Examining the Short-Term Macroeconomic Effects of Community Development Financial Institution Fund Investment in Low-Income Arkansas Counties

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Abstract

Due to the considerable size of Community Development Financial Institution Fund investment in low-income Arkansas counties, I measure the short-term macroeconomic effects in investment counties and investigate whether a noticeable effect is produced by such colossal funding in relatively low GDP counties. The effects focused on include county-level poverty rates, homeownership rates, unemployment rates, and per capita personal incomes. The research attempts to find an effect over a zero-to-three-year period after the initial funding in order to test for any delayed effect produced. My results suggest that there is not a statistically significant relationship between investment and any of the four macroeconomic effects over the periods included.

Acknowledgements

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1. Introduction

Community Development Financial Institutions (CDFIs) play a critical role in providing financial access and resources to underserved communities around the country. Unable to obtain capital and credit from large commercial banks, communities (often low-income and/or rural) turn to CDFIs, which provide an array of resources that range from financial literacy education to small business and personal loans to residential housing project funding. The goal of these institutions is to build wealth and access that will make a lasting impact.

Tracing back the history of CDFIs, the Community Development Banking and Financial Institutions Act of 1994, signed into law by President Bill Clinton (an Arkansas native, the focus state of this research paper), created the CDFI Fund under the U.S. Department of the Treasury to "promote economic revitalization and community development" through the means of "equity investments, capital grants, loans, and technical assistance support."[1] In addition, the legal framework for the definition of a CDFI was outlined, and the certification is provided by the CDFI Fund to qualifying entities that match the mission goals of the fund. Since its inception, the CDFI Fund has distributed over $7.4 billion to CDFIs, allocated $71 billion in tax credit allocation authority to Community Development Entities, and closed guaranteed bonds for over $2.1 billion.[2]

As one of the nation's poorest regions, the South and Delta areas have received a great deal of CDFI Fund investment, and thus, large quantities of funding would be expected to have a strong impact on the poverty-stricken area. With limited, if any at all, investment coming from elsewhere, a relationship between CDFI Fund investment and county macroeconomic metrics,

[1] CDFI Coalition, 2023
[2] CDFI Fund, 2023

which are lagging behind the national averages, could prove to be useful information for policymaking and encourage further investment in the region. Through the implementation of a multiple linear regression model, the relationship will be tested for a zero-to-three-year period after CDFI Fund investment took place, which may prove to be a long enough time frame for an effect to be produced.

2. Literature Review

Current literature surrounding the topic of the Community Development Financial Institution Fund is limited on its own. While there are a couple of modern papers that focus on a few short-term effects from CDFI funding, most stray away from the macroeconomic effects produced by the large investments, and no focus on Arkansas (or other areas of the South) exists.

Cortés and Lerner (2013), "Bridging the Gap? Government Subsidized Lending and Access to Capital," evaluates the CDFI Fund's commitment to its mission of expanding the capacity of financial institutions to provide credit, capital, and financial services to those that are typically overlooked in society – underserved communities. The paper uses a regression model to analyze the loan growth effects of CDFI Fund grant awards to credit unions in underserved communities. Ultimately, the authors find that loan growth increases by 3% of assets, meaning that there is going to be a greater amount of money loaned out to those who have trouble receiving it. While this is beneficial research, a large portion of the funding provided by the CDFI Fund is left out of the analysis, leaving the direct effects of those investment dollars unknown, and on top of that, the analysis only yields a growth effect of CDFI Fund grant dollars, not analyzing the broader county-level impact, although this could also be a result of limited data at the time.

Lenton and Paul Mosley (2013), "Financial Exit Routes from the 'Poverty Trap': A Study of Four UK Cities," analyzes the effect produced from CDFI loans on low-income households and focuses on the loans coming after the 2008/2009 recession. The paper uses a three-stage least squares estimate and finds that the loans, mixed with the financial literacy resources provided by the CDFI, had a strong effect on low-income households being able to exit from poverty. While the paper evaluates the direct effect of CDFI funds, it only uses a small population of 360 households in its data. This makes the dataset fairly small and harder to generalize for the broader public, and a focus on multiple counties could yield good analysis on how the CDFI dollars affect different areas. Not only this, the research is from the UK, instead of the US, where a number of factors are different.

Kolodinsky, Stewart, and Bullard (2006), "Measuring Economic and Social Impacts of Membership in a Community Development Financial Institution," evaluates the social benefits effects of CDFI involvement in communities, using combined economic and social metrics to analyze impact. The paper ultimately concludes that CDFIs provide a very strong social impact due to clients being able to pay off their debts and be confident for the future. While this study provides strong insight into the social effects of CDFI funding, it, like many other papers, is limited in scope, as the data was only related to one CDFI. There was also no prolonged time metric, as the social metrics were measured very soon after CDFI involvement, leaving no analysis over lasting or delayed effects.

Harger, Ross, and Stephens (2015), "What Matters More for Economic Development, the Amount of Funding or the Number of Projects Funded? Evidence from the Community Development Financial Investment Fund," evaluates the effect of CDFI and NMTC funding on the number of new businesses in low-income areas, finding that it appears to be the size of the

loan amount that has an effect on an area, not the total number of loans given. This paper gives one of the few recently published insights into macroeconomic effects of CDFI funding; however, it is wholly generalized to the country, only focusing in areas at a certain income level, leaving a geographic focus nonexistent. Due to the variable nature of funding and macroeconomic effects in different regions with different purchasing powers, a further specialization in one region could have yielded more applicable results related to this research, but the analysis, itself, was sound and did yield an effect of funding, giving hope that the macroeconomic effects at a county-level will prove similarly in Arkansas.

