

# The Source of Aggregate Inequality: Employment and Income Changes from 1999 to 2014.

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## Abstract

The wage gap between top and median earners in the United States has been increasing since the early 1980's and spiked dramatically in the aftermath of the two most recent US banking crises in 1982 and 2008. The exact causes of this increase in inequality is uncertain, but both weakening bargaining power among laborers and increased education and experience premiums have been proposed as explanations in the literature. I find that, while education and work experience are significant to relative income growth in measured occupations, changes to education or experience premiums cannot account for most of the observed changes in relative earnings of workers in the United States. Furthermore, there were marked differences between the ways income inequality grew from 1999-2004 and 2006-2014. From 1999-2004 income inequality was driven by uneven wage growth across occupations and an increase in employment and wages in engineering and technical fields as well as large wage increases among executive and financial occupations. From 2006-2014 income inequality was driven more by the failure employment to recover among many technical and administrative occupations and a relative increase in employment among lower-wage occupations.

## 1 Introduction

"One might then assume a long swing in the inequality characterizing the secular income structure: widening in the early phases of economic growth when the transition from pre-industrial to the industrial civilization was most rapid; becoming stabilized for a while; and then narrowing in later phases"

-Kuznets (1955)

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"Today, the Kuznets curve is widely held to have doubled back on itself, especially in the United States, with the period of falling inequality observed during the first half of the 20th century being succeeded by a very sharp reversal of the trend since the 1970's"  
-Piketty and Saez (2001)

The proportion of national income going to the top 1 percent of earners as well as the earnings gap between the top and median quintiles of earners declined steadily in the United States and many other developed nations during the post-war period (See Figure 1). This trend reversed dramatically in the early 1980's with a rapid increase in the dispersion of wages nationwide, both between the upper and lower quintiles of earners as well as within the upper and lower quintiles themselves. Once the phenomenon of increasing income inequality became apparent, three primary questions arose: first, what caused this sudden reversal of trend? Second, is this change secular or transitory? And, third, what are the likely effects of increasing income inequality on long-run growth?

The first two questions are still in contention today. Studies in the early 1990's suggested that the change in relative incomes was likely caused by a shift in labor demand to favor workers of different skill sets driven by technological changes and increased use of computers (Autor et al., 1998), or by a decrease in the strength of labor market institutions, like Unions, that protect the rights and bargaining power of low to middle class laborers (Bound and Johnson, 1992).

Some studies in the later 1990's and early 2000's, however, like Lee (1999), Card and DiNardo (2002), and Lamieux (2004) claim that a large portion of the wage divergence can be explained by the declining real value of the minimum wage and increasing average experience and education levels of workers. Lamieux (2004) argues that such a change in labor composition would be transitory and not indicative of any changes to the structure of the labor market itself. Machado and Mata (2005) decompose changes in the Portuguese working population and income inequality between 1986 and 1995 and find that increasing average education levels likely contribute to increasing wage inequality.

Autor et al. (2008), meanwhile, find that dispersions in the upper-quintile of earners increased nearly as rapidly in the 1990's as in the 1980's. While dispersion within the lower half of earners may have been an episodic event, the wage gap between the bottom and top of the wage distribution as well as increasing upper-tail inequality appears to be a secular phenomenon that cannot be explained by the real value of the minimum wage or changes in skill or experience premiums.

Regardless of its causes or whether it is transitory, the long-run economic impacts of drastic income inequality are troubling. Stiglitz (2012) shows that increasing income in-

equality may slow long-run economic growth, while Berg et al. (2012) show that the length of periods of economic growth are shorter when there is a high degree of income inequality. Mishkin (1978), Eichengreen and Mitchener (2003), and Persons (1930) show that the Great Depression was likely caused in part by rapidly increasing household debt which in turn may have been spurred by income inequality. van Treeck (2014) also provides evidence that income inequality leads to more frequent and economically damaging recessions in developed countries.

While there may be potential economic consequences to income inequality, there is no consensus in the literature about what mechanisms cause income inequality to disrupt growth. Kumhof et al. (2013) show that a secular increase in income inequality can drive up credit demand among lower-income households even when such households do not expect increased wages in the future. Borio and Lowe (2002) find that such credit booms since the 1970's have generally preceded financial instability. Similarly, Jorda et al. (2015) find that credit booms increase financial risks, making asset bubbles both more dangerous and more likely and Kirschenmann et al. (2016) find that income inequality is *the biggest* predictor of financial risk in a study spanning 18 countries and 138 years.

