The Effect of Universal Basic Income on Educational Assessment Scores

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Abstract

Previous literature has found that socioeconomic status has long been found to be an indicator of a child's education with students from lower socioeconomic families facing more issues than their higher socioeconomic counterparts. Expanding on this, we will explore the Universal Basic Income programs that are starting in Los Angeles and Chicago in a retrospective, observational study to see how a monthly stipend will affect education levels. Using the grades of students in these UBI pilot families compared to the grades of students that did not win the UBI lottery we should be able to see the effect of income, in the context of increasing it through UBI, on educational outcomes.

1 Introduction

Morality, work ethic, critical thinking, and a general knowledge and understanding of things. None of these essential aspects of being an adult are inherent in human biology, they must be nurtured. The importance of education can not be overstated, it is the foundation of how we behave once we take on the responsibilities of contributing to and running our society and our world. This is why it is important that everyone receives accommodating, high-quality education.

Children and teenagers, being dependent of their parents or guardians, are highly affected by the circumstances and decisions of their guardians in many aspects of their lives. In fact previous literature has shown that low income families are more susceptible to stress [16] and more likely to work more jobs or hours trying to make ends meet. If parents are too busy worrying about work and bills they will not have as much time to dedicate to their children which previous studies have shown that early childhood education experiences could enhance cognitive development.[7] Furthermore, children of low income families are more likely to have parents who did not go to college[14] which has been shown to increase the risk of learning-related behavior[12] problems and decrease the amount of resources that a low income student has.[1] Parent education has been shown to be one of the strongest predictors of literacy [6] along with early literacy ability being a strong indicator of

a child's literacy performance down the road. [8]

There are many potential variables to explore that we could use to help improve education however lack of time, lack of education, and lack of resources are the main issues low income parents face when trying to give their children the best education they can. To address all these issues we believe it would be the most effective to tackle the root of it all, low income. Previous research shows that higher income has a connection with higher educational assessment scores such as GPA, SAT scores, and ACT scores. [9]

To pair with this, recent pilot programs in the United States have sprung up, testing the viability and usefulness of Universal Basic Income. Research has shown that similar unconditional cash transfer programs enhances services such as education, health services, and nutrition [13] can improve the odds of being enrolled and attending school.[2] Additionally UBI programs have also been able to increase the ability to meet basic needs.[10] One of the biggest and most recent UBI initiatives found in a preliminary analysis that a guaranteed income enabled recipients to find full time employment and created new opportunities for goal setting and risk taking, while decreasing levels of depression and anxiety in participants.[3]

While there is a lack of studies directly looking at the educational benefits and effects of UBI programs on children, mostly due to the limited size and scope of recent pilot programs, from the findings of similar smaller programs we believe that there is the potential for UBI programs to have a positive effect on the education of children. In this study we layout a design which will collect data from Los Angeles' and Chicago's Universal Basic Income programs and determine whether increasing income improves education. Data will be analyzed using a t-test, t-test with stratification, and a mean squared error measurement using a multi-layered perceptron artificial intelligence model. The results of this study would set out to both look in depth into income as a factor in improving education as well as showcase the an educational benefit of Universal Basic Income, hopefully inspiring more income and education programs and studies to be implemented.

1.1 Definitions and Background Information

1.1.1 UBI program

Universal basic income (UBI) is a government program in which every adult citizen receives a set amount of money regularly with the goal to help alleviate poverty. The idea of universal basic income has gained momentum in the U.S. as it is also a solution to automation increasingly replacing workers in manufacturing and other sectors of the economy. And even more recently, pilot programs have appeared in response to COVID and it's detrimental effect on the economy exposing the need for economic reform. [15]

1.1.2 Los Angeles UBI Program

Los Angeles is implementing such a program in the Big:Leap program[5]. The Basic Income Guaranteed: Los Angeles Economic Assistance Pilot will provide approximately 3,000 individuals with $1,000 per month for 12 months. These will be unconditional, regular, and direct cash payments to individual participants that supplement existing welfare programs. This means there are no restrictions on how the money can be spent and no requirements for the participants.

