Rural Minimum Living Standard Guarantee (Rural Dibao) Program Boosts Children's Education Outcomes in Rural China

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Abstract

In order to combat poverty in China's rural areas, the Chinese government has established an unconditional cash transfer program known as the Rural Minimum Living Standard Guarantee (Rural Dibao) Program. Many studies have investigated the program's effect on rural households, only to come back with mixed findings. Interestingly, despite the importance of education in breaking cycles of poverty, little is known about Rural Dibao's impact on rural children's education. This study investigates Rural Dibao's impact on rural children's learning outcomes by first examining targeting issues within the program, exploring a causal relationship between Rural Dibao and learning outcomes, and then exploring potential mechanisms and heterogeneous effects. Data from China Family Panel Studies (CFPS) from the years 2010, 2012 and 2014 were used. The results suggest that the Rural Dibao program suffers from high levels of targeting error, yet is still effective (i.e. program transfers generally still go to people in need). The fixed effects models find that program participation raises rural children's standardized test scores in CFPS Chinese-language and math tests. In investigating mechanisms, increased education and food expenditures seem to connect Rural Dibao participation to increased learning results. The heterogeneity analysis shows that poorer, non-eastern children benefit from the program (while others have no effect). These findings suggest that Rural Dibao participation boosts rural children's learning, which could indicate a long-term anti-poverty effect, and that if the program can resolve targeting problems, this effect could be even greater.

Keywords: Education; Low income subsidy; Impact evaluation; Rural China

JEL code: I21; I38

1. Introduction

Despite four decades of rapid economic growth and development, China continues to struggle with issues of rural poverty. To combat poverty in rural areas, the Chinese government has established the Rural Minimum Living Standard Guarantee (hereafter, Rural Dibao) program. The policy aims to provide approved poor families with monthly unconditional monetary cash transfers that cover their living needs, such as food, clothing, and housing (Han, Gao, & Xu, 2016). Rural households with family per capita income lower than local Rural Dibao thresholds can apply for the program. By the end of 2018, more than 100 billion Renminbi (RMB; over 14 billion US dollars) were transferred to 35 million people in 19 million different rural households by the Rural Dibao program (Ministry of Civil Affairs, 2019).

Although many studies have examined Rural Dibao's effect on poor families, these studies have yet to reach consensus on Rural Dibao's ultimate effect on household welfare. As Rural Dibao is designed as a direct cash transfer to participants, Rural Dibao participation has been shown to raise the income of the enrolled families (Golan, Sicular, & Umapathi, 2017; Kakwani, Li, Wang, & Zhu, 2019; Li & Sicular, 2014; Westmore, 2018). Beyond the current income effect, however, researchers disagree on how the program affects household welfare more broadly. Gao, Wu, and Zhai (2015) claim that Rural Dibao has a negative impact on household welfare by showing that Rural Dibao participation leads to less time spent on work, leisure, and social activities and more time spent on being idle, resulting in reduced household welfare. Han, Gao, and Xu (2016) support this argument by showing that participation leads to less expenditure on social activities. Nevertheless, Han, Gao, and Xu (2016) as well as Zhao,

Gui, and Shao (2017) and Wang, Qin, and Sui (2019) find some positive impacts of Rural Dibao on rural household welfare (e.g., participation is related to increased health expenditure).

Despite the findings of earlier research on Rural Dibao's effect on households as similar in some respects, the findings are mixed. For example, Zhao et al. (2017) showed that housing expenditure, and thus household welfare, is increased by Rural Dibao participation. In contrast, Han et al. (2016) and Wang et al. (2019) found that housing expenditure does not increase. The contradictions that exist among these studies make it difficult to describe Rural Dibao's ultimate effect on household welfare.

Although there may be a number of reasons for why different studies arrive at different conclusions, studies that examine Rural Dibao diverge for two main reasons. The first reason, targeting error, reflects issues in the way that the Rural Dibao program identifies who receives transfer payments versus who does not qualify. According to authors, e.g., Golan et al. (2017) and Kakwani et al. (2019), there is a great deal of targeting error; a large number of households are actually poor but do not qualify, while a large number of non-poor households receive payments. There may be many reasons for this poor targeting (from corruption to just being a difficult process to identify actual household income). However, if targeting error is not considered in analyzing Rural Dibao's anti-poverty impacts, because poverty is no longer the only determinant for program participation, the evaluation may be biased.

The second reason for mixed findings is the absence of researchers to adequately identify the causal relationship between the program and household welfare. Almost all of the previous studies produce empirical findings that are based on correlations and do not produce estimates of

the true causal relationship between Rural Dibao participation and household welfare. For example, many previous studies (e.g., Gao et al., 2015; Han et al., 2016; Kakwani et al., 2019; Li and Sicular, 2014; Wang et al., 2019; Zhao et al., 2017) have used only a single set of cross-sectional data in their analyses. In other studies, for example, Golan et al. (2017) and Westmore (2018), the authors have panel data but do not exploit the over-time characteristics of their samples to identify causality. The only three papers that claim to address the endogeneity problems that exist in studying the program's impacts on welfare all rely on propensity score matching with their cross-sectional data (Gao et al., 2015; Han et al., 2016; Wang et al., 2019). Propensity score matching, however, has become increasingly known to be a weak approach to identification, as the basic assumption needed for propensity score matching—a lack of confoundedness—has been shown to be rarely proven (King & Nielson, 2019).

In addition to the mixed findings on Rural Dibao's effect, the program also receives criticism for offering only short-term poverty relief. Anti-poverty programs are often criticized for providing only short-term aid, which may hinder long-term anti-poverty efforts by generating welfare dependency (Blank, 2003). Rural Dibao also is subject to this criticism. As noted, Gao et al. (2015) show that Rural Dibao participants may reduce their work time and time spent on leisure or social activities, resulting in more time in being idle, indicating that, although the program provides short-term relief, this relief might not translate into long-term welfare gains. Research, however, has looked mainly at short-term measures of welfare gains, such as working time and expenditures. Therefore, there is a need for studies to examine the long-term welfare effects of Rural Dibao.

