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Wage inequality: The role of education

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Abstract

We hypothesize that the role of education in driving wage inequality is not the same across three racial groups in the United States. Using the Current Population Survey (CPS) data for the period 2000-2021, we show that education weighs at most 32% in explaining wage inequality. Further, we observe a decrease in the role of education in explaining wage inequality among Black and White Americans.

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1 Introduction

The human capital model is the base model to understand the relationship between education and inequalities in earnings. The model suggests that one way individuals could improve their productive skills and earnings is through education (Tomaskovic-Devey et al. (2005)).[1] Individuals with more education are expected to complete complex work for the firm successfully. Employers will recognize such skills and reward higher-educated workers with higher earnings. Implications of the human capital model are that improvement in access to education should alleviate disparities in earnings within a society. Overall, the literature shows supporting evidence for these implications. Becker and Chiswick (1966) and Chiswick (1971) show that income inequality is positively correlated with inequality in schooling. Becker (1975) finds that the distribution of earnings is positively skewed, especially among professionals and other skilled workers. Rodríguez-Pose and Tselios (2009) shows that access to education is likely to provide for upward mobility and therefore lower income inequality. Interestingly, the authors find that the returns to education tend to be higher for the rich than for the poor. However, we should emphasize that a significant proportion of the variation in income inequality across countries and over time remains unexplained.

The positive relationship between education and wage is evident in our data. Figures 1, 2, and 3 show wage ratios of an individual with an advanced degree relative to an individual with a high school degree across three racial groups and three wage distribution points. We see similar trends in wage ratios across three racial groups. An individual with advanced education within each wage group makes, approximately, twice as much as an individual with only a high school education, regardless of race.[2]

This paper contributes to the literature by re-examining the role of education as one of the critical drivers of earnings inequality among Asian, Black, and White Americans. Specifically, we construct an additively decomposable inequality measure (Theil Index) for each racial group (Asian, African Americans, and White Americans) from three points in the wage distribution across the three levels of education (high school, bachelor's degree, and advanced degree). This allows us to quantify the contribution of education (between groups) and within-group wage differences towards the overall wage inequality measure separately for each racial group over the last two decades.

We observe an increase in overall wage inequality among Asian, Black, and White Americans. Interestingly, our results reveal that relative to Black and White Americans, wage inequality (in levels and growth rate) is higher for the Asian American group. We find that education explains at most 32% of the variation of overall wage inequality among Asian Americans. Surprisingly, the role of education became weaker in explaining the dynamics of wage inequality for White Americans. The contribution decreased from 26% in 2000 to 23% in 2021. We observe a similar trend for Black Americans. Our results affirm that the role of education in driving dynamics of income inequality varies across races and time. The

[1] In Castelló-Climent and Doménech (2021), the authors study the relationship between education inequality (which they refer to as "human capital inequality") and income inequality relying on the Gini coefficient as the metric of inequality. Their results show (i) significant variation among these two inequality indicators across countries, and (ii) education inequality has a direct and positive effect on income inequality.

[2] We analyze the wage ratios in more detail and report our findings in section 4.

findings of this paper highlight that examining wage inequality at an aggregate level fails to capture the substantial disparities present among different racial groups in society.

The remainder of the paper is organized as follows. In section 2, we define and describe the features of Theil measure of income inequality and its decomposition. In section 3, we describe the data set used in our analysis. In section 4, we present the results. Section 5 contains a discussion of the results. We conclude in section 6.

2 Theil Measures and its decomposability

We employ Theil measure of inequality for analysis of wage income distribution.[3] It was introduced in Theil (1967) and is defined follows:

$$T^N(x) = \frac{1}{N}\sum_{i=1}^{N}\frac{x_i}{\mu}\ln\left(\frac{x_i}{\mu}\right), \text{ where } x \in \mathbb{R}_+^N, x > 0. \tag{1}$$

Each N-distribution $x = \{x_1, \cdots, x_N\}$ specifies a scheme of allocating income among N persons where the average income per person is μ. Theil index T^N helps us compare the level of inequality for any given population N. In addition, while the Theil index takes the population size as given and fixed, it is defined over all possible population sizes, $N \in \mathbb{N}$ and income distributions, $x \in \mathbb{R}_+^N$, $x > 0$. For an egalitarian income distribution Theil index attains its minimum value which is zero. Since the maximum value of Theil index is the natural logarithm of the sample size $\ln N$, the index T^N could assume unbounded values as the population size N tends to infinity.