Compared to the current economic research that has been done on the Community Development Financial Institution Fund, this approach will be focused on macroeconomic effects (poverty rates, homeownership rates, unemployment rates, and per capita personal incomes) and analyzed over a zero-to-three-year period in low-income counties that received large amounts of CDFI Fund investment. Previous research on the question remains focused on non-macroeconomic metrics and on CDFI-specific resources, rather than the Fund's; however, in order to help test if the funds are being efficiently used, one could expect there to be sustained growth that could possibly be seen as soon as a year after taking place. This new approach will have an updated dataset up to 2021 and only include counties that are in Arkansas. Much of the current research touches on the fact that the actual distribution of investment resources is the most variable and significant factor of the CDFI Fund, which indicates that geographical variation might have a strong effect on what the influence of investments entails.

While research might not have been conducted on areas that received CDFI Fund investment due to the lower nature of the typical investment compared to a whole city's GDP level, by focusing on low-income Arkansas counties in which towns that receive funds have

relatively small populations and aggregate income, the investment totals have the potential to have noticeable effects. For example, Camden, Arkansas had a total of $7,000,000 invested from the CDFI fund in 2020 alone. This is extraordinarily high for a town that only has 10,000 residents. There are lots of examples in the state that are just like this, leaving the potential for large effects in the region, and the area is one that needs to be researched better, as Arkansas has the third lowest median household income[3] and sixth highest poverty rate[4] in the nation. This would mean that there are pertinent policy implications that could be brought about by the results of the research conducted in the paper and through this approach.

Lastly, the inclusion of 2020 and 2021 allows for the pandemic, and correspondent lockdown, period to be incorporated in the regressions. The CDFI Fund could be expected to have a very pronounced effect due to the near-complete slowing of the economy for the large part of a year in which low-income, underserved communities were hit especially hard during the global recession. However, due to the limited nature of data available for such a recent event, the extended effects are limited in scope, as all but one macroeconomic metric being regressed only date up to 2021. This may be a silver lining, though, as it would add an extra layer of difficulty in controlling for external federal funding, such as the Paycheck Protection Program that was issued during the same year and is hard to track.

Most importantly, however, the linear regression estimations will use data from the past two decades and examine the influence of CDFI Fund investment, rather than bank-specific personal loans, on macroeconomic factors, leading to new research in a minimally studied field.

[3] U.S. Census Bureau, 2021
[4] Gilligan, Chris, 2023

3. Data

Diving deeper into the datasets, the data seems up to the task of achieving the research goal at hand. Looking first at the Community Development Financial Institution (CDFI) Fund expenditure/investment dataset, which covers up to 2021 in its most recent public release under the U.S. Department of the Treasury, there are thirteen variables included, and its earliest receipt dates back to 2001. The variables include project and transactions ID number, Census tract, a metropolitan/non-metropolitan indicator, origination year, Community Development Entity (CDE) name, investment amount, city, state, zip code, purpose of investment, QALICB type, and an indicator of whether it is a multi-tract QLICI. Since the focus of the dataset will only be on Arkansas investment from the fund, the 18,618 investments can be narrowed down to 221, and the oldest investment date is now 2004, rather than 2001.

After sifting through the data to only include datapoints in Arkansas, there appears to be a large array of counties that have received a significant amount of CDFI Fund investment. Due to the fact that the emphasis is on low-income counties in the state and those that are historically underserved, the large-metropolitan area investments can be ignored, as there are a lot of confounding variables and other sources of federal funding. These cities include Little Rock, North Little Rock, Hot Springs, Fayetteville, Rogers, and Springdale. This narrows the data down to 22 counties, which are Drew, Jefferson, Monroe, Van Buren, Desha, Arkansas, White, Mississippi, Howard, Franklin, Ouachita, Faulkner, Stone, Jackson, Crawford, Johnson, Bradley, Clark, Phillips, Union, Sebastian, and Lawrence County.

Continuing in the examination of the Arkansas investments of the dataset, there looks to be mix between business financing, real estate, and other investment types. The three category types are defined below by the U.S. Department of Treasury:

"**Real Estate QALICB:** Financing provided to a Real Estate QALICB refers to entities whose predominant business activity (e.g. more than 50 percent of gross income) is the development (including construction of new facilities and rehabilitation/enhancement of existing facilities), management, or leasing of real estate that will be sold or leased to third parties.

Non-Real Estate QALICB: Transactions with QALICBs whose predominant business activity includes all other types of business activities other than those listed above should be classified as Non-Real Estate QALICBs regardless of: 1) how the business intends to use the proceeds of the transaction; or 2) whether the business intends to use any real estate owned as collateral for a loan.

Special Purpose Entity QALICB: Loans or investments made to a special purpose entity that is controlled by or under common control with an Operating Business, and that was set up specifically to lease the property back to the Operating Business such that the Operating Business is the principal user of the property, must be classified as a Special Purpose Entity QALICB. An Operating Business is the principal user of the QALICB's property if it is the occupant of a majority (i.e., greater than 50%) of the rentable square footage of the QALICB's property. The QALICB may lease the balance of its property to one or more third parties. The term "Operating Business" is defined in the glossary of the 2014 MTC Allocation Application."[5]

All three of these investment types will be included in the regressions, for all could be expected to have an effect on the macroeconomic metrics. If the estimates produced are statistically significant, an examination of each investment type's individual effect on the metrics will be

[5] "Allocatee (CDE) Transaction Level Report Data Point Guidance for AMIS," *CDFI Fund, 2021*

warranted. With the examination finished, it appears that this dataset does not possess any foreseeable problems or lack any necessary information.

Turning to the second dataset, the source of the data is Federal Reserve Economic Data (FRED), which is published and maintained by the Federal Reserve Bank of St. Louis. The data extracted from the source is the estimated percent of people of all ages in poverty (poverty rate) for each county being used. The U.S. Census Bureau provides these annual estimates through its Small Area Income and Poverty Estimates (SAIPE) program. These estimates are not direct counts, but instead, they are derived by modeling income and poverty estimates through the combination of survey data, population estimates, and administrative records. There are only two variables provided – time and the estimated poverty rate. The data dates back to before the first recorded CDFI Fund investment and up to 2021. The only downside of the dataset is that there is no available data for 2022, meaning the delayed investment effect will be limited for some of the more recent observations, as previously mentioned.

