Labor Market Dynamics: Education and Unemployment Trends in U.S. Adults (2017–2022)

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This report examines the relationship between educational attainment and unemployment rates among adults aged 18 and older in the United States from 2017 to 2022. it aims to uncover how education influences economic stability across life stages. With higher education often linked to greater employment security, this analysis spans a period that includes both pre- and post-COVID-19 pandemic trends, shedding light on the labor market's vulnerabilities and resilience. By analyzing patterns across age groups and educational levels, the report seeks to demonstrate the critical role of education in shaping employment outcomes and economic resilience during times of stability and crisis.

I. DATA SOURCES

The data used for this analysis consists of two SQLite datasets, each containing a single table derived from a data pipeline that cleaned and transformed the original source data for analytical purposes. The data pipeline has been fully explained previously. The first dataset captures educational attainment levels across various age groups and years, while the second dataset provides unemployment rates for corresponding age groups and educational levels over the same time frame. Together, these datasets enable a comprehensive examination of the relationship between educational attainment and employment outcomes from 2017 to 2022.

A. Data Structure

The datasets are structured as matrices, where rows represent specific combinations of age groups (e.g., "18 to 24") and education levels (e.g., "bachelor's or higher degree") and columns correspond to years from 2017 to 2022. In the educational attainment dataset, cell values are numeric and indicate the number of individuals within each category. Additionally, the dataset includes a "Total" row that aggregates the counts across all education levels for each age group. (Fig 1)

Age group and level of educational ...	2017	2018	2019
18 to 24 Bachelor's or higher degree	3355	3449	3662
18 to 24 High school completion	8658	8683	8688
18 to 24 Less than high school completion	4641	4764	4586
18 to 24 Some college, no bachelor's degree	12750	12468	12150
18 to 24 Total	29404	29363	29085

Fig 1: Samples from Educational Attainment

The unemployment dataset has a similar structure, but its cell values contain paired data: the unemployment rate and its associated standard error, separated by a comma. These values represent the proportion of individuals unemployed within each demographic and the corresponding uncertainty in the estimate. This dataset includes an "all education levels" row to aggregate unemployment rates across all education categories for each age group.(Fig 2)

Age group and highest level of educ...	2017
18 to 24 all education levels	15.543847956859846, 0.814793420023705
18 to 24 Less than high school completion	26.85032528905666, 2.5572862916515415
18 to 24 High school completion	16.037840212683214, 1.0724826026689054
18 to 24 Some college, no bachelor's degree	10.94031815888394, 1.4929748243955547
18 to 24 Bachelor's or higher degree	4.670097335686188, 0.7561990161848036

Fig 2: Samples from Unemployment rates

These structured datasets provide a solid foundation for analyzing trends and correlations between education and unemployment, with the inclusion of standard errors ensuring the precision and reliability of the unemployment data.

II. ANALYSIS

To analyze the correlation between educational attainment levels among adults aged 18 and older in the United States from 2017 to 2022, various data visualization techniques were employed, including heatmaps, line plots, and

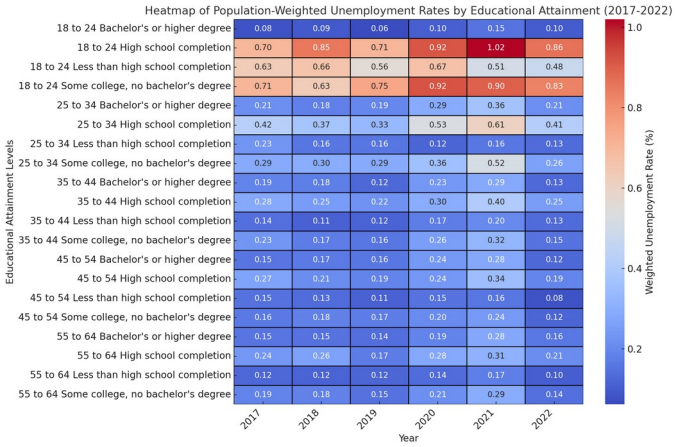

Fig 3: Heatmap of Population-Weighted Unemployment Rates by Educational Attainment

bar-and-line combination charts. These methods facilitated the exploration of unemployment trends across different educational attainment levels, age groups, and years, offering a comprehensive understanding of the data.