Eligibility for applying is as follows:

1. Must reside in Los Angeles

2. Applicants must be 18 years or older

3. You have at least one dependent child (younger than 18 or a student younger than 24) OR are pregnant

4. Your income level falls at or below the Federal Poverty Level (more information on the exact ranges of the federal poverty level is in the referenced article)

1.1.3 Chicago UBI Program

While an official document outlining the details of this new program has yet to be released to the public, an article announced that the passing of Mayor Lori Lightfoot's 2022 budget Wednesday sealed the deal on Chicago's first experiment with guaranteed basic income for low-income residents. In her remarks after the budget passed, Lightfoot said the money is intended to help keep working families afloat as the city continues its pandemic recovery. "Having extra income consistently for some time can make the difference for the working poor who are living on the cusp of financial ruin," Lightfoot said. "That's why $35 million of the $157 million that we're investing in family assistance programs will fund the largest pilot program in the country, providing $500 a month to 5000 families with cash assistance to lift them up out of poverty." [11]

Eligibility for applying is as follows:

1. Must reside in Chicago

2. to have experienced a COVID-19 Impact at the time of application

3. to have an income at or below 300% of the federal poverty guidelines

4. to not be employees of or elected officials of the City of Chicago or the State of Illinois

1.1.4 Connection between Income and Educational Assessment Outcomes

A Canadian study has shown a connection between income and educational outcomes. They found that the incidence, depth, duration and timing of poverty all influence a child's educational attainment, along with community characteristics and social networks. Additionally, both Canadian and international interventions have shown that the effects of poverty can be reduced using sustainable interventions. Our motivation stems from this study and the potential it showed in being able to influence the disparities between wealth and education.[9]

2 Study Design

The question is, does providing families with universal income affect a student's grade and performance in school? To answer this we will be conducting a retrospective observational study, individuals are to be identified to participate after the outcome has occurred Randomization will occur naturally as universal income program participants are chosen from a lottery. The study will occur in Los Angeles and Chicago, where the universal income programs are being implemented. We hope to go more in depth into the benefits of universal basic income and the potential interventions in improving education.

2.1 Participants

Our population includes the families with children enrolled in school from K-12 that were eligible for and applied for the universal basic income programs in Los Angeles or Chicago, including families that won the lottery and families that did not. As these programs are fairly new

there isn't too much information about the methods they use yet but for the purposes of the study we assume that we at least have information on the lottery participants. About 9.000 families are already part of the universal income program. However, assuming not every family will reply to the survey and not every family will have children we estimate that the UBI arm will have around 3,000 families or 3,000 observations. This means that we must survey at least 3,000 families with children and comparable income ranges (i.e. participants that were eligible to apply for the UBI program but was not accepted) in the Los Angeles and Chicago area.

2.2 Variables

ID	GPA	SAT	Test	Income	UBI
123	1	2	2	1	1
124	5	4	4	1	0

We plan to collect 6 different variables from our participants. GPA, SAT/ACT scores, State Standardized test scores, income, and participant status in the Universal Income Program will be recorded, an example of how this would look like for categorical variables is shown above. The continuous version of this would simply be their actually GPA, exact SAT score, exact income, etc. Continuous data will be used for the t-tests and the AI model while categorical data will be used for just the AI model (via encoding methods such as one hot encoding). We will predict GPA and SAT scores using the Universal Income variable. For the categorical version they will be assigned numbers indicating different ranges, in general the range behaves such that 1 corresponds with low values and 5 corresponds with high. More specifically:

- GPA is the student's grade point average. GPA is represented by enumerated categorical variables with 1

representing a grade of D or lower, 2 is a C, 3 is a B, and 4 is an A.

- SAT is the student's SAT score and follows the test's 400-1600 score range. SAT is represented by enumerated categorical variables with 1 representing a score between 400-600, 2 representing 601-800, 3 representing 801-1000, 4 representing 1001-1200, 5 representing 1201-1400, and 6 representing 1401-1600. While standardized tests are useful.

- Test is the student's score in their state's standardized test. This score will range from state to state but will follow a grading scale similar to GPA and will be assigned an enumerated categorical variable between 1 and 4 based on the grade given by $\frac{score}{highest\_possible\_score}$. Considering this may not work for every state's standardized test this variable may need to be analyzed strictly on a state-level.

- Income is the student's income range. 1 represents lower than \$20k, 2 represents \$20-40k, 3 represents \$40-60k, 4 represents greater than \$60k. The possible ranges of income that could be under the poverty line, given the number of dependents in the family, follows the scale given by the city of Los Angeles.

- UBI is the student's status as a member of a Universal Basic Income program. 0 represents not being a program and 1 is being a part of a program.

If we are given lottery information from these program it would be best to use continuous variables and capture the data as is. For categorical data, the small and simplistic method of data collection is designed to encourage higher participation and prevent inaccurate answers from

parents estimating scores. As our population may end up being very limited and the information that will be provided from the program is still unknown it is essential that this design nets a high response rate in case we need to conduct a survey without government assistance and data. We may suggest the collection of others variables in the following tests, this table just shows the basic variables that remains constant between all our tests.

Furthermore, as the paper may have influence in public policy we have to consider the importance of both the matching power of our tests as well as the interpretability of our tests to the general public. Given this we have outlined a diverse, three different tests to find our estimand.