Education is one way to examine long-term welfare gains. Improving educational outcomes is seen as an effective long-term anti-poverty effort (Luccisano, 2004), and financial investments in education are associated with breaking the intergenerational cycle of poverty (Barham, Boadway, Marchand, & Pestieau, 1995). Even though improving children's education affects long-term welfare, only three papers have explicitly investigated Rural Dibao's effects on rural children's education, and these papers have mixed results. Han et al. (2016) and Wang et al. (2019) both find that Rural Dibao has no significant impact on education expenditure. Zhao et al. (2017), however, found that household participation in Rural Dibao increases household expenditure on education by 19%. Although these studies offer a valuable contribution to the literature, unfortunately, like other studies that examine Rural Dibao, they fail to address identification in their analyses. Finally, these studies all focus exclusively on education expenditure, which, although important, does not describe actual changes in student achievement. Therefore, by focusing exclusively on education expenditure, these papers also fail to show whether Rural Dibao participation leads to increased academic achievement (or real increases in learning).

This paper aims to examine the effect of Rural Dibao on rural children's education. To accomplish this goal, we have four specific objectives. First, we describe the distribution of Rural Dibao participants and show the existence of targeting error within our data. Second, we reveal the causal relationships between Rural Dibao participation and children's learning outcomes. Third, we investigate the potential mechanisms that connect Rural Dibao to children's learning results. Fourth, we discuss the program's impact on different groups of children.

To meet these objectives, we used data from the 2010, 2012, and 2014 China Family Panel Studies (CFPS). The CFPS is a biennial survey that includes approximately 14,000 Chinese households per survey wave in 25 Chinese mainland provinces (including municipalities and autonomous regions). This nationally representative survey gathers information about the Chinese population's well-being and economic activities. Relevant to our study, the CFPS specifically collects data on Rural Dibao participation and children's education outcomes (expenditure and learning results), as well as other data used to analyze potential mechanisms and controls.

We first describe our sample with both descriptive statistics and a difference-in-differences method to show the existence of targeting problems within the program. We then use a fixed effects model to reveal causal relationships between program participation and standardized test scores. A fixed effects model controls for unobserved, non-time varying individual characteristics, which helps to address issues of identification. We also investigate the mechanisms between Rural Dibao participation and individual learning results. Finally, we divide the children into different groups according to their family per capita income and province and use a fixed effects model to determine how the program affects these different subgroups.

We find that participation in Rural Dibao leads to better learning outcomes for rural children. We first show that the problem of targeting exists in the program but ultimately find that targeting error does not fully undermine the program's effect. We then use a fixed effects model as an identification strategy and find that Rural Dibao participation raises Chinese-language test scores by 0.297 standard deviations and math test scores by 0.219 standard

deviations. In examining potential mechanisms, we show that Rural Dibao participation leads to higher education expenditure and higher food expenditure, which both lead to better test scores. Participation raises annual education expenditure by an average of 727 RMB (approximately 106 US dollars). An increase of 1,000 RMB (approximately 145 US dollars) in education expenditure increases Chinese-language test scores by 0.0393 standard deviations and increases math test scores by 0.0558 standard deviations. Rural Dibao participation additionally raises annual family per capita food expenditure by 456 RMB (approximately 66 US dollars), and an increase of 1,000 RMB in food expenditure increases Chinese-language test scores by 0.0379 standard deviations and math test scores by 0.0575 standard deviations. Finally, from our heterogeneous effects analysis, we find that the program has a significant impact only on poorer and non-Eastern children.

Our study contributes to the broader literature in three significant ways. First, this is the first paper to elucidate a causal relation between Rural Dibao and rural children's learning, which indicates the long-term impact of the Rural Dibao program. Our use of a fixed effects model allows us to better control for non-time varying unobserved heterogeneity, representing a methodological improvement over previous papers. Second, by investigating the mechanisms that connect Rural Dibao to learning outcomes (via education and food expenditures), we further deepen our understanding of Rural Dibao's effect on education. Third, by exploring the program's heterogeneous effect on different groups, we not only clarify the effect of Rural Dibao but also can make suggestions on how best to target the program.

Our paper is organized as follows. First, we present our data and our identification strategy. In addition to providing descriptive statistics, we also show the existence of targeting error in our data and resolve the issues related to it. Second, we present the results of our empirical analysis, showing not only Rural Dibao's effect on learning but also the potential mechanisms that connect Rural Dibao participation and education outcomes. Third, we show the heterogeneous effects of the program on different groups of children. We conclude by discussing the implications of our study and providing policy recommendations.

2. Data and methodology

2.1 Data

Data source. We use data from the 2010, 2012, and 2014 CFPS, which is a nationwide longitudinal survey that has been conducted biennially by the Institute of Social Science Survey of Peking University since 2010. The CFPS focuses on gathering information about the Chinese population's well-being and economic activities, such as education outcomes, spending patterns, Rural Dibao participation, family dynamics, and so on. It collects these data on three levels: individual, family or household, and community.

The CFPS covers 25 out of 31 Chinese mainland provinces (including municipalities and autonomous regions, but excluding Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia, and Hainan). The provinces that are part of the sample contain approximately 95% of the Chinese population. To create a nationally and provincially representative data set, the CFPS uses a multistage, implicit stratification and probability proportional to size sampling approach to

collect individual-, family-, and community-level data (Xie & Hu, 2014). All CFPS samples are randomly acquired through three stages. First, county-level units (rural counties or urban districts) are randomly selected from the 25 sampled provinces. Second, from these county-level samples, village-level samples (rural villages or urban communities) ae randomly selected. Finally, from these village-level samples, individual households are selected. All family members present during the household survey were interviewed. Around 14,000 Chinese households, including over 30,000 adults and 8,000 children, were surveyed in each wave.

