
Other transportation and support activities
Publishing industries, except internet (includes software)
Legal services
Computer systems design and related services
Hospitals and Nursing and residential care
Educational services
Management of companies and enterprises
Securities, commodity contracts, and investments
Broadcasting and telecommunications
Insurance carriers and related activities
Construction
Administrative and support services
Miscellaneous professional, scientific, and technical services
Federal General Govt
Ambulatory health care services
-0.005 -0.004 -0.003 -0.002 -0.001 0 0.001 0.002 0.003 0.004

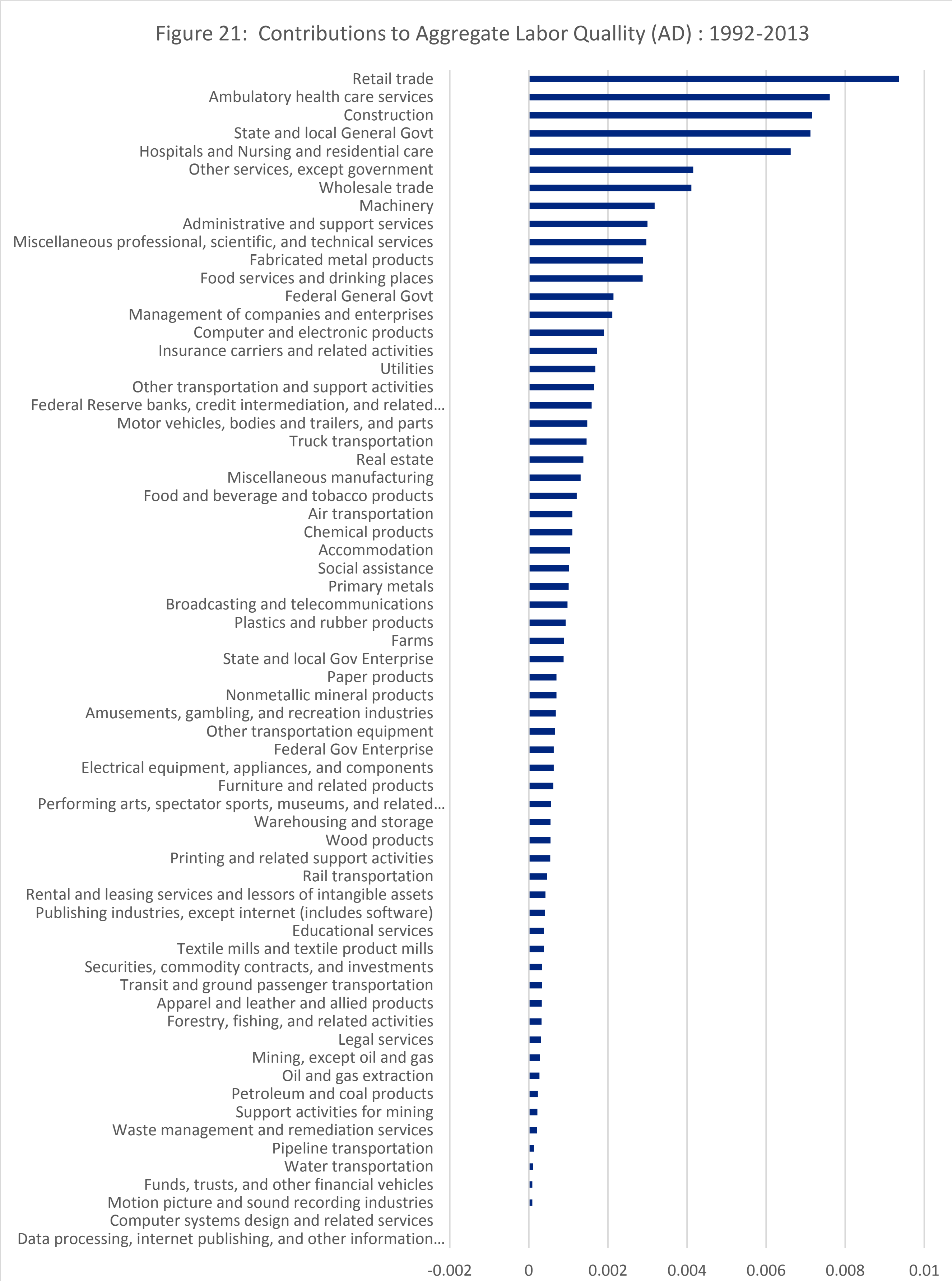


Figure 21: Contributions to Aggregate Labor Quallity (AD) : 1992-2013
Retail trade
Ambulatory health care services
Construction
State and local General Govt
Hospitals and Nursing and residential care
Other services, except government
Wholesale trade
Machinery
Administrative and support services
Miscellaneous professional, scientific, and technical services
Fabricated metal products
Food services and drinking places
Federal General Govt
Management of companies and enterprises
Computer and electronic products
Insurance carriers and related activities
Utilities
Other transportation and support activities
Federal Reserve banks, credit intermediation, and related…
Motor vehicles, bodies and trailers, and parts
Truck transportation
Real estate
Miscellaneous manufacturing
Food and beverage and tobacco products
Air transportation
Chemical products
Accommodation
Social assistance
Primary metals
Broadcasting and telecommunications
Plastics and rubber products
Farms
State and local Gov Enterprise
Paper products
Nonmetallic mineral products
Amusements, gambling, and recreation industries
Other transportation equipment
Federal Gov Enterprise
