

Final Paper – Difference-in-Difference Analysis

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1 Research Question

The state child support agency introduced a novel program aimed at providing intensive case management services to non-custodial parents (NCPs) in selected local child support sites across the state. The objective of the program was to assist NCPs in finding jobs, making child support payments, and developing better relationships with their children and custodial parents. The program was administered in selected local child support sites across the state, and in these sites, the program was also rolled out at varying dates. To evaluate the effectiveness of the program, we propose using a Difference-in-Difference (DD) research design, which would allow us to compare outcomes between the selected sites and non-selected sites. Specifically, we aim to examine the program's impacts on the likelihood of NCPs owing child support debt and employment of both NCPs and single mothers.

2 Methodology and Findings

In this setting, a Difference-in-Difference research design can be used to examine the impacts of the intensive case management services on the likelihood of owing child support debt and employment of NCPs and single mothers. The DD design compares the outcomes of NCPs and single mothers who received the intensive case management services in the selected local child support sites (the treatment group) with those who did not receive the services in the non-selected sites (the control group). The DD design allows researchers to isolate the impact of the intensive case management services from other factors that

might affect the outcomes, such as changes in the state or national economy or policy changes.

To ensure the validity of the results of the experiment, it is crucial to confirm that we have varying dates of treatment before the experiment. This allows for a more robust comparison between the sites that received the intervention and those that did not. Without such variation, it would be challenging to determine whether any changes in outcomes were a result of the intervention or other factors occurring concurrently. By having different dates of treatment, we can compare outcomes before and after the intervention, which allows for a more accurate estimate of the causal impact of the intervention on the outcomes of interest. It also provides an opportunity to analyze the differential impact of the intervention over time and to identify any changes in outcomes that might be attributed to factors other than the program. Table 1 indicates that out of the total sample size, the control group holds around 69.35% proportion of all NCPs. For the remaining NCPs, the treatment dates varied from as early as 2014 to as late as the third semester of 2016 as shown in Table 2, reflecting the staggered rollout of the program across the selected sites.

Table 1: Distribution of NCPs

Group	Number	Proportion
Control Group	5160	69.35%
Treatment Group	2280	30.65%

Table 2: Distribution of Treatment Group

Date of 1st adoption treatment	Number	Proportion
2014-Q1	40	1.75%
2014-Q2	200	8.77%
2014-Q3	200	8.77%
2014-Q4	80	3.51%
2015-Q1	240	10.53%
2015-Q2	400	17.54%
2015-Q3	160	7.02%
2015-Q4	120	5.26%
2016-Q1	40	1.75%
2016-Q2	360	15.79%
2016-Q3	320	14.04%
2016-Q4	120	5.26%

To conduct a rigorous difference-in-differences (DD) analysis, we need to analyze the data from both the treatment and control groups before and after the implementation of the program. This approach allows us to isolate the effect of the program from other factors that may be affecting the outcomes. We compare the difference in outcomes between the two groups before the program was implemented to the difference in outcomes after the program was implemented. To visualize the impact of the program, we plot the average employment rate for noncustodial parents (NCPs), single mothers, and the fraction of NCPs that owe child support debt over the years, as shown in Figure 1 and 2.

