2019

Universal Basic Income and Its Effect on the Capital to Labor Ratio

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April 30, 2019

This thesis is submitted in partial fulfillment of the requirements for the course Senior Seminar (EC 375), during the Spring Semester of 2019

While writing this thesis, I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Skidmore College Honor Code

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Abstract

This paper examines the possibility of a Universal Basic Income (UBI) implementation in the United States. Theory and past experiments suggest a reduction in work hours, but both say little regarding the capital to labor ratio. Existing literature on the topic is also underwhelming, therefore this paper will go on to examine their relationship. It also reviews healthcare's role in this relationship as it is related to worker productivity as well as nearly one fifth of GDP for the US.

I. INTRODUCTION

The US economy has benefited greatly from technological advancements over the 200 years beginning with the American Industrial Revolution. Different markets across the US have benefitted in everything from greater efficiency through massive economies of scale to the lowering of transactions costs to companies through computer technology. However, in the past 50 years the US economy has begun to feel the negative effects of technology as the machines created begin to replace the US workforce. As anyone who has worked to support their lives knows, their largest and most valuable asset to them is their working income, which has been increasingly at risk due to automation. According to Forbes in 2018: "Technology Has Already Taken Over 90% Of The Jobs Humans Used To Do" (Forbes, 1). A prime example of this is the rapid advancement in equipment for farming over the past 100 years. The US has changed from a place that was majority farmers to one where a small minority is easily able to produce food for the rest of the country. In the US, only 0.6% of employment is in agriculture (Bureau of Labor Statistics). As it is apparent, technology has already taken millions of jobs away from the American workforce and can continue to do so in the future. Figure 1 shows the different occupations by volume in the US. In most of them, some jobs have already been taken by automation and computer technology.

While US consumers and producers alike have enjoyed the lower costs that come with these technological advances, the labor force continues to worry about this advanced capital replacing them. This problem is presented in the form of the capital to labor ratio. Figure 2 shows the capital to labor ratio in the US over time since 1948. It is obvious that, with some variation, capital has steadily become a larger proportion of input in US production. One potential answer to this problem is presented in the form of Universal Basic Income (UBI). The goal of this paper is to further examine UBI and other cash transfer programs and analyze whether they help address the modern issue of technology replacing the workforce. Furthermore, this paper will analyze how health and healthcare plays a role in this relationship between UBI and the capital to labor ratio.

Currently, there is no existing empirical literature that directly answers this research question. There does exist, however, literature that helps set the stage for this complex research question. There is literature that illustrates the effect of health and healthcare on worker productivity, the effect of increased income on health in low income households, and the effect of cash transfer programs on work hours and labor input. There is also basic economic theory that describes how the above relationships should behave, as well as the effects between worker productivity and the capital to labor ratio. It is important to note that most literature on unconditional cash transfer programs centered on the US are from the 1970's after four US based Negative Income Tax (NIT) experiments and one in Canada.

The contributions of this work are to open the door for more research and focus on the use of UBI and other unconditional cash transfer programs to address the issue of US workers being replaced by capital. This is a highly debated topic in the US due to its political sphere being highly charged by the loss of jobs across the country. On top of that, UBI has made an

appearance in the US political stage for the first time since the 70's when the NIT experiments were conducted. This paper hopes to encourage more study within and outside of the US of this relationship, especially within the scope of capital being altered or not due to UBI or an equivalent being implemented.

To analyze the research question stated above, this paper runs a least-squares regression with capital to labor ratio as the dependent variable. The result is that UBI has a negative coefficient significant at the 0.1 level. Worker health was measured using average sick days taken, which will be explained later, and was also found to have a negative coefficient significant at the 0.01 level. This means that UBI does in fact negatively impact the capital to labor ratio as the research question hypothesizes. However, worker health measured by sick days taken has a negative coefficient which signifies that healthier workers lead to an increase in the capital to labor ratio, contrary to the hypothesis.

The rest of this paper goes into a deeper analysis of the above summary. The second section describes the theory and literature review necessary to address the topic. This section will be important to understand why data is chosen in the way it is later in the paper. The third section describes the methodology on obtaining the data for the regression and how it was run. The fourth section is a review and analysis of the results from the third section. This section also includes possible shortcomings in collecting data for the regression and possible problems in the regression itself. The fifth section is a conclusion of the topic including possible avenues for future study as well as policy recommendations based on the findings. The sixth section will contain all figures and tables. The seventh section will have all references used in the creation of this paper.

II. THEORY AND LITERATURE REVIEW

UBI in the United States has evoked strong feelings both supporting and opposing the idea. Although the idea of UBI or similar welfare programs has existed for centuries before, the large amount of the discussion in the US didn't begin until the early to mid-1970's when five experiments were conducted in North America. Four of these experiments were based in the US and were all Negative Income Tax (NIT) experiments. NIT is slightly different from UBI but close enough to be comparable as will be discussed later. The first of the experiments was the New Jersey Graduated Work Incentive Experiment, which took place from 1968-1972 and was conducted in New Jersey and Wilkes-Barre, Pennsylvania. The second was the Rural Income Maintenance Experiment (RIME), which took place from 1970-1972 and was conducted in rural parts of Iowa and North Carolina as a supplement to the New Jersey experiment. The third was the Seattle/Denver Income Maintenance Experiment (SIME/DIME), which took place from 1970-1980 with the expectation that it would last until 1990. This means that the subjects believed it would be extended another 10 years when it was cut short. The fourth experiment was the Gary Income Maintenance Experiment, which took place from 1971-1974 and conducted in Gary, Indiana. The fifth experiment, the one in Canada, was the Manitoba Basic Annual Income Experiment, often abbreviated to Mincome. This experiment took place from 1975-1978 when the experiment was cancelled by the Canadian government. Table 1 below highlights further details on the experiments and their differences.

The experiments had common themes in their results that varied slightly depending on the focus of the researcher presenting them. What did not appear was any significant difference in the outcomes between the Mincome experiment and the other four NIT experiments, therefore, as I move forward, they will be referenced as all five experiments instead of four and

one. What did appear, as was expected, were reduced work hours in the treatment groups of these experiments when compared with their respective control groups. That reduction varied depending on the head of the household and the type of family that was being observed, but overall there were consistent reductions. In fact, US media mostly focused on the change in work hours with articles titles such as "Would payments to those who earned less than a certain amount reduce their incentive to work?" (Scientific American, 1). This article was published in October of 1972, just as interest in the field began to rise. From that moment up through 1980, 242 academic articles were published addressing the new topic, most of which had the same question: How much less will people work? Most of these articles failed to state, however, that even though work hours were reduced, this did not necessarily translate to a reduction in labor supply as will be explained below.