Moving on to the third dataset being used in the research analysis, the source of the data is, once again, Federal Reserve Economic Data (FRED). The data being used is the homeownership rate (5-year estimate) at a per-county basis. The homeownership rate is calculated using data provided by the U.S. Census Bureau and is the estimated total county population in owner-occupied units divided by the estimated total county population. The Bureau defines a housing unit as owner-occupied if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. While the original intent was to use median property value at a per county basis, the data was unexpectedly elusive and only found to go back up to five years, not including enough datapoints or a wide enough timeframe to be sufficient for my research goals. Therefore, the measurement shifted towards homeownership, which is a very applicable

metric to track when evaluating CDFI Fund investment, especially when focusing on rural areas that have lower levels of apartments/rental properties. The investments made by the CDFI Fund are expected have an effect on homeownership rates if efficient in rural communities and low-income counties. While it is not a perfect measurement, it is still a significant variable to include in the analysis.

Focusing back on the homeownership rate dataset, itself, from FRED, there are only two variables provided, the homeownership rate (5-year estimate) and time. The data goes back to 2009 and is recorded annually. The sole foreseeable issue with the dataset is that it only dates back to 2009. This poses a potential problem, as some of the CDFI Fund investments from the previous dataset date back to 2004. To solve this issue, the best course of action appears to be to only include investments made in 2009 and beyond when regressing for homeownership rate as the dependent variable. While some investments will be left out as a result of doing so, it is the best way to manage the analysis with the available data.

Transitioning to the fourth dataset, the source of the data is Federal Reserve Economic Data (FRED). The metric derived from the site is the unemployment rate at a county-basis. The observations are provided at a monthly frequency, so the yearly rates being used come from the January 1st observation for each year, which is in line with the annual frequency metrics provided by FRED. The data provided comes from the U.S. Bureau of Labor Statistics' Current Population Survey (CPS), which is also known as the household survey. The unemployment rate used is the unemployed percent of the civilian labor force and uses the standard economic definitions of each term in the calculation. Two variables are included for each county – time and the unemployment rate. Similar to the poverty rate metric, the data spans back to before the first recorded CDFI Fund investment; however, the unemployment rate does include 2022

observations, allowing for the delayed investment effects to be further tested for this macroeconomic metric compared to the others.

Shifting to the fifth dataset, the source remains the Federal Reserve Economic Data (FRED). The metric being used is per capita personal income at a county-level, annual basis. This data comes from the U.S. Bureau of Economic Analysis in its "Personal Income by County and Metropolitan Area" release. It is important to note that personal income is the income that is received by persons from all sources, meaning that it is calculated as the "sum of wages and salaries, supplements to wages and salaries, proprietors' income with inventory valuation and capital consumption adjustments, rental income of persons with capital consumption adjustment, personal dividend income, personal interest income, and personal current transfer receipts, less contributions for government social insurance."[6] Yet again, two variables are provided – time and the per capita personal income metric. The data dates back to before the first recorded CDFI Fund investment, but unfortunately, it does not include 2022 as an observation.

Concluding the dataset examinations with the sixth and final dataset, it, again, comes from Federal Reserve Economic Data (FRED). The last metric originating from the source is resident population at an annual, per-county basis. FRED obtains this data from the U.S. Census Bureau. The population estimates use yearly data on births, deaths, and migration to calculate any population change that has occurred since the most recent decennial census. Time and the population estimate are the only variables provided, and the data spans across all of the investment years being used. This data will be used in conjunction with per capita personal income to calculate aggregate income.

[6] Federal Reserve Bank of St. Louis, 2023

4. Empirical Design and Strategy

A previous attempt looking for a relationship between CDFI Fund investment and different macroeconomic metrics used a difference-in-differences approach. The DID approach allowed for the effects of the investment to be estimated and indicate how things would have turned out in the "treated" counties had they not received the exogenous investment by using the control group counties as the baseline. This, of course, was held under the assumption that parallel trends were present, meaning that if the treatment did not take place, the control and treatment groups would have had a constant difference.

Before diving into the regression equation used, the key variables are defined below (the $Y_{1,\,i,\,c,\,t}$ variable changed to total employer establishments and poverty rate in the two other DID regression types):

$Y_{1,\,i,\,c,\,t}$ = *homeownership rate of citizen i in county c and in period t if there is CDFI Fund investment*

$Y_{0,\,i,\,c,\,t}$ = *homeownership rate of citizen i in county c and in period t if there is no CDFI Fund investment (counterpart of* $Y_{1,\,i,\,c,\,t}$*)*

$D_{c,\,t}$ = *a dummy variable that represents whether or not there is CDFI Fund investment in county c and time t –* $D_{c,\,t}$ = *1 if there is, and* $D_{c,\,t}$ = *0 otherwise*

γ_c = *county fixed-effect*

λ_t = *time fixed-effect*

Under the model, the identification assumption was made, meaning that when there was no CDFI Fund investment, the expected homeownership rate in the triple *i,c,t* was $E[Y_{0,\,i,\,c,\,t} \mid c, t] = \gamma_c + \lambda_t$,

connoting that there was an additive structure of a county fixed-effect γ_c and a time fixed-effect λ_t. Lastly, letting $E[Y_{1, i, c, t} - Y_{0, i, c, t} \mid c, t] = \delta$, the equation was verified:

$$Y_{i, c, t} = \gamma_c + \lambda_t + \delta * D_{c, t} + \epsilon_{i, c, t} \text{ where } E[\epsilon_{i, c, t} \mid c, t] = 0$$