Income inequality, then, has clearly troubling implications for economic well-being both at a national and global level: it can lead to deeper, more prolonged recessions, lead to increased indebtedness among households, and lead to greater global financial instability. Yet, there has not yet been a comprehensive study of where this income inequality is coming. To date every comprehensive look at changes in income inequality in the United States as a whole have used aggregate national data for incomes and worker education and experience. What is lacking in the income inequality literature, and what this paper provides, is a comprehensive assessment of what exact distributional changes in occupations of different types in different geographic areas bring about the inequality that is used to fuel all of these studies and a comparison of changes in this distribution in periods both before and after a banking crisis.

So far, studies on geographic disparities in income inequality focus on its impact on household debt or net employment in the midst of a crisis, like Mian and Sufi (2014), or on aggregate dispersions of different kinds of income (wage income vs. capital income, for example) over time, like Piketty and Saez (2006) or Atkinson et al. (2011). But, knowing the exact changes to the employment structure of different geographic areas could help us to understand what exactly the causes and effects of income inequality may be. In particular, isolating changes in intra-occupational and inter-occupational income distributions in different areas can help us to understand whether changes in income inequality are driven by inter-regional disparities, inter-occupational disparities and changes to employment structures, or increased inequality within occupational groups. Understanding the source of changes to

inequality can help shed some additional light on what mechanisms may be responsible for the changes and, in turn, what policy actions may best treat the problem.

One barrier to assessing distributional changes in occupational employment and earnings in the US during the 1980's and 1990's was the consistent availability of data with the appropriate details over a large enough area of the country. Data series featured in the literature focus on average national incomes or aggregate income percentages going to different percentile, decile, or quintile groups because, until the late 1990's, no finer resolution data was available. The Occupation and Employment Statistics (OES) from the US Bureau of Labor Statistics, however, now offers occupational employment and income distribution data for over six hundred occupation categories across nearly four hundred metropolitan areas. The data set goes as far back as 1997, with nationwide aggregate data for some occupation groups going back to 1988. Inconsistencies in measurement techniques and data recorded, however, necessitate the restriction of the study to the 1999-2014 window as some earlier observations are not comparable.

With this data, I compare employment and income distributions within and across metropolitan areas, across regions, and nationwide over time using a simple difference-in-difference method. The analyses are broken into two time periods: 1999-2004 and 2006-2014. With these two time periods we can analyze both "normal" post-1980 changes to income and employment distributions and those changes that coincide with the 2008 financial crisis and its aftermath. The 1999-2004 period also contains the dot-com recession, which can further help us to identify the differences in changes to employment and income structures coinciding with a "normal" recession compared to a financial crisis.

For robustness, I test changes in income and employment changes within locations and nationwide against average educational requirements, worker experience, required on-the-job training, and nationwide average occupational educational attainment of workers from the Current Population Survey (CPS) data administered by the Bureau of Labor Statistics. This will give some indication of whether and to what extent income and employment changes may be driven by changes to education or experience premiums.

By highlighting distributional and structural changes to employment and income throughout the United States and in each metropolitan area I can determine what common factors may be responsible for income dispersions within the lower 99% of earners and how much changes in skill, education, or experience premiums can explain increases in income inequality trends both before and after the 2008 financial crisis.

I find that a large portion of growth in the gap between the top and lower quintiles of earners between 2006 and 2014 can be explained by changes in employment structure: a much greater proportion of workers in 2014 were employed in lower-paying occupations

than in 2006, while occupational incomes were relatively unchanged for most occupations (the average worker in 2014 worked in an occupation for which the average real income had increased by only half a percent since 2006). In particular, a decline in employment and employment growth among engineering and other technical professions combined with a rise in lower-paying administrative and business occupations nationwide seems to drive this phenomenon. These problems were especially prevalent in the South and Midwest. What occupational income changes there were had little significant correlation with educational requirements or educational attainments of workers.

The period from 1999 to 2004, in contrast, was characterized by more even growth and less changes to the occupational structure. There was still growth in inequality (the gap between the top and median quintile of earners nationwide grew by about 14% during that time), but more of it was driven by unequal wage growth than by declining employment in higher-income occupations. Most occupations experienced average real wage increases of 4% or more, but high-income occupations were disproportionately likely to see large increases in real wages. The highest paid groups of managers, executives, and financial occupations saw average wages increase by 17%, nearly five times the average rate of 3.6%.

Changes to employment structures between 1999 and 2004 actually favored a decline in inequality, though these changes were clearly outweighed by income structure changes to produce a net increase in income inequality nationwide. Some of the largest gains in employment between 1999 and 2004 occurred in computational fields, particularly those devoted to integrating computers and technology in business, and business administration, both of which pay over \$50,000 annually on average. Meanwhile, the largest declines in employment were a nearly 30% decline in workers in executive/managerial or financial occupations as well as a nearly 20% decline in employment in production occupations, which inhabit opposite extremes of the pay scale nationwide.