Articulating basic economic labor theory is crucial to understanding why reduced work hours were highlighted in the US and continue to be highlighted around the world with similar unconditional cash transfer programs such as NIT and UBI. Focusing down to a microeconomic level, it is apparent that there exists a basic utility function for any given individual that demonstrates the balance between gaining satisfaction from consuming goods vs. leisure. $U = f(C, L)$. The model then progresses by including a budget constraint on the utility function. $C = wh + V$. In this equation, C represents the dollar value of expenditures on goods, w represents the hourly wage rate, h represents the the number of hours the individual will spend in the labor market, wh therefore represents the individual's labor earnings, and V represents nonlabor income. In our model, we are comparing the time spent by the individual as time spent towards work or leisure, so we can say that their total amount of time is equal to the amount they spend doing either activity, $T = h + L$. Then we can arrange our previous equation in terms of total

time and leisure such that, $C = w(T - L) + V = (wT + V) - wL$, which will be our budget constraint.

For the purpose of this paper, the main focus of the equation will be the change of V, which would be representative of an increase or implementation of UBI or some similar welfare program. From the equations it is obvious that an increase in V results in an upward shift in the budget constraint, which allows the utility curve to move further out. Depending on the individual and their utility function, theory suggests that hours of leisure could either increase or decrease hours of leisure. However, empirical data, including from the five NIT experiments, suggests that it is usually an increase in hours of leisure, in other words, a reduction in work hours. This basic idea is exactly why work hours were headlined in the US for during the experiment's run times. However, the basic theory that non-economists latched onto such as above, makes several assumptions about an individual and says nothing as to how they would take time off work.

Misinformation stemming from the desire for a bottom-line conclusion from the experiments in the US led people to often say that people were working less. However deeper analysis revealed that reduced hours worked often appeared in the form of occasional hours taken off during the week or longer periods of time taken in unemployment while workers took a longer time searching for new jobs. Even more dangerous, the above misinformed statements also led the general US public to believe that NIT would reduce the labor supply, which is understood as a worst-case result from the experiments. However, deeper analysis yet again shows that these believes were not consistently supported. Instead, some studies that mentioned labor supply in their analysis found little to no change in labor supply of the treatment groups in comparison to their respective control groups, or that these changes were often insignificant. The

New Jersey Experiment Summary Report explains this the best at the end of their Labor Supply Response Section. “The patterns of labor supply response found in the experiment are not as clear as might have been expected. Yet in many ways they are clearer and more sensible than the results of much of the nonexperimental literature. Certainly they call into serious question the very large effects estimated in some of the nonexperimental studies. On the basis of the experimental results, it does not appear that income-conditioned cash transfers for intact families at the levels of basic benefits and implicit tax rates employed in the experiment would have very large effects on labor supply” (New Jersey). If the aggregate were to behave as the individual does in the consumption and leisure model we created, then it can be reasonable to state that hours worked across the US will be reduced as a result. However, this would suggest that there is no evidence stemming from the experiments to support that labor supply would be reduced across the country. In one paper by Hum and Simpson (1993), their estimates show that elasticities for substitution and income in reference to structural labor-supply response are quite low, hovering around .08 and -.10 respectively. These results show that the elasticities are extremely inelastic in both directions. If that is the case, then an increase in nonlabor income such as NIT or UBI would have a minimal effect on the labor supply. Hum and Simpson even go on to note that many competing regression results of the elasticities will switch signs, and many end up being insignificant results, which means that elasticity can often be ignored and thought of as zero.

Other academic articles supported public opinion with their analysis of labor supply from the NIT experiments. For example, “*A Comparison of the Labor Supply Findings from the Four Negative Income Tax Experiments*” by Philip K. Robins was one of the first comprehensive summaries of the NIT experiments and described it as a clear and consistent decrease in labor

supply. “This paper provides a set of consensus estimates of the labor supply responses to these experiments. It is found that despite the wide range of treatments and evaluation methodologies, the results are remarkably consistent. On average, husbands reduced labor supply by about the equivalent of two weeks of full-time employment. Wives and single female heads reduced labor supply by about the equivalent of three weeks of full-time employment. Youth reduced labor supply by about the equivalent of four weeks of full-time employment. Estimated income and substitution effects are quite similar” (Robins, 1985). It is important to address the kind of labor supply reduction that Robins is using in his paper, as it is a source of difference and confusion between advocates for and against UBI when citing labor supply. Robins describes two possibilities for defining labor supply: annual hours of work and the employment rate. Most of his emphasis lies in the former, specifically as he continues to reiterate how average work hours across all workers in the experiments were reduced. The theory behind using this as labor supply says that if every laborer decreases the amount of hours they work, then overall work decreases, which he says represents labor supply.

The contrary idea of labor supply, which is more formally accepted in modern labor economics, describes it as the number of hours people are willing to and able to supply at a given wage rate. While similar, the important distinction between the two definitions is the word “willing”. Robins’ labor supply strictly evaluates work hours of all laborers with no consideration for the unemployed, those who would add hours if given the opportunity. In this paper, labor supply will be defined by the Bureau of Labor Statistics where data is being collected from as Labor Input: “defined as “Tornqvist aggregate of of hours of all persons (classified by age, education, and gender) using compensation per hour to determine weights. The level of labor input is the Tornqvist quantity index of labor multiplied by the 2012 labor

compensation" (BLS). This definition is clearly closer to Robins' definition, and purposefully so. This definition will help set up a more direct relationship between labor input and health of workers which will be analyzed later in this section. Using this definition also echoes the bias that previous studies held, the main one being that the implementation of an unconditional cash transfer program decreases labor supply, as supported by theory and empirical evidence from the NIT experiments. A decrease in labor supply automatically pushes the capital to labor ratio up, which is an extremely important bias to keep in mind moving forward. Now that labor supply has been defined, it is important to remember that these results and discussions from previous literature are in reference to NIT and not UBI. The two unconditional cash transfer programs can certainly be thought of in a similar light, but there is a slight difference that needs to be understood in order to correctly assess the bias that exists from analyzing UBI using past NIT experiments.

To begin, it is necessary to define the terms and explain the difference between them. NIT is a form of basic income where subjects receive varying amounts of government supplied income depending on their income. The lowest earners, say someone who has an income of $0, would receive the maximum possible benefit. In the RIME for instance, the maximum possible benefit for the Guarantee Level (G) 1.00 was 100% of the income necessary to reach the poverty line. As the subject receives more and more income, the amount that they received declined from 1.00 down to 0.30 as the Tax Rate (t) reached 0.70. This method is clearly structured towards bringing everyone up to the poverty line or beyond as is possible. UBI on the other hand gives a flat amount of money. There are plenty of versions that vary, but to keep analysis consistent with discussion in the current academic and political sphere, this paper will focus on $1000 dollars a month for persons 18 years and older. According to the US government, the US poverty

guideline for the 48 contiguous states for a four-person family is $25,750. This means that if a subject family has no other income, then they will be just below the poverty line provided there are two adults receiving this income. If the subject is an individual, the poverty line is $12,490, and this version of UBI will bring the subject just below the poverty line as well. If an individual receiving UBI were to have an income that raised them from $0 a year to $12,490 a year, then they would still receive the $12,000 a year constant from UBI. If the same person were receiving NIT instead of UBI, this person would no longer receive any unconditional cash transfers once their income reached the poverty line of $12,490. From the above descriptions it is observable that NIT will adjust depending on the subject's income situation and the country's poverty lines. While UBI will stay fixed regardless of subject's income or the country's poverty line. The only change will occur when the policy framing UBI changes.