Theil (1967) showed that for a population comprising of multiple groups of income earners, the inequality index $T^N(x)$, as defined in (1), can be expressed by the sum of two distinct terms, namely "within group" inequality and "between groups" inequality. Within group inequality is defined as the sum of inequality indices of each group weighted by the share of income it earns as a proportion of the total income of the population. The second term, "between-group" inequality, captures the inequality in a "smoothed" income distribution where the average income of each group is treated as the income of each member of the group.[4] Following Foster (1983), we can describe the decomposition of Theil index in formal terms as below. Let the population of size N be partitioned in $l \geqslant 2$ groups having $n_1, \cdots, n_l$ (with $n_1 + \cdots + n_l = N$) members respectively. Let the income distributions of the smaller groups be $x^{(i)} \in \mathbb{R}_+^{n_i}$, $x^{(i)} > 0$, $i = 1, \cdots, l$. Then the Theil index $T^N(x)$ can be decomposed as

$$T^N(x) = \sum_{i=1}^{l}\left(\frac{n_i\mu^i}{N\mu}T^{n_i}(x^{(i)})\right) + T^N(\mu^1 u^{n_1}; \mu^2 u^{n_2}; \cdots; \mu^l u^{n_l}), \tag{2}$$

[3] It is one of the most widely used inequality index which measures an entropic "distance" between any given income distribution and the "ideal" equitable distribution where everyone has equal income. Census Bureau regularly reports the Theil index among the measures of household income dispersion.

[4] For example, if $x = (2, 4, 6, 8, 4)$, and x is partitioned into two sets $x^{(1)} = (2, 4)$ and $x^{(2)} = (6, 8, 4)$. Then $n_1 = 2$, $n_2 = 3$, $\mu = 4.8$ $\mu^1 = 3$, and $\mu^2 = 6$. Decomposition property of T^5 implies that $T^5(x) = \left(\frac{2\cdot3}{5\cdot4.8}\right)T^2(x^{(1)}) + \left(\frac{3\cdot6}{5\cdot4.8}\right)T^3(x^{(2)}) + T^5(3, 3, 6, 6, 6)$.

where $\mathfrak{x} = \left(\mathfrak{x}^{(1)}; \cdots; \mathfrak{x}^{(\mathfrak{l})}\right)$, $\mu^{\mathfrak{i}}$ is the average income of group $\mathfrak{i}$ and $\mathfrak{u}^{n_{\mathfrak{i}}} = \{\underbrace{1, 1, \cdots, 1}_{n_{\mathfrak{i}} \text{ elements}}\}$ is the sum vector for $\mathfrak{i} = 1, \cdots, \mathfrak{l}$.

We use the above method to calculate the Theil Index that presents overall wage inequality within Asian, African, and White Americans across the three wage subsets (first decile, third quartile, and ninth decile) and three education levels (High School, Bachelor Degree, and Advance Degree). Then, for each race, we decompose the index into within-and-between wage groups. Note, the *within* component captures the gap among wage groups (first decile, third quartile, and ninth decile) whereas, the *between* component captures the wage gap between individuals with different levels of education (high school, bachelor, and advanced degree). The analysis allows us to identify how the wage disparities between the bottom, middle, and top of wage distribution contribute to overall wage inequality relative to wage disparities among individuals with different levels of education.

3 Data and Resources

We use weekly wages in current dollars for workers employed full-time and older than 16 years from the Bureau of Labor Statistics (BLS) [5] Current Population Survey (CPS). The wage measure represents earnings before taxes and other deductions and includes any overtime pay, commissions, or tips usually received (at the main job in the case of multiple jobholders). CPS provides basic information on the labor force, employment, and unemployment.[6] The earnings data are collected from one-fourth of the CPS monthly sample and are limited to wage and salary workers. All self-employed workers, both incorporated and unincorporated, are *excluded* from the CPS earnings estimates.

To construct the wage disparity measure and subsequently decompose it into within and between groups disparities, we classify individuals by the level of education (high school, bachelor's degree, and advanced degree) and distribution (first decile, the third quartile, and the ninth decile) for the three racial groups recognized by U.S. Census (Whites, Black or African American, and Asians) for the period 2000 to 2021.[7]

4 Results

Before we report findings on the Theil measure of wage inequality, we explore the ratios of wage income of those with an Advance degree and a High School degree. Figures 1, 2 3 contain this information for Asians, Whites, and Blacks respectively. For Black and White Americans in the first decile, the wage ratios show a steady decline from 1.9 to 1.6. For Asians, the ratio is relatively steady at around 2.

Comparing the wage ratios for the third quartile and the ninth decile of the wage distributions reveals many surprises. While for Black Americans, the two ratios have a similar

[5] https://www.bls.gov/news.release/pdf/wkyeng.pdf

[6] The survey is conducted monthly for the BLS by the U.S. Census Bureau using a scientifically selected national sample of about 60,000 eligible households, with coverage in all 50 states and the District of Columbia.

[7] Sample selection is driven by the availability of the data at a quarterly frequency.

pattern, for Whites, the ninth decile wage ratio is consistently larger than the wage ratio for the third quartile. For Asians, the wage ratio for the ninth decile shows larger variation while assuming lower values for several years as compared to the wage ratio for the third quartile.

The heterogeneity in the wage income distribution for the three races is persistent over time. We find that wage ratios are a useful metric to study the role played by race and education in the level and the structure of diversity in income distribution. Next, we investigate the dispersion in wage income distribution using the Theil index which is a widely used measure of inequality in income distribution.