A. Heatmap of Population-Weighted Unemployment Rates by Educational Attainment(Fig 3)

Methodology: A heatmap was employed to investigate the relationship between unemployment rates, educational attainment, and age groups over the period 2017–2022. This visualization technique was chosen for its ability to represent multivariate data effectively, highlighting patterns and variations in unemployment rates across different demographic and educational categories over time.

Result: The heatmap reveals a clear pattern: unemployment rates are inversely related to educational attainment. Individuals with a bachelor's degree or higher consistently exhibit the lowest unemployment rates (e.g., below 0.2% in most years), whereas those with less than a high school diploma experience the highest rates, particularly among younger age groups (e.g., 18–24). The unemployment spike in 2020 is notable across all groups, with lower-educated individuals disproportionately affected.

B. Line Plots of Unemployment Rates by Educational Attainment Over Time, Faceted by Age Group(Fig 4)

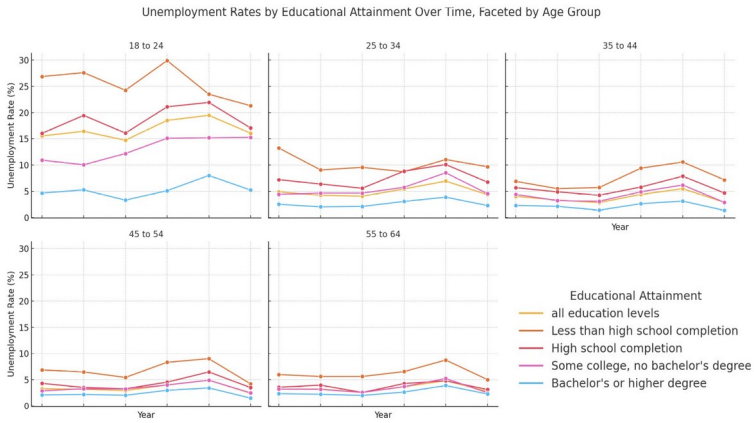

Fig 4: Line Plots of Unemployment Rates by Educational Attainment Over Time, Faceted by Age Group