Sample of children. To build a panel data set that we will use, in part, to identify the causal impacts of Rural Dibao on education outcomes, we combine 2010, 2012, and 2014 CFPS data to generate one panel data set that spans three waves. We take three steps to arrive at this final dataset. First, we match each child with his or her parents and family characteristics. Second, we drop children with urban *hukou* to generate panel data for children with rural *hukou*. Third, we trim education outcome data by excluding children who go to college or have dropped out of school in 2012 or 2014. The CFPS children survey, the CFPS section that collects children's data including educational outcomes, targets children younger than 15 years old. Some children were under 15 in 2010 but became too old to participate in the CFPS children survey in later waves. Despite their ages, they still completed the CFPS learning tests. To track long-term changes in educational outcomes, we keep their data only if they are still at school and have not gone to college yet. After doing this, we created a panel data set with a total of 3,228 rural children followed across all three waves. Of this overall sample, 787 of the individuals are

students over 10 years old in 2010 who completed Chinese-language and math tests in both 2010 and 2014.

We further divide these children into subgroups to analyze the heterogeneous impact of Rural Dibao on education. We divide the children into different groups, according to their family per capita income or their home geographic districts. In both ways, the children are divided by using indicator variables to split the sample into two subgroups. Family per capita income subgroups are determined when a family's income is below or above the average Rural Dibao threshold. District subgroups indicate whether a respondent lives in China's wealthier, more developed Eastern provinces. We group China's provinces into two geographical districts: Eastern and non-Eastern China. Eastern China includes the following provinces: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, and Guangdong. Non-eastern China includes all other surveyed provinces.

Key variables. There are four key variables in the CFPS that are particularly relevant to our study. First, the CFPS contains information about Rural Dibao participation in the three survey years: 2010, 2012, and 2014. CFPS enumerators asked each respondent whether the surveyed family participated in Rural Dibao that year. If the answer was yes, the survey labeled all of the members of the family as participants.

Second, the CFPS contains children's learning results, as measured by two CFPS-administered scales. Specifically, the CFPS contains a section that asks children 10 years or older to complete both a Chinese-language test and a math test in 2010 and 2014. The Chinese-language test asks respondents to identify and pronounce (aloud) one Chinese character for each

question. The math test is a paper examination that asks respondents to answer increasingly difficult math questions. Both tests are scaled appropriately to the respondent's grade. In each test, the test score is the number of the most difficult question that the respondent can answer correctly. Each test stops when the respondent incorrectly answers three consecutive questions. We standardize the scores for each wave to capture a student's relative score change compared to others. We use these standardized test scores to indicate childhood learning results. The CFPS switches between two versions of tests biennially, meaning that only the 2010 and 2014 test questions are exactly the same. Therefore, to effectively compare test results over time, we compare these two waves and exclude 2012 test data.

The third variable that we use to measure the impact of Rural Dibao on education investment is the amount of annual education expenditure on each individual in the family. This is a variable for which data are available for all three waves. The CFPS items ask about children's education expenditures in detail, including annual spending on tuition, books, school room and board, transportation, and so on. The CFPS also sums these up for each individual as a total annual expenditure on education. In this paper, we use the total sum of annual expenditure in our analyses. Unlike test scores, education expenditure does not measure learning directly. Nevertheless, the variable does tell us how much the families invest in their children's education, which may be connected to learning results (we test this assumption later in our analysis). In this paper, we examine whether increased education expenditure could be the mechanism that connects Rural Dibao participation to increased learning. Because expenditure data are collected

for all three waves, we are able to use three waves of CFPS expenditure data (compared to only two waves of data on learning results).

The final key variable that we extract from the CFPS data is one that measures food expenditure. Previous studies suggest that nutrition, which may be associated with higher food expenditure, can affect an individual's rate of learning (Li, Huang, Shi, Luo, Yang, & Rozelle, 2018). For example, poor nutrition may lead to anemia, which may limit a child's academic performance. Food expenditure is, therefore, an alternative mechanism whereby Rural Dibao participation can affect a child's level of learning. The CFPS items ask about food expenditure for an entire household. We divide family food expenditure by family size to get annual family per capita food expenditure.

Additional control variables. The CFPS data also has rich information about family and individual demographics. In terms of family information, the survey items ask about family annual income, family size, ethnicity, and province of residence, allowing us to control for all of these. We divide family annual income by family size to obtain family annual per capita income, thus controlling for both income and family size. Aside from controlling for income and family size, the annual family per capita income variable is also important in determining who should receive Rural Dibao, as income levels determine Rural Dibao eligibility (although whether this is true is an empirical exercise on which we report in the Results section). For ethnicity, we divide our sample based on whether each respondent is ethnically Han.

There are also several additional variables that measure individual characteristics. Specifically, the survey items ask each family member his or her age, and the gender of each

child is enumerated. The CFPS items also ask about parental education in terms of the highest level of education achieved by a child's mother and father. We use such information to control for parental education by separating parents based on their completion of junior high school. Table 1 contains the definitions of all the variables used in our regressions.

[Insert Table 1 about here]

2.2 Empirical Strategy

We first use a basic ordinary least squares (OLS) model to explore the correlation between Rural Dibao and childhood learning:

$$Learning_{it} = \beta_0 + \beta_1' Dibao_{it} + \beta_2' X_{it} + \varepsilon_{it} \quad (1)$$

Here, $Learning_{it}$ is child i's education outcome in year t. We use standardized test scores (both as Chinese-language test scores or math test scores) to represent learning results. $Dibao_{it}$, our main independent variable of interest, is a dummy variable that indicates whether child i's family participated in Rural Dibao in year t. X_{it} contains control variables, including family per capita income, ethnicity, father's education, mother's education, gender, age, and district (Eastern China or not). ε_{it} is our error term.

Although the results from equation (1) are of interest, this basic model does not address endogeneity from unobserved characteristics that are correlated with both the independent variable of interest and the dependent variable. A fixed effects model can address part of this endogeneity problem. By controlling for individual fixed effects, we are able to eliminate differences that stem from individual, unobserved, non-time varying characteristics. The fixed effects model that we use for the rest of our analyses can be written as follows:

$$Outcome_{it} = \beta_0 + \beta_1' Dibao_{it} + \beta_2' Income_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

The variable $Dibao_{it}$ is the same in Model (2) as in Model (1). The variable $Outcome_{it}$ refers to our outcome variables of interest, which are standardized test scores, education expenditure, and family per capita food expenditure. For our main analysis, standardized test scores, which indicate learning results, is our main outcome of interest. Education expenditure and family per capita food expenditure are used in analyzing the mechanisms of Rural Dibao. $Income_{it}$ denotes child i's family per capita income in year t, and μ_i captures child i's individual fixed effects. All observed and unobserved non-time varying individual and family characteristics are controlled for by μ_i. Except for income (which varies over time), other control variables in X_{it} (which are all non-time varying) from Model (1) are controlled for by μ_i in Model (2).