Going further,

$$E[Y_{i, c, t} \mid c = \text{county that did not receive CDFI Fund investment, } t = \text{post-treatment}] - E[Y_{i, c, t} \mid c = \text{county that did not receive CDFI Fund investment, } t = \text{pre-treatment}] = \lambda_{post} - \lambda_{pre}$$

$$E[Y_{i, c, t} \mid c = \text{county that did receive CDFI Fund investment, } t = \text{post-treatment}] - E[Y_{i, c, t} \mid c = \text{county that did receive CDFI Fund investment, } t = \text{pre-treatment}] = \lambda_{post} - \lambda_{pre} + \delta$$

Thus, the population DID was the causal effect of interest:

$$\{E[Y_{i, c, t} \mid c = \text{county that did receive CDFI Fund investment, } t = \text{post-treatment}] - E[Y_{i, c, t} \mid c = \text{county that did receive CDFI Fund investment, } t = \text{pre-treatment}]\} - \{E[Y_{i, c, t} \mid c = \text{county that did not receive CDFI Fund investment, } t = \text{post-treatment}] - E[Y_{i, c, t} \mid c = \text{county that did not receive CDFI Fund investment, } t = \text{pre-treatment}]\} = \delta$$

The approach used six treatment counties and ten control counties that corresponded to the “did receive” and “did not receive” counties in the equation above. Three metrics of interest were used – homeownership rate, total employer establishments, and poverty rate – as well as the treatment years of only 2014, 2015, and 2017. The metrics in the post-and-pre-treatment period

were taken as their average of a year and a half before/after the treatment. Ultimately, the δ, the casual effect of interest, was found to be statistically insignificant for all counties and years tested.

The approach above was too limited in nature, only regressing a couple of counties across three years. In order to get an accurate estimate of the effect of CDFI Fund investment on macroeconomic metrics, more observations need to be included and span from the Fund's first investment in Arkansas up to the present day, only eliminating those made in high-income counties. In order to accomplish this, the regression model will shift from a DID approach to a pooled multiple linear regression model. This model estimates the relationship between variables by fitting a line to the observed datapoints. After only excluding the counties in which large sources of outside funding and growth occur, as previously mentioned, there are a total of 49 investments across 22 counties. The mean investment value in the data is $8,807,175.88, and the median value is $2,540,000.00. The years included range from 2004 to 2022, creating a total of 418 observations (one for each of the 22 counties and 19 years). When the regressions are run, observations for years in which the macroeconomic metrics are not available will not be included. Returning back to the model, the key variables in the equation are defined below:

$y_{i,t}$ = *predicted value of the macroeconomic metric (dependent variable) for any given value of* $x_{i,t}$

$x_{1\,i,t}$ = *CDFI Fund investment (independent variable)*

$x_{2\,i,t}$ = *1-Year delay CDFI Fund investment (independent variable)*

$x_{3\,i,t}$ = *2-Year delay CDFI Fund investment (independent variable)*

$x_{4\,i,t}$ = *3-Year delay CDFI Fund investment (independent variable)*

$x_{5\ i,\ t}$ = *time-dummy variable*

$x_{6\ i,\ t}$ = *county-dummy variable*

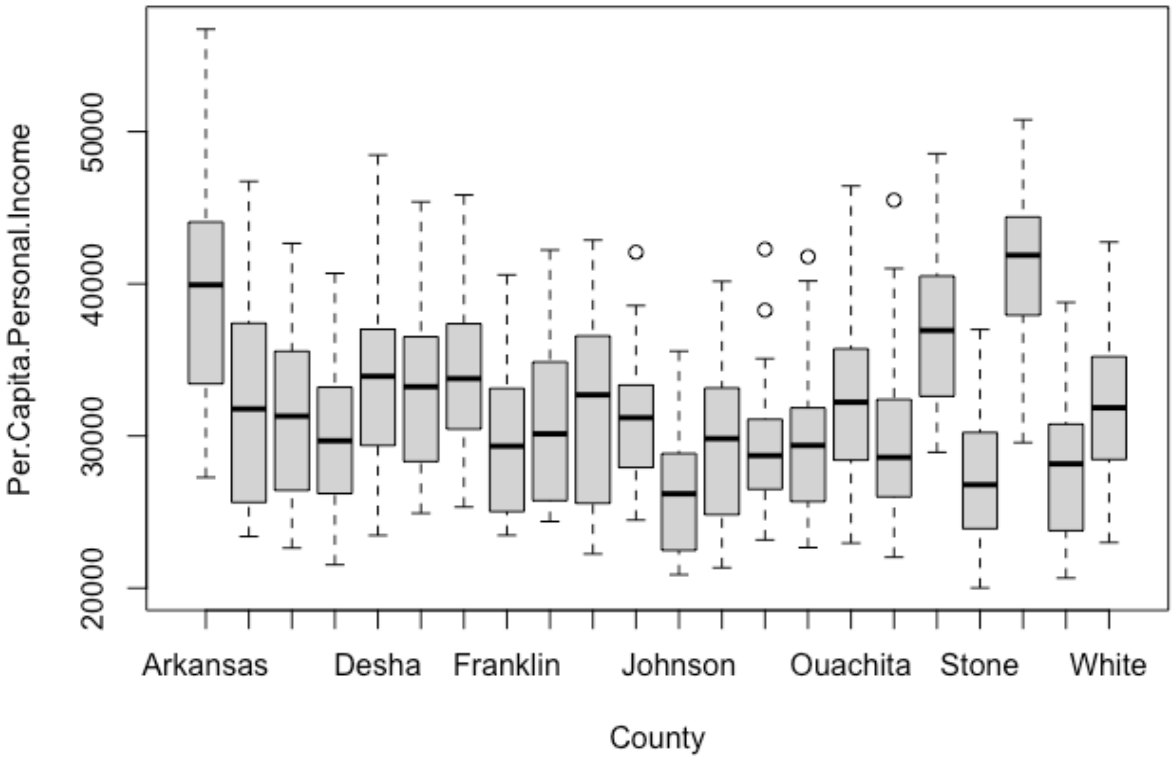
These variables fit into the multiple linear regression equation:

$$y_{i,\ t} = \beta_0 + \beta_1 * x_{1\ i,\ t} + \beta_2 * x_{2\ i,\ t} + \beta_3 * x_{3\ i,\ t} + \beta_4 * x_{4\ i,\ t} + \beta_5 * x_{5\ i,\ t} + \beta_6 * x_{6\ i,\ t} + \epsilon_{i,\ t}$$

