Mini Project 1: Income inequality

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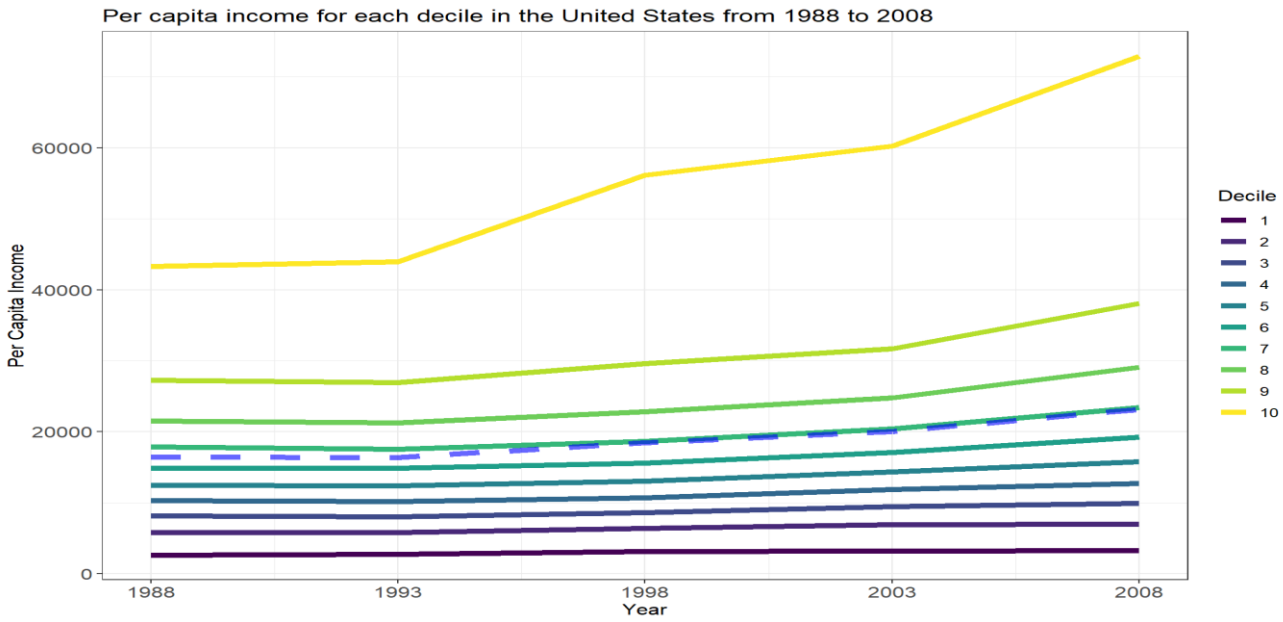
Introduction:

Gaps in earnings between a nation's most affluent and the rest of the country continue to grow every year. This project explores this major research issue of uneven distribution of income in the U.S. and other countries between 1988 and 2008. We primarily used three datasets to investigate this topic:

1) Lakner-Milanovic World Panel Income Distribution (LM-WPID)
2) Ventile
3) World Income Distribution (WYD)

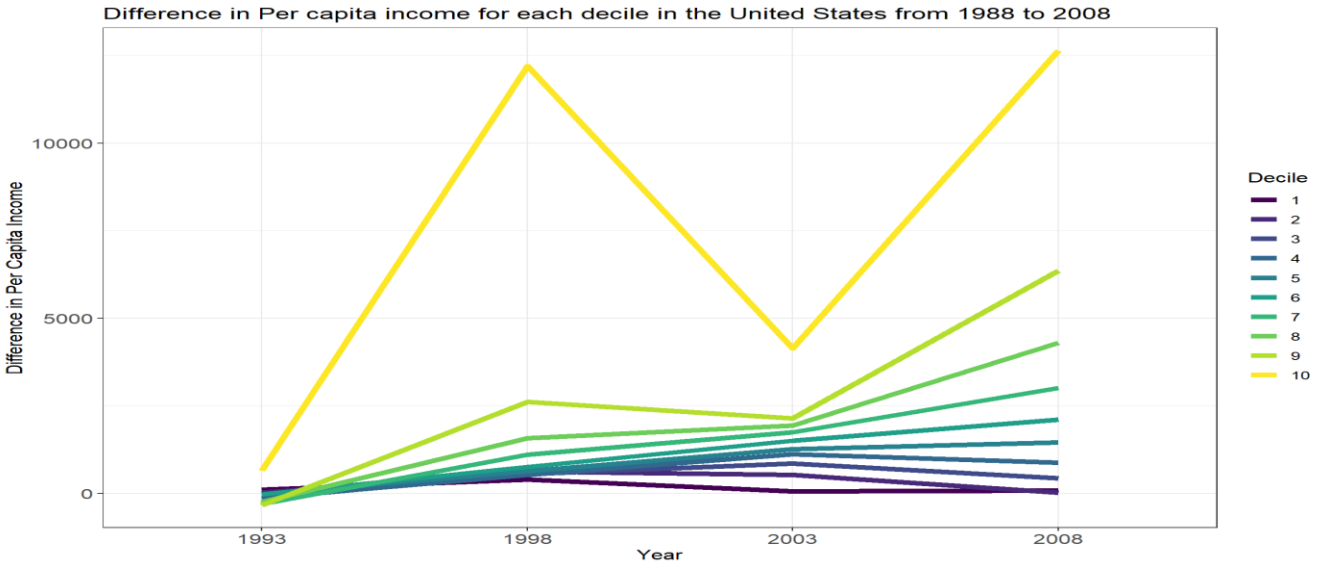
1. Variation of the Per capita income for each decile in the US since 1988