We suspect that Rural Dibao participation affects test scores through increased expenditures. To explore such mechanism, we first redefine our $Outcome_{it}$ variable in Model (2) to food and education expenditures. In addition to education expenditure, we suspect that food expenditure also can be affected by program participation. Our $Dibao_{it}$ variable remains the same. This allows us to determine whether Rural Dibao participation actually increases relevant expenditures. We then test whether these increased expenditures are related to higher test scores. To do so, we replace $Dibao_{it}$ in Model (2) to education or food expenditure and set our $Outcome_{it}$ variable to test scores. We suspect that participation in Rural Dibao first enhances expenditures, which then lead to higher learning results.

We also use Model (2) to explore the program's heterogeneous effects on different subgroups. To do so, we simply define $Outcome_{it}$ in Model (2) as test scores and keep everything else the same. We then trim our data to include only members of certain subgroups. As stated earlier in our Sample of Children section, we have four subgroups based on two indicators: family per capita income and district. We run regressions, using these subgroups and Model (2), and observe changes in our coefficients.

3. Results

In this section, we present the results of our empirical analyses. First, we demonstrate targeting problems with Rural Dibao and provide the summary statistics of our sample. Second, we present our main regression results and then investigate the mechanism between participation and learning results. Finally, we investigate the program's heterogeneous effect on different groups of children.

3.1 Targeting Error and Descriptive Statistics

Our data suggest that two types of targeting error exist in the Rural Dibao program. On the one hand, there are wealthy families who should not qualify but are participating. On the other hand, there are poor families who should be qualified but do not participate. Despite these errors, our results suggest that the overall targeting of the program is still relatively good, as the program generally targets those who are poor, have fallen upon hard times, or have fairly poor educational outcomes.

The existence of targeting error in the Rural Dibao program is shown in Table 2, which shows children's participation across five different family per capita income quantiles. As it is a poverty-relief program, Rural Dibao should exclusively assist poor families. According to the Ministry of Civil Affairs (2010, 2012, 2014), the average annual Rural Dibao threshold was 1,404 RMB in 2010, 2,057.8 RMB in 2012, and 2,777 RMB in 2014. These amounts are within the first two quantiles in each wave. Ideally, we would expect Rural Dibao participants to be almost exclusively in the first two income quantiles. However, as seen in Table 2, this is not the case. The table shows the existence of two kinds of targeting errors in the implementation process of the program. The first error is that many poor are not in the program. For example, in 2010, only 18% of the poorest quantile are part of the program. The second error is that many wealthy families who should not qualify are in the program. In every year, children from every quantile, including those above Dibao thresholds, participate. In 2012, 5% of the wealthiest income quantile participated in Rural Dibao. In addition, these trends do not change over time. Wealthier families continue to participate in each year. Participation rates for those in the lower income quantiles also remain consistently low. In each year, only around 20% of the poorest quantile join the program, meaning that around 80% of the poorest quantile, those who may benefit the most from joining Rural Dibao, continually do not join the program.

[Insert Table 2 about here]

Although the targeting error suggests that program leakages exist, our data also demonstrate that such leakages do not completely undermine the Rural Dibao program, as Rural Dibao transfers, on average, still go to families in need. Table 3 shows the summary statistics of

our sample, including income levels, levels of academic achievement, and expenditures, as well as other controls. Column 1 contains the results for all surveyed children followed across all three waves, totaling 3,228 observations. Column 2 presents the results for children who were over 10 years old in 2010 and who did the same math and Chinese-language tests in 2010 and 2014, with 787 total observations. Column 3, a subgroup of Column 2, contains the results for children who participated in Rural Dibao for all three waves and who completed math and Chinese tests in 2010 and 2014, with only 43 observations.

[Insert Table 3 about here]

The results presented in Table 3 show that these Rural Dibao children (Column 3) are still worse off in terms of income and food expenditure than are other children (Column 2). For example, in 2010, the average annual family per capita income of these Rural Dibao children was 2,925 RMB (approximately 425 US dollars), compared to an average income of 5,082 RMB (approximately 739 US dollars) among all of the children 10 years or older. As noted, this suggests that, although targeting error exists, Rural Dibao transfers still go to those in need.

It is also worth noting that Rural Dibao tends to go to families with lower levels of human capital. Table 3 shows that Rural Dibao children have lower test scores and education expenditure. For example, in 2010, the average standardized Chinese-language test score for Rural Dibao children was -0.154 standard deviations, compared to an average of -0.025 standard deviations for all of the children 10 years or older, a difference of over 0.1 SDs. In addition, Table 3 shows that the human capital of Rural Dibao parents is low. Only 35.5% of Rural Dibao fathers whose children are at least 10 years old completed junior high school, compared to 49.2%

of all fathers in the sample. The situation for Rural Dibao mothers is even worse. Only 13.9% of Rural Dibao mothers whose children are at least 10 years old completed junior high school, which is less than half the average rate of all mothers in the sample (30.8%). Thus, although the program has targeting errors, Rural Dibao participants are generally worse off than are their non-Dibao counterparts.

Table 4 also shows that Rural Dibao is not completely undermined by targeting problems. As can be seen in the table, Rural Dibao participants are generally worse off even if they participate only temporarily. Rural Dibao participation trends vary, and households often drop in and out of the program. The first three columns in Table 4 show whether an individual participated in Rural Dibao during a certain wave (with a value of 1 that shows that they participated that year and 0 if they did not participate). These individuals were at least 10 years old in 2010. The last row of Table 4, therefore, denotes the same children as does Column 3 in Table 3 (that is, children who participated in Rural Dibao for all three waves and participated in the tests). Thus, Table 4 can be understood as an extension of Column 3 in Table 3. We also can see that there are children who participated in Rural Dibao for only one or two waves. Those who never participated in Rural Dibao have higher levels of family per capita income than do those in nearly all the other groups who participated in Rural Dibao. For example, in 2010, the average family per capita income for non-Dibao children was 5,513 RMB (approximately 780 US dollars), but the numbers for all the other groups who participated for at least one year in Rural Dibao were under 5,000 RMB. Thus, program recipients are generally families that have lower incomes.