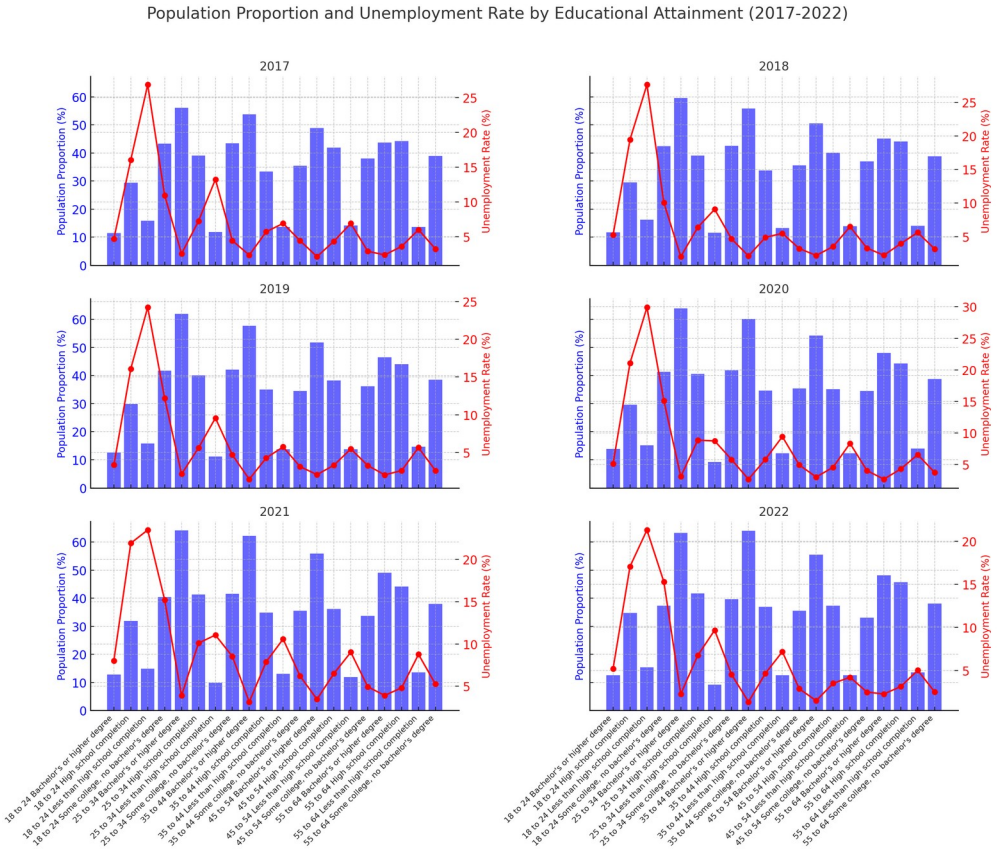

Fig 5: Bar and Line Charts of Population Proportion and Unemployment Rates by Educational Attainment

Methodology: To analyze trends in unemployment rates by educational attainment over time, faceted line plots were generated, segmented by age group. This approach enabled a detailed comparison of unemployment trends within distinct age categories, illustrating how varying levels of education influenced labor market outcomes during the observed period.

Result: The line plots reveal that individuals with higher educational attainment consistently have lower unemployment rates across all age groups and years. Younger age groups (e.g., 18–24) show the greatest variability and the highest unemployment rates overall, especially for those with less than high school education. In contrast, older age groups (e.g., 45–54) display greater stability, with lower unemployment rates overall, even for those with less education.

Interpretation: These trends highlight that higher education significantly mitigates unemployment risks and that younger individuals are more vulnerable to job market fluctuations.

C. Bar and Line Charts of Population Proportion and Unemployment Rates by Educational Attainment(Fig 5)

Methodology: Bar-and-line combination charts were utilized to examine the interplay between population proportions at each educational attainment level and their corresponding unemployment rates. This method was particularly effective in integrating population distribution with unemployment data, providing a comprehensive view of how education levels shape employment outcomes.

Result: The charts show that individuals with lower educational attainment (e.g., "less than high school completion") make up a smaller proportion of the population but face significantly higher unemployment rates. Conversely, individuals with a bachelor's degree or higher represent a larger proportion of the population but consistently exhibit far lower unemployment rates, even during economic downturns like 2020.

Interpretation: This analysis underscores the strong correlation between educational attainment and employment outcomes while highlighting the demographic composition of educational levels. The visualization is appropriate as it effectively contextualizes unemployment rates within population proportions, providing a holistic understanding of the data.

III. CONCLUSIONS

Based on the provided plots, the answer to the question "How do unemployment rates correlate to educational attainment levels among adults aged 18 and older in the United States from 2017 to 2022?" is:

There is a **strong negative correlation** between educational attainment levels and unemployment rates. Specifically:

- **Higher Education Reduces Unemployment Risk**: Individuals with a bachelor's degree or higher consistently have the lowest unemployment rates across all age groups and years. Those with lower education levels, such as "Less than high school completion," experience the highest unemployment rates, especially among younger adults (i.e., 18–24 and 25–34 age groups).
- **Age Amplifies the Effect of Education**: Younger adults (i.e., 18–24) experience the highest unemployment rates, even at higher educational levels. This could reflect early career challenges or labor market entry barriers. In contrast, older adults (45 and above) tend to have lower unemployment rates overall, regardless of educational attainment, likely due to greater career stability or accumulated work experience.
- **Economic Shocks Highlight the Gap**: During economic downturns, such as in 2020, unemployment spiked across all education levels; however, the increase was more pronounced among those with lower education levels. This suggests that higher education serves as a buffer against economic disruptions.
- **Population Distribution and Unemployment**: Although individuals with a bachelor's degree or higher make up a smaller share of the population compared to those with lower educational levels, their unemployment rates are consistently and significantly lower. Conversely, individuals with "Some college, no bachelor's degree" or "High school completion" form a larger proportion of the population but experience moderate unemployment rates.

IV. Critical Reflection: Limitations, and Potentials

The analysis highlights key trends but has limitations. Aggregate data (i.e., "Total" and "all education levels") and standard errors (SE) were excluded, limiting broader trend analysis and statistical reliability. Incorporating these could provide population-wide insights and allow for the assessment of the statistical significance of observed patterns. Future work should leverage these data points for a more holistic and robust understanding of education’s impact on labor markets.