(The β values represent the regression coefficients)

Focusing on the variables in the equation, given that there are numerous multi-million-dollar CDFI Fund investments, it can, undoubtedly, take time for the money to be distributed and the project to be completed, resulting in its effect on macroeconomic metrics being potentially delayed. To account for this in the model, additional independent variables are created to lag investments by one, two, and three year increments and can be seen through $x_{2\ i,\ t}$, $x_{3\ i,\ t}$, and $x_{4\ i,\ t}$. The investment variables are the first to have controls added in order to strengthen the relationship being tested and help prevent confounding variables from interfering with the estimates.

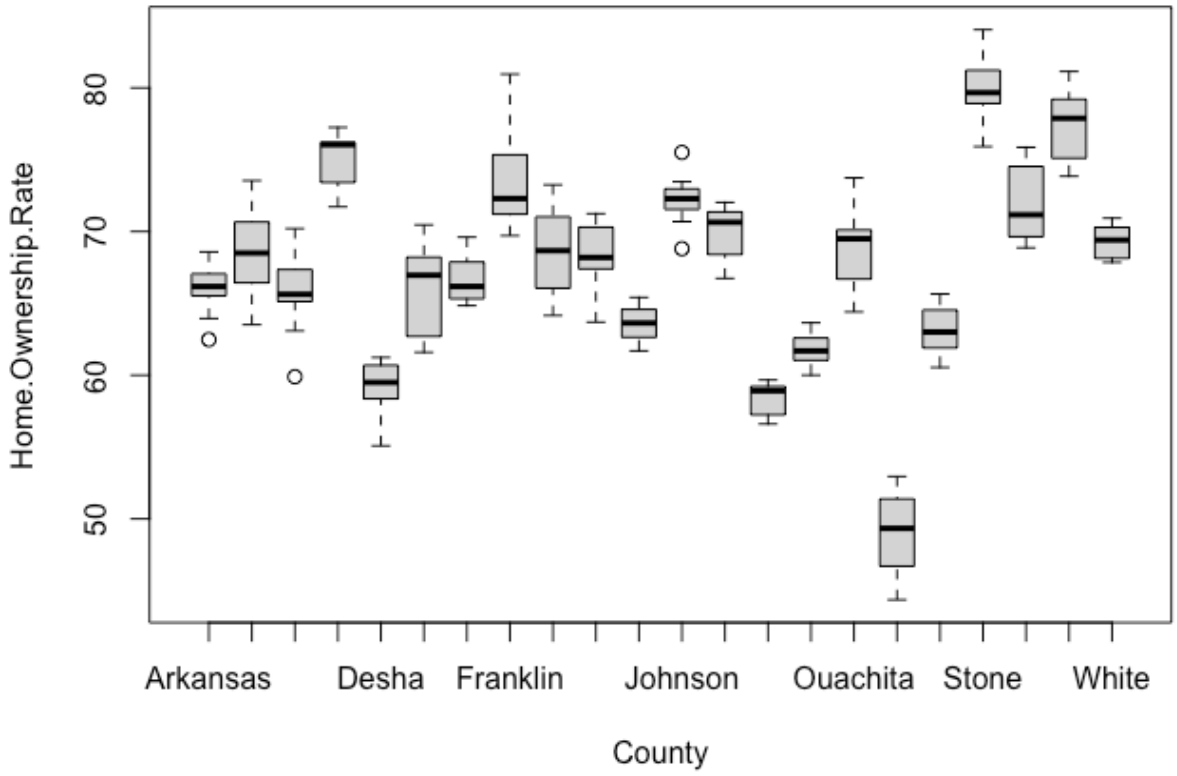
Figure 1: Per Capita Personal Income ($) Data Visualization



As seen in the Figure 1 boxplot, the per capita personal income varies by year and county to a noticeable degree, and this trend extends to population as well. Therefore, in order for investment to have an equivalent impact across counties, the values have to be scaled. In order to do so, the investment is divided by aggregate income (population*per capita personal income) for each respective year. Transitioning to the second control included in the model, the time-dummy variable is included in order to account for business cycles and other seasonality that might confound the investment's effect on the dependent variables. These variable values are straightforward, with each observation in the dataset only taking one of two values for each year's time dummy – a one for a given year and a zero for all other years (resulting in 19 time-dummy variables, one for each year). This same practice is used for the county-dummy variable, assigning a one for a given county and a zero for all other counties in each observation (creating

22 county-dummy variables, one for each county). Looking at Figure 2 below, the homeownership rates all appear to be similarly skewed; however, there are a couple of counties with rates both below and above the majority of the others', meaning that the linear regression model will likely create an intercept that does not properly estimate the homeownership rate if not controlled and scaled properly. This stretches to the other macroeconomic metrics being used, making it critical to include the county-dummy and scaled investment variables.