[Insert Table 4 about here]

We conduct a difference-in-differences analysis to further show that Rural Dibao money still goes to families in need. The difference-in-differences analysis uses the results in the first two rows in Table 4. The key difference between these two rows is that the results in the first row are from children who never joined Rural Dibao, whereas the results in the second row represent children who joined Rural Dibao in 2014 (and participated only in 2014). Participation in Rural Dibao can, therefore, be considered the "treatment" with those who never participated as representing a control group.

Table 5 presents a comparison of how their family per capita income changes over time. The results indicate that, between 2010 and 2012, the two groups have no significant differences in terms of income growth, i.e., they are comparable. The Rural Dibao group, however, has significantly less income growth between 2012 and 2014. As the program gives transfers to participating families, participation in the program would not lower their income growth. Therefore, they likely first encountered some negative shock to income, then were able to participate in the Rural Dibao program.

[Insert Table 5 about here]

It is clear that targeting errors exist in Rural Dibao program implementation. It is important to note, however, that our data show that this targeting error does not completely undermine the program. The program, at least in general, appears to be targeting families that have experienced negative shocks to their incomes. Given these results on targeting, in the next

section, we address the second objective of the paper and present the results of the analysis of the impact of the program on educational outcomes.

3.2 Children's Learning Outcomes

Table 6 shows the results of Model (1), our basic OLS regression, that help us to analyze the effect of Rural Dibao program participation on children's learning results. Each column represents one dependent variable (standardized Chinese-language test scores or standardized math test scores). Columns 1 and 2 show the OLS results with family per capita income as our only control variable. Columns 3 and 4 contain other control variables, including location, age, gender, ethnicity, and parental education.

[Insert Table 6 about here]

The results of our OLS model show no statistically significant relationships between Rural Dibao participation and children's standardized test scores. This is true regardless of whether the analysis uses control variables. According to these simple OLS regressions, the program appears to be failing to raise the learning outcomes of children whose families receive Rural Dibao.

This model, however, cannot express a causal relationship. To address this endogeneity, we use a fixed effects model. Table 7 shows results of the fixed effects regression analysis of the program's effect on learning results, as stated by Model (2). We see that, once we control for individual fixed effects, the relationship between Rural Dibao participation and learning outcomes becomes positive and statistically significant, indicating that participation in Rural Dibao benefits children's learning. Specifically, we see in Column 1 that a child's Chinese-

language test score will rise, on average, by 0.297 ($p < 0.01$) standard deviations if the child's family participates in Rural Dibao. Column 2 shows that a child's math test score will increase, on average, by 0.219 ($p < 0.10$) standard deviations if the child's family joins Rural Dibao. Thus, program participation is shown to causally benefit a child's learning.

[Insert Table 7 about here]

3.3 Mechanism for the Relationship between Participation and Test Scores

We assume that education and food expenditures play intermediate roles in connecting Rural Dibao to learning results. Education expenditure has a direct impact on academic achievements, as more education expenditure implies that more resources are invested into a child's learning process, facilitating higher levels of academic achievement. More food expenditure may lead to improved nutrition, which may improve learning results. Therefore, we suspect that Rural Dibao participation first boosts education and food expenditures, which results in higher test scores. We test this assumption by modifying Model (2), as detailed in our methods section. First, we test Rural Dibao participation's effect on food and education expenditures, followed by how food and education expenditures affect test scores.

Table 8 shows the effect of program participation on food and education expenditures. The results demonstrate that participation has a positive and statistically significant effect on annual family per capita food expenditure as well as individual education expenditure. By joining the program, food expenditure is raised by 456.4 ($p < 0.10$) RMB (approximately 66 US dollars). Participation raised education expenditure by 726.5 ($p < 0.10$) RMB (approximately 106 US dollars).

[Insert Table 8 about here]

Table 9 shows the effects of these expenditures on test scores, which include significant and positive coefficients between test scores and education expenditure as well as food expenditure. An increase in education expenditure of 1,000 RMB (approximately 145 US dollars) raises standardized Chinese-language test scores by 0.0393 ($p < 0.01$) standard deviations and standardized math test scores by 0.0558 ($p < 0.01$) standard deviations. An increase in annual family per capita food expenditure of 1,000 RMB raises standardized Chinese-language test scores by 0.0379 ($p < 0.01$) standard deviations and standardized math test scores by 0.0575 ($p < 0.01$) standard deviations. Therefore, we suggest that participation in Rural Dibao first enhances education and food expenditures, and then these enhanced expenditures lead to higher learning results. Thus, both food and education expenditures act as mechanisms that connect Rural Dibao participation and learning results.

[Insert Table 9 about here]

We notice, however, that the effects of education and food expenditures on standardized test scores are smaller than the effect of participation itself. For example, as noted above, participation leads to a 0.297 standard deviation increase in Chinese-language test scores, but an additional 1,000 RMB of education or food expenditures boosts test scores by only 0.0393, or 0.0379 standard deviations. If we consider that the increases in education and food expenditures boosted by Rural Dibao participation are both less than 1,000 RMB, we can assume that the actual effect of expenditures on scores may be even smaller.

These findings suggest that there must be other mechanisms that connect Rural Dibao with learning outcomes. Ma, Zhou, Yi, Pang, Shi, et al. (2014) show that test scores can be boosted by 0.11 standard deviations after they provide eyeglasses to children with myopia in rural China. If Rural Dibao transfers allow parents to buy glasses for their children, this also could contribute to better learning results. Therefore, Rural Dibao transfers could be used flexibly to address specific challenges that either the family or child faces, and this spending might not always fit neatly into a typical expense category. Because the CFPS data have information only about large expense categories, we cannot investigate all spending possibilities or possible mechanisms.