While occupational wage growth in this period was correlated with education of workers and occupational education and experience requirements to a greater extent than in 2006-2014, changes in education and experience premiums from 1999-2004 could account for, at most, approximately one third of changes in wage dispersion that developed during that time. Furthermore, most of the increased benefits from education were driven by the rapid increase of wages among business administrators, executives, and financial occupations. If those occupations, which contain relatively few workers nationwide, are excluded from the sample then the correlation between worker education and wage growth rates almost disappears entirely.

These results suggest that increasing experience, or education premiums are likely not primarily responsible for increases in income inequality between 1999 and 2014 and that

either there has been a substantial change in the labor market, specifically in the bargaining power of traditionally middle-class laborers as suggested by Bound and Johnson (1992), or there is an increased reliance on unobserved skills not correlated with education or experience in determining worker wage and employment, as suggested by Autor et al. (1998).

The rest of the paper is structured as follows: Section 2 details data and empirical methods, sections 3 and 4 detail results for the 1999-2004 and 2006-2014 time frames respectively, and section 5 compares the results for each time period. All graphs and figures are located in the Figures section at the end of the paper.

## 2 Data

The principal data that I use in this paper is the Occupation and Employment Statistics (OES) data from the Bureau of Labor Statistics (BLS), as well as occupational education requirements, educational attainment, experience and on-the-job training from the BLS and nationwide worker education and experience data from the Current Population Survey (CPS), also administered by the BLS.

This data allows for incomes and employment to be broken down not by individuals, but by locations and occupations, which in turn allows for a structural analysis of what occupations are gaining and losing employment and relative income and where these changes are occurring. Along with the occupational education, experience, and training data allows for a solid test of whether or not divergence in income is driven by changes in education or experience premiums, and the occupations and locations where such premiums are most expressed.

I examine two time periods with this data to find the structure of changes in employment and income nationwide in two different economic paradigms. First, there is the time period from 1999-2004, which captures the dot-com recession and illustrates post-1980 growth and a "normal" recession. The 2006-2014 time period captures the end of the housing bubble and the recovery from the 2008 financial crisis.

Data from the OES goes back to 1997 for most occupation groups, and back to 1988 for some industry-level occupation and income data. But, observations before 1999 use different occupation classifications for many occupations from observations in 1999 and later. While the major occupation groups are nominally the same between 1997/1998 and 1999, major occupation groups are missing employment and occupational income distribution data for most metropolitan areas, making it difficult to compare occupational income distributions from 1997 and 1998 with those from 1999 and later even for major occupation groups. In the interest of consistency, I restricted my sample to 1999 and later years to avoid the problem

of comparing occupations that were not entirely similar.

Occupational educational attainment among workers, education requirements, experience requirements, and on-the-job training requirement data from the BLS only goes back to 2008, so I have to use that data for occupational education requirements in both 1999 and 2006. This presents a potential source of error in the analysis, but as long as the same occupations require at least a bachelor's degree or five years or more of work experience in a similar occupation in 1999 as in 2008, the core of the education and experience analysis remains intact. Since BLS and Census Bureau estimates of occupational education requirements are recorded and computed as ten-year averages, however, 1999 and 2006 both fall within the 1998-2008 window on which those estimations are based.

To ensure that all wages are comparable, I adjust all income data by regional CPI data from the BLS. Using regional CPI rather than national allows for income in different metropolitan areas to be adjusted more appropriately for the actual buying power of the region. Otherwise, tests for regional effects and inter-regional comparisons would be skewed, as some regions have much higher costs of living on average than others. While municipality-level CPI data is available for a few cities, the municipality-level data only counts consumers and purchases within the city itself, while the metropolitan areas of the OES data generally encompass a larger area. All wages and dollar values given in this paper are in terms of 2006 dollars as valued in the Northeast region of the United States.

To examine the changes in occupation and income structure I treat the locational occupation data as a panel and perform a series of difference-in-difference measures to assess the relative rates of employment and income growth of occupations, metropolitan areas, and regions of the United States. I compare the employment and income changes of each occupation group in each metropolitan area against equivalent occupation groups in other metropolitan areas, other occupation groups in the same metropolitan area, and occupation groups of similar income levels both within the metropolitan area and in other metropolitan areas. I also compare total income and income for the average worker across metropolitan areas within and between regions of the United States. Finally, I use a simple least squares estimator to test all of these features for correlation with occupational and national average worker education, required worker education, experience, on-the-job training, region, metropolitan area income, and initial (either 1999 or 2006) levels of employment and income.

### 3 Changes in US Income and Occupational Employment Structure: 1999 to 2004

The period from 1999 to 2004 saw an increase in employment concentrations in occupations making over \$60,000 annually and large increases in wages for occupations making \$80,000 or more in 1999. Occupations making less than \$60,000 also experienced income growth on average, but with smaller percent increases nationwide.