Figure 2: Homeownership Rate (%) Data Visualization



With the general econometric model previewed above, a focus on the trends and regressions being used for the research can now be achieved. In total, there will be four primary

multiple linear regressions run, with them only differing by which macroeconomic metric – poverty rates, homeownership rates, unemployment rates, and per capita personal incomes – is being used as the dependent variable. Looking first at the general trends for each metric across counties in Figures 3 – 6, a consistent pattern appears to be present. Almost every county follows the same trend across time; however, there are a number of data points that take a sudden jump or fall when the rest of the counties continue on their normal trend, hinting that something is causing county-specific shifts away from mean changes in certain years. Turning the attention to

Figure 3: Poverty Rate Trends

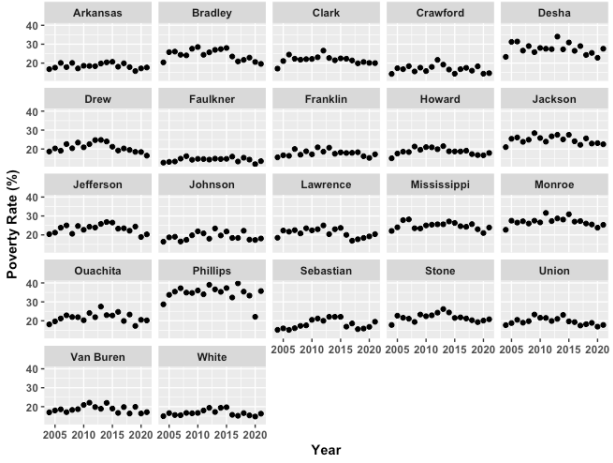


Figure 4: Homeownership Trends

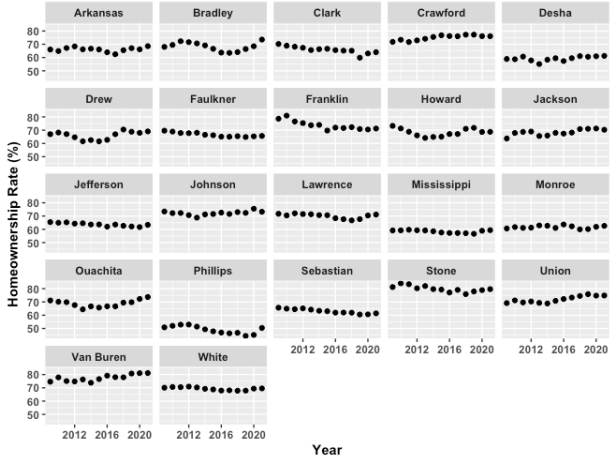


Figure 5: Unemployment Rate Trends

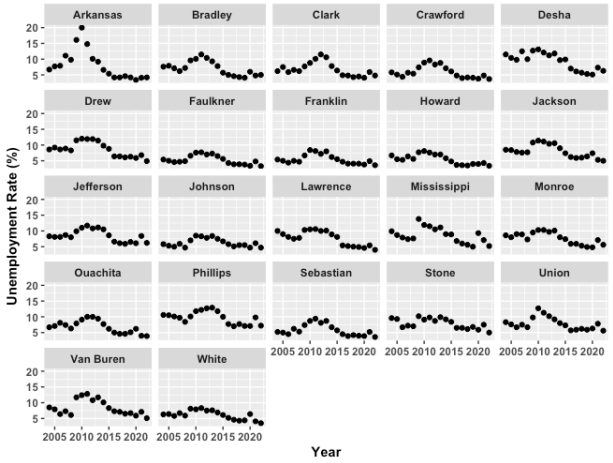


Figure 6: Per Capita Personal Income Trends

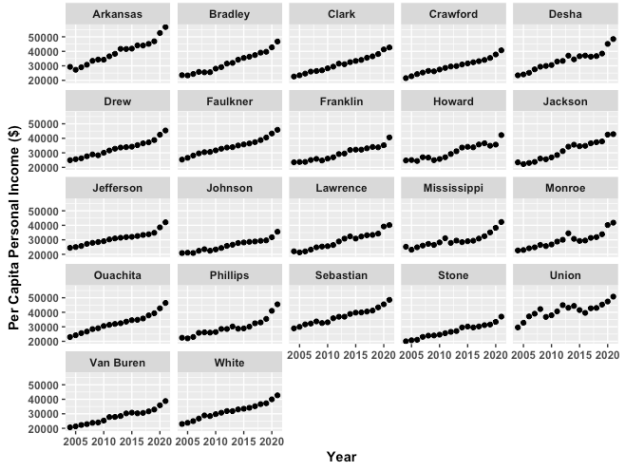
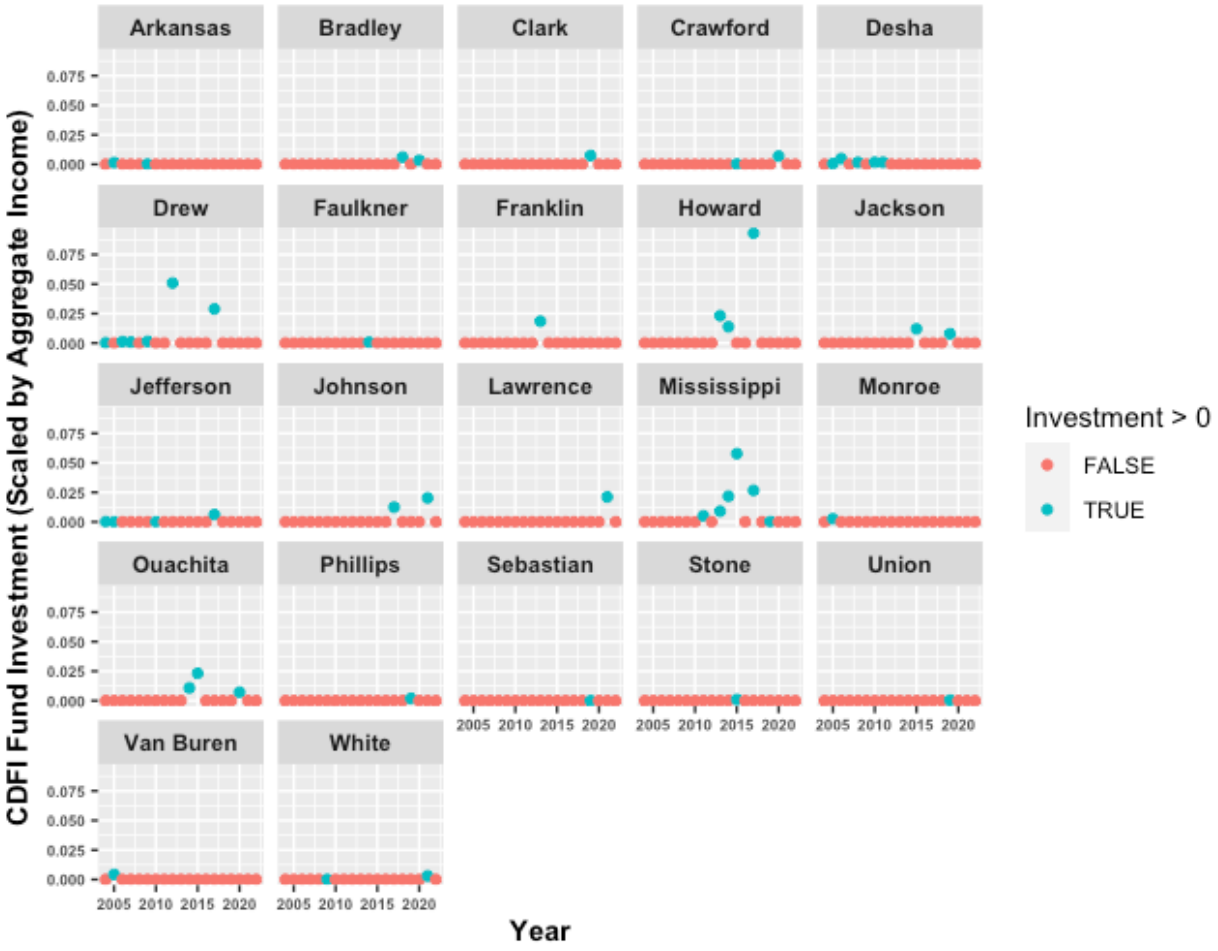


