1. Introduction

According to the US National Center for Education Statistics, between 2000 and 2016 educational attainment (highest level of education completed) rates among individuals aged 25 to 29 years have increased from 88% to 92% for high school diploma, 38% to 46% for associate's degree and 29% to 36% for bachelor's degree [1]. This increase in Educational attainment rate plays a major role in shaping up society and labor markets. Better educated individuals are more skilled, more motivated to be employed and hence we believe have higher earnings. This earnings gap across different levels of educational attainment is important to understand/study given the investment in education is not cheap in terms of both time and money.

Furthermore, between 2000 and 2016, increase in educational attainment rate has varied by race i.e. White (from 94 to 95 percent), Black (from 87 to 91 percent), Hispanic (from 63 to 81 percent), and Asian (from 94 to 97 percent) for high school diploma [1]. This implies that individuals from different races have different access and emphasis on education along with different economic and social conditions. Similarly, individuals from different races face different barriers/challenges (like disparities in employment rates and earnings) in the labor market widening the earnings gap even for the same level of educational attainment. So, it is imperative to study the impact of race on the premium of educational attainment.

We aim to explore economic disparities by researching: Impact of educational attainment on earnings? And whether the premium of educational attainment varies by Race? Our study contributes to the existing knowledge base by providing evidence for the existence of earnings gap across educational attainment levels, within and across four different Races namely White, Black, Asian and Hispanic. It helps to answer questions such as:

- Is there an earning gap between Professional and Bachelor's Degree for individuals of the same race?
- Is there an earning gap between White and Black individual both with Bachelor's degree?

We estimate earnings gap (log earnings) by educational attainment (8 different levels) after controlling for Age, Gender and Marital Status across four races – White, Black, Asian and Hispanic.

We find positive correlation between each level of educational attainment and logs earning across all races. For example, 10.75% of Whites have Master's degree and they earn 116% more than Whites who are high school dropouts, reflecting the earnings gap by educational attainment. Similar findings for other races and educational attainment levels are discussed in the sections below. We also find earnings gap between races like White and Black for a certain educational attainment to be noteworthy.

2. Econometrics Model and Estimation Method

We use Ordinary Least Square estimation method to estimate parameters in our multiple regression model. Since it is appropriate to find the earnings gap in percentage difference rather than actual dollar value, we use log of annual earnings as our dependent variable. This log-level functional form of our model also corrects for skewness in the earnings distribution.

Our model includes following independent variables: Age, Gender, Marital Status and Educational Attainment. While we control for Age, Gender and Marital Status, our model enables us to differentiate among eight different levels of education: Professional degree, Doctorate, Master's degree, Bachelor's degree, Associate degree, Some college, High School degree and No High School degree (Reference Category).

Our model also includes Age that represents the number of years of work experience of an individual. It is included in quadratic form (i.e. Age and Age Squared terms), so that it can account for its diminishing effect on earnings. We estimate our model for each race separately, so that it distinguishes among White, Black, Asian and Hispanic individuals.

3. Data

Our data is a subset of data from 2011 American Community Survey (ACS). The original 2011 ACS data is a national level random sample of household units; however, our research intends to estimate the earnings gap at an individual level. Therefore, our data set is a subset of original 2011 ACS data at individual level aged 18 to 64 years. This data includes economic and demographic characteristics such as age, gender, marital status, educational attainment, race/ethnicity and annual earnings.

Our objective is to estimate the earnings gap, so we exclude unemployed individuals from this dataset, which leaves us with 55,032 individuals from the total 64,999 individuals in initial dataset. We further restrict our model to four racial groups – White, Black Asian and Hispanic as other racial groups are underrepresented (filtering out 1,832 individuals). In addition, many individuals have reported annual earnings below Census Bureau's Poverty Threshold (which was 14,710 USD for the year 2011) [2], so we restrict our sample to represent individuals with earnings greater than this poverty threshold. This gives us our final sample of 33,018 individuals, which comprise of 73.38% Whites, 9.03% Blacks, 5.40% Asians and 12.19% Hispanics.

Table 1 represents the descriptive statistics of all variables in our sample dataset by race/ethnicity. In this table, we observe that for all races there is a huge variation in annual earnings (for e.g. White individuals earnings' varies from 14,800 USD to 577,000 USD). Further, this variation is highest among Asian individuals, which is in-line with our finding that 67.9% of Asians in our dataset have post-secondary degree.

We find that median earnings increase with every step increase in educational attainment for all races i.e. median earnings increases in the following sequence:
No High School -> High School -> Some College -> Associate Degree -> Bachelor's Degree -> Master's Degree -> Doctorate -> Professional Degree

The only exception to this is Hispanics individuals, where median earnings for Doctorates (70,000 USD) is more than the median earnings of Professional degree (61,500 USD) holders.