Nationwide, the wage gap between the top quintile and median quintile of earners increased by about 13% between 1999 and 2004. Income changes within occupations and the amount of total income going to an occupation (employment multiplied by income) were positively correlated with both education and experience required for the occupation as well as educational attainment of the average worker. However, only about five of the thirteen percentage points of wage gap increase can be explained by explained by this estimated change in education and experience premiums (requiring a Bachelor's degree or higher). Educational requirements were more strongly correlated with changes in total income going to an occupation than income growth within the occupation itself. This is likely due to the large increases in employment among computational and mathematical occupations, health-care and healthcare technical support occupations, and business and financial operations occupations, most of which require at least a bachelor's degree of education and pay more than \$50,000 annually on average.

The average worker in the United States in 2004 worked in an occupation for which the average wage had increased by approximately 9% within her metropolitan area and wage dispersion within the occupation had increased by only 1% since 1999. Any worker nationwide was nearly 10% more likely to be employed in an occupation earning \$60,000 or above and was approximately 6% more likely to work in an occupation that required education of at least a bachelor's degree than in 1999, as well.

From 1999 to 2004 the employment structure in US metropolitan areas saw an increase of approximately 15% in the proportion of workers employed in occupations with average real wages between \$60,000 and \$80,000 and a decline of 12% employed in occupations earning over \$100,000 annually. The proportion of workers employed in occupations with other average incomes remained largely unchanged. Upper-level executives/business administrators and financial occupations saw nationwide declines in employment of nearly 30% on average.

Nationwide, the occupation group with the fastest growing employment was legal occupations, for which employment grew by nearly 30% between 1999 and 2004. The largest absolute changes in employed workers were in business operations occupations, food service occupations, personal care and service occupations, and computation and mathematical



occupations. Employment among all of these occupation groups grew consistently across metropolitan areas in different regions and with differing levels of wealth.

The largest declines in employment nationwide were among managers/executives and production occupations, both of which saw employment declines of nearly 11% and 18% respectively. These occupation groups were clear outliers in employment changes among occupation groups: Engineering occupations suffered the next-greatest loss in employment, but employment in those occupations declined by only 3% on average nationwide.

The loss of production jobs affected metropolitan areas nationwide, but was especially pronounced in poorer metropolitan areas and in the South. Production job loss in the south was also more concentrated in textile and garment production and machinist occupations, while nationwide there was a more even spread of proportional employment loss across all production types.

Management and executive employment loss also occurred nationwide, and, while it occurred evenly across regions, wealthy metropolitan areas were much more likely to see large proportional losses in employment for this occupation group, even after controlling for the relatively high concentrations of managers/executives in those wealthy metropolitan areas.

The shift in employment across income categories reflects both income changes within occupations and employment shifts across occupations. While there was wage growth across many different occupation types, executives and financial occupations saw the greatest increases in real income. Workers in these professions experienced an increase of locational average income of 17% across all metropolitan areas between 1999 and 2004. But, this wage increase was not enough to offset the loss of employment that these occupations experienced; the total income going to these occupations declined by approximately 20%. A lot of this decline in upper-executive and financial employment and total income coincided with shocks associated the dot-com bubble and 2001-2002 recession from which employment in those sectors did not recover by 2004.

These high-income occupations were most likely to see large gains average income in wealthy metropolitan areas. Nearly all of the metropolitan areas that did not see a net increase in average income for executives and financial occupations were in the poorer 50% of metropolitan areas nationwide and most were located in the South or Midwest. Income changes for most other occupation groups were more even across regions and metropolitan areas, with the exception of education occupations and personal care and service occupations, which grew disproportionately slowly in poorer metropolitan areas, particularly in the South.

There were only mild statistical differences across regions. Overall employment grew by larger percentages in metropolitan areas located in the South and West than in the Midwest

and Northeast. The large percent change in employment in metropolitan areas in the South is largely a result of occupations in southern metropolitan areas starting at lower employment levels in 1999 than those of other regions, but engineering occupations, particularly computer hardware and environmental engineers, as well as accounting and business administration occupations did experience above average absolute employment growth in the South.

Wage growth was largely consistent across regions, with average real wage growth slightly higher in the West and Northeast than in the South or Midwest. The average worker's wage growth in a western metropolitan area was only 1.5% more than her southern or midwestern counterparts (for northeastern workers this difference is only 1.2%). This difference in averages, however, seems to be driven largely by the concentrations of upper executive and financial positions in western and northeastern metropolitan areas. If we exclude wage growth among upper executive and financial occupations, the difference between average worker's wage growths in the West and South/Midwest drops to only .3%.