Figure 7, the yearly (scaled) investment made in each county is illustrated and allows for a surface-level analysis to occur in an attempt to see if any deviations in the macroeconomic metric trends correlate to when investment occurred. In the Figure 7 graphs, years in which investment occurred are highlighted by blue dots, and those when no investment occurred are marked by reddish dots. A brief examination yields hints of a relationship being present. For example, Phillips County investment made just before 2020 seems to correlate with a large jump in both the homeownership rate and per capita personal income soon afterwards, two shifts in the trends that are noticeably greater than in the other counties at the same time. This concept can be seen for an array of other counties as well. For instance, the Bradley County and Drew County investments seem to cause a similar effect on their respective homeownership rates in the period during and directly following their funding. While conclusions cannot be drawn from this evaluation of trends, it is a good method of visualizing the data and correlations and creates promising curiosity about the results of the regressions.

Figure 7: CDFI Fund Scaled Investment Per County



5. Results

The results of the four primary regressions run, one for each macroeconomic metric being used as the dependent variable, are displayed below in Table 1. With the only coefficients of interest being those of the scaled investment variables, as they will indicate whether or not a relationship exists between CDFI Fund investment and county-level macroeconomic metrics, the 19 time-dummy and 22 county-dummy variable coefficients were not included and only indicate expected $y_{i,t}$ differences between each year and county from the intercept.

Table 1: Regression Estimates

	(1) Poverty Rate	(2) Homeownership Rate	(3) Unemployment Rate	(4) Per Capita Personal Income
Intercept	19.719*** (0.512)	71.249*** (0.743)	5.046*** (0.327)	41,249.4*** (454.7)
Scaled Investment	11.474 (12.839)	-13.194 (17.479)	3.679 (8.289)	-9,970.1 (11,397)
1-Year Delayed Scaled Investment	2.759 (13.173)	6.628 (17.952)	-0.295 (8.288)	-2,457.3 (11,693.7)
2-Year Delayed Scaled Investment	-5.569 (13.216)	5.413 (18.018)	2.204 (8.503)	-19,833.1 (11,732.1)
3-Year Delayed Scaled Investment	10.944 (13.276)	-8.210 (18.113)	4.660 (8.533)	-31,875.7*** (11,786.0)
Adjusted R^2	0.889	0.906	0.820	0.952

Standard errors in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01

Before diving into the coefficient estimates of the regression outputs in Table 1, a note about the Adjusted R^2 value needs to be mentioned. While the statistic typically indicates how well the model fits the data and is the proper one to look at in a multiple linear regression, as compared to the Multiple R^2 value, the use of such a high number of predictor variables (the time-dummies and county-dummies) can inflate this value and mislead the model's fit. To get a better picture of how well the model fits the data, the Quantile-Quantile (Q-Q) plots of the regressions can be

examined to see how normally distributed the residuals are. While not a perfect method, it allows for an assumption of the linear model to be strengthened. Looking at Figures 8-11, below, the poverty rate and homeownership rate regression residuals appear to be fairly normally distributed, indicating that the model is a good fit for the data with a limited number of outliers; however, this does not appear to be the case for the unemployment rate and per capita personal income regressions (fat tails and many outliers), suggesting a violation of an assumption made under the linear regression model and that the coefficient estimates produced need to be taken tentatively and not causally.