In this regard, it is important to note an individual's decision making in either scenario. Say there are three possible income levels for an individual who is employed in the US. Their income is either above $0 but below the poverty line, their income is exactly at the poverty line, or their income is above the poverty line. If individuals maximize their utility, then a person receiving NIT has different incentives depending on which scenario they are in. If they are in the lowest income level, and they have no ability to acquire a job that will secure them an income higher than the poverty level, then they have no incentive to work. This is because they will be pushed up to the poverty line regardless of whether or not they work, so they may as well spend their time on leisure rather than work. For an individual whose income is exactly at the poverty line, it is likely they will act in the same way. They could not work and receive the same income. They have been separated in this example, however, because it is possible that an individual at this level could expect their income to rise if they keep working, so they may push to reach the

next level of income above the poverty line. For individuals above the poverty line, they have no incentive to work less. If they work less, they will receive a lower income because the highest they can get using NIT is already below their current income. Now comparing to UBI there is no difference among the three scenarios. Regardless of an individual's income, they will receive the same amount from UBI. Therefore, their decision making on whether or not to work is less affected with UBI than NIT especially at lower levels of income. If an individual is looking to maximize their utility, they should still work even after receiving UBI because they would be able to directly increase their total income.

The results from the five experiments then need to be re-analyzed in context of the differences between NIT and UBI and how they are framed in this paper. To do this I will discuss the theory behind the five experiments and apply it to UBI specifically. In a model between wage and hours worked, there is a shift of the supply curve with the introduction of NIT, which results in higher wages and, with a low demand elasticity, a slight decrease of hours worked. This however does not change the overall labor supply as was discussed before. A change from NIT to UBI has no direct reason to change this. Using the above descriptions for NIT, as people have less income, they receive more in cash transfers. There is a clear risk in this situation where many people would stop working a low paying job if they believe it doesn't change their income situation. However, with UBI, this risk is largely nullified due to the fact that there is not a direct reward for quitting the labor force. Regardless of hours worked, a person's government cash transfers will remain constant, therefore it is much more likely that people would aim to stay in the labor force to earn as much income as possible. Therefore, the concern of less hours worked, and a decreased labor supply is lower in UBI than with NIT, where demand was already inelastic enough to make both of the above negligible.

The other side of the question for this paper comes from the amount of production that stems from the input of capital instead of labor. As was stated towards the beginning, capital, in the form of technology, has taken the vast majority of jobs that the US has to offer. However, there are quite a few approaches to measure capital and many economists have argued about which is the proper way for different discussions. For this paper I will define the amount of capital as capital services. According to the Bureau of Labor Statistics capital services are defined as: "Tornqvist aggregates of capital stocks (equipment, structures, intellectual property products, inventories, and land) using rental prices to determine weights. The level of capital services is the Tornqvist quantity index of capital multiplied by the 2012 capital income." (BLS).

The past NIT experiments do not, however, mention this version of capital in their papers. In fact, the summary reports and following articles focus in solely on the labor supply effects with no mention of non-human capital whatsoever. The exception is the summary report for the Iowa and North Carolina Experiment which mentions a similar type of capital called capital input. "It is noteworthy that farm hours among controls in both' North Carolina and Iowa were declining over time. This control group trend may have been the result of such phenomena as the adoption of labor-saving capital inputs, the improvement of off-farm job opportunities which alleviated some underemployment on the farm, or changes in natural conditions such as weather" (Rural Income Experiment). It is possible that the NIT experiment helped keep the labor supply from being replaced by capital as described above such that the control groups hours were declining. However, because that was not the focus of these experiments, they did not extrapolate on that subject. More recent studies in other countries also shed no light on the effect on capital. A major issue and possible explanation as to why they do not is because the experiments focus on some groups of low income individuals in an area, and not on the entire

population. Therefore, it would not be a fair and balanced assessment to look at capital services in the area of the experiment because different businesses would realistically have different proportions of employees in the treatment or control groups.

To get around this in my paper, the first idea was to look at other countries that may have implemented UBI or NIT throughout the entire country and then examine their country capital service levels, but no such country exists. Therefore, for this paper, in order create a relationship, I will equate NIT and UBI to other social welfare programs in the US. The programs are Social Security Disability Insurance (1956), the Food Stamp Program (1964), Medicaid (1965), Supplemental Security Income Program (1972), Earned Income Tax Credit (1975), Low-Income Home Energy Assistance (1981), Temporary Assistance for Needy Families (1996), and The Affordable Care Act (2014).

As the conversation surrounding the capital to labor continues to develop in this paper, it is important to start referencing how a proposed UBI implementation would affect health and healthcare in the US. One of the most important points within economics of healthcare is that it is always cheaper and more efficient for the healthcare system for people to partake in preventative measures of healthcare rather than last minute measures. These preventative measures include less smoking, drinking, body fat, and more exercise (Leigh & Fries). This comparison could be demonstrated by the difference between someone who eats healthy and exercises vs. someone who becomes obese by eating poorly and never exercising, only to get a liposuction later in life to try and get rid of that fat. This choice appears to be such an obvious one that many people would scoff at the comparison, however, not eating healthy and not exercising is sometimes required by people depending on their economic situation. Take for example someone who is below the significantly below the poverty line, working two jobs to try

and feed and care for their family in a low-income area. Low-income areas typically suffer from a problem known as food desserts: an area in which grocery companies don't find it profitable to build stores. The result is a large area, sometimes ten square miles, that has no access to fresh and healthy foods. For the type of person described above, they likely have no time in their schedule to travel that distance. Even if they have a car, they would have to pay for the extra gas to make the trip, when it is realistically far cheaper and efficient for them in their current situation to pay for less healthy food that they could find in their area. Not only is low income a strong negative factor on preventative physical healthcare, it is also detrimental on mental health.

James House described the importance of income as it relates to health in his book "*Beyond Obamacare*" (2015). He references a paper from 2000 that shows data that people with lower income, especially below 50% of the poverty line, tend to have much higher psychosocial risk factors than their counterparts that have higher incomes. These risk factors include high hostility, unmarried, never attend meetings, talk with others less than once a week, low self-efficacy, high depressive symptoms, and two or more recent negative events. A large part of healthcare that is underdeveloped is healthcare aimed towards mental health including areas that would address the above issues.