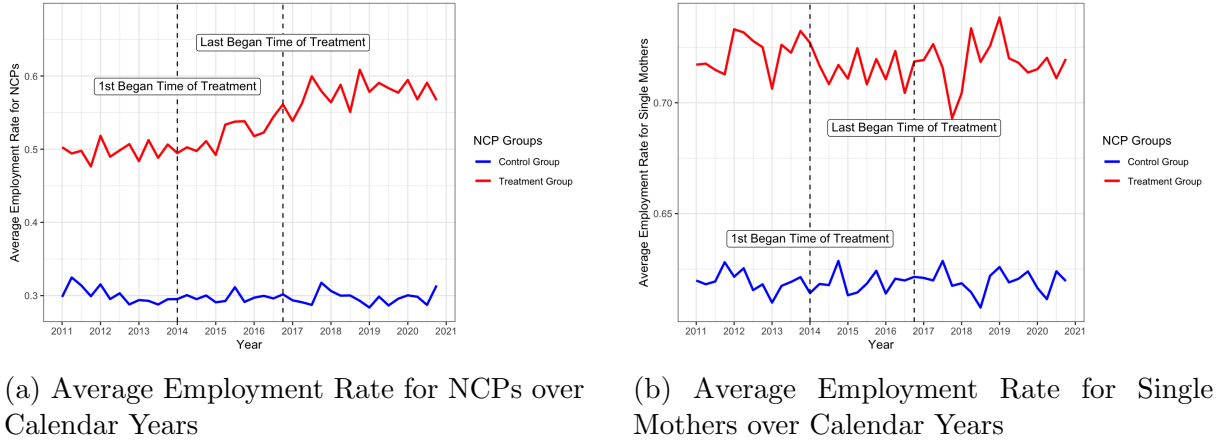


Figure 1: Comparison of Employment Rates for NCPs and Single Mothers

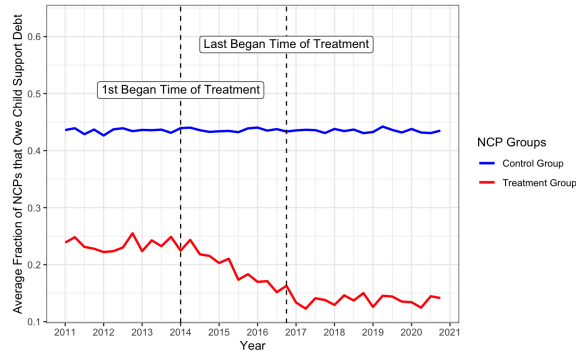


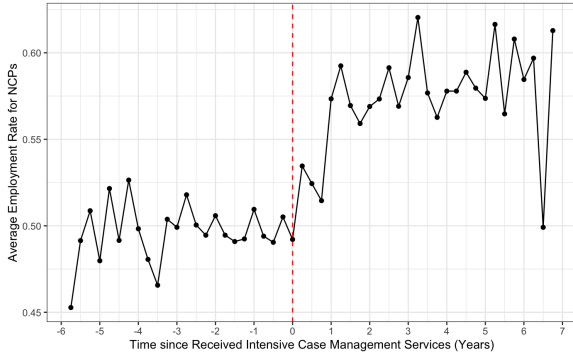
Figure 2: Average Fraction of NCPs Owe Child Support Debt over Calendar Years

Our findings reveal an upward trend in the average employment rate for NCPs who received treatment, accompanied by a steady decline in their debt fraction. Conversely, there is almost no change in the trends for NCPs in the control group. Additionally, the trends for single mothers in both groups seem similar before and after the program implementation. Interestingly, after the last began time of treatment, the average debt

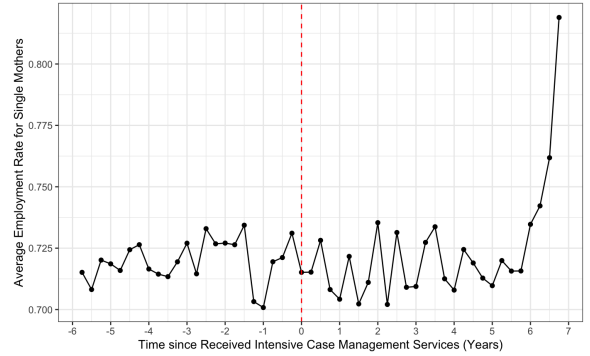
fraction and employment rate for NCPs become steady again.

These results suggest that the DD research design is appropriate for our analysis and that the intensive case management services program may have a positive impact on the employment and debt outcomes of NCPs. The services provided by the program, such as job training and career counseling, have likely helped NCPs secure employment and improve their financial situation. This, in turn, may have led to improvements in their employment rate and reduced child support debt.

To gain a more comprehensive understanding of the long-term impacts of the intensive case management services, we conducted further analysis of the effects of time since treatment on the average employment rate for NCPs, single mothers, and the fraction of NCPs that owe child support debt. After narrowing down the group to only include the treatment group, we plotted the trends between different times since receiving intensive case management services and the employment rate or debt fraction. The results, presented in Figures 3 and 4, showed that the average employment rate or fraction in the treatment group remained relatively stable before the treatment became effective. However, after the treatment was administered, there was a noticeable increase in the average employment rate for NCPs and a significant decrease in the fraction of NCPs that owe child support debt in most years.



