Providing A Healthier Start To Life: The Impact of Conditional Cash Transfers on Infant Mortality

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Abstract

In this paper I evaluate the impact of Mexico's income transfer program, Oportunidades, on infant mortality. This program is a radical departure from typical income transfer programs since cash transfers are provided conditional on the beneficiaries going for regular health care check-ups, mothers and small children receiving nutritional supplements and children attending school. The program started in 1997 and by 2001 it had reached approximately 63,500 rural communities or approximately 10 percent of the rural population of Mexico. While other studies on Oportunidades take advantage of a randomized treatment and control evaluation database performed in 506 communities, the database lacks sufficient sample size to measure impacts on infant mortality. Instead I use vital statistics data to compute municipality level rural infant mortality rates and use the phasing-in of the program over time both between and within the municipality to identify the impacts. I find that Oportunidades led to an approximately 5 percent decrease in infant mortality in Mexcio. However, the reductions are as great as 10 percent in those communities where household had better access to piped water and electricty prior to program interventions.

1 Introduction

In 1995, over 9 million children under the age of five died from avoidable deaths (Filmer 1997). These deaths predominantly took place in low and middle income countries where the child mortality rate averages 120 and 38 per 1000 respectively as compared to 7 per 1000 in high income countries. Conditional income transfer programs are a new type of poverty alleviation tool in developing countries that help stimulate demand for health care

and may lead to important infant mortality reductions. These programs differ from typical income transfer programs since cash transfers are provided conditional on the beneficiary household engaging in a set of behaviors designed to improve their health, nutrition and education status. The aim is to build the human capital of young children and break the intergenerational transmission of poverty. Mexico was the first country to embark on such an initiative in 1997 with its program Oportunidades (formerly known as Progresa). The program targeted the rural poor and reached almost 2.5 million rural households by 2000. The Oportunidades model is extremely popular throughout the Latin American region and has been adopted by Brazil, Argentina, Columbia, Honduras, Jamaica, and Nicaragua. In this paper I evaluate the impact of Oportunidades on the rural infant mortality rate (IMR).[1] Showing that there are reductions in infant mortality is particularly important since it implies there has also been decrease in child morbidity, and because infant mortality is a good general indicator of the overall health of the population (Lederman, 1990).

To date, there is limited evidence from developing nations of the ability of income transfers (conditional or unconditional) to improve child health outcomes. A study of the impact of increasing the amount and coverage of the social pension program in South Africa for the elderly black population finds that income transfers to grandmothers led to nutritional improvements of girls (Duflo, 2003). Research of the conditional income transfer program in Columbia find that while there is a reduction in the incidence of acute diarrhea there is no measurable impact on nutrition. Past research on Oportunidades has taken advantage of a natural experiment in which 506 communities in rural Mexico were randomized into treatment and control areas. They show that the nutrition status of children from beneficiary families improved and that the number of days a mother reported her child ill reduced as compared to those from similar families but that do not receive the transfer (Gertler and Boyce, 2001; Gertler 2004; Behrman and Hoddinott, 2001). While this indicates that there are some important child health benefits of Oportunidades, it is a less objective measure of child health than infant mortality and may be influenced by the health education component of the program. Finally, research in the US shows that poor families that benefit from health interventions similar to those families in Mexico are being encouraged to utilize via the cash transfer do experience a reduction in infant mortality.(Currie and Gruber, 1996; Devaney et. al., 1990) While this does provide some reassurance that the Oportunidades program might impact infant mortality, there were no

[1] Infant mortality is defined as the number of death of children under the age of one in a given year per 1000 live births in the same year.

cash transfer associated with the US studies.