Electrical equipment, appliances, and components
Furniture and related products
Performing arts, spectator sports, museums, and related…
Warehousing and storage
Wood products
Printing and related support activities
Rail transportation
Rental and leasing services and lessors of intangible assets
Publishing industries, except internet (includes software)
Educational services
Textile mills and textile product mills
Securities, commodity contracts, and investments
Transit and ground passenger transportation
Apparel and leather and allied products
Forestry, fishing, and related activities
Legal services
Mining, except oil and gas
Oil and gas extraction
Petroleum and coal products
Support activities for mining
Waste management and remediation services
Pipeline transportation
Water transportation
Funds, trusts, and other financial vehicles
Motion picture and sound recording industries
Computer systems design and related services
Data processing, internet publishing, and other information…
-0.002
0
0.002
0.004
0.006
0.008
0.01

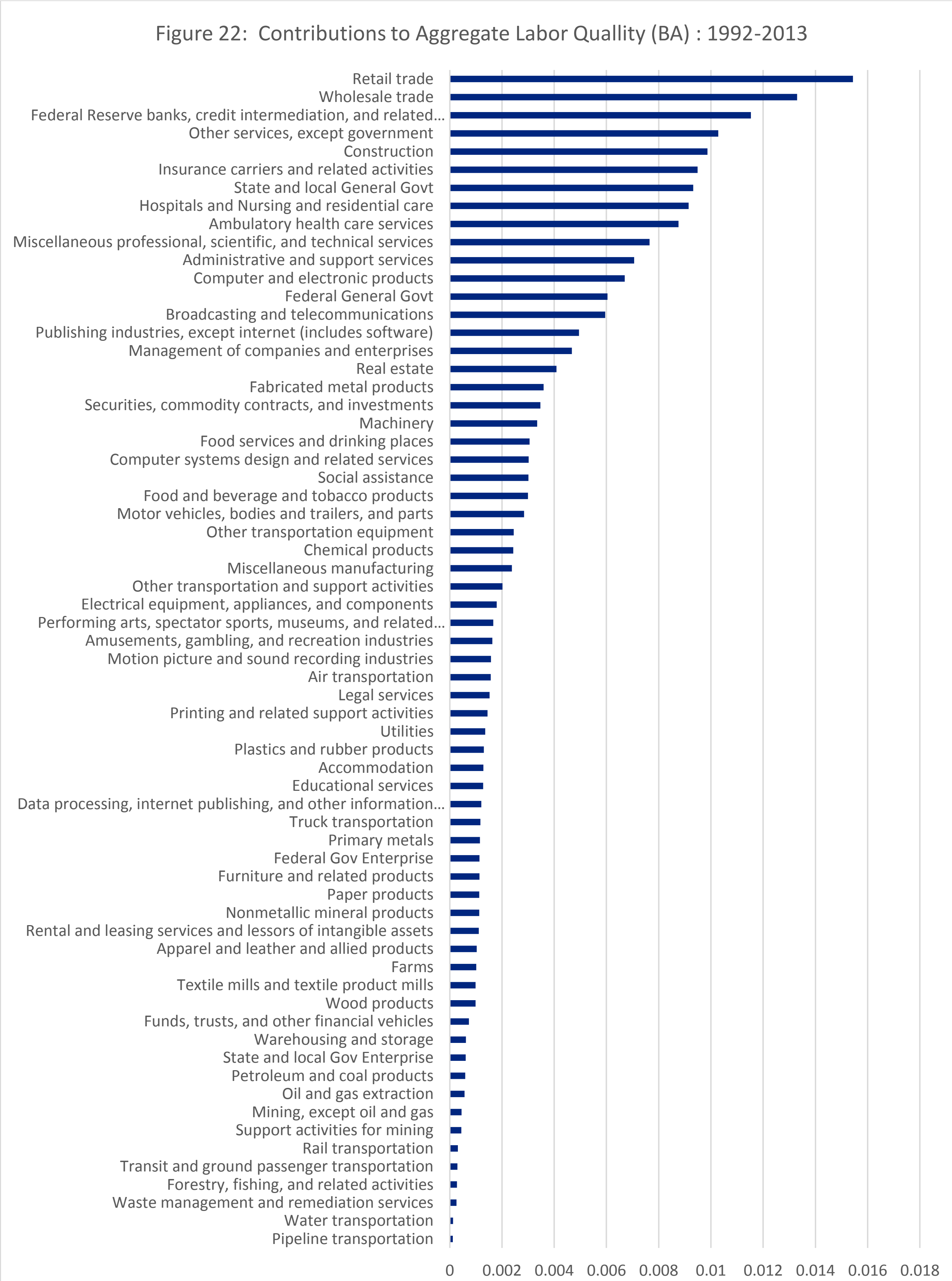


Figure 22: Contributions to Aggregate Labor Quallity (BA) : 1992-2013
Retail trade
Wholesale trade
Federal Reserve banks, credit intermediation, and related…
Other services, except government
Construction
Insurance carriers and related activities
State and local General Govt
Hospitals and Nursing and residential care
Ambulatory health care services
Miscellaneous professional, scientific, and technical services
Administrative and support services
Computer and electronic products
Federal General Govt
Broadcasting and telecommunications
Publishing industries, except internet (includes software)
Management of companies and enterprises
Real estate
Fabricated metal products
Securities, commodity contracts, and investments
Machinery
Food services and drinking places