The aggregate measure of inequality is reported in Figure 4 which provides the Theil Index measure for each racial group. It can be seen that for each race, inequality is increasing over the two-decade period (2000-2020). The inequality index is highest among Asians, followed by Whites, and lowest among Blacks. Immigration has been the largest contributing factor to the growth of the Asian population (84% from 1970 to 2016), and it is considered one of the driving forces of inequality within this group. Notably, a significant portion of Asian immigrants are highly skilled, working in the technology sector with high-paying jobs [8].

Wage inequality is highest among Black Americans, followed by Asians, and lowest among White Americans. Interestingly, most of the increase in wage inequality among Black Americans occurred after 2008, while for White Americans, the increase primarily took place before 2008. These findings reveal that the benefits of economic growth following the Great Recession were unevenly distributed, with Black Americans being the most affected, followed by Asian Americans.

After 2015, wage inequality among Asians and White Americans remains relatively flat. Interestingly, inequality is declining among Black Americans since 2015, which is distinct from the trend for the remaining two races. Results reveal that the gains from post-2015 economic growth disproportionately benefited Americans who were previously left behind. This is no surprise, as during the period from 2015 to 2019, the US unemployment rate was historically low, encouraging individuals from disadvantaged groups to join the labor force [9].

Next, we decompose the aggregate Theil index reported in Figure 4 as the sum of inequality measure within the groups (i) High School degree holders, (ii) BA degree holders, and (iii) advanced degree holders and the inequality measure between these three groups as described in (2). We report the percentage contribution of the inequality measure within the three groups and between these three groups leading to the aggregate Theil index in Figures 5- 8.

Figure 5 provides calculations of wage inequalities within the High School degree holders for each racial group. Note, the measure captures the dispersion between wages in the first decile, third quartile, and ninth decile for individuals that hold only a high school degree. Specifically, we report the findings as the ratio to overall inequality. It allows us to identify how much of the wage dispersion among individuals with high school education adds to overall inequality. 12 to 14% of overall wage inequality within White Americans comes from

[8] https://www.pewresearch.org/social-trends/2018/07/12/income-inequality-in-the-u-s-is-rising-most-rapidly-among-asians/fn-39469-3

[9] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.govinfo.gov/content/pkg/ERP-2020/pdf/ERP-2020-chapter2.pdf

wage dispersion among individuals identified as White with only a high school degree. The contribution for Asians is slightly lower. 10 to 11.5% of overall wage inequality within the Asian group is attributed to wage dispersion among high school degree holders classified as Asians. The contribution of wage inequality from within the High school Degree Holders classified as Black to the aggregate inequality for Blacks drops from 12% (the year 2010) to 8% (2021). However, over the same period (2010 to 2021) total wage inequality among Blacks increased (Figure 4). These findings suggest that there is some wage convergence happening among individuals that have only High School degrees and are classified as Black.

Figure 6 provides contributions of wage inequalities from within the BA degree holders for each racial group. Wage disparity among the BA degree holders is the largest for Black and White Americans. 29 to 32% of the aggregate wage inequality for Black and White Americans comes from wage disparities that exist among individuals that hold only a BA degree. 24 to 28% of the aggregate inequality for Asians is due to the wage disparity among the BA degree holders.

Figure 7 provides contributions of wage inequalities from within the Advance degree holders for each racial group. The inequality among the Whites with advanced degrees contributes 31 to 33.5% to the aggregate inequality for the Whites. This is the largest in comparison to the other two racial groups. 30 to 32% of the total inequality for Asians is attributed to wage disparities among advanced degree holders. For the Blacks, the contribution ranges from 23 to 30%. Interestingly, there is a downward trend in the contributions of wage inequalities from within the Advance degree holders for Asians and Black Americans for the period post-2015.

Figure 8 depicts inequality between education groups for each racial group. The graph helps us understand how much of the total inequality for each racial group comes from differences in wages from different levels of education (high school, bachelor's degree, and advanced degree). The largest contribution is for Asians. 30 to 32% of total wage inequality for Asians is due to wage differences between the high school, bachelor's, and advanced degree holders. For Blacks, the contribution of wage differences due to education towards the total wage inequality remains relatively flat (27%). Towards the end of the sample period, the contribution drops down to 23%. Similarly, there is a decline in the contribution of education in driving wage inequality for Whites. The contribution of wage disparities between high school, bachelor's, and advanced degree holders for Whites is 25%, during the early 2000s, and it goes down to 23% for the period post-2015. Results suggest that wages due to differences in the level of education are steeper only for Asians. For Blacks and Whites, education as a driver of wage disparity is weighing less. In addition, we performed a similar analysis for groups with less than a high school education, high school only, and bachelor's and higher degrees [10]. Differences in education levels explain at most 50% (Asian group) of the variation in the Theil index. Interestingly, most of the remaining variation stems from wage disparities within the bachelor's and higher-degree group. Up to 40% of the variation in the Theil index for Black and White Americans is attributed to wage disparities within this group. This confirms our earlier findings that wage inequality among highly educated earners is significant.