(a) Average Employment Rate for NCPs by Time since Treatment



(b) Average Employment Rate for Single Mothers by Time since Treatment

Figure 3: Comparison of Employment Rates for NCPs and Single Mothers by Time since Treatment

Interestingly, we observed a sudden decrease in the employment rate for NCPs and a sudden increase in debt fraction for NCPs after 6.5 years since receiving the intensive

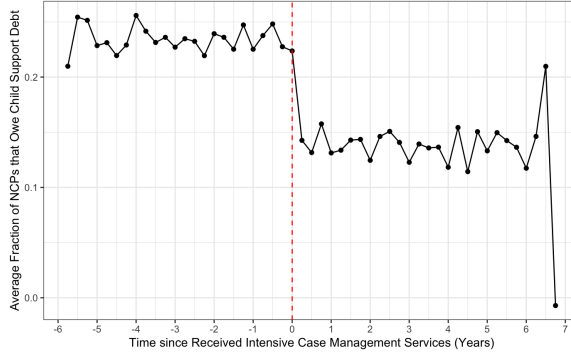


Figure 4: Average Fraction of NCPs Owe Child Support Debt by Time since Treatment

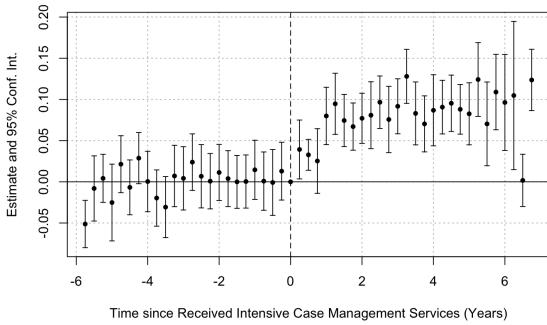
case management services. However, after 6.75 years, there was a noticeable decrease in the debt fraction for NCPs, which is near to 0, suggesting that nearly no NCPs had debt after receiving the intensive case management services for a longer period. Furthermore, the trend for the average employment rate for single mothers throughout the time since they received intensive case management services remained mostly steady, except for a noticeable increase after 6 years. This finding indicates that the intensive case management services may first influence the employment rate for NCPs, and then influence the single mothers' employment rate when the services become effective after several years. Based on our analysis, it is evident that the intensive case management services program has a significant and long-lasting positive impact on the employment and debt outcomes of NCPs. Furthermore, our findings suggest that the program's benefits extend to single mothers, who experience an increase in their employment rate after several years of receiving the services. Therefore, the intensive case management services can be considered effective in improving the economic well-being of both NCPs and single mothers in the long run.

To estimate the impact of the intensive case management services on the employment rate and debt fraction of NCPs and single mothers, we conducted a regression analysis using the Difference-in-Difference (DD) research design:

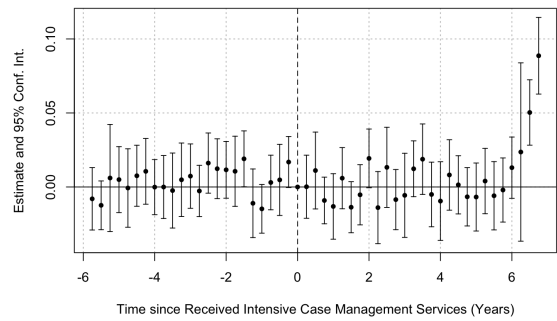
$$\gamma_{it} = \alpha_0 + \alpha_1 T_i + \sum_{k \neq 0} [\delta_k D_{ik}] + \gamma_n + \gamma_s + \gamma_t + \epsilon_{it}$$

where γ_{it} denote employment rate (debt fraction) for NCPs or single mothers in year t ,