The Oportunidades program is well known for its randomized treatment and control data base. While this database contains information on the number of infant deaths, it lacks sufficient sample size to be able to estimate the impact of the program. To solve the problem of insufficient sample size, I explore the impact of the program on the rural infant mortality rate at the municipality level and use a non-experimental research design. I use a novel panel data set of 2399 municipalities from 1992 to 2001 that I assembled from a variety of sources. I take advantage of the variation in the percent of rural households covered by the program across municipalities and within municipalities over time to measure the average treatment effect of Oportunidades on rural infant mortality. I estimate the impact using municipality and time fixed effects regressions including variables associated with the program phase-in rule to control for program timing bias at the municipality level and general time trends. (Rosenzweig and Wolpin, 1986) I explicitly control from changes in the supply of free health care in rural area,

An interesting aspect of the analysis is that I am able to use the urban IMR to verify that there is likely to be no other unobservable time-varying variables that are biasing the results. Since Oportunidades was not provided in urban areas before 2000, there should be in program impact in these areas unless there are municipality trends are correlated with the treatement variable. The result show that the program had no spurious impact on urban infant mortality. I also verify that the impact is not a result of an endogenous increase in the number of live births.

I find that Oportunidades led to a 5 percent reduction in the rural infant mortality rate in program municipalities This is double the reduction in mortality that occurs each year due to the time trend. Reductions in infant mortality were as great as 10 percent in program areas that had better access to piped and electricity in the household prior to the introduction of Oportunidades. These results are important because they show that conditional cash transfer program, when designed with appropriate health interventions, can reduce infant mortality. To the extent that piped water is a good proxy for clean water, the findings suggest that for programs to be successful in other countries there must be an adequate provision of clean water and electricity.

The remainder of the paper is organized as follows. In section 2 of the paper I describe the Oportunidades program including the targeting mechanism and the phase-in rule. A description of the data is provided in section 3. The identification strategy, including a description of the sources of variation in the treatment variable and the empirical model

are presented in section 4. Results are provided in section 5 and section 6 concludes.

2 The Rural Oportunidades Program

Adopted in 1997, Oportunidades[2] aims at breaking the intergenerational transmission of poverty by improving the human capital of poor children in Mexico. The program combines two traditional methods of poverty alleviation: cash transfers and free provision of health and education services. Oportunidades relaxes the household budget constraint by providing an income transfer, but uses the transfers as an incentive to increase utilization of health and education services. The key feature of the program is that payments of the transfers are conditional on children attending school, and family members obtaining sufficient preventative health care. While the program commenced in rural areas, it expanded into urban areas in 2000. The focus of this study is on the rural program.

An important aspect of the Oportunidades program is that its health activities were designed to address many recalcitrant health issues in rural Mexico. In particular, the program targets infants, children, and pregnant and lactating women in an effort to ensure that children have a healthy start to life. Mothers receive cash transfers conditional on the households' participation in four program activities:

1. Children receive growth monitoring from conception to age 5;
2. All family members receive regular preventative health services including prenatal care, well baby care and immunizations;
3. Mothers attend health, hygiene and nutrition habits education programs;
4. Children age 0-2 and pregnant and lactating women take nutritional supplements.

Although the main stay of the program is to offer demand incentives via an income transfer, Oportunidades also worked with the Ministry of Health to provide supplemental health services in the program areas. Since receipt of the transfers are conditional on regular health care check-ups, the program also tried to ensure an adequate supply and quality of health care. Following national guidelines, each clinic was equipped to deliver a minimum basic package of health care. In addition, the program used mobile clinics and

[2] The program was formerly known as PROGRESA.

foot doctors to reach many marginalized communities that did not have access to health clinics[3].

Amongst other beneficial outcomes, the program's health activities are likely to reduce infant mortality. Adequate prenatal care, medical assistance at birth, immunizations and good breast-feeding practices are all known to be important for proper in uterine growth of a child and for reducing the probability of infant death (Murata et. al., 1992; Costello and Manandhar, 2000; World Bank, 2003). Research has also shown that programs in the US that target poor families and are similar to Oportunidades in terms of the type of health interventions have led to reduction in infant mortality (Currie and Gruber, 1996; Devaney et. al., 1990). Thus given the program's health activities, it is reasonable to expect that one outcome of Oportunidades could be a reduction in infant mortality in beneficiary households.