Here the terms decile and ventile have the following meanings:
Decile: 10% of the population, where "Decile 1" means the 10% of individuals in the country with the lowest income, while "Decile 10" means the 10% of the individuals in the country with the highest income.
Ventile: 5% of the population, where "Ventile 1" means the 5% of individuals in the country with the lowest income, while "Ventile 20" means the 5% of the individuals in the country with the highest income.

The above graph plots the per capita income for each decile (10% of the population) in the United States from 1988 to 2008. The dotted line almost coinciding with the 7^{th} decile marks the mean per capita income for the United States. As can be seen, there are 6 deciles i.e. 60% of the total population below the mean per capita income. The deciles 1^{st} ,2^{nd} ,3^{rd} and 4^{th} does not exhibit much of a change in per capita income. It is almost a constant line with only a negligible increase as we proceed from 1988 towards 2008. In contrast, if we look at the 7^{th}, 8^{th} and 9^{th} deciles, it is evident that there is a considerable exponential increase in per capita income with respect to the year. For the 10^{th} decile, there is not much of growth in Per Capita Income from 1988 to 1993. However, after 1993, the 10^{th} decile experiences an explosive growth in the per capita income.

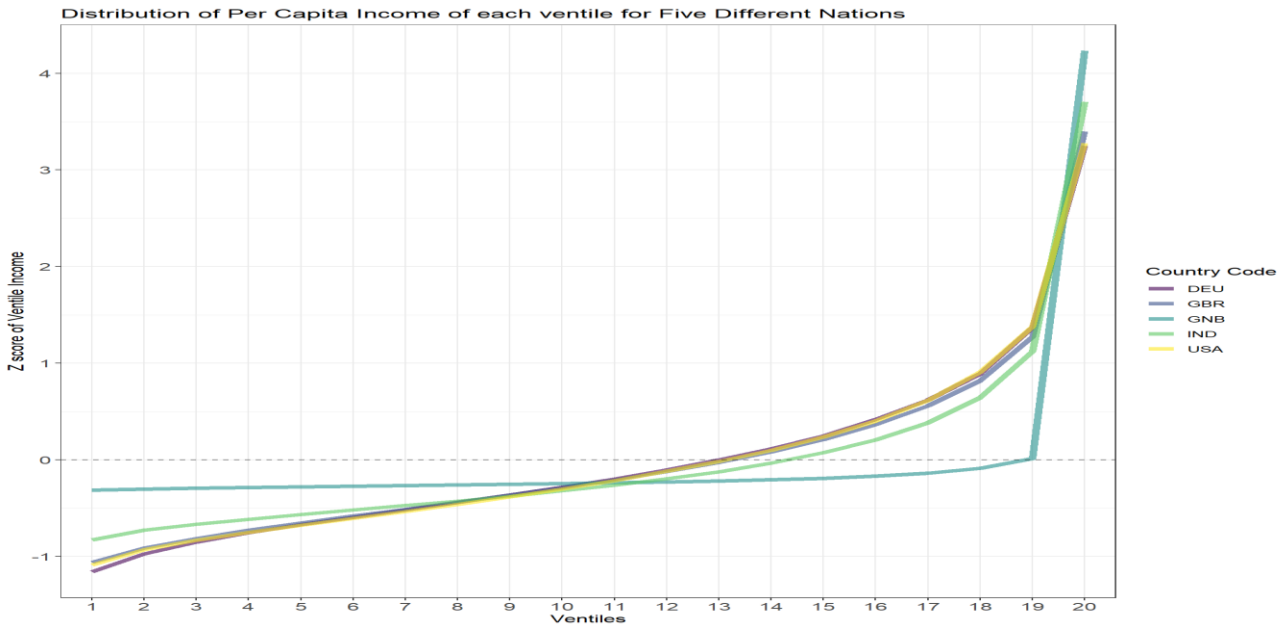
When we plot the difference in changes in per capita income for each decile in the US from 1988 to 2008, we get the below graph. The difference in per capita income increases from 1993 to 1998 for all deciles out of which it is steepest for the 10^{th} decile (i.e. for 10% of individuals with the highest income in the country). Thereafter, we observe a sudden decrease in the difference in per capita income for the 10^{th} decile. And for deciles 1, 2 and 9 there is a decrease. However, for the remaining deciles (deciles 3 to 8), a slight increase in the difference in per capita income is observed. From 2003 to 2008, deciles 1 and 2 continue their steady decrease, however, we witness a considerable increase for deciles 9 and 10. The difference in Per capita income began decreasing for deciles 3 and 4, whereas it continued increasing for decile 5 to 8. Overall, the rise and fall have been stark for the richer strata of the US population and minor for the lower strata of the population. The middle-class has experienced an overall growth in per capita income.