## 4 Changes in US Income and Occupational Employment Structure: 2006 to 2014

### 4.1 Nationwide Employment Changes

While overall employment nationwide increased by around 3% between 2006 and 2014, the employment structure in most locations and in the national average shows a decline in employment in occupations with real<sup>1</sup> average annual incomes between \$60,000 and \$80,000. Approximately 63% of metropolitan areas experienced some decline in employment in occupations where the average real income was between \$60,000 and \$80,000 in that metropolitan area. On the national level, employment in these occupations declined by approximately 7%. Loss in employment in Architectural and Engineering occupations, Computing and Mathematical occupations, and Business and Financial occupations drove the decline in employment of workers in occupations with average incomes in this range for most metropolitan areas.

There was also a decline in nationwide employment for occupations making less than \$35,000 annually of approximately 9%. Nearly all metropolitan areas saw a decline in employment in occupation groups with annual incomes in this range. This may be because the OES data only factors in full-time employment, and the workers making \$35,000 or less in 2006, many of whom were concentrated in retail or food service occupations, may have been

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<sup>1</sup>All wages and prices are given in 2006 dollars as valued in the Northeast region of the United States.

replaced with part-time workers by 2014. Nationwide, this decline in full-time employment among workers making \$35,000 or less annually was driven by declines in the Sales and Retail and Food Service occupational employments. Approximately one third of metropolitan areas, however, saw larger declines in employment in Transportation and Material Moving and Production occupations than in Sales/retail and Food Service. This pattern of employment loss was most common in the South.

Occupations with average real incomes between \$35,000 and \$50,000 saw the largest net gains in employment nationwide, increasing by approximately 12%, primarily in the Office and Administrative Support occupations. Employment in occupations making more than \$90,000 on average annually rose by approximately 6% as well, though this is mostly due to increasing average wages for Management occupations and Legal occupations in the wealthier 50% of metropolitan areas and is not totally driven by changes in employment in any particular occupational group.

Surprisingly, neither average education required nor average education attained by workers in an occupation group was significantly correlated with changes in employment nationwide or in most metropolitan areas. Average work experience of workers in that occupation group was also not significantly correlated with changes in employment.

While education required was not statistically significant in predicting employment recovery or growth, the interaction of education and on-the-job training requirements was. Average required on-the-job training for an occupation group alone was significant to an occupation group's ability to recover employment lost in the financial crisis. Nationwide, occupation groups that required moderate on-the-job training, long term on-the-job training, or internships were nearly 15% less likely to return to 2006 employment levels by 2014 than those groups that required short term on-the-job training or no on-the-job training. This problem was especially prevalent in the South and Midwest, where less than 20% of occupation groups with moderate or long term on-the-job training and education requirements of an Associate's degree or lower returned to 2006 levels of employment by 2014.

Locational income dispersion within an occupation group in 2006 (here measured as the difference between the top decile and median incomes for that occupation group in a given metropolitan area) was negatively correlated with employment loss in an occupation within a metropolitan area, even when average income of the occupation group was taken into account. This means that the occupation groups that lost the most employment nationwide, like sales and retail or business and financial occupations, were less likely to lose employment in metropolitan areas where there was significant wage dispersion within the occupational group. Note that this correlation only exists when looking at net employment changes between 2006 and 2014. Occupation groups with high locational wage divergence in 2006

were actually more likely to lose employment between 2007 and 2009, but employment in those groups recovered much more quickly than those groups where wage divergence was low in 2006.

There were some regional disparities in employment changes as well. Employment for the majority of occupation groups in metropolitan areas in the south failed to return to 2006 levels by 2014. This problem was particularly pronounced in the Gulf Coast states (Louisiana, Mississippi, Alabama, Georgia, Florida, Texas) where the majority of measured metropolitan areas lost 5% or more of total 2006 employment by 2014. Notable exceptions to this are the Atlanta, GA, Houston, TX, and Abilene, TX metropolitan areas, whose total employment between 2006 and 2014 grew significantly above the national average.

The Northeast and West regions of the United States lost much less employment in their metropolitan areas' occupation groups than the South or Midwest did. Employment in metropolitan areas in the Northeast and West regions grew by equivalent percentages (approximately 5 % on average), but employment growth in the Northeast was highly concentrated in a few major cities (New York, NY, Boston, MA, Philadelphia, PA), with smaller metropolitan areas growing much more slowly or losing employment between 2006 and 2014. Growth in the West was much more consistent, but spread out. metropolitan areas in the southern and eastern sections of the West (Wyoming, Nevada, Utah, New Mexico, Arizona, Montana) experienced slower average employment growth than the Pacific coast state metropolitan areas on average, but even in those states the majority of occupation groups returned to within 2% of 2006 employment levels by 2014.

We can see from these statistics that, between 2006 and 2014, full-time employment became much more concentrated nationwide in occupations where the average wage was between \$35,000 and \$50,000 annually and much less concentrated in occupations making between \$60,000 and \$90,000 annually. National employment also became more concentrated in the Northeast and Western regions of the US, particularly on the Pacific coast (California, Washington, Oregon) and the largest cities in the Northeast and less concentrated in the South and Midwest.