[10]These results are available upon request

5 Discussion

In the field of labor economics, the primary driver of increased inequality is considered to be skill-biased technical change. Since both the relative wage and quantity of college graduates have increased since 1970, the skill-biased technical change theory suggests that there has been a corresponding increase in employer demand for educated workers. Consequently, individuals with higher education earn a wage premium (Gordon and Dew-Becker (2008)).

In this study, we hypothesize that the education wage premium should dominate wage inequality in society. From our results, we infer that the education wage premium drives wage inequality by at most 32% (for Asians). Consequently, non-education factors such as experience, industry, and job type may be the main contributors to wage inequality in society. It should also be noted that the literature highlights immigration as a potential factor dampening the education wage premium (Hatton and Williamson (2008)). The findings from our study carry important policy implications for addressing wage inequality. While the education wage premium is a significant driver of wage inequality, its contribution is limited, suggesting that policies aimed solely at increasing access to higher education may not sufficiently reduce overall wage inequality. Since non-education factors such as experience, industry, and job type play a major role in driving wage inequality (Gordon and Dew-Becker (2008)) , policies should focus on improving opportunities for skill development, career mobility, and equitable access to high-paying industries. For instance, job training programs and targeted support for underrepresented groups in high-demand sectors could help reduce disparities.

6 Conclusion

In this paper, we re-examine the role of education as one of the critical drivers of earnings inequality among Asian, Black, and White Americans. Specifically, we construct an additively decomposable inequality measure (Theil Index) for each racial group (Asian, African Americans, and White Americans) from three points in the wage distribution across the three levels of education (high school, bachelor's degree, and advanced degree).

Our results are notable in two key ways. First, we empirically document that wage inequality has increased across all racial groups over the two-decade period (2000–2020). Specifically, we show that the inequality index is highest among Asians, followed by Whites, and lowest among Blacks. Our contribution to the literature lies in emphasizing that analyzing wage inequality at an aggregate level overlooks the significant differences that exist across racial groups in society.

Second, we find that wage disparity due to differences in educational attainment is increasing only among Asians. Moreover, the role of education as a driver of wage disparity is diminishing overall. From our results, we infer that educational attainment alone has a limited impact on eliminating wage disparities in society.