Numerical Results:

For the 10th decile, there is not much of growth in Per Capita Income from 1988 to 1993. However, the incomes of the ultra-rich (10th decile) saw an explosion between 1993 to 1998 when around 33% growth was reported. The upward surge continued with a 20 percent growth in Per Capita Income from 1998 to 2003. Similarly, from 2003 to 2008 there is a 21.6 percent growth. For the 9th decile, there is a slight decrease of 3.57% in Per capita income from 1988 to 1993. In contrast, it grows by 18.51% from 1993 to 2003 and another 18.75% from 2003 to 2008. For the 8th decile, there is not much change in Per capita income from 1988 to 1993 but has a jump of 19.05% from 1993 to 2003, which is succeeded by a 16% growth from 2003 to 2008. For the 7th decile, the per capita income remains almost constant from 1988 to 1998. There is about a 22% increase from 1998 to 2008. From deciles 1 to 6th (deciles below mean), the change in per capita income is not major in the span of 20 years. The overall growth is around 1-2% from 1988 to 2008.

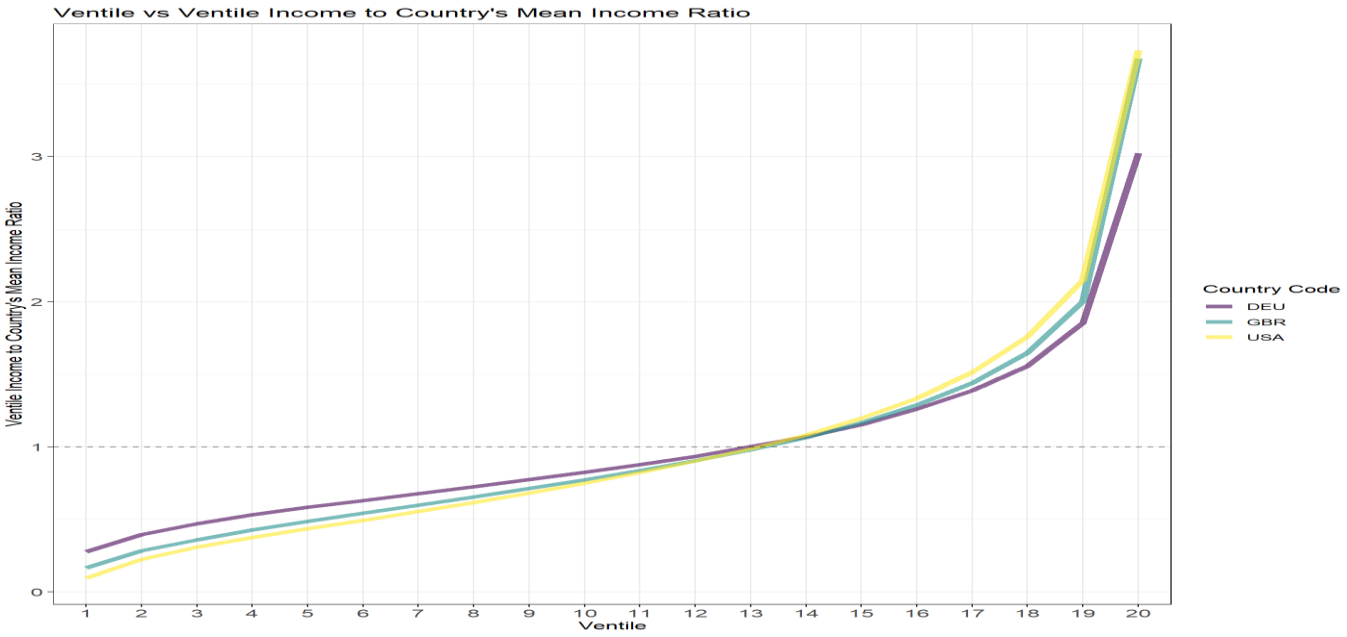
2. How does the present distribution of income, relative to a country's mean, differ between selected countries?