2.3   t-test

Considering we have 3,000 observations per arm (a UBI and non-UBI arm), we will be using a 0.05 significance level and 0.8 for power, resulting in an effect size of 0.072. Our null hypothesis is that the UBI program does not improve educational outcomes while the alternative hypothesis is that the UBI at least has an effect on educational outcomes where, for instance, θ indicates the average grades of students with an income range of \$20-40k while $\hat{\theta}$ is the average grades of students with an income below \$20k but are in the UBI program. (Note that these comparisons indicate a \$20k difference between θ and $\hat{\theta}$ for categorical and a difference equal to the money given by the UBI program for continuous):

$$H_0 = \theta - \hat{\theta} = 0$$
$$H_a = \theta - \hat{\theta} \neq 0$$

If our p-value is below our significance level of 0.05, then we would reject the null

hypothesis, meaning there is a significant association between income level and educational outcomes. If our p-value is above our significance level of 0.05, then we would fail to reject the null hypothesis, meaning there is not a significant association between income level and educational outcomes.

2.4   t-test with Statification

T-test with stratification will occur using the following variables; education of primary guardian, language spoken at home, and income of neighborhood.

Education of parent will be split into a separate category depending on what the highest level of formal or equivalent education completed by every guardian was: middle school/ junior high, high school, college or beyond, and other.

Primary language spoken by parents at home will be spilt into those who speak English a majority of their time at home and those who speak a a different language the majority of their time at home.

Mean income of neighborhood of school which the student attends will also be determined and will be categorized using the same groupings as above: \$20k, \$20-40k, \$40-60k, and \$60k.

2.5   Mean Squared Error with Multi-Layered Perceptron

Once the data is collected we also plan to train a multi-layered perceptron AI to predict educational assessment scores from income. We will compare to see if the predicted scores match what we will observe from UBI program participants. More specifically we will input GPA, SAT scores, and test scores in order to predict whether or not As a statistical measure, we will use the mean squared error formula (the Y's will follow θ and $\hat{\theta}$):

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

This measure is used to check how close the estimates of a model are compared to the actual values so that we can check to see if our estimates based on a model trained on non_UBI participants are close to the actual grades of UBI participants.

In other words, if the MSE of a typical student that's not on the UBI program with a \$20-40k family income compared to students with a family income less than \$20k but is on the UBI program is close to zero than it shows that the two values are typically very close, suggesting UBI does increase a student's grades.

On the contrary, if the MSE of the predicted grades of students not on the UBI program with a family income of less than \$20k compared to the grades of students on the UBI program with less than \$20k income is close to zero then that means UBI does not help improve grades.

2.5.1 MSE Analysis Example

We trained a mlp model on a dataset very similar to what we're looking for. We're doing this to better illustrate our goal as the interpretability of regression and artificial intelligence based models is a concern considering this study's potential influence on public policy.

We trained our model on the CORGIS dataset.[4] The CORGIS dataset is compiled from the Common Core of Data. The Common Core of Data (CCD) is the Department of Education's primary database on public elementary and secondary education in the United States. CCD is a comprehensive, annual, national database of all public elementary and secondary schools and school districts. CORGIS is a subset of this information focusing on the total GPA, total SAT scores, and average income of different states in different years. By using

the total amount of students in recorded in each state, which is also provided by the dataset, we reformat the data to proportions. While this isn't exactly how we would format the data of our study design it is very similar. This example should serve not as a one-to-one replacement for our unexposed group but as an example and a more easily understandable visualization of how our model would be interpreted.
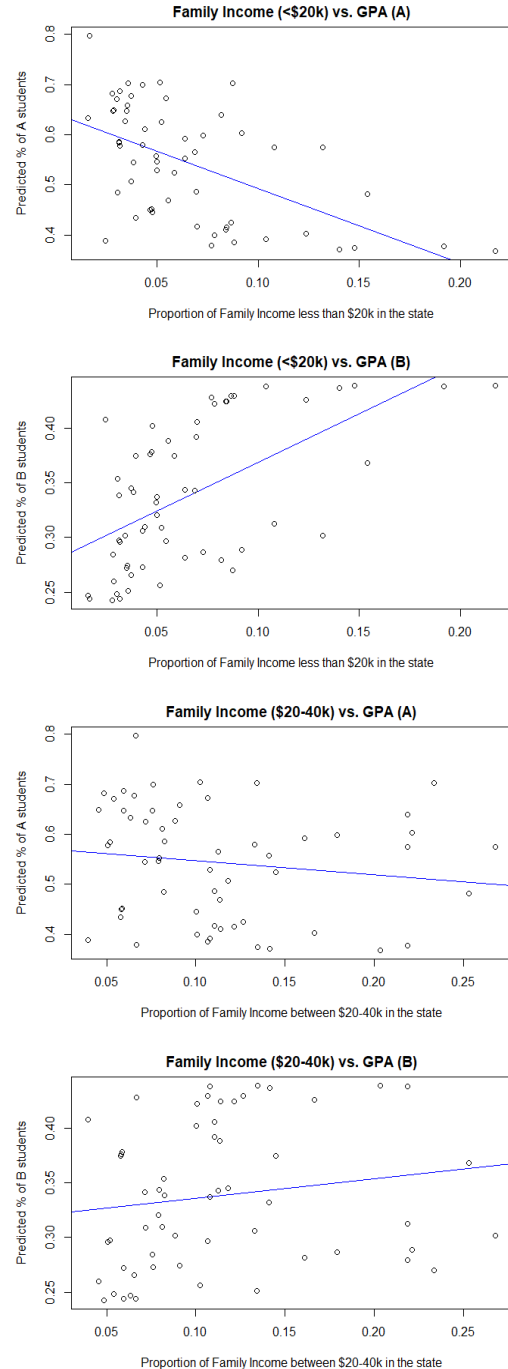
These graphs show a scatter plot rep-