UBI likely would have very little influence on the health and lives for those people far above the poverty line. However, it is clear that for those near and below the poverty line, it could be a huge increase to their physical and mental health in the long run by giving them the tools to work on their preventative healthcare. The basic relationship between health and income is clear as well. "These indices of morbidity, both self-reported and measured, are approximately linearly related to the logarithm of income, in all except very high and low incomes (this means that increasing income is associated with better health, but that there are diminishing returns at

higher levels of income)" (Ecob & Smith). The five NIT experiments also recorded many different quality of life measures that that some studies of that decade did address. These measures ranged from healthier birth rates, to more dedication to education, even to healthier eating habits. Several studies did confirm that the treatment groups were healthier, divorces withstanding. The reason can be logically traced back to the reduction in work hours. remember that many of the reduced hours were not from dropping from the labor supply, but rather taking a few hours a week off from work. These work hours would presumably be used to substitute in healthy consumption or leisure. Both of these are positive influences on long term health (Coleman & Iso-Ahola). On top of that, another key fact of healthcare economics is that healthier workers produce more in the workplace. (Boles, Pelletier, & Lynch) This makes them more valuable in the work force in comparison to capital. However, it also increases their wages since they have become more valuable, making them less competitive against capital in the work place. This paper seeks to understand how a possible change in health from UBI as described above would affect the capital to labor ratio. The health variable that will be used is number of sick days taken off by an individual on average every year. This is the most logical variable for this paper because if an employer is analyzing whether to invest in labor or capital, one piece of the puzzle they will likely look at is how many days their workers are taking off for sick days. The more days that are being taken off for sick days, the less productive their workers are being relative to capital. Therefore, those would theoretically be substituted for capital.

III. METHODOLOGY

To examine UBI's effects on the capital to labor ratio, this paper will use a least-squares regression using $\frac{K}{L}$ as the dependent variable. All of the variables for this regression are listed below in Table 3. The first variable, Year, is self-explanatory and tells us the data is time-series

going from 1948 to 2018. The second variable, CapitalServices is defined as follows according to the Bureau of Labor Statistics, “Tornqvist aggregates of capital stocks (equipment, structures, intellectual property products, inventories, and land) using rental prices to determine weights. The level of capital services is the Tornqvist quantity index of capital multiplied by the 2012 capital income.” (BLS). The third variable, LaborInput, is defined as follows also according to the Bureau of Labor Statistics, “Tornqvist aggregate of of hours of all persons (classified by age, education, and gender) using compensation per hour to determine weights. The level of labor input is the Tornqvist quantity index of labor multiplied by the 2012 labor compensation.” (BLS). These definitions for capital and labor allow us to compare the weighted values of capital and labor against each other accurately in the ratio. The data for both capital and labor over time in the US came from the Bureau of Labor Statistics. The fourth variable, CapitaltoLaborRatio, is generated by dividing Capital Services by Labor Input. The fifth variable, Grossdomesticproduct, is the GDP of the US indexed at 2012 = 100 and came from the Federal Reserve Bank of St. Louis. The sixth variable, sickdays, is the average number of sick days any given individual took on a given year. This data comes from the National Health Interview Survey (NHIS) which collected data on sick days taken from work for the year 1977, 1997-2017. It is important to note that this is the first variable that does not have a value for every single year. The seventh variable, UBI, is an incremental variable, which increases by one on years that major social welfare programs are implemented that affect the working population in the US. These programs as stated above are: Social Security Disability Insurance (1956), the Food Stamp Program (1964), Medicaid (1965), Supplemental Security Income Program (1972), Earned Income Tax Credit (1975), Low-Income Home Energy Assistance (1981), Temporary Assistance for Needy Families (1996), and The Affordable Care Act (2014). The eighth variable, slopedum, is a slope

dummy variable created by the multiplication of the variables sickdays and UBI. This variable is meant to help identify the partial effects of UBI on the capital to labor ratio while holding sick days constant. Before moving forward, it is important to note an issue that would arise if nothing is adjusted. From 1978-1996 there is no data for average sick days taken by an individual, and after that time period, there is only one incremental change in the UBI variable in 2014. Therefore, there are a lot of problems dealing with partial and perfect multicollinearity between the two variables. To help amend this issue, data for sick days between 1977 and 1997 will be interpolated linearly. This leads to a lot more independent variation among these two explanatory variables and a stronger regression. This is represented by the ninth variable, polatesickdays. The tenth variable, polateslopedum, creates another slope dummy variable similar to the first one, but this one uses the interpolated sick days data instead of the regular sick days data. Note that the two variables with interpolated data have 41 observations as opposed to the 22 observations their non-interpolated partners have. The eleventh and last variable, partial, is the partial derivative of the main regression taken with respect to UBI. This equation is shown below.

There are multiple regression possibilities given the above variables and they are ordered as follows. The first regression is run simply with GDP, Year, and UBI. This regression is meant to give a starting point for UBI and get a sense of it's initial direction and significance without introducing the intercorrelated variable sickdays.

Regression 1:

$$K/L_t = \beta_0 + \beta_1 GDP_t + \beta_2 YEAR_t + \beta_3 UBI_t$$

The second regression keeps the original three variables and aims to add in sickdays to see its effect on the significance of the other variables, specifically UBI.

Regression 2:

$$K/L_t = \beta_0 + \beta_1 GDP_t + \beta_2 YEAR_t + \beta_3 UBI_t + \beta_4 SICKDAYS_t$$

The third regression is meant to create coefficients that exist in correspondence with the slope dummy variable. This is the type of regression that is going to have its partial derivative taken with respect to UBI.

Regression 3:

$$K/L_t = \beta_0 + \beta_1 GDP_t + \beta_2 YEAR_t + \beta_3 UBI_t + \beta_4 SICKDAYS_t + \beta_5 UBI_t * SICKDAYS_t$$

The fourth regression takes a step back from the slope dummy variable as it adds in the interpolated data of sickdays into the regression. This regression is meant to be compared with the second regression in terms of what variables are now significant and if any signs have changed.

Regression 4:

$$K/L_t = \beta_0 + \beta_1 GDP_t + \beta_2 YEAR_t + \beta_3 UBI_t + \beta_4 POLATESICKDAYS_t$$

The fifth and final regression takes a step forward again and reintroduces the slope dummy variable using the interpolated data. This regression again will have its partial taken with respect to UBI and it will be compared to the partial realized by the third regression.