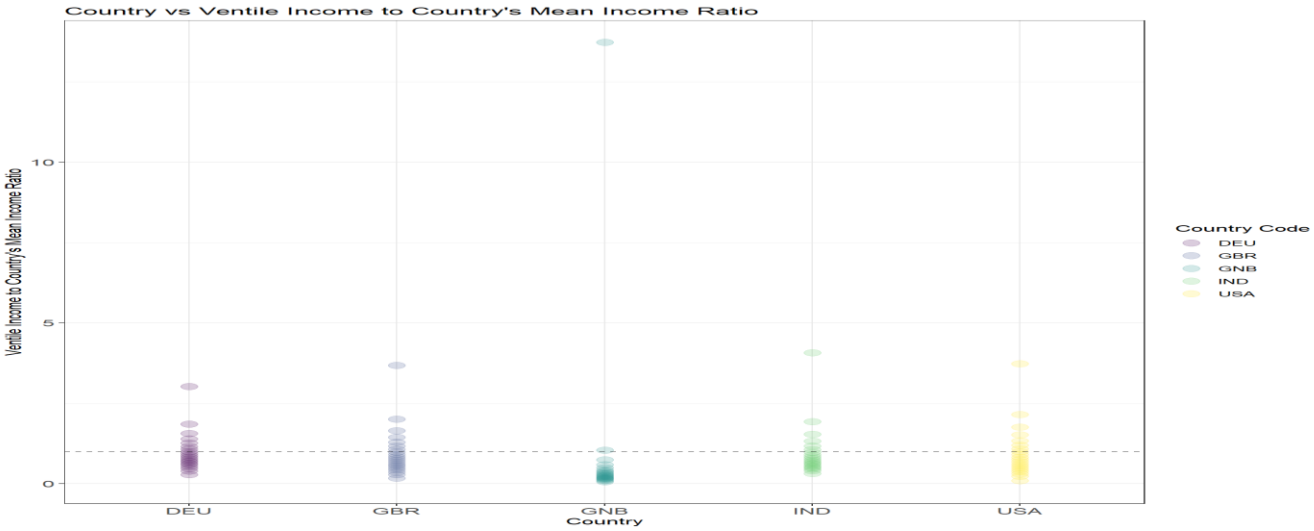
We know that the region may affect our results since e.g. relatively low-income people in the US have higher incomes than relatively high-income people in Guinea-Bissau (GNB). In order to reduce this effect, we normalized the data using the Z-score metric (X-mean/standard deviation).

The distribution of z scores of ventile incomes has been almost similar for Germany, Great Britain and the United States with their increasing z-score per capita income for each ventile touching the mean around the 13th ventile and touching the mean around the 14th ventile for India. Their observations for 1-19 ventiles are within -1.5 to 1.5 standard deviations away from the

mean. Their 20th ventile is within 3.5 standard deviations away from the mean. However, it has been slightly lesser steep for India and almost constant for Guinea-Bissau with its z-score approaching mean only around the 19th ventile. No significant change is observed for Guinea Bissau for 1-19 ventile. However, the z score of 20th ventile is more than 4 standard deviations away from the mean. The richer (20th ventile) in Guinea-Bissau are relatively far richer than their counterparts in United States, Great Britain, Germany, and India since their z-scores are more than 3.5 standard deviations away, whereas it is lesser than 3.5 standard deviations away for other nations. This proves that, the rich strata in Guinea-Bissau is significantly richer than the richest strata in all the other countries taken into consideration. It is to be noted that we did not plot a line graph since each ventiles are separate, discrete categorical values. The z-scores of ventile incomes of DEU, GBR and USA almost looks the same. Hence, we must compare the distribution for only these three countries. For this purpose, we are considering the metric Ventile Income to Country's Mean Income Ratio.