Table 1: Descriptive Statistics

Variable	White	Black	Asian	Hispanic
Earnings in USD, M	58249.12	43066.68	67498.99	39667.48
(SD)	(55136.17)	(32925.15)	(65120.57)	(32973.28)
Educational Attainment (%)				
Professional Degree	2.76	1.11	5.56	1.64
Doctorate	1.67	1.11	5.00	0.37
Masters Degree	10.71	9.02	17.14	4.94
Bachelors Degree	25.13	16.49	33.00	12.35
Associates Degree	10.18	9.39	7.25	7.38
Some College Degree	21.88	28.06	12.09	22.06
High School Degree	24.13	27.89	12.70	26.76
No High School Degree	3.54	6.94	7.25	24.50
Age in years, M (SD)	44.25 (11.71)	42.99 (11.41)	42.30 (10.98)	39.53 (11.40)
Married (%)	66	43	71	57
Female(%)	45	56	46	40
Sample size	24,231	2,983	1,779	4,025

White individuals who did not pursue education beyond Associate degree are earning more (higher median earnings) in comparison to their counterpart from other races. Intuitively, it makes sense as White individuals tend to have bigger network with traditional and small business owners who would offer jobs without formal degree.

On the other hand, Asians with Bachelor's degree or higher have highest median earnings in comparison to their counter parts from other races. This makes sense as Asians tend to work in technical jobs (IT, Research, Accounting, Medical etc.) that have higher pay-out.

4. Results

Table 2 below represents our log earnings model estimates for each race. Our model rejects null hypothesis in BPG test (H0: Homoskedasticty exists) for all races indicating that our standard errors are not robust. Therefore, we calculate robust standard errors for each race that are seen in the table. Based on parameters estimates, our initial belief that educational attainment drives earnings positively prove correct. This means for all four races earnings increase as we move from one degree to higher one.

On an average, for White individuals, controlling for all other variables:

- Professional degree holders earn 234.3% more than high school dropouts,
- Doctorate degree holders earn 141.7% more than high school dropouts,
- Master's degree holders earn 116% more than high school dropouts,
- Bachelor's degree holders earn 86.3% more than high school dropouts,
- Associate degree holders earn 41.3% more than high school dropout,
- Some College degree holders earn 33.9% more than high school dropouts,
- High school graduates earn 15.3% more than high school dropouts.

Aforementioned illustrates that earnings gap by all levels of educational attainment is big enough to matter in the real world, which indicates that return on investment in higher education is high. Also, all these gaps are highly statistically significant at 0.1% level i.e. we reject the null hypothesis that earnings do not vary by educational attainment for White individuals.

Similarly, all other races follow the same pattern of being economically and statistically significant at 0.1% level except for High School degree holders among Asian and Black individuals, where the earnings gap is not statistically significant and significant at 5% level respectively. Overall, this indicates that U.S. workers with higher education are very likely to earn more than those who did not continue their studies past high school.

Table2: Estimated Log(Earnings)				
	Dependent Variable: log(Earnings)			
	White	**Black**	**Asian**	**Hispanic**
(Intercept)	8.679***	8.955***	8.3616***	9.088***
	(0.046)	(0.1065)	(0.2098)	(0.0877)
Labor Demographics				
Age	0.0726***	0.0545***	0.0861***	0.0442***
	(0.0022)	(0.0053)	(0.0105)	(0.0047)
Age * Age	-0.0007***	-0.0005***	-0.0009***	-0.0004***
	(0.00003)	(0.00006)	(0.0001)	(0.00006)
Female	-0.3162***	-0.1396***	-0.1949***	-0.1776***
	(0.007)	(0.018)	(0.0276)	(0.0154)
Married	0.1029***	0.0718***	0.0406	0.0501**
	(0.0075)	(0.0182)	(0.0313)	(0.0158)
Educational Attainment	Reference Category: No High School Degree			
Professional Degree	1.207***	1.027***	1.3791***	0.9082***
	(0.0334)	(0.1404)	(0.0922)	(0.105)
Doctorate	0.8826***	0.9293***	1.1207***	0.9688***
	(0.0369)	(0.0776)	(0.0797)	(0.1425)
Master's Degree	0.7703***	0.7527***	0.9428***	0.8119***
	(0.0198)	(0.0453)	(0.0537)	(0.0413)
Bachelor's Degree	0.6223***	0.5335***	0.7791***	0.6251***
	(0.0177)	(0.04)	(0.0477)	(0.0283)
Associates Degree	0.346***	0.3078***	0.4204***	0.4918***
	(0.0188)	(0.0434)	(0.0632)	(0.0305)
Some College	0.2919***	0.243***	0.3647***	0.3384***
	(0.0173)	(0.0359)	(0.0526)	(0.0212)
High School Degree	0.1421***	0.0766*	0.1059	0.223***
	(0.0171)	(0.036)	(0.0505)	(0.0186)
No. of Observations	24231	2983	1779	4025
R^2	0.3046	0.2794	0.3491	0.2746
Adjusted R^2	0.3043	0.2767	0.3451	0.2727

Notes: *Robust Standard Errors are in parenthesis.*
**** significant at 0.1%, ** significant at 1%, * significant at 5%*
Red color indicates that coefficicents are statistically significantly different for White w.r.t. other Races.