resenting how the mlp model predicts the percentage of students with the overall GPA of A or B given the proportion of $20-40k or less than $20k family income in the fifty states for different years (roughly in the 2000s time frame). From these we can see our assumptions from prior research is true and lower income correlates with lower grades.

To simplify, the regression lines or lines of best fit is calculated on each graph and our job would essentially be to see how close the best fit line for UBI students with a family income of less than $20k matches the best fit line for the non-UBI students with a family income of $20-40k as opposed to the non-UBI students with less than $20k.

3 Discussion

3.1 Strengths

As stated before, if we do not have access to continuous data then this study design encourages participation through simple survey questions. And, considering this is an observational study, there are no harmful interventions being done and participants are anonymized with ID numbers and generalized ranges making this experiment ethical. Randomization is easy to implement as we take advantage of the lottery system put in place by the UBI programs to chose our UBI and non-UBI observations.

Additionally, as this study may become very relevant to policy it's important we have a balance of interpretability and statistical power. For this study we provide 3 tests which would allow us to address these concerns, a t-test provides easy interpretability, stratification reduces variance by comparing within groups, and an AI model provides a thorough test and higher matching power (as well as a back-up plan if sample size or continuous data is restricted).

Sampling individuals rather than something like cities, states, groups or clusters also increase the statistical power of our study which is very much needed as without more funding and another UBI program we cannot increase the number of samples. This is also supported by the eligibility requirements of the UBI programs themselves. While the adults themselves may not always be recorded, the eligibility requirements of both UBI programs seems to primarily target individuals that are in school or have at least one dependent that's in school which is helpful for our study. The program also requires adults to be below the poverty line and the requirements to be under the poverty line decreases the more children a family takes care of. All factors which allows more individuals to be sampled.

3.2 Limitations and Critiques

The generalizability of this study is put into question as this study is only being done in two cities. The program only lasts a single year and it may be that one year may not be enough time to have or show a significant effect on student's lives and education.

Lastly, we need to address our assumption that parents will use UBI for factors that would help student's education. For instance, [9] it was shown that pediatricians and family doctors have many opportunities to influence readiness for school and educational success in primary care settings. Additionally, in another health based study it was found that adults with higher educational attainment live healthier and longer lives compared to their less educated peers. In this paper, they review and critically assess the current state of research on the relationship between education and health in the United States. [17] While

income shows a connection to educational outcomes we also have to consider what the parents are spending this money on. If the parents spend the money on health then we may see the the increase in test scores that we would expect. If however the parents spend money irresponsibility in a way that doesn't positively affect the family or the children then it's possible we may not see an increase in test score despite the increase in income. Future work may find that addressing these concerns more directly, such as a universal health care program, may be more effective and as these UBI programs do not hold any restrictions as to what the money is spent on and monitoring parent's spending habits may be unethical or not feasible such a study design sticking strictly to UBI may be difficult to execute.

4 Future Work

During the design of this study we have also considered the possibility of also collecting time-series data. If we were to do this than a time based test such as a synthetic control method would more clearly show the grade progression of students and we would be able to see whether or not the grades of UBI student follows or exceeds what would be expected of them. The reason we did not go forward with this idea however is that this introduces complications and the potential for even more confounders which will be hard to address with our limited sample size and need for simplicity and high participation.

Conclusion

There is not much we can do about much of our critiques, especially on a limited budget, as our sample size and location is strictly limited to pre-existing UBI programs rather than being controlled by us. Regardless, the results of this study design gathers as much information as it can from what already exists in order to showcase the benefits of UBI. Additionally, as the disparity between wealth and educational success has been an established concern this study may also serve as evidence for the potential of income as a intervention for improving educational assessment outcomes. If these results have implications of educational success it may become a useful foundation and catalyst for future, more highly funded UBI and education programs.

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