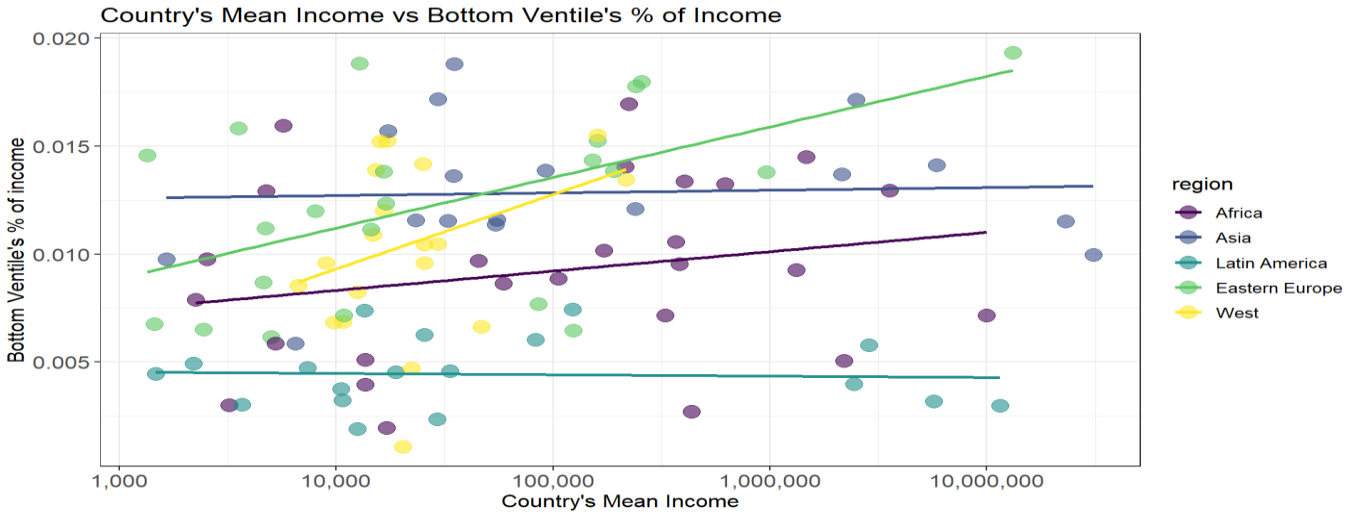


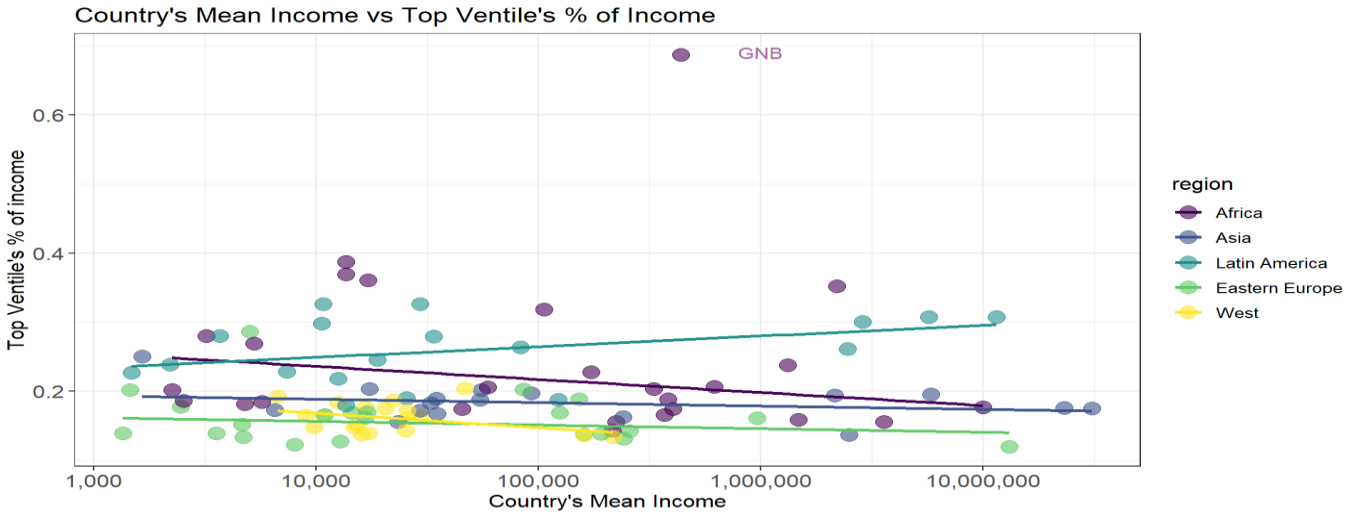
The distribution of Ventile Income to Country's Mean Income Ratio of USA is wider (far below 1) for lower ventiles and further away for higher ventiles compared to DEU and GBR. Hence, we can say that the poorest in the United States are poorer than average compared to Germany and Great Britain and the richest in United States are richer than average compared to Germany and Great Britain. The distribution of Ventile Income to Country's Mean Income Ratio of DEU is closer to the mean line and hence narrower for lower ventiles and it is also, closer to mean line for higher ventiles. Hence, we can say that the poorest in Germany are less poor than average compared to United States and Great Britain and the richest in Germany are less rich than average compared to the United States and Great Britain. The distribution of Ventile Income to Country's Mean Income Ratio for GBR is in between the USA and DEU.