3.4 Heterogeneity Analysis

In this section, we present the heterogeneous effects for children with different family per capita income and from different areas. For these analyses, we use Model (2), our fixed effects model to explore the impact of participation on test scores. To do so, we first look at children with different family per capita income levels. As noted in relation to Table 2, the average national Rural Dibao thresholds are within the first two income quantiles in each wave. We use this to divide the children into two groups. The first group of children are from the first two family per capita income quantiles for each wave; these children represent those with family per capita income below Rural Dibao thresholds. The second group, the more well-off families who also received Rural Dibao due to targeting error, is for the last three quantiles. We run Model (2) of the program's effect on standardized test scores for the two groups separately.

Table 10 shows the results of the heterogeneous effects analysis. The findings indicate that the program significantly and positively affects learning results only for those from the first two income quantiles. For these quantiles, participation boosts Chinese-language test scores by 0.483 ($p < 0.05$) standard deviations and math test scores by 0.352 ($p < 0.10$) standard deviations. In contrast, the program has no significant effect on learning for the last three quantiles. Therefore, the program tends to boost the learning only of children from poor families. This means that, if the program can better target poorer families, the effect will be even larger.

[Insert Table 10 about here]

We then investigate the effects of location. Eastern provinces in China tend to be wealthier than are other provinces (Table 1 for the provinces). We run Model (2) of the program's impact on learning for children from Eastern and non-Eastern provinces separately. Table 11 presents the results, which indicate the program only positively and significantly affects the learning of children from the poor provinces in Central and Western China (the non-Eastern provinces). For the students from non-Eastern provinces, participation boosts Chinese-language test scores by 0.343 ($p < 0.01$) standard deviations and math test scores by 0.203 ($p < 0.10$) standard deviations. Rural Dibao participation, however, has no significant effect on children from Eastern provinces. Clearly, given the lower per capita incomes of families in Central and Western China, this means that the program benefits children from poorer areas more.

[Insert Table 11 about here]

4. Discussion and conclusion

Although education is an important long-term impact of anti-poverty programs, only three papers have investigated Rural Dibao's effect on rural children's education (Han et al., 2016; Wang et al., 2019; Zhao et al., 2017). These three papers diverge on whether the program increased participating children's education outcomes. In this paper, we argue that these studies almost certainly diverge because they fail to address targeting error, and the authors did not use methods that consider issues of identification. In response to these shortcomings, we extensively analyzed Rural Dibao's targeting issues and sought to identify the causal relationship of Rural Dibao and several key outcome variables by using fixed effects models and utilizing panel data from the CFPS from the years 2010, 2012, and 2014. In addition, the earlier research focused only on education expenditures and did not examine learning. In the education literature, it is well known that, when studying the impact of a program on learning outcomes, using outcome measures from a standardized scale is generally a better metric than are educational expenditures. Our study examines the impact on both educational expenditures and learning, thus allowing us to better analyze the effects of Rural Dibao on long-term human capital outcomes.

Using our approach, we show and address targeting problems within the Rural Dibao program. The analysis demonstrates that there are two types of targeting error. First, many poor households that can participate do not. Second, many wealthy households that should not be participating still receive Rural Dibao money. Based on the data, this pattern does not appear to change over time. Although the analysis indicates that targeting is not perfect, it should be emphasized that both the descriptive statistics and regression analysis show that, at the time that

they are chosen to receive Rural Dibao, these recipients are generally worse off in terms of income and education than are those families who do not receive Rural Dibao. In other words, there is empirical evidence that the program does not completely fail at targeting people in need. We conclude that, even though targeting error exists, China's Rural Dibao programs from 2010, 2012, and 2014 are still, in general, targeting families in need.

Once we address the issue of causal identification by using a proper identification strategy, we find that Rural Dibao improves children's learning outcomes. When we use a fixed effects model, which helps to control for endogeneity by accounting for all non-time varying unobserved heterogeneity, we find positive and significant results. Specifically, the analysis finds that program participation increases Chinese-language test scores by 0.297 SDs and standardized math test scores by 0.219 SDs. When reviewing the impacts of different education interventions, Hill, Bloom, Black, & Lipsey (2008) found that middle school student's tests scores, over the course of a normal academic school year, improve by about 0.2 to 0.3 SDs. Hence, it seems that the Rural Dibao program can be thought of as a relatively effective means of increasing a child's learning. These results also are important, as, according to our descriptive statistics, Rural Dibao participants tend to underperform academically. As a consequence, the boost from Rural Dibao may be allowing these children to (at least partially) catch up.

In trying to identify the mechanism that links Rural Dibao and improved learning, we find through analysis that Rural Dibao participation boosts education expenditures. The analysis also shows that higher education expenditure leads to higher scores. Although the magnitude of the increase in education expenditure is modest, it is still significant in the context of rural China,

as this increase may be allowing poorer, rural Chinese families to better cover a number of incidental education expenditures that, in turn, lead to better learning.

We find that food expenditures also may play an intermediate role in connecting program participation and increased test scores. The results demonstrate that Rural Dibao participation also increases household food expenditures, which is also related to higher scores. Given the high rates of anemia and other micronutrient deficiencies that have been documented in China, which negatively affect learning outcomes of children (Li, Luo, Sylvia, Medina, & Rozelle, 2015; Li et al., 2018; Luo, Zhang, Liu, Zhao, Shi, et al., 2011), increased food expenditures may allow children the opportunity to eat a more nutritious diet (e.g., in the case of anemia, a more iron-rich diet), which increases health and, therefore, increases their learning outcomes. Thus, the analysis suggests that food expenditure is another part of the mechanism that helps to translate the transfers from Rural Dibao into better learning.

We also conduct a heterogeneity analysis to investigate the program's impact on different groups of children. We find that the program has stronger positive impacts on the learning outcomes of those from poor families. Specifically, the program increases scores only for those people with a family per capita income below Rural Dibao thresholds. We also find that the program has a positive impact on the learning of only those children from poorer provinces. The heterogeneous effects analysis implies that, if the program can target well and reduce program leakages, the positive impacts will be even larger.