Computer systems design and related services
Social assistance
Food and beverage and tobacco products
Motor vehicles, bodies and trailers, and parts
Other transportation equipment
Chemical products
Miscellaneous manufacturing
Other transportation and support activities
Electrical equipment, appliances, and components
Performing arts, spectator sports, museums, and related…
Amusements, gambling, and recreation industries
Motion picture and sound recording industries
Air transportation
Legal services
Printing and related support activities
Utilities
Plastics and rubber products
Accommodation
Educational services
Data processing, internet publishing, and other information…
Truck transportation
Primary metals
Federal Gov Enterprise
Furniture and related products
Paper products
Nonmetallic mineral products
Rental and leasing services and lessors of intangible assets
Apparel and leather and allied products
Farms
Textile mills and textile product mills
Wood products
Funds, trusts, and other financial vehicles
Warehousing and storage
State and local Gov Enterprise
Petroleum and coal products
Oil and gas extraction
Mining, except oil and gas
Support activities for mining
Rail transportation
Transit and ground passenger transportation
Forestry, fishing, and related activities
Waste management and remediation services
Water transportation
Pipeline transportation
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018

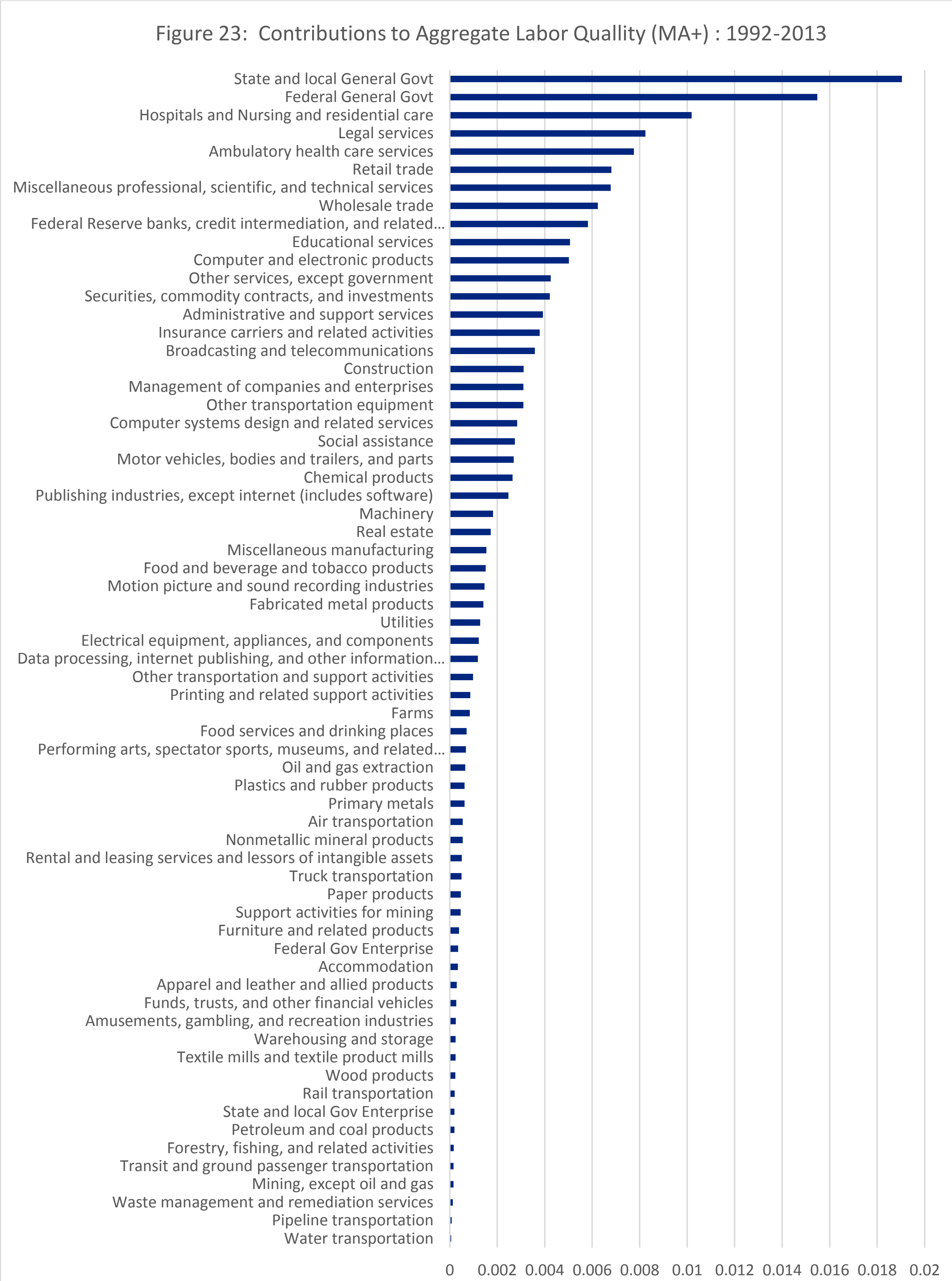


Figure 23: Contributions to Aggregate Labor Quallity (MA+) : 1992-2013
State and local General Govt
Federal General Govt
Hospitals and Nursing and residential care
Legal services
Ambulatory health care services
Retail trade
Miscellaneous professional, scientific, and technical services
Wholesale trade
Federal Reserve banks, credit intermediation, and related…