Regression 5:

$$K/L_t = \beta_0 + \beta_1 GDP_t + \beta_2 YEAR_t + \beta_3 UBI_t + \beta_4 POLATESICKDAYS_t + \beta_5 UBI_t * POLATESICKDAYS_t$$

The structure of the partials for the third and fifth regressions look nearly identical. Their only differences to be analyzed, and the purpose of looking at them both, are the coefficients brought about by interpolating the sick days data.

Partial of Regression 3:

$$\frac{\partial \frac{K}{L_t}}{\partial UBI_t} = \beta_3 + \beta_5 SICKDAYS_t$$

Partial of Regression 5:

$$\frac{\partial \frac{K}{L_t}}{\partial UBI_t} = \beta_3 + \beta_5 POLATESICKDAYS_t$$

Based on the theory and explanations above, UBI is expected to take on a negative coefficient and $SICKDAYS$ is expected to take on a positive coefficient. That is to say, it is expected that the implementation or increase of social welfare programs that have a similar effect to UBI to will decrease the capital to labor ratio. It also is expected that an increase in sick days taken, and therefore a decrease in healthy workers, will increase the capital to labor ratio. However, it is still possible to obtain a negative coefficient on $SICKDAYS$ due to the idea that healthier workers could potentially require higher wages, and therefore will be replaced by capital despite being more productive.

It was also stated how UBI should have a positive effect on health, and because of this interaction, $UBI * SICKDAYS$ is in our regression. Looking at the partial derivates of regressions 3 and 5 it is expected that there will be a positive slope in both cases. A positive slope would indicate that there is an interaction between the variables. More than that, the interaction would describe an increase in sick days taken, and therefore unhealthy workers, should make the partial effect that UBI has on the capital to labor ratio more positive.

For robustness checks, it is important with these regressions to check for multicollinearity. For each regression, this is tested using the VIF command in Stata.

IV. RESULTS

The results from the five regressions are listed in Table 3. To begin, look at the coefficients for UBI across all of the regressions. In every single one UBI has taken on a negative coefficient as expected. However, only three of these coefficients are significant at any level. Remember that regressions 3 and 5 are mostly used for the partial effect of sick days on UBI, so focus the evaluation of the UBI coefficients to regressions 1, 2, and 4. It is apparent that UBI is significant for all three of these regressions at the .05, .01, and .10 levels respectively. With the introduction of sick days in the second regression, UBI's significance went up as its coefficient became more negative. Then in the fourth regression, as the sick days data was interpolated, its significance went down from 0.01 to 0.10, and its coefficient became less negative. For the variables sickdays and polatesickdays, continue to focus on regressions 2 and 4. Sickdays was significant at the 0.10 level and polatesickdays was significant at the 0.01 level with both variables having negative coefficients, which is more negative for polatesickdays than sickdays. This does not support the hypothesis that as sick days increase, the capital to labor ratio also increases. This coefficient effectively means that as firms evaluate their workers health and productivity via the number of sick days they take, they decide to lay off workers as fewer sick days are taken. In other words, they are replacing workers with capital the healthier they are. This does support the idea that healthier and more productive workers could warrant higher wages. While more productive than if they were taking more days off, they also cost more to the company and therefore are being replaced. Across all of the regressions, GDP does very little to describe the capital to labor ratio, even when it was significant in regression 1 it had an extremely small positive coefficient. The R-Squared values for all of the regressions are very high, suggesting that the regression fits the data very well.

Next are the results from the partial derivatives of regressions 3 and 5. Look at Figures 2 and 3 respectively for scatter plots illustrating these relationships. The first thing to notice between the two plots is that they have opposite relationships. Figure 2, depicting the relationship between sick days and UBI using non-interpolated data shows a negative relationship. This would suggest that as the average number of sick days taken by an individual increases, the partial effect of UBI on the capital to labor ratio holding sick days constant becomes more negative. This means that UBI becomes a more effective tool for decreasing the capital to labor ratio as laborers become unhealthier. Figure 5 depicts the exact opposite situation. This scatter plot suggests UBI becomes a more effective tool for decreasing the capital to labor ratio as laborers become healthier. This issue stems from the fact that the coefficients on the slopedum variable and the polateslopedum variable have opposite signs. Then it is necessary to evaluate the differences between these two slope dummy variables as they relate to UBI. Slopedum has data points for the years 1977, 1997-2018, during which time UBI has a total of 3 different values, one of which on 1977, and can largely be ignored. Polateslopedum has data points for the year 1977-2018, which includes a larger variation of UBI values at 4, with multiple instances for each values. Therefore, the partial relating to regression 3 will be ignored and the scatter plot depicting the partial relationship using regression 5 will be accepted. This result is also far more logical in practice. As workers become healthier, it would make sense that the receiving of UBI would decrease the capital to labor ratio more than if they were not healthier in the eyes of their employers.

Then the question to be answered is what do these results mean in the eyes of existing literature and what are its limitations. To begin, this paper is the culmination of many existing stigmas and contrary thoughts surrounding the use of UBI and its effects on the working class in

the US. Furthermore, it dives into a possible involvement of health and healthcare that exists between the relationship between UBI and the capital to labor ratio. This means that this paper and its results have been wrought by decades of existing literature that connects different parts of this puzzle. But on the other side, this is the first paper that attempts to put the capital to labor ratio next to UBI, let alone add worker health into the mix. Because of that fact, there are many places where this paper can be made better by additional future literature. Strictly contained to the data and variables, there are several things that other researchers could do differently.

First, the use of sick days as a measure of health could easily be flawed. There are countless ways that one could evaluate the health of individuals. A few examples could include life expectancy, morbidity, functional living, and an assessment of the healthcare system. The use of sick days could be appropriate in order to highlight its place in the workplace and the effect that could have on the substitution of capital and labor. But the number of sick days an individual takes could be based on any number of factors besides being sick, including a stigma in the US against taking sick days at all and how that could change over the years. The amount of data available is also small relative to the number of years that the capital to labor ratio has been tracked in the US. The interpolation of data obtained from the NHIS could have been inappropriate if the data is not truly linear, but it was necessary in order to obtain data that varied more often among the incremental variable, UBI.

That brings the second possible area for improvement in this paper, the UBI variable. Using other social welfare programs in order to create a regression based on the entire US could also be flawed. While it does create the closest possible relationship that exists between UBI and capital, it is still using country wide data to estimate something that has only ever been done in small experiments. UBI as described above, functions similar to a given social welfare program

that affects the health and spending of those in lower incomes far more than those above the poverty line. But that does not make it a perfect substitute for those programs. To be more accurate would be to say that the incremental variable is a rough estimator of the existence of social welfare programs that affect lower income citizens. Any given researcher could do a much different set of welfare programs to represent their incremental variable over the years and defend it as strongly as the variables in this paper. Furthermore, the UBI variable could also be changed to a pure dummy variable that takes the value of one once a large welfare program is implemented in the US, such as the Earned Income Tax Credit.