We plotted the *Ventile Income to Country's Mean Per Capita Income* for each ventile (5% of the population) for five different nations viz. United States (USA), United Kingdom (GBR), Germany (DEU), Guinea-Bissau (GNB) and India (IND). We observe that for Germany (DEU), Great Britain (GBR), United States (USA), and India (IND) the observations for ventiles 1 to 19 are spread mainly around the mean and for the 20th ventile it is three to four times the mean. However, for Guinea-Bissau, the spread is majorly below the mean, with one ventile (19th) coinciding with mean and for the richest (20th ventile) the ventile income to country's mean ratio is 13 times over the mean (extremely far away from the mean). This clearly shows a clear income imbalance in Guinea-Bissau (GNB) where the 20th ventile is far richer compared to their counterpart in other countries. For countries, the United States, Germany, and Great Britain, the 20th ventile is not very far from the mean (within 3.5 times the mean). For India, it is slightly far from the mean compared to the previous three countries and for Guinea Bissau, it is significantly far away (around 13 times the mean) from the mean. Thus, we can conclude that the rich in Guinea-Bissau (GNB) is relatively far richer than the richest in the other countries since they are farther away from the mean per capita income.

3. Is the percentage of income earned by the top 5 percent in a country related to mean income in that country? What about the percentage of income earned by the bottom 5 percent?