The impact of race on the premium of the educational attainment is shown as follows:

White vs. Black

White individuals with bachelor's degree earn 86.3% more than high school dropouts on an average after controlling for all other variables. While Black individuals with Bachelor's degree earn 70.5% more than high school dropouts. The difference between these two premiums is statistically significant at 5% level. However, the difference between White and Black individuals for any other level of educational attainment is not statistically significant. This means that there is a high probability that White Bachelor's degree holder earns more than Black Bachelor's degree holder.

White vs. Asian

The estimated earnings premium for Doctorate (206.7% vs 141.7%), Masters (156.7% vs 116%) and Bachelor's degree (117.9% vs 86.3%) is higher among Asians than among White individuals (in comparison to respective high school dropouts). The difference between the respective premiums for two races is statistically significant at 5% level. This means on average, Asians earn more than White individuals for these degrees.

White vs. Hispanic

The estimated earnings premium for Professional degree (147.9.7% vs 234.3%) is lower among Hispanics than among White individuals (in comparison to respective high school dropouts). The difference between these two premiums is statistically significant at 5% level. The estimated earnings premium for Associate (63.5% vs 41.3%) and High School degree (24.9% vs 15.3%) is higher among Hispanics than among White individuals (in comparison to respective high school dropouts). The difference between the respective premiums for two races is statistically significant at 5% level. This means on average, Hispanic High School and Associate degree holders earn more than White individuals with respective educational attainment. However, White Profession degree holders earn more than Hispanics.

From above, we have enough evidence to reject our null hypothesis that educational attainment and Racial disparity doesn't exist.

In addition, on average after controlling for all other variable:

- earnings gap by gender (Coefficient is significant at 0.1% level for all races) follows the order: White(27.1%), Asian(17.7%), Hispanic(16.3%) and Black(13%).
- earnings gap by marital status (Coefficient is significant at 0.1% level for White and Black while significant at 1% level for Hispanic and not significant for Asian) follows the order: White(10.8%), Black(7.4%) and Hispanic(5.1%).

Predicted earnings for White, Black, Asian and Hispanic individuals peak at 51.9, 54.5, 47.8 and 55.25 years respectively. Further, the coefficient of Age (significant at 0.1% level – all races) is positive while for Age Squared it is negative, this indicates that earnings curve w.r.t Age is parabolic in shape i.e. earnings increase at a decreasing rate until the optimal Age of the respective race and then decrease at an increasing rate.

It is interesting to note that Asians have their earnings peak at a younger age in comparison to other races. Holding everything else constant, on average, predicted increase in earnings associated with one-year increase in age for a 30 years old White, Black, Asian and Hispanic individual is 3.1%, 2.5%, 3.3% and 2% respectively.

Our estimates also indicate that only 30.5%, 27.9%, 34.9%, 27.4% of the variation in log earnings is systematic i.e. can be explained by our model for White, Black, Asian and Hispanic respectively.

5. Conclusion

Our study concludes on the existence of earnings gap (statistically significant and economically viable) based on the levels of educational attainment reflecting high ROI on education. As it is seen from our results, this gaps increases as we move from lower (High School dropouts) to higher levels of education (Professional Degree).

US has a history of racial inequality in education. Different races have different access to educational opportunities and face different barriers in the labor market. These factors determine social construct, ensures parity in the quality of life across communities. We find evidence confirming that the premium of educational attainment varies by race. This is an important finding that should be considered while designing educational reform policies to make education accessible to all irrespective of race. This reduces social injustice and makes co-existence among races cohesive.

We find that, after controlling for age, gender and marital status, Asians leverage the ROI on education most among all races i.e. the earnings gap from one level to another is higher in comparison to White. Further, contrary to the popular belief (Asian work force is cheaper in comparison to Whites), Asians have highest earnings per educational attainment level among all races.

The idiosyncratic variations in log earnings that are not explained by our model can be because of missing specifications as following:

- Quality of education and schools/college for ex. one can't compare master's from city college to master's form an ivy league college.

- Innate learning ability of individuals i.e. people with higher IQ and higher motivation to learn.
- Actual working experience, we are considering Age as a proxy for work experience. However, different individuals may join the work force at different age but still can have same number of years of experience.
- More than one person in the family, extrapolation from original household ACS data to an individual level data set that we have used in our study losses the characteristics of belonging in the same family. Individuals belonging to a family will have different opportunities/barriers influencing earnings that are currently being missed in our data.
- Characteristic of individuals being full time or part time workers.
- Survey respondents reporting higher or lower earnings than the actual figure.

We find our initial believes of earnings gap in US by educational attainment and race to be valid from this study (statistically significant and economically viable).

6. References

[1] https://nces.ed.gov/fastfacts/display.asp?id=27
[2] https://aspe.hhs.gov/2011-hhs-poverty-guidelines
[3] https://www.census.gov/programs-surveys/acs/

7. Contributions

All of us worked on exploratory data analysis and model estimation. Statistical tables and graph were generated by Avanti Likhite and Mansi Agarwal. Research question, motivation and regression results were analysed and discussed by all of us together. Introduction and conclusion of the paper were written by Preeti Jain. Further, everyone contributed towards the initial draft of the paper and Preeti Jain combined our final paper into one. All of us proofread final version.