Thus, our results appear to strongly suggest that at least part of the financial transfers from Rural Dibao that are received by poorer families spills over into the education and increases

learning of the children in the family. This means, of course, that there almost certainly will be a positive, long-term impact of the program. This finding is consistent with previous studies that analyze anti-poverty programs in other countries. Dahl and Lochner (2012) show that the US Earned Income Tax Credit program enhanced children's academic achievements. An additional 1,000 US dollars given to households increases children's reading and math test scores by 6%. Duncan, Morris, and Rodrigues (2011) combine different US and Canadian anti-poverty programs and show similar results—an additional 1,000 US dollars leads to a 5% to 6% increase in children's academic achievement. Our study shows that this trend continues in China's rural areas, which may contribute to the literature streams on developing Asian countries.

Our findings have implications for policy. First, like other papers (e.g., Golan et al., 2017; Kakwani et al., 2019; Westmore, 2018), we show the existence of targeting error in the program. Our heterogeneous effects analysis shows that, if the program can target well, the effect on rural children's education will be even larger. The Rural Dibao program should, therefore, be reformed to address targeting error and reduce program leakages. An example reform could be a proxy means test developed by Kakwani et al. (2019), which they suggest could enhance Rural Dibao's targeting and, thus, performance.

Second, our results suggest that an effective way to improve children's education may be to improve the general household situation. Our results show that, when households have more resources (in this case, more income from Rural Dibao), these resources naturally spill over into their children's education. By raising a household's level of income, policymakers can enable a certain desired behavior. Thus, if policymakers have a specific goal or behavior that they wish to

encourage, they should first consider whether solving a more general issue may help to achieve their specific goal.

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Table 1. Definition of Variables

Variable	Definition
Year	CFPS surveyed year (2010, 2012, or 2014)
Participation (dummy)	1 = family participated that year; 0 = family did not participate that year.
Family per capita income	Family annual income per capita for previous year
Standardized Chinese-language score	Standardized score for CFPS Chinese-language test
Standardized math score	Standardized score for CFPS math test
Individual education expenditure	The individual child's total annual education expenditure for last year
Family per capita food expenditure	The child's family per capita food expenditure for last year
Ethnicity (dummy)	1 = Han; 0 = other
Father's education (dummy)	1 = completed junior high; 0 = education less than completion of junior high
Mather's education (dummy)	1 = completed junior high; 0 = education less than completion of junior high
Gender (dummy)	1 = male; 0 = female
Age	Individual child's age in years
Eastern China (dummy)	1= Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, or Guangdong; 0 = all other surveyed Chinese provinces

Table 2. Participation across Five Income Quantiles

Year	Family per capita income quantile	Family per capita income range (RMB)	Respondents in each quantile	Rural Dibao children in each quantile (*n*)	Rural Dibao children in each quantile (%)
2010	Poorest	Lower than 1,841	646	117	18%
	Poor	1,841–3,054	646	76	12%
	Middle	3,055–4,455	645	53	8%
	Wealthy	4,456–6,999	646	37	6%
	Wealthiest	Higher than 6,999	645	22	3%
2012	Poorest	Lower than 1,221	646	116	18%
	Poor	1,221–3,125	647	91	14%
	Middle	3,126–5,539	644	78	12%
	Wealthy	5,540–9,634	646	65	10%
	Wealthiest	Higher than 9,634	645	30	5%
2014	Poorest	Lower than 2,111	646	154	24%
	Poor	2,111–5,000	654	105	16%
	Middle	5,001–7,840	637	76	12%
	Wealthy	7,841–12,016	646	67	10%
	Wealthiest	Higher than 12,016	645	37	6%

Data source: CFPS 2010, 2012, and 2014.

Table 3. Summary Statistics

		(1)	(2)	(3)
		Full sample	Children over 10 years old in 2010	Children over 10 years old in 2010 (participated in three waves)
Variable	Year	Mean (SD)	Mean (SD)	Mean (SD)
Family per capita income (RMB)	2010	5,056 (100.4)	5,082 (208.7)	2,925 (456.8)
	2012	6,096 (123.0)	6,110 (264.6)	3,340 (449.5)
	2014	7,823 (127.8)	8,112 (274.8)	6,377 (805.4)
Standardized Chinese-language score	2010	--	-0.025 (0.035)	-0.154 (0.169)
	2014	--	0.551 (0.029)	0.463 (0.118)
Standardized math score	2010	--	-0.104 (0.034)	-0.408 (0.135)
	2014	--	0.506 (0.036)	0.433 (0.117)
Individual education expenditure (RMB)	2010	596.0 (22.21)	779.7 (45.02)	371.9 (79.00)
	2012	1,857 (53.35)	2,889 (159.7)	1,341 (240.9)
	2014	3,002 (69.93)	4,675 (161.5)	2,798 (389.4)
Family per capita food expenditure (RMB)	2010	1,168 (24.51)	1,258 (61.47)	633.5 (88.30)
	2012	1,926 (45.22)	1,915 (82.13)	1,127 (159.2)
	2014	2,325 (53.50)	2,517 (122.1)	1,546 (265.3)
Ethnicity (1 = Han)		0.881 (0.003)	0.906 (0.006)	0.837 (0.033)
Gender (1 = male)		0.523 (0.005)	0.480 (0.010)	0.457 (0.044)
Age (in 2010)		6.978 (0.071)	11.968 (0.058)	11.651 (0.264)
Father's education (1 = completed junior high)		0.511 (0.005)	0.492 (0.011)	0.355 (0.046)
Mother's education (1 = completed junior high)		0.381 (0.005)	0.308 (0.010)	0.139 (0.035)
Number of observations		3,228	787	43

Data source: CFPS 2010, 2012, and 2014.

Table 4. Variation in Participation Trends Over Three Waves

Participation in each wave			Number of observations	Family per capita income (RMB)		
2010	2012	2014		2010	2012	2014
0	0	0	614	5,513	6,589	8,450
0	0	1	38	4,139	5,487	6,185
0	1	0	21	4,283	5,913	11,181
0	1	1	26	3,244	4,135	4,949
1	0	0	25	3,951	4,125	8,235
1	0	1	7	4,155	2,805	5,178
1	1	0	13	2,305	4,351	6,210
1	1	1	43	2,925	3,340	6,377

Data source: CFPS 2010, 2012, and 2014.