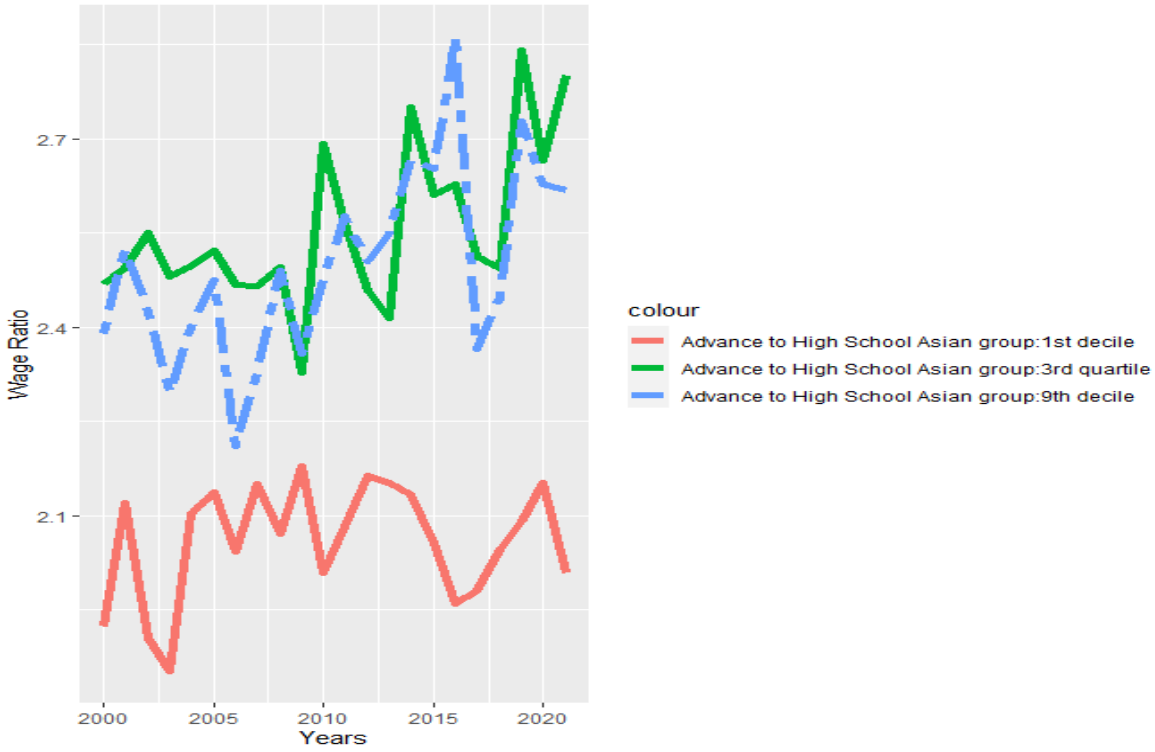

Figure 1: Advance to High School Degree Wage Ratios: Asians

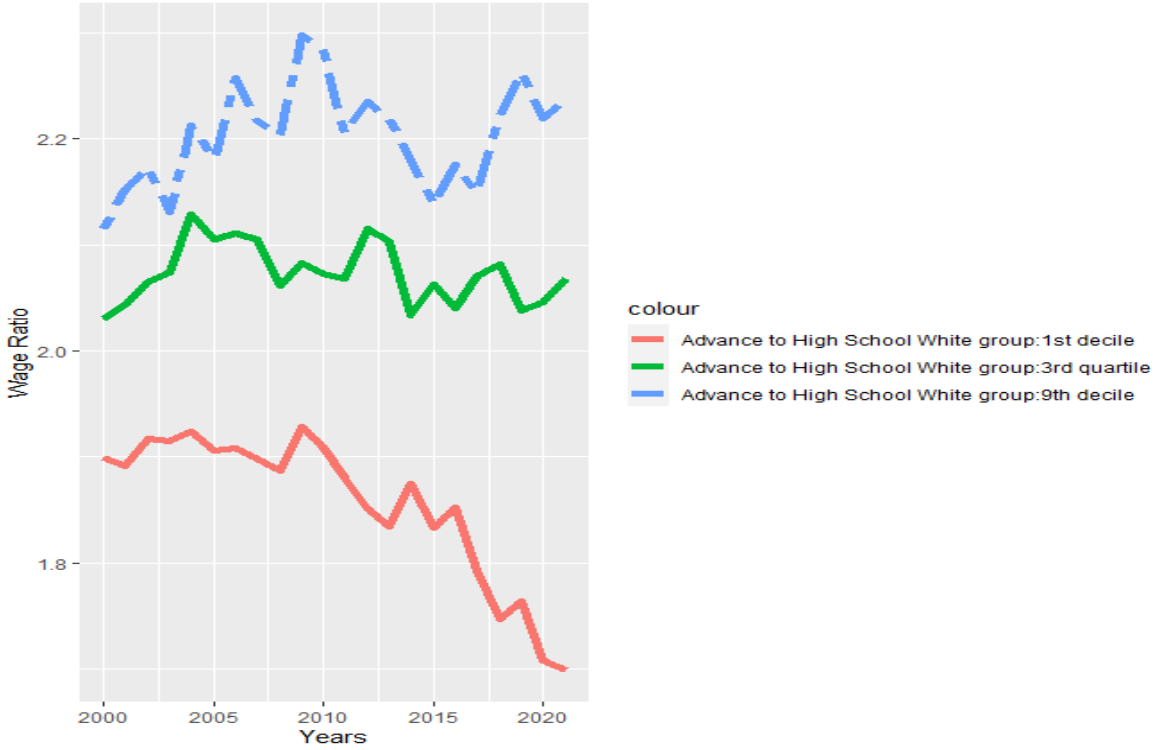