It is also possible to alter the focus of this study by defending the idea that health and healthcare does not have much of any relationship to the capital to labor ratio. One could easily find a far different topic that relates closer to the UBI and capital to labor ratio relationship. One such topic could be related to governmental efficiency on the distribution of such cash transfers, and how it being handled from a state or federal level may alter the effectiveness of the transfer.

The regressions that were run in this paper were also most certainly not impervious to issues. According to the robustness checks, it is apparent that there exists plenty of multicollinearity between variables. R-Squared is extremely high for all of the regressions, which highlights the probability of an imperfect multicollinearity issue within the regression. From Table 4 it is clear that GDP for instance is highly correlated with VIF values reaching over a hundred. UBI and sickdays were also not exempt from appearing to be possible multicollinear with VIF occasionally exceeding values of 5.

The partials of regressions 3 and 5 are also blatantly opposing each other in their results. Supporting one of the partials over the other could easily be a defendable stance for any logical and accomplished economist. It would be just as easy to defend the third scenario where neither

partial should be defended due to a couple different facts. The VIF values for both of those regressions are extremely high suggesting a lot of partial multicollinearity. This makes perfect sense because even the interpolated data for sick days only covers roughly have of the years where both UBI and the capital to labor ratio have values. In fact, in the data set, sickdays only exists at the same time as UBI for four of the nine values that the incremental variable takes on over the course of 71 observations. On top of that, sickdays has no exact reason to perfectly follow the linear path between 1978-1996 that the interpolation executes for it. Between the years of 1996 and 2018 the values of sickdays seem to change with no discernable pattern whatsoever, increasing and decreasing at different random years. And finally, as if there wasn't enough reasons to positively pick one scenario or the other, none of the important variables are significant at in regressions 3 or 5. The coefficients that gives the slope of figures 2 and 3 specifically are the coefficients for slopedum and polateslopedum respectively, and neither are significant. Even more so, their 95% confidence intervals have both positive and negative values in nearly equal amounts. Yet again, the construction of the UBI, sickdays, and polatesickdays variables could easily be changed and defended by any logical and accomplished economist. Because of that fact, this would be the largest issue among all of the data and variables. If other researchers decide to use this paper as a starting point or a reference point for use on expanding the topic of interest, they would need to address these variables first.

Most of these major issues stem from the simple idea that this paper could not be written on a narrowed down singular experiment or set of experiments within or across different nations. As researchers continue the study of this topic, it is important to look at this paper and move forward with the idea that there may be a better way to analyze capital on a smaller scale in the area of the experiments. Because this paper was not able to do such a thing, there are a lot of

generalizations that result in far less conviction in the analyzation of the results and what they can be extrapolated to describe.

V. CONCLUSION

It is clear that this paper is not perfect and should not be the final declarative study on the subject. In fact, this paper should be used as a stepping stone for more research and analysis in the same area, while addressing the issues that this paper dealt with. One of the first issues with collecting data to address the research question is that data specific to the question does not exist. To reiterate, only one of the reports for the NIT experiments in North America mentioned capital services at all, and it was more of an interesting trend they noticed rather than an actual area they sought to understand. Unfortunately, despite there being a promising amount of logic and theory supporting the idea that capital services is tied to the implementation of UBI or an equivalent, current experiments outside the US continue to not record capital services in their analysis.

This omission of data collection could stem from a couple of places. First of all, it could simply be ignorance. As was stated before, this is the first academic paper that defined a research topic in such a narrow space and sought to analyze it with available data. The lack of such other similar works could in fact be a direct cause of there being a lack of awareness or interest in recording capital data in modern experiments. The second reason there might be omission is the possible difficulty of obtaining it. As stated above in the third section, these experiments are typically aimed towards low income individuals in certain areas. While it is possible that these individuals make up a large enough proportion of the area to make a difference in the capital services input locally, it is far more likely that it would be a negligible difference, especially in the high density areas within which these experiments are often conducted.

The omission of data collection of capital services is not the only part of this new area that could be improved upon either. The health side of the research question could also be expanded upon in current and future experiments on UBI. This is much easier data to collect than capital services if the variable remains as sick days from an experimental standpoint. Those running the experiment simply collect the data themselves in interviews with those in the treatment and control groups. It could be argued that worker health should be defined in a separate way, but along with the reason for it being used in this paper, sick days is also far less confidential and easier to obtain from test subjects.

If data collection in experiments began to include capital services despite the two possible issues above, as well as sick days of the test subjects, then the ability to answer this research question becomes far easier. The data and regressions could then be brought down to a local level and specified for the area that is being treated in the experiment. Even further, if this became a constant among several different experiments in different countries, then the effects could be measure in regressions over time and across different areas. This would be a very strong addition to the current literature surrounding the topic. Also, in this way, the variables would no longer have to be reasoned out to try and use in a regression such as UBI and sick days were. Another possible solution to the data problems that this paper struggles with is the implementation of UBI on a country wide level in any country in the world. Even a similar unconditional cash transfer program would suffice to recreate this paper with far fewer weaknesses in its arguments. At that point, the only variable that would have to be sought after is sickdays, which is occasionally a comically easy variable to find with countries like the UK for example. Without the adjustments from a data collection standpoint, this topic will remain difficult to empirically analyze. If that is the case, then future research should do its best to use

this paper as a home base to explore from in the usage of new variables and different data sources for existing variables.

As it stands, this paper acting alone can provide a very specific set of policy recommendations for those who would hope to reference it in the implementation of UBI. If whoever is implementing UBI desires to use it to decrease the capital to labor ratio, they could potentially succeed according to the theory and coefficients on UBI in regressions 1, 2, and 4 that support that idea. However, it must not be understated that the health aspect of this paper goes the opposite direction from what was hypothesized. This means that the healthier workers that the US would be supplied with would increase the capital to labor ratio, and according to the regression, would increase it more than UBI or an equivalent would decrease it. The partial of regression 5 does defend the idea that UBI would be more effective given healthier workers, but that does not necessarily translate to it outweighing the effect that sickdays is having on its own. As Table 2 shows, the coefficients on the sickdays may be outweighed by UBI in regression 2, but the interpolated sickday coefficients outweigh the UBI coefficients in regression 4. Therefore, this paper cautions those policymakers using this paper or the ideas this paper proposes as reasons to implement UBI to decrease the capital to labor ratio. This paper emphasizes that they may not get the effect they are hoping for if their sole purpose is to decrease the capital to labor ratio.