T_i denote an indicator for receiving intensive case management services, D_{ik} denotes an indicator variable for receiving intensive case management and having time since treatment = k , γ_n denotes the number of NCPs served by the site fixed effects, γ_s denotes site id dummies, and γ_t denotes calendar year dummies. Our regression analysis, as shown in Figures 5, and 6, provides further evidence of the positive impact of the intensive case management services program. The plots reveal that the coefficients for the debt fraction and employment rate of NCPs remain relatively stable over time, indicating that the treatment consistently affects these two outcome variables. However, there is a notable decrease in the coefficient of the debt fraction in 7 years since receiving the program. This could be attributed to the possibility that the long-term effects of the intensive case management services may become more pronounced over time. Additionally, we found an interesting result regarding the relationship between time since treatment and the average employment rate of single mothers. As time since received the intensive case management services increased, this relationship became significant, suggesting a positive spill-over effect of the treatment on single mothers. It is possible that the NCPs' improved financial situation and employment status, as a result of the program, may have indirectly benefited their children and the mothers who rely on child support. Therefore, our analysis provides further support for the effectiveness of the intensive case management services program in improving the employment and financial outcomes of NCPs and potentially benefiting single mothers as well.



(a) Average Employment Rate for NCPs DD Coefficients



(b) Average Employment Rate for Single Mothers DD Coefficients

Figure 5: Comparison of Average Employment Rate for NCPs and Single Mothers DD Coefficients

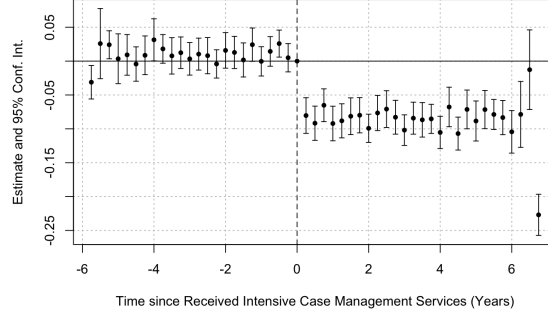


Figure 6: Average Fraction of NCPs Owe Child Support Debt DD Coefficients

To explore the relationship between treatment and outcome variables after the treatment becomes effective, we introduce a new variable called *TAfter*. *TAfter* is defined as *T* multiplied by *After*, where *T* is an indicator for a treatment observation and *After* is an indicator for time since treatment being positive. We then estimate the following regression:

$$\gamma_{it} = \alpha_0 + \alpha_1 T_i + \delta T_i \textit{After} + \gamma_n + \gamma_s + \gamma_t + \epsilon_{it}$$

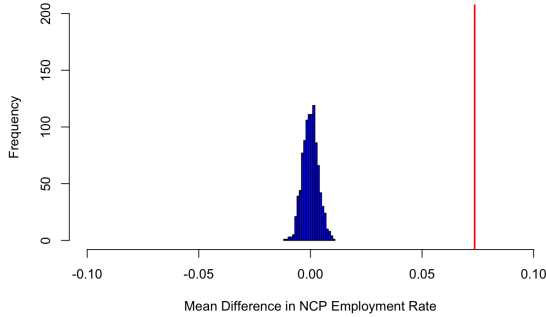
The regression results are shown in Table 3 indicate that the employment rate and debt fraction for NCPs are statistically significant with *TAfter*. This suggests that after the treatment becomes effective, the intensive case management services will increase the employment rate for NCPs by 7.36% and decrease the fraction of debt for NCPs by 9.48%. However, we find that the treatment has no significant relationship with the employment rate of single mothers. This finding also indicates that the positive impact of the intensive case management program on NCPs' employment is not only statistically significant but also economically meaningful as it is associated with a considerable decrease in their debt fraction. The negative coefficient between the employment rate and debt fraction suggests that when NCPs are employed, they are more likely to make their child support payments on time, which can help reduce their outstanding debt. This further emphasizes the importance of providing employment services to NCPs as a way to improve their financial well-being and increase their contribution to their children's lives. Additionally, the regression results indicate that for every 1% increase in the employment rate for NCPs, there is a corresponding 1.289% decrease in the debt fraction for NCPs, which suggests

that even a small increase in the employment rate for NCPs can have a notable effect on reducing their debt fraction.