Figure 8: Regression (1) Q-Q Plot

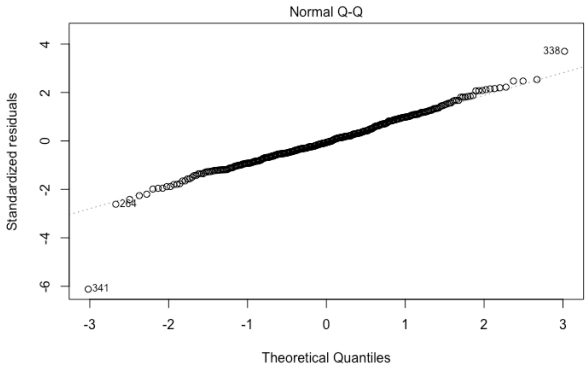


Figure 9: Regression (2) Q-Q Plot

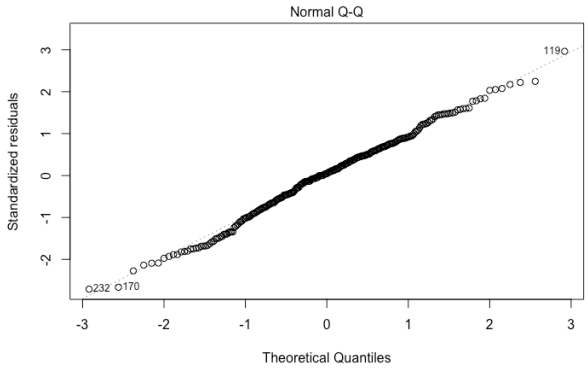


Figure 10: Regression (3) Q-Q Plot

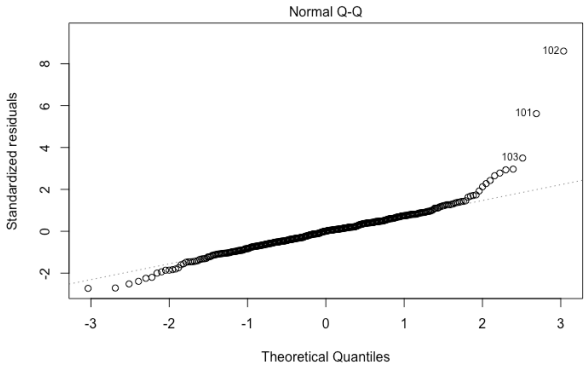
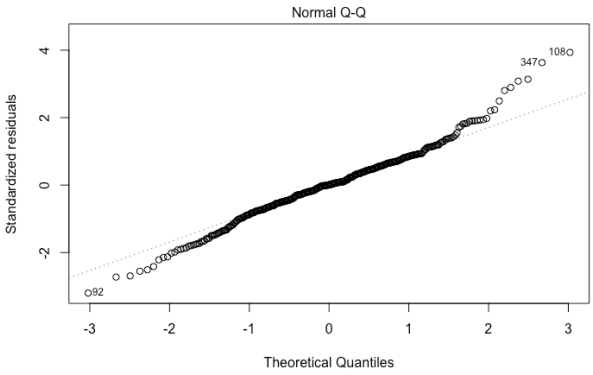


Figure 11: Regression (4) Q-Q Plot



Turning to the estimates, the intercept coefficient estimate provides the expected value of the macroeconomic metric (dependent variable) when there is zero CDFI Fund investment (independent variable). Next, the scaled investment coefficient estimates are the expected change in the intercept value for each unit of scaled investment. Given that the scaled investment values are small compared to one, as seen in Figure 7, the investment estimate values in Table 1 appear extreme for a one unit change but simply have to be scaled down for a more accurate picture in order to reach the unit change size of an average investment. However, this analysis appears to not be necessary, as there are no statistically significant relationships present between investment and any of the four macroeconomic metrics. The p-values for all but one coefficient estimate are extremely high, and the standard errors follow a similar pattern. The only statistically significant investment coefficient produced is one of the delayed effect investments for per capita personal income and indicates a negative relationship (investment caused a drop in income), but this correlation should be considered spurious due to its illogical nature and most likely a result of the data not being normally distributed, as seen from Figure 11. Because none of the CDFI Fund investment coefficient estimates are statistically significant, the model fails to reject the null hypothesis and thus does not provide sufficient evidence that a relationship exists between CDFI Fund investment and any of the four macroeconomic metrics tested – poverty rates, homeownership rates, unemployment rates, and per capita personal incomes.

6. Conclusion

Looking at the results of the multiple linear regressions, the data indicates that there is not enough evidence to posit that CDFI Fund investment has an effect on macroeconomic metrics in low-income Arkansas counties. Although not the anticipated result, the results are still significant

and highlight the need for more research. The results found that investment effects were not seen between a zero and three year period following the initial funding; however, with many of the project following a multi-year tract, the influence of such large funding in low-income areas could very understandably take more than three years to come into effect. The delayed time effect was held at a three year maximum in this study, for each additional delayed year further limited the amount of datapoints, which were already not in abundance. Outside of the four metrics tested for, additional research evaluating different metrics could find a statistically significant relationship present. At a state level, Arkansas has not had a statistically different 3-Year Average Official Poverty Rate from 2009-2011 to 2019-2021[7], serving as evidence that the included metrics might not be the best to test for. Not only this, a shift away from the use of a linear model could better analyze whether a relationship exists between investment and macroeconomic metrics. Two of the four metrics included were shown to not fit the model very well, and a new approach could yield statistically significant results. For instance, a time-series model could fit the data better and track the variables across each year, yet there is still the possibility that the limited number of data points available could be constraining. Additionally, the inclusion of county budgets as a scaling method or as a control could prove useful to future research, and were intended to be included in this study, but only eight out of seventy-five Arkansas counties post their annual budgets online for public viewing, leaving the majority of counties merely publishing an appropriation notice in the paper of record, due to it being a legal requirement. As a result, it is extremely difficult to find county budget records, especially ones that date back nearly two decades. While these are just a few considerations for further research,

[7] Shrider, Em, 2023

the need for it is evidently present due to its limited nature and huge policy implications if relationships are found to exist.

It is worth noting in the analysis of the results that the CDFI Fund does not incorporate the incredible widespread work that Community Development Financial Institutions (CDFIs) do for underserved communities across the country and especially in Arkansas. On top of providing traditional banking services, they provide lending and financial literacy resources that have a significant impact on the communities that they serve. An analysis using CDFIs' lending and resource data has the strong potential to show a relationship between its resources and county-level effects, especially for rural areas of Arkansas that have limited access to capital sources, if a researcher were granted access to this data.

However, ultimately, the research showed that CDFI Fund investment appears to not have an impact on the county-level macroeconomic metrics of poverty rates, homeownership rates, unemployment rates, and per capita personal incomes in Arkansas counties, but it strengthens the idea that more research is needed on the topic.

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