If policy makers are looking to address the issue of the capital to labor ratio, then it is likely that one of the many other proposed federal or state welfare programs could do a better job than UBI. For example, at the time this paper is being written, the US political sphere is debating on something called the Job Guarantee. Such a program would place the federal (or possibly state) government in a position to become the last resort for jobs to the general public. Suffice to

say, this would directly tackle the issue on automation replacing jobs by having the government supply jobs straight to those who require them. Of course, this proposal is not perfect either, but it just goes to show that there are clearly options for addressing the capital to labor ratio that do not involve UBI. Furthermore, based on the results from this paper, UBI, sickdays, and their interaction does not result in a clear effect to the capital to labor ratio. While specific values may be significant, different variables are significant in directions that support opposing results.

FIGURES AND TABLES

Figure 1: Capital to Labor Ratio over time

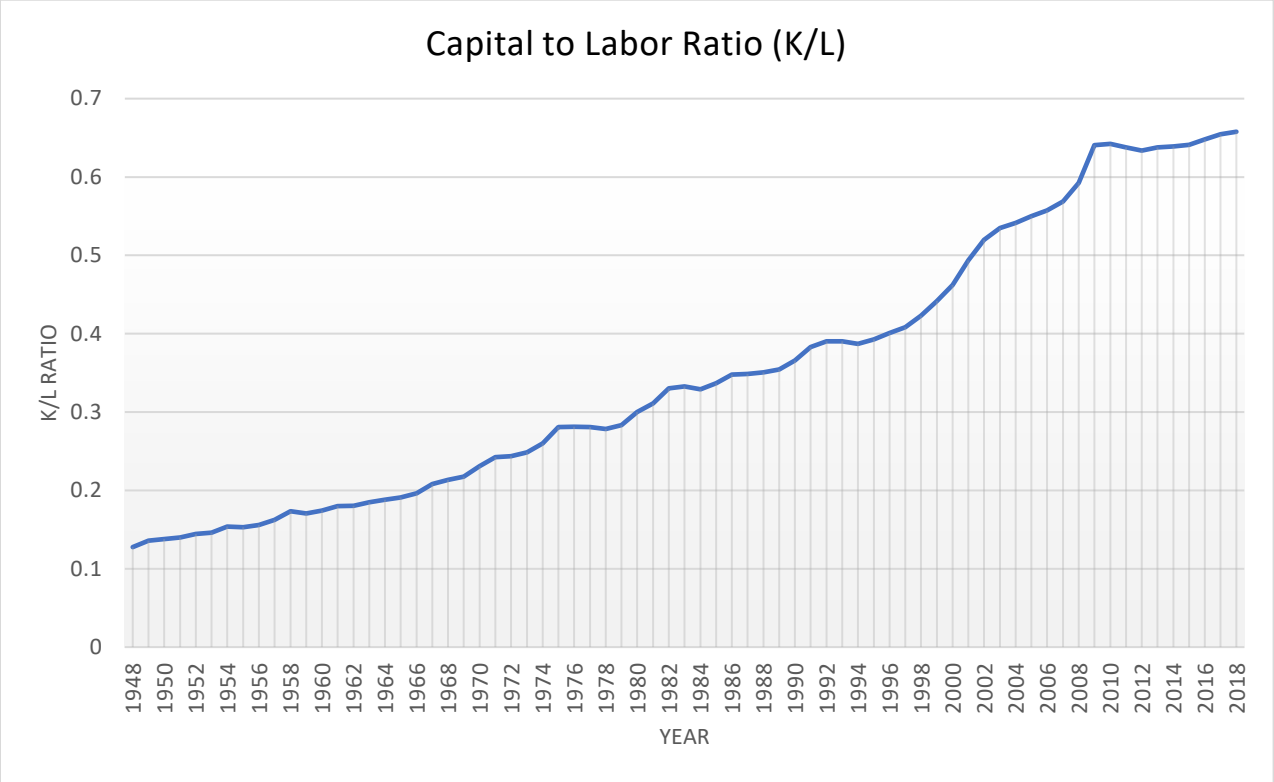

Figure 2: Partial of Regression 3

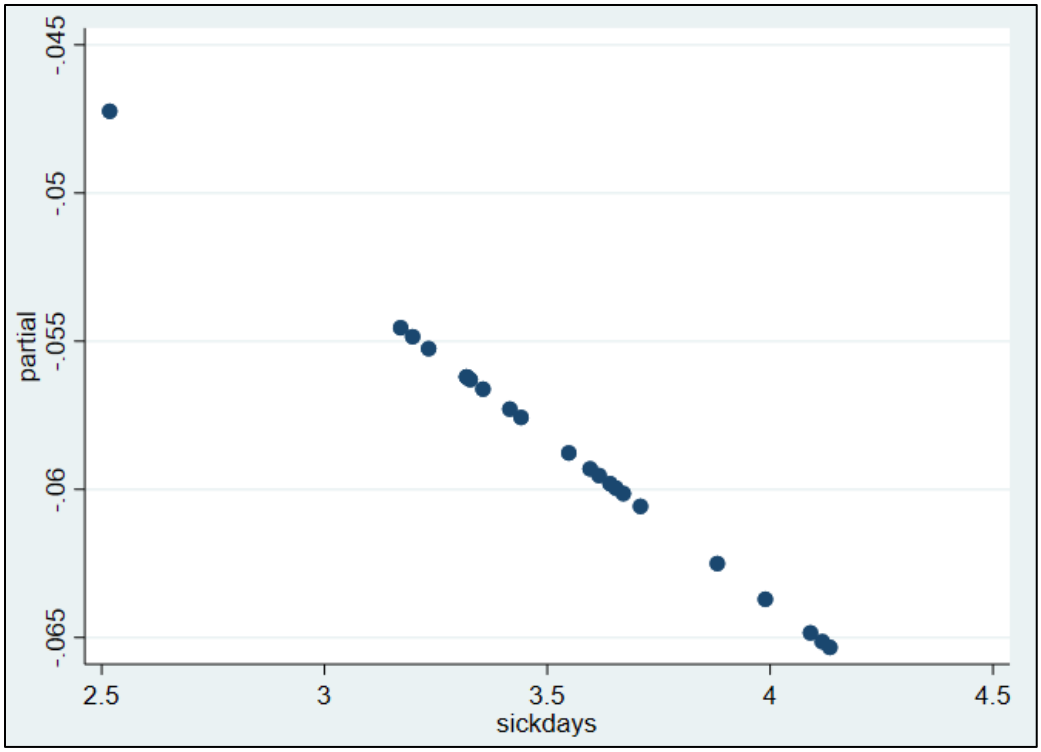

Figure 3: Partial of Regression 5

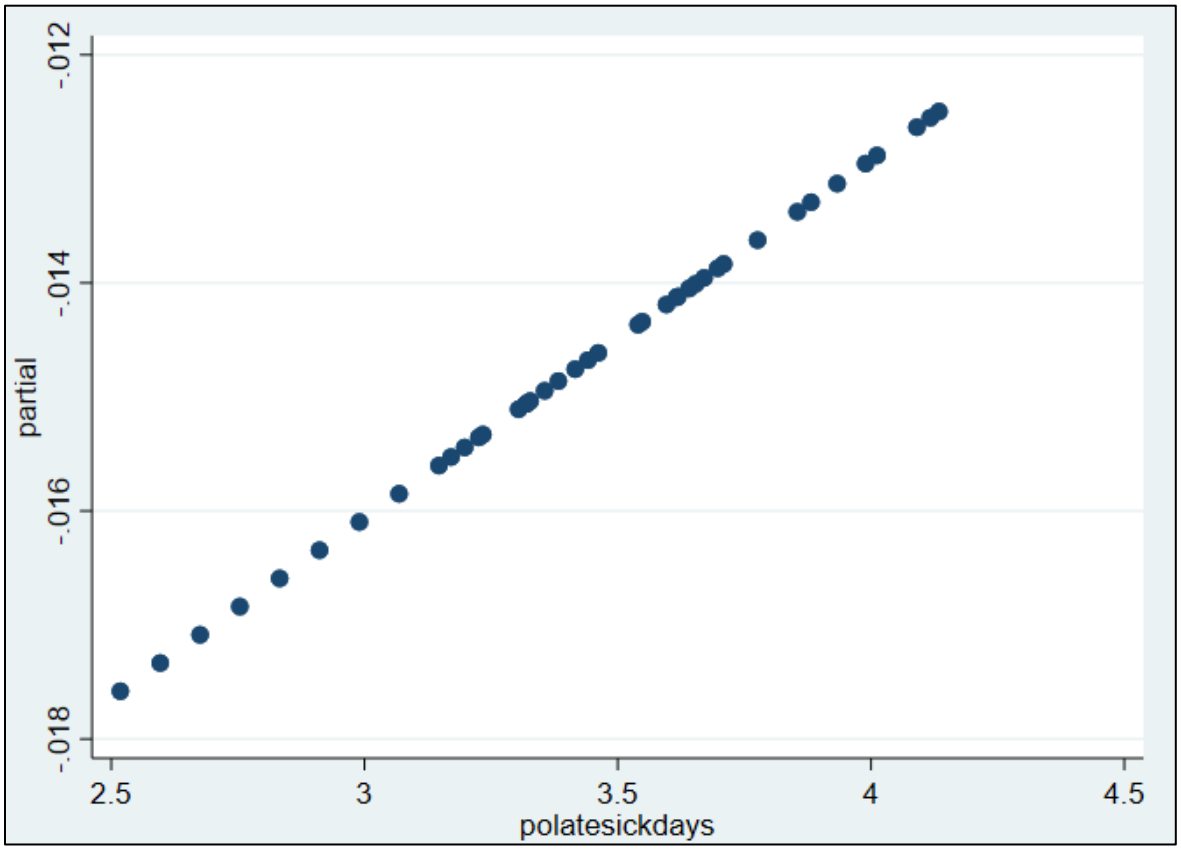

Table 1: Summary of NIT experiments from basicincome.org

Name	Location(s)	Data collection	Sample size: Initial (final)	Sample Characteristics	G*	t**
The New Jersey Graduated Work Incentive Experiment (NJ)	New Jersey & Pennsylvania	1968-1972	1,216 (983)	Black, white, and Latino, 2-parent families in urban areas with a male head aged 18-58 and income below 150% of the poverty line.	0.5 0.75 1.00 1.25	0.3 0.5 0.7
The Rural Income-Maintenance Experiment (RIME)	Iowa & North Carolina	1970-1972	809 (729)	Both 2-parent families and female-headed households in rural areas with income below 150% of poverty line.	0.5 0.75 1.00	0.3 0.5 0.7
The Seattle/Denver Income-Maintenance Experiments (SIME/DIME)	Seattle & Denver	1970-1976, (some to 1980)	4,800	Black, white, and Latino families with at least one dependent and incomes below $11,00 for single parents, $13,000 for two parent families.	0.75, 1.26, 1.48	0.5 0.7, 0.7-.025y, 08-.025y