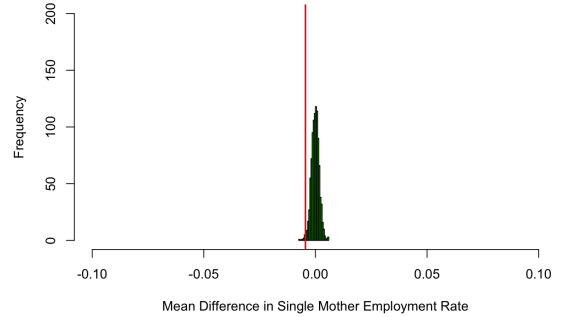
Table 3: Regression Results of TAfter for Each Outcome Variable

Outcome	Estimate	Std. Error	t-value	P-value	Significance
ncp_emp_rate	0.0736	0.005	14.794	0	***
smom_emp_rate	-0.0045	0.003	-1.523	0.133	
ncp_wdebt	-0.0948	0.003	-35.645	0	***

In order to validate the robustness of the experiment, I conducted permutation tests on the three outcome variables to determine if the observed effects were due to random chance. The results of the permutation tests are presented in Figure 7 and 8, where the treatment effects were randomized across 1,000 iterations, and the red lines represent the actual observed treatment effects. The figures provide strong evidence that the effects on the debt fraction and employment rate of NCPs are not due to random chance. Therefore, the results of the experiment can be considered robust and reliable.



(a) Permutation Test for Employment Rate of NCPs



(b) Permutation Test for Employment Rate of single mothers

Figure 7: Comparison of Permutation Test for Employment Rate of NCPs and Single Mothers

3 Conclusion

After analyzing the results of our Difference-in-Difference (DD) research design, we were able to confidently conclude that the treatment group experienced significant improvements in employment rates and a decrease in child support debt fractions. These findings provide strong evidence that the intensive case management services are successful in

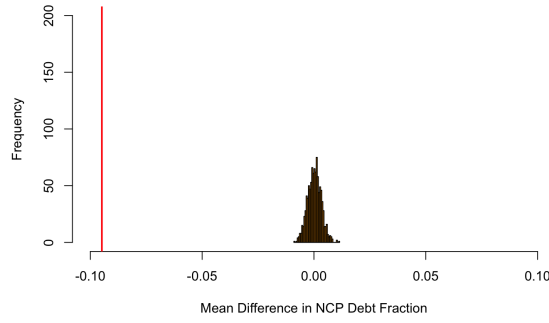


Figure 8: Permutation Test for Debt Fraction of NCPs

achieving their intended outcomes and providing support to NCPs in need. Moreover, the observed positive spill-over effect on single mothers suggests that the program’s benefits may extend beyond the targeted group of NCPs. It is possible that the program’s job training and career counseling services have positively influenced the employment rates of both NCPs and single mothers, leading to a more stable financial situation for both groups. This highlights the potential of intensive case management services to improve the lives of not only NCPs but also their families and dependents.

The findings of our research hold significant implications for policy-makers and practitioners, given that millions of children in the United States are impacted by the issues we have explored. In 2017, approximately 21.9 million children had at least one noncustodial parent living outside their household, constituting 26.5% of all children under 21 years of age in the country (Grall, 2020). Furthermore, children living in noncustodial households have a poverty rate that is three times higher than that of children living with both parents, reaching about 30.1% (Grall, 2020). These factors contribute significantly to the problem of nonpayment and partial payment of child support orders, with only 46% of the ordered amount being received in 2017, and only 30% of those owed child support actually receiving payments (Grall, 2020).

The consequences of nonpayment of child support can be serious and long-lasting, affecting not only the children who miss out on financial support for healthy development but also the custodial parents who may struggle to provide adequate care. Moreover, non-custodial parents who fail to make child support payments may accumulate significant debt, leading to strained relationships with their children and reduced involvement in their

lives (Nepomnyaschy, Emory, Eickmeyer, Waller, & Miller, 2021). Additionally, failure to pay child support can result in incarceration for some noncustodial parents, disrupting the growth and development of their children. On the other hand, research suggests that child support payments are linked to improved academic outcomes, such as higher test scores, graduation rates, and college enrollment (Nepomnyaschy et al., 2021), as well as better health outcomes (Baughman, 2017). Therefore, providing resources or assisting noncustodial parents in accessing resources may be positively and meaningfully linked to both child support payment and earnings, which may ultimately facilitate consistent child support payments (Riser, Meyer, Berger, & Kamble, 2023).

In this context, our results indicate that the introduction of intensive case management services could help improve the employment rates of noncustodial parents and decrease the proportion of child support debt owed. Ultimately, these changes could benefit the well-being of children and their families, which highlights the importance of addressing the issue of nonpayment and partial payment of child support orders in the United States.

References

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