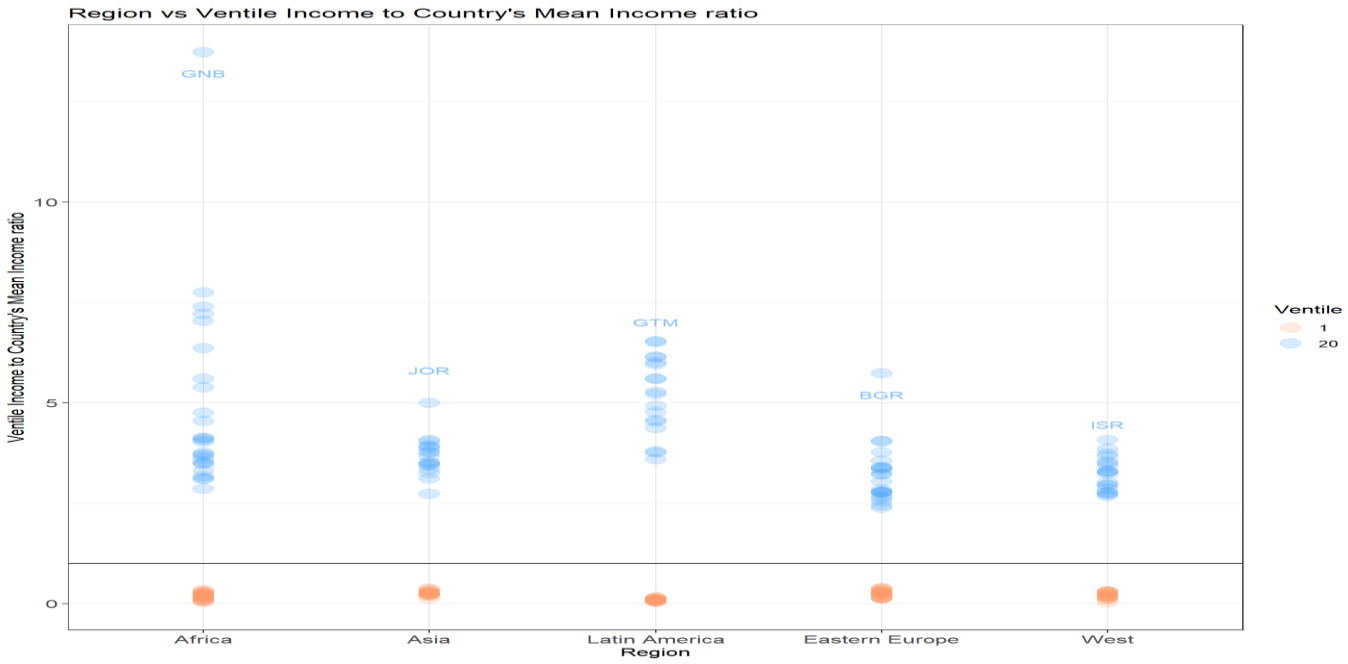




From the first plot, it is clear that the percentage income earned by bottom 5% (1st ventile) in a country is relatively unaffected by country's mean income, as we could see this ventile contribute to 0.5 to 2% of overall income for countries at different mean income. But if we analyse this region-wise, there is an increase in percentage income earned by bottom 5% as mean income of the country increases for Eastern Europe, Africa and West regions. The increase is high for West and comparatively less for Africa. Hence, we can say that if mean income of the country increases, then the income of bottom ventile increases for countries in these regions. This becomes clearer from increased percentage of income for bottom 5% as Country's mean income increases for above three regions. The regions Asia and Latin America experience a subtle fall as mean income of the country increases.

From the second plot, it is clear that the percentage income earned by top 5% in a country is relatively unaffected by country's mean income, as we could see this ventile contribute to 10 to 40% of overall income for countries at different mean income. But if we analyse this region-wise, there is a decrease in percentage income earned by top 5% as mean income of the country increases for regions of Eastern Europe, Asia, Africa and West. This signifies that if the country's mean increases, the percentage of income earned by other ventile increases and because of that the percentage income of top 5 % decreases for these regions. The decrease is high for Africa and comparatively less for Eastern Europe. The region of Latin America experiences a raise as mean income of the country increases, thereby experiencing the opposite effect.

We can also spot an outlier in Country's Mean Income vs Percentage income of Top Ventile plot. This is the african nation of Guinea-Bissau (GNB) where the percentage income of top ventile is over 60%, showing that the greater portion of wealth in this country is in the hands of top 5% of nation's population.