Table 5. Difference-in-Differences Analysis of Family Per Capita Income Growth

	Children who have never joined (n = 614)	Children who joined in 2014 (n = 38)	
	Family per capita income growth (RMB)	Family per capita income growth (RMB)	Difference (RMB)
2010–2012	1,076	1,348	272
2012–2014	1,861	698	-1,163*

Data source: CFPS 2010, 2012, and 2014.

Note. The two groups were created from the top two rows of Table 4, with "Children who have never joined Rural Dibao" as the top row in Table 4 and "Children who joined Rural Dibao in 2014" as the second-to-top row in Table 4.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 6. OLS Correlations between Participation and Children's Learning Outcomes

Variable	Standardized Chinese-language score	Standardized math score	Standardized Chinese-language score	Standardized math score
Participation (1 = participated)	-0.0498	-0.0543	-0.0620	-0.0939
	(0.0705)	(0.0768)	(0.0679)	(0.0678)
Family per capita income (1,000 RMB)	0.0217***	0.0189***	0.0130***	0.00833***
	(0.00337)	(0.00367)	(0.00317)	(0.00316)
Ethnicity (1= Han)	--	--	0.427***	0.281***
			(0.0740)	(0.0738)
Father's education (1 = completed junior high)	--	--	0.0322	0.0553
			(0.0440)	(0.0439)
Mother's education (1 = completed junior high)	--	--	0.115**	0.119**
			(0.0470)	(0.0469)
Gender (1 = male)	--	--	-0.167***	-0.0159
			(0.0426)	(0.0425)
Eastern China	--	--	0.0519	0.0274
			(0.0512)	(0.0511)
Age	--	--	0.229***	0.331***
			(0.0131)	(0.0130)
Year	--	--	-0.0970***	-0.189***
			(0.0171)	(0.0170)
Constant	22.78***	11.81***	191.7***	374.6***
	(0.266)	(0.200)	(34.17)	(34.08)
Observations	1,574	1,574	1,433	1,433
R-squared	0.027	0.018	0.294	0.387

Data source: CFPS 2010, 2014.

Note. Standard errors in parentheses.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 7. Impact of Participation on Children's Learning Outcomes

	(1)	(2)
Variable	Standardized Chinese-language score	Standardized math score
Participation (1 = participated)	0.297***	0.219*
	(0.109)	(0.113)
Family per capita income (1,000 RMB)	0.0324***	0.0326***
	(0.00502)	(0.00522)
Constant	0.0108	-0.0421
	(0.0411)	(0.0427)
Individual fixed effects	Yes	Yes
Number of children	787	787
Observations	1,574	1,574
R-squared	0.058	0.051

Data source: CFPS 2010, 2014.
Note. Standard errors in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 8. Program Impact on Food and Education Expenditures

	(1)	(2)
Variable	Family per capita food expenditure (RMB)	Individual education expenditure (RMB)
Participation (1 = participated)	456.4*	726.5*
	(256.5)	(390.4)
Family per capita income (1,000 RMB)	49.18***	97.41***
	(11.83)	(18.08)
Constant	1,519***	2,060***
	(97.00)	(147.7)
Individual fixed effects	Yes	Yes
Number of children	787	787
Observations	2,335	2361
R-squared	0.013	0.020

Data source: CFPS 2010, 2012, 2014.
Note. Standard errors in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 9. Impact of Education and Food Expenditures on Learning Outcomes

	(1)	(2)	(3)	(4)
Variable	Standardized Chinese-language score	Standardized math score	Standardized Chinese-language score	Standardized math score
Individual education expenditure (1,000 RMB)	0.0393***	0.0558***	--	--
	(0.00680)	(0.00692)		
Family per capita food expenditure (1,000 RMB)	--	--	0.0379***	0.0575***
			(0.0109)	(0.0112)
Family per capita income (1,000 RMB)	0.0238***	0.0205***	0.0305***	0.0290***
	(0.00515)	(0.00524)	(0.00508)	(0.00523)
Constant	-0.00121	-0.0860**	-0.00896	-0.0982**
	(0.0389)	(0.0395)	(0.0420)	(0.0432)
Individual fixed effects	Yes	Yes	Yes	Yes
Number of children	787	787	787	787
Observations	1,574	1,574	1,558	1,558
R-squared	0.088	0.120	0.066	0.079

Data source: CFPS 2010, 2014.
Note. Standard errors in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 10. Impact of Program Participation on Learning Outcomes by Family Per Capita Income

	Children from first 2 income quantiles		Children from last 3 income quantiles	
Variable	Standardized Chinese-language score	Standardized math score	Standardized Chinese-language score	Standardized math score
Participation (1 = participated)	0.483**	0.352*	-0.0512	-0.0486
	(0.185)	(0.197)	(0.195)	(0.204)
Family per capita income (1,000 RMB)	0.124**	0.138***	0.0289***	0.0295***
	(0.0481)	(0.0511)	(0.00611)	(0.00639)
Constant	-0.177	-0.266**	0.0495	-0.00310
	(0.111)	(0.118)	(0.0663)	(0.0694)
Individual fixed effects	Yes	Yes	Yes	Yes
Number of children	469	469	619	619
Observations	637	637	937	937
R-squared	0.075	0.060	0.066	0.063

Data source: CFPS 2010, 2014.
Note. Standard errors in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Table 11. Impact of Program Participation on Learning Outcomes by District

	Children from Eastern provinces		Children from non-Eastern provinces	
Variable	Standardized Chinese-language score	Standardized math score	Standardized Chinese-language score	Standardized math score
Participation (1 = participated)	-0.187	0.380	0.343***	0.203*
	(0.317)	(0.336)	(0.117)	(0.122)
Family per capita income (1,000 RMB)	0.0171**	0.0220***	0.0400***	0.0383***
	(0.00727)	(0.00771)	(0.00646)	(0.00674)
Constant	0.245***	0.0882	-0.0647	-0.0888*
	(0.0739)	(0.0784)	(0.0485)	(0.0506)
Individual fixed effects	Yes	Yes	Yes	Yes
Number of children	187	187	601	601
Observations	373	373	1,201	1,201
R-squared	0.031	0.048	0.072	0.055

Data source: CFPS 2010, 2014.
Note. Standard errors in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$