Figure 2: Advance to High School Degree Wage Ratios: Whites

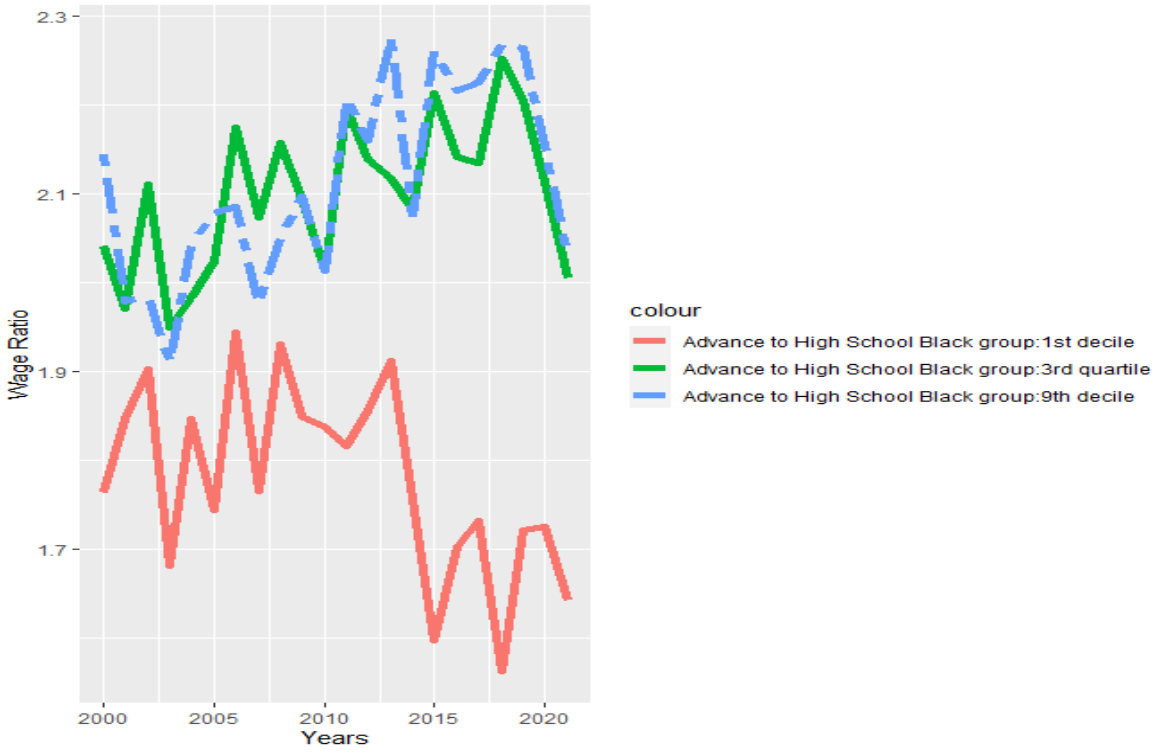

Figure 3: Advance to High School Degree Wage Ratios: Blacks

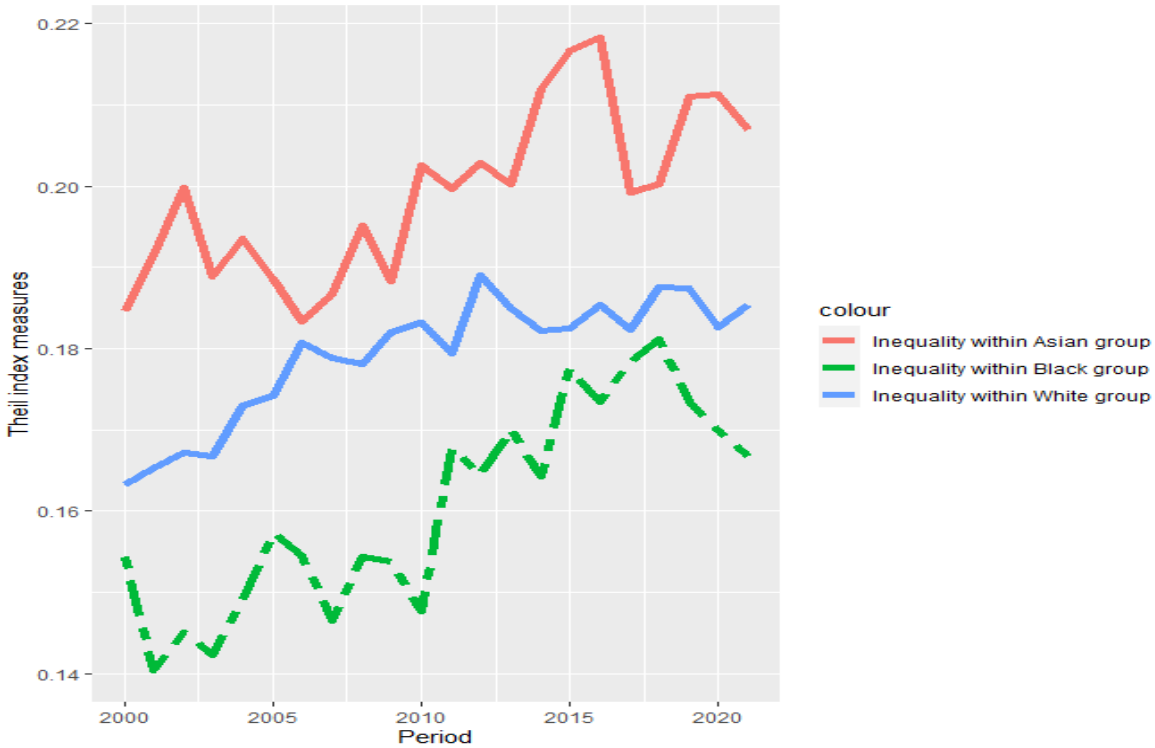