## 4.2 Occupational Income Changes

The average worker in the US in 2014 works in an occupation for which the average wage increased by .5%, the median wage decreased by .8%, and the gap between the top ten percent and median earners within the occupation group increased by 8% since 2006 in the metropolitan area where she lives.

However, over half of total workers in approximately 60% of metropolitan areas in 2014

worked in occupations for which the average real wage declined between .5% and 3%. The average wage for the average worker includes the increase in average annual wages for Management occupations, Legal occupations, and Business and Finance occupations, for which average annual wages increased by 10-15% in most of the richest 50% of metropolitan areas.

This disparity in earnings growth is not unexpected; we know already that the income of the top quintile of earners, particularly the top decile and percentile, has grown much faster than the income of lower quintiles since 1980. What is somewhat surprising is that, both by individual metropolitan area and nationwide, whether an occupation's average income increased as well as how much it increased between 2006 and 2014 was only weakly correlated with the education or job experience in a similar field required to acquire a job in that occupation group. These factors were uncorrelated with occupational wage growth both when tested separately and when tested jointly. The difference between actual educational attainment among workers in the occupation group and the occupation group's requirements was negatively correlated with wage growth (occupations where workers tended to be "overqualified" tended to have less wage growth on average), but that correlation was only significant at a 5% level nationwide and was completely absent in many metropolitan areas when taken individually.

Occupations with real average incomes above \$80,000 in 2006 experienced 10% more wage growth than other occupations, but below \$80,000 average annual incomes in 2006 were largely uncorrelated with wage growth between 2006 and 2014. Occupations with annual incomes below \$35,000 and large differences between the top decile and median earners within the metropolitan area in 2006 saw shrinking gaps between earners on average by 2014, though this may be due to the decrease in employment those occupation groups experienced over the same time period. Occupations with large average incomes (\$80,000 or above) and large wage dispersions saw increases in average income and intra-occupational income inequality on average.

While wage growth of an occupation group within a metropolitan area was not correlated with the particular average wage of the occupation group in question, wage growth was correlated with both the average real wage of a worker in the metropolitan area and total income of the metropolitan area in 2006. As with employment growth, wage growth was slowest for occupation groups in the South, particularly the Gulf Coast states. Nearly 60% of occupation groups in the South experienced zero or negative average real wage growth between 2006 and 2014. The Midwest did not perform much better: over half of occupation groups in midwestern metropolitan areas experienced zero or negative wage average wage growth as well.

This is likely at least partially because most of the poorest measured metropolitan areas

in 2006 were clustered in the South and Midwest states. The West and Northeast, with higher concentrations of richer cities (both as measured from total metropolitan income and average worker wage), experienced higher wage growth on average. Only about 40% of occupation groups in the West and Northeast experienced negative wage growth. But, it should be noted that poorer metropolitan areas in the West or Southeast were still about 10% less likely to experience wage declines in any given occupation group than their southern or midwestern counterparts with similar metropolitan total or average incomes.

Between the changes in income and changes in employment nationwide, if we exclude executives and management occupations (the employment for which did not change drastically nationwide), the average worker in the United States in 2014 earns around 7% *less income* annually than in 2006 and is almost 10% less likely to make over \$60,000 annually than in 2006. Furthermore, these changes are not primarily driven by changes in income within occupations, but is instead driven by the change in employment structure: fewer people are able to find employment in occupations that pay between \$60,000 and \$90,000 annually nationwide, regardless of education or work experience.

What income change there was within occupations was, nationwide, uncorrelated with education requirements, attainments, or average work experience of workers in the occupation. It is therefore difficult to support any argument that income inequality is being driven by changing education or experience premia, at least for the period of 2006 to 2014.

Overall, the 2008 financial crisis and its aftermath increased inequality between metropolitan areas. The income gap between the richest quintile of metropolitan areas (as determined by total income from occupation groups in the metropolitan area) and the median quintile grew by nearly 11%, while the gap between the top and bottom quintiles of metropolitan areas grew by approximately 15%. But, when using average worker wage as a measure of metropolitan area income, the divergence is not so extreme. While total income in a metropolitan area and average worker wage are correlated, the average worker wage does is much better at not allowing employment changes to eclipse wage changes.

When using the average worker's wage as the measure of metropolitan income, the changes in income gap between the top and median quintiles and top and bottom quintiles only grew by approximately 4% and 7% respectively. This suggests that a large portion of the change in relative income among metropolitan areas is driven by changes to employment and employment structure rather than differing rates of wage growth for most workers.