Educational services
Computer and electronic products
Other services, except government
Securities, commodity contracts, and investments
Administrative and support services
Insurance carriers and related activities
Broadcasting and telecommunications
Construction
Management of companies and enterprises
Other transportation equipment
Computer systems design and related services
Social assistance
Motor vehicles, bodies and trailers, and parts
Chemical products
Publishing industries, except internet (includes software)
Machinery
Real estate
Miscellaneous manufacturing
Food and beverage and tobacco products
Motion picture and sound recording industries
Fabricated metal products
Utilities
Electrical equipment, appliances, and components
Data processing, internet publishing, and other information…
Other transportation and support activities
Printing and related support activities
Farms
Food services and drinking places
Performing arts, spectator sports, museums, and related…
Oil and gas extraction
Plastics and rubber products
Primary metals
Air transportation
Nonmetallic mineral products
Rental and leasing services and lessors of intangible assets
Truck transportation
Paper products
Support activities for mining
Furniture and related products
Federal Gov Enterprise
Accommodation
Apparel and leather and allied products
Funds, trusts, and other financial vehicles
Amusements, gambling, and recreation industries
Warehousing and storage
Textile mills and textile product mills
Wood products
Rail transportation
State and local Gov Enterprise
Petroleum and coal products
Forestry, fishing, and related activities
Transit and ground passenger transportation
Mining, except oil and gas
Waste management and remediation services
Pipeline transportation
Water transportation
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