Figure 4: Theil Index

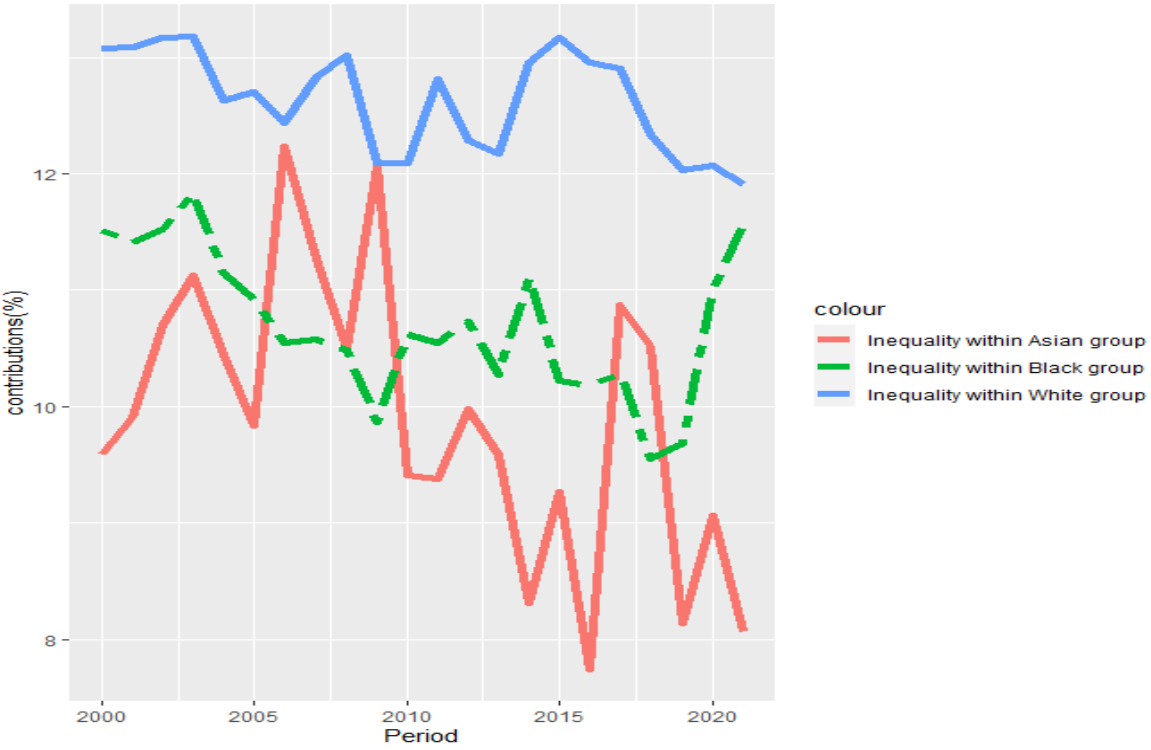

Figure 5: Contributions from disparities within High School Group across three races