## 5 Comparison of Changes from 1999-2004 to 2006-2014

The most immediately apparent difference between changes in income inequality in the 1999-2004 and 2006-2014 time periods is the different sources of income inequality within the occupational data. From 2006 to 2014 the main cause of changes to differing relative wages was changes to the occupations of workers. There was a large shift in employment from high-wage, technical and administrative occupations to lower-wage business occupations. Similarly, many low-income, non-technical jobs disappeared as well, either due to failure for the market for their services to recover after the 2008 financial crisis or due to a change in the labor market structure. Both of these changes reduced dispersion among lower quintiles of earners, particularly within the median quintile, while increasing dispersion between top earners and the rest of the distribution.

From 1999 to 2004 occupation and employment changes favored less dispersion between top earners and the rest of the distribution. Rising employment in computational and technical fields as well as higher-wage business operations occupations lead to growth in the proportion of workers making between \$60,000 and \$90,000 annually, while employment in management, executive, and the highest earning financial occupations declined. Inequality did increase, both between the top decile (or quintile) of earners and the rest of the distribution and within earning quintile groups, but this inequality was driven by unequal real wage growth rather than the disappearance of high-income jobs.

Occupational income growth also occurred much more evenly across regions and metropolitan areas between 2006 and 2014 than between 1999 and 2004. Between 1999 and 2004 a lot of growth in inequality came from disproportionate income growth among top-earning workers, particularly in executive and higher-wage management occupations, many of which were concentrated in wealthy metropolitan areas in the West or Northeast regions of the United States. The gap in average total income between the wealthiest and middle deciles of metropolitan areas grew by 6% between 1999 and 2004, largely driven by the wage growth of these highest earning occupations. If the occupations with the largest wage growth (executives, lawyers, and specialist medical doctors) are excluded from the sample, the change in the average income gap between those groups of metropolitan areas shrinks to approximately 3%. The remaining change in the income gap between metropolitan areas is largely due to disproportionate employment growth among computer and mathematical occupations that occurred in wealthier metropolitan areas.

In contrast, while there was actually more inequality between occupations in real income growth the difference between the top and median deciles of metropolitan areas in both total income and average income only increased by 4% between 2006 and 2014. This is

because, even though income growth was even more concentrated in higher income occupations, which in turn were more concentrated in wealthier metropolitan areas, and income for all occupations increased slightly faster on average in higher income metropolitan areas, these same wealthy metropolitan areas also experienced the largest decline in proportional employment among computational, engineering, and higher-income business operations occupations. This lost income due to changes in the employment structure made it so that the average workers in the wealthiest metropolitan areas were scarcely better off than their counterparts in poorer metropolitan areas.

Income divergence from 1999 to 2004 was driven by uneven wage growth at the top and bottom tails of the income distribution nationwide, a large decline in production employment and a large increase in employment in computational and technical fields nationwide. Inequality changes from 2006 to 2014 were also driven by uneven wage growth and employment changes, but, while changes in the 1999-2004 period were positive overall for most workers with disproportionate benefits going to the highest earners, changes from 2006 to 2014 were largely negative for most workers and only positive for the highest earners.

While real incomes did not decline within most occupations in most metropolitan areas, the high-paying business operations and computational and technical jobs that drove much of the wage growth among the lower 90% of earners between 1999 and 2004 experienced large employment losses from 2006 to 2014. So, while most occupations did not experience declines in real income, many workers did as they were forced to move from high-paying technical jobs to lower paying ones in other occupation groups, often office and administrative support business operations.

Another way to think of the difference between changes in income inequality during these two periods is that, in the pre-financial crisis period of 1999-2004, income inequality was actually driven by unequal income growth and growth in employment in high-skill occupations. So, while a disproportionate amount of income growth went to workers in occupations that already earned the most (executives, etc.), there was income growth among the lower 90% of workers both due to income growth within occupations and increased employment in computational and technical occupations. This is why, even though occupational income growth was not strongly correlated with education of workers in the occupation, total income going into an occupation *was* correlated with education. The education premium may have increased slightly, but a lot of the gains income gains outside of the top decile of earners were due to a greater proportion of workers receiving the education premium.

The cause of growth in income inequality between 2006 and 2014, in contrast, seems more due to a large-scale misallocation of workers and, consequently, human capital, than unequal wage growth across occupations. Not only did workers' wages fail to increase evenly, many



of the occupations that had provided much of the income growth for lower earning decile workers disappeared. There were employment losses for occupations between 1999 and 2004 as well, but they were concentrated either in lower wage production jobs or in high-wage executive positions; the employment loss effected the tails of the income distribution rather than the center. Between 2006 and 2014 the employment losses were at the top-center of the income distribution and impacted technical fields which likely employed workers with the most human capital invested in performing the particular tasks of their occupations, which makes their reallocation to lower-skill, lower-paying jobs costly both for them personally and for the economy as a whole.