The Gary, Indiana Experiment (Gary)	Gary, Indiana	1971-1974	1,799 (967)	Black households, primarily female-headed, head 18-58, income below 240% of poverty line.	0.75 1.0	0.4 0.6
The Manitoba Basic Annual Income Experiment (Mincome)	Winnipeg and Dauphin, Manitoba	1975-1978	1,300	Families with, head younger than 58 and income below $13,000 for a family of four.	C$3,800 C$4,800 C$5,800	0.35 0.5 0.75

Table 2: Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Year	71	1983	20.63977	1948	2018
CapitalSer~s	71	2025.506	1474.162	411.1883	5175.585
LaborInput	71	5075.08	1499.191	3114.343	7868.552
CapitaltoL~o	71	.3512966	.1700668	.1276524	.6577557
Grossdomes~t	71	53.27227	31.09984	13.006	114.629
sickdays	22	3.542987	.3766358	2.518138	4.134289
UBI	71	4.633803	2.647044	0	8
slopedum	22	25.16488	3.326504	12.59069	28.94002
polatesick~s	41	3.432373	.4207921	2.518138	4.134289
polateslop~m	41	22.59274	4.484695	12.59069	28.94002
partial	41	-.0147052	.0013233	-.0175804	-.0124978

Table 3: Regressions

	Regression 1 b/se	Regression 2 b/se	Regression 3 b/se	Regression 4 b/se	Regression 5 b/se
Year	0.004*	0.014***	0.013**	0.010***	0.010**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Gross domestic pro~t	0.004***	0.000	0.000	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
UBI	-0.011*	-0.056***	-0.019	-0.015	-0.025
	(0.00)	(0.01)	(0.13)	(0.01)	(0.04)
sickdays		-0.022	0.050		
		(0.01)	(0.26)		
slopedum			-0.011		
			(0.04)		
polatesickdays				-0.046***	-0.066
				(0.01)	(0.08)
polateslopedum					0.003
					(0.01)
constant	-7.183*	-26.359***	-25.841**	-19.128***	-20.150**
	(2.97)	(6.61)	(7.04)	(4.57)	(6.26)
R-sqr	0.987	0.978	0.979	0.984	0.984
dfres	67	17	16	36	35
BIC	-341.9	-108.9	-105.9	-203.3	-199.6

* p<0.05, ** p<0.01, *** p<0.001

Table 4: VIF values, Test on Multicollinearity

Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Year	175.21	69.87	80.47	105.32	203.47

GDP	77.47	65.46	65.59	98.45	185.26
UBI	30.28	4.84	493.06	6.91	164.50
Sickdays	-	1.29	712.23	-	-
Slopedum	-	-	1332.94	-	-
Polatesickdays	-	-	-	1.37	161.45
Polateslopedum	-	-	-	-	442.23
Mean VIF	94.32	35.37	536.86	53.01	231.38

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