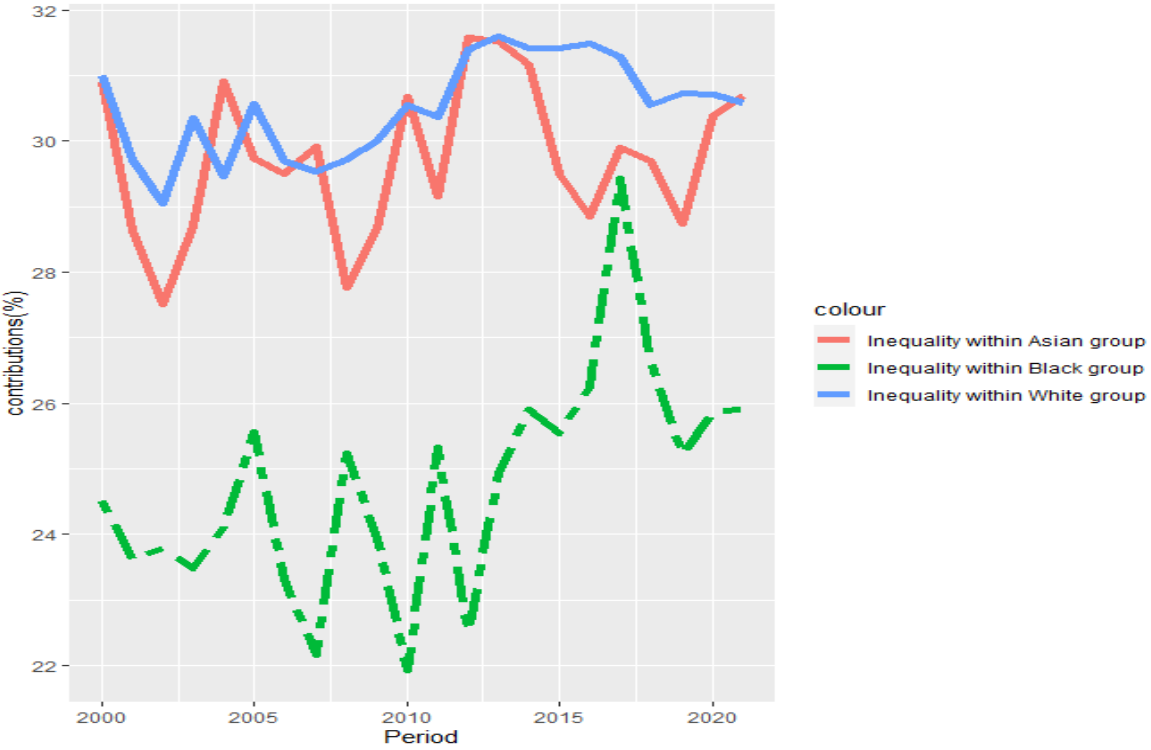

Figure 6: Contributions from disparities within BA Group across three races

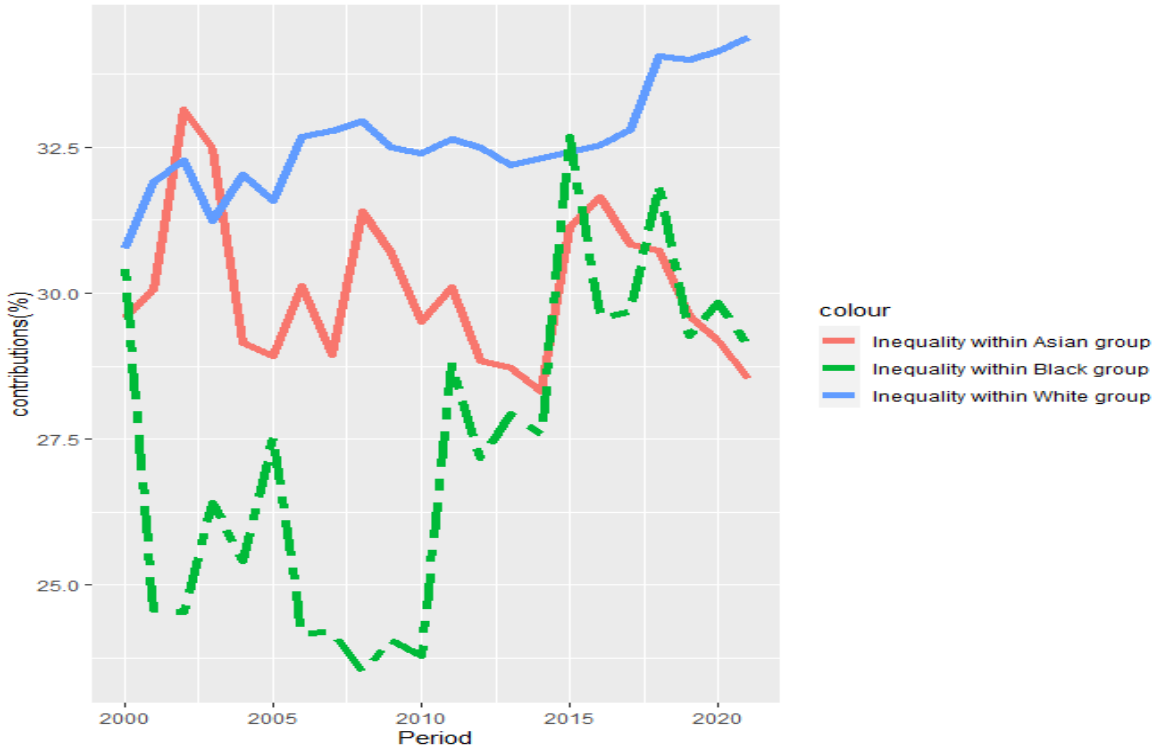

Figure 7: Contributions from disparities within Advance Degree Group across three races

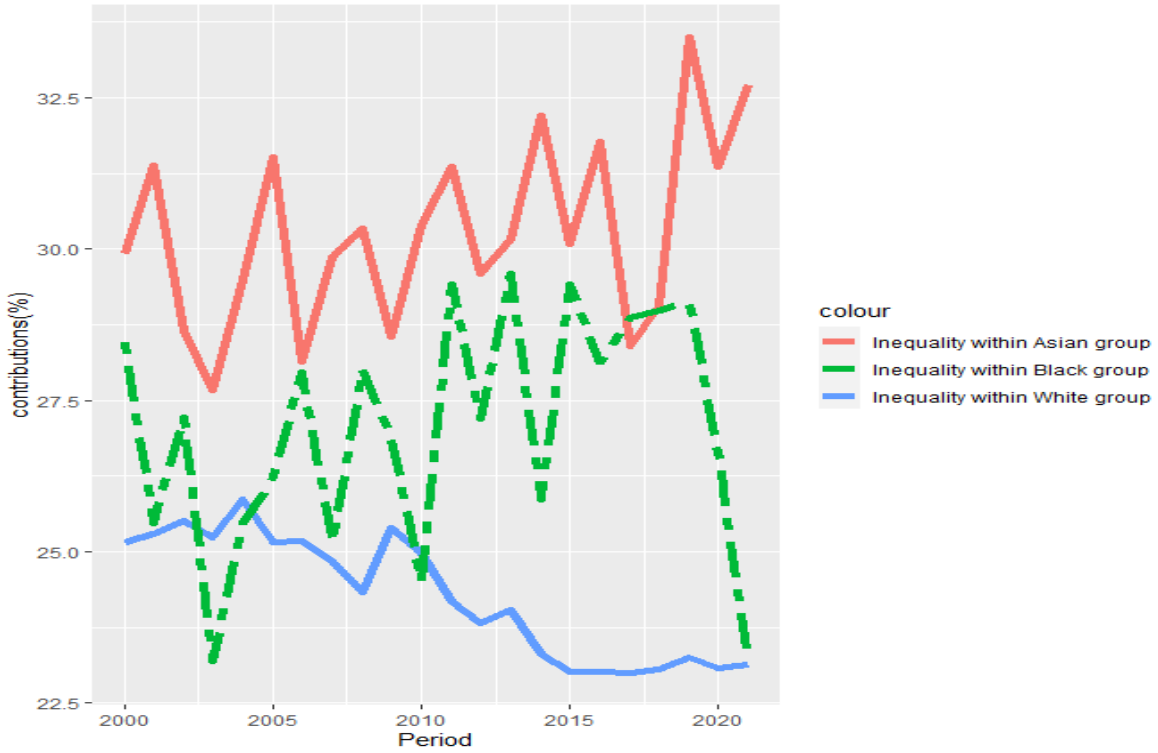

Figure 8: Contributions from disparities between Degree Groups across three races

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