## 6 Comparing Recessions: 2001-2003 and 2008-2010

## 7 Conclusion

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## 8 Figures

Figure 1: 20th Century Trend:

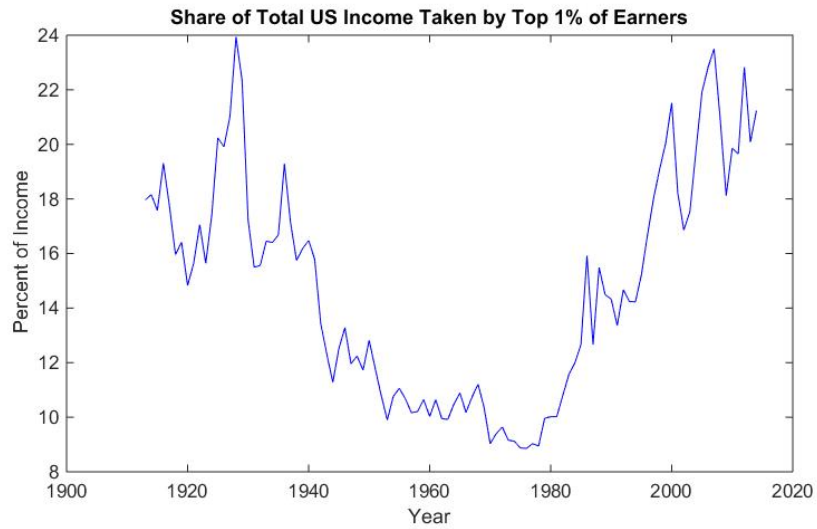


Figure 2: Income gap between Top and Median earning quintiles in logs

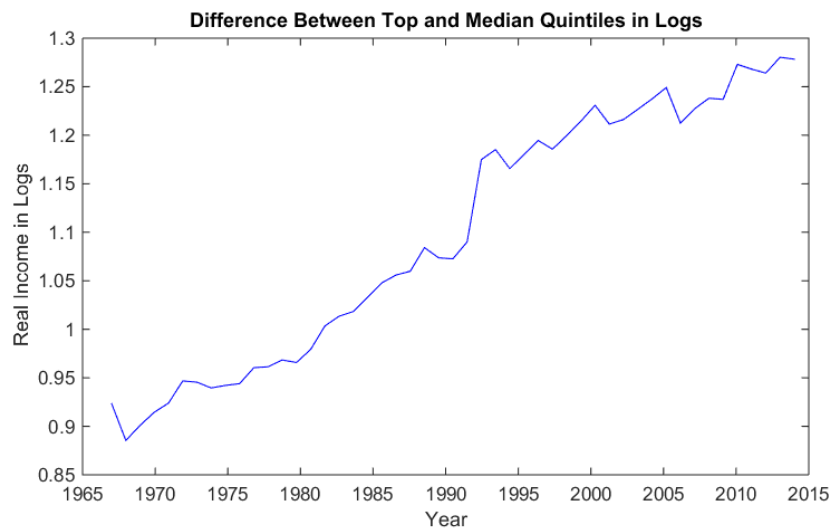


Figure 3: Employment Composition by Average Income of Occupation Group: Seattle, WA 2006-2014

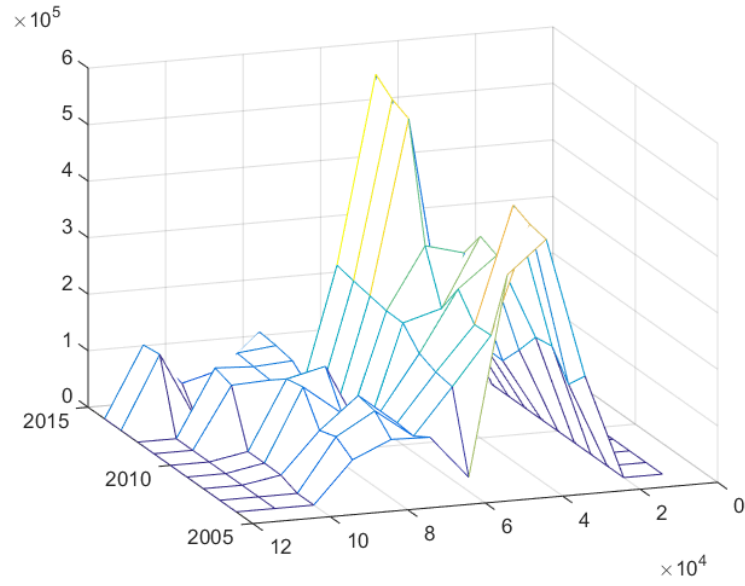


Figure 4: Employment Composition by Average Income of Occupation Group: Knoxville, TN 2006-2014