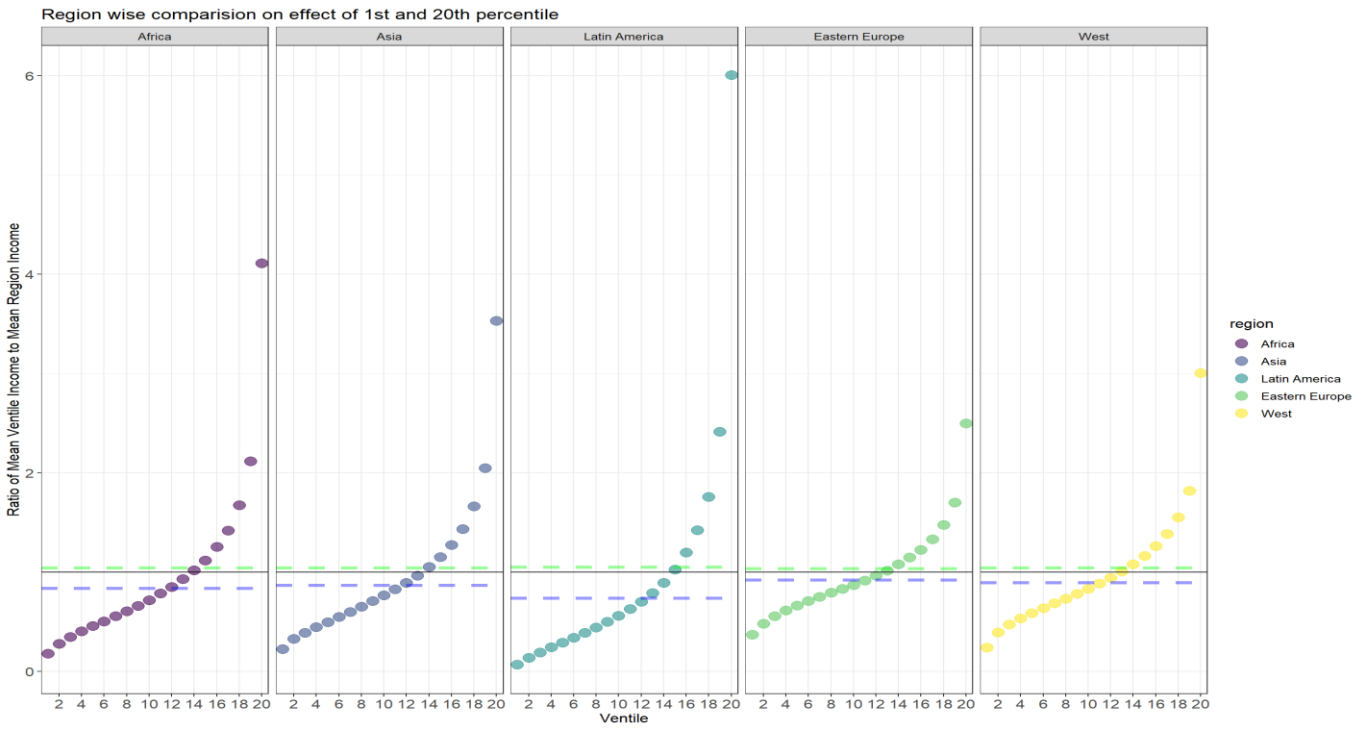


Since it is odd to compare all the nations, we are grouping them into five different regions. These five regions are Africa, Asia, Latin America, Eastern Europe, and the West. In this graph, we are considering the *Ventile Income to the Country's Mean Income Ratio* for ventile 1 and ventile 20 for each of the five regions.

For countries in Africa, the values of 20th ventile are widely spread with the highest value beyond 13 times the mean for Guinea-Bissau (GNB). This confirms the fact there is a lot of income inequality in African countries compared to the countries in other regions. If we look at the countries in Latin America, the distribution of 20th ventile is concentrated between 3.5 to 7.5 times the mean. However, for Eastern Europe, the highest value of 20th Ventile Income to the Country's Mean Income Ratio lies around 6 times the mean value for Bulgaria (BGR) and the other countries in the regions are distributed between 2.4 to 4.4 times the mean. In Asia and the West, the distribution of countries' 20th Ventile Income to the Country's Mean Income Ratio lies within 5 times the mean.

Here, from the graph, you can clearly see that the distribution of the parameter Ventile Income to the Country's Mean Income Ratio is similar for all nations in a region for lower ventiles and as slight to significant discrepancies only at higher ventiles. Having said that, considering this as an assumption, we are taking mean ventile scores of each ventile across all relations in the region.

This graph below summarizes the issue of income inequality. We consider the *Mean Ventile Income for all Countries* in a region rather than the country's ventile income individually and plot the *Ratio of Mean Ventile Income for all countries in that region to Mean Income of all countries in that region*. This will give us 20 observations for each region under consideration. The bold **black line** at 1 marks the mean of Ventile Income for all Countries in that region. The **green line** marks the mean of these values after removing ventile 1. Similarly, the **blue line** marks the mean of these values after removing ventile 20.



Now, we test the impact of the top 5% income holding population and the bottom 5% income holding population for each region. We do so by removing the 1st and the 20th ventiles one by one and checking the shift in the mean. When we remove ventile 20(top 5% income holders) in Africa, Asia, Latin America, Eastern Europe and West, the mean ratio drops. It drops the least for Eastern Europe and the maximum for Latin America which signifies that very less of the total population is rich. This thereby, shows a great income inequality in the countries in Latin America. This is because the 20th ventile observation for Latin America is far away from the mean (around 6 times). However, for Eastern Europe, the difference is not that major since the 20th ventile is closer to the mean (around 2.5 times). Mean drops in the order Eastern Europe < West < Asia < Africa < Latin America. Similarly, when we remove the ventile 1 (bottom 5% income holding population), there is a very slight (almost negligible) change in the mean for all the regions in consideration as expected. This insignificant change on removing the lowest ventile and major change on removing the highest ventile clearly signifies the concentration of lower income population in the region and pronounced income disparity between the higher and the lower strata of the society for all regions.

Conclusion:

In the United States, the rich keep getting richer and end up towering stunningly higher over the general population. The variation has been lofty for richer Americans whereas subtle for the poor. The middle class has experienced and overall growth in its per capita income. In such a case, increasing the incomes of low-wage workers would produce stronger beneficial economic effects rather than boosting bonuses for the rich.

The distribution of income relative to country's mean is closely similar for the United States, Germany and Great Britain, but the distribution is little steeper for India. The distribution is almost constant for all ventile in Guinea Bissau with a sudden jump for 20th ventile. This reiterates the point that, the rich in countries like Guinea Bissau are much richer when compared to the rich in the developed countries like USA. This indicates a lofty divide between the rich and poor in the under-developed countries.

Overall, the percentage of income earned by top ventile or bottom ventile doesn't depend much on the country's mean income. Since the incomes are in the country's own currency and not fixed for inflation. But there exists a subtle region effect for both the % of income earned by top and bottom ventile. For example, the percentage of income earned by top ventile increases as mean income increases for Latin America. But on a whole it decreases for the rest of the region.

We conclude that there is a widespread income disparity within countries, among different countries in a region, and within regions. The effect is more pronounced for under-developed and developing regions of the world.