2.1 Targeting and Program Phase-in In Rural Mexico

Oportunidades used a two stage process to identify eligible beneficiary households in rural areas. In the first stage, rural[4] communities or localities were selected. In order to meet the program's objectives, localities where chosen based on a number of attributes. All localities were first ranked by a marginality index and only those with a high or very high marginality were considered for the program. This included 76,098 localities. The program used population density data and information on the number of localities to identify groups of communities where the maximum benefit per household in extreme poverty would be reached. Any locality with less than 50 inhabitants was excluded from the program, as were those that were determined to be geographically isolated. Lastly, localities were required to have access to primary and secondary schools as well as a permanent health care clinic to be considered.[5]

While the exact program phase-in rule in not clear, the general criteria used is known. Due to logistical and financial reasons the program was phased-in over time starting in 2,578 localities in 7 states in 1997 (see Figure 1). In 1998, the program greatly expanded reaching almost 34,000 localities. In this year the requirement that localities had to have

[3] This outreach was provided in combination with a Mexican Government/World Bank program operating in similar communities at the time, Programa de Ampliacion de Cobertura (PAC).

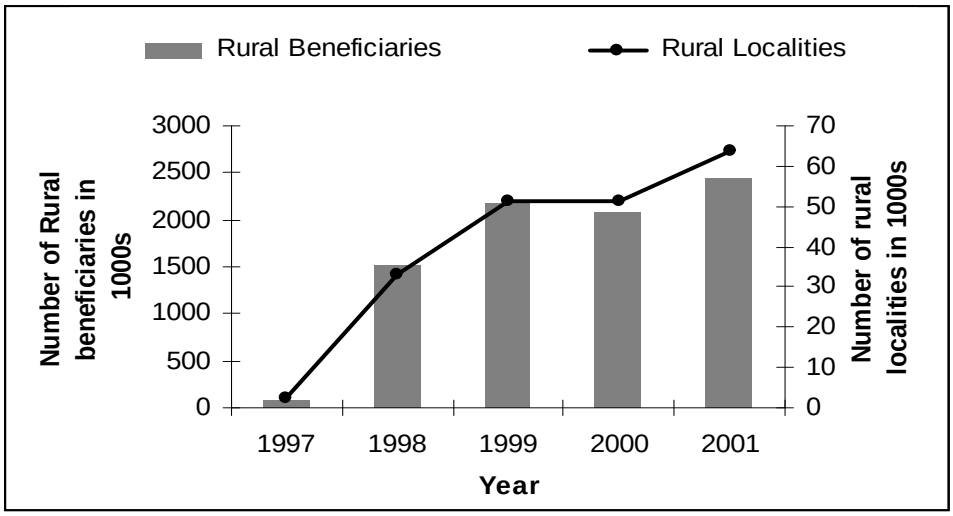
[4] A locality is defined to be rural if it has less than 2500 inhabitants.

[5] For a locality to be considered as having access to a health care clinic the clinic need not be in the locality but in a locality at most 15 kilometers away. See Skoufias et al 1999 for more details.

access to permanent health care clinics was relaxed. The remaining localities were brought into the program in 1999, and localities which were previously excluded due to geographical isolation were also included. [6]

Once localities were chosen, beneficiary households in each community were identified. A census, called the Encaseh, was taken of all households in the program localities. This census included information on household income and characteristics that captured the multidimensional nature of poverty. Using these data a welfare index was established and households were classified as poor or non-poor. Subject to approval of a community assembly, only the poor became eligible for benefits. Due to the means testing, a different percent of the rural population is covered by the program in each locality. Only families who were living in the locality at the time of the Encaseh were eligible for program benefits. A recertification of eligibility took place in 2000.

Figure 1: Trends in The Number of Oportunidades Beneficiaries and Localities



2.2 The Randomized Experiment

A prominent feature of this program is the randomization by the Mexican government of 506 Oportunidades localities in seven states into control and treatment villages. Eligible households in treatment villages received benefits immediately, while eligible household in

[6] See Skoufias, Davis, Behrman 1999 for more details.

control villages became part of the program about 2 years later. A baseline survey was performed in October 1997 and six follow-up surveys were taken at approximately 6 month intervals. The design was created in order to ensure rigorous evaluation of the program impacts. The delay in the implementation of the program in control villages was justified since the government lacked sufficient funds to provide the program nationally when the program began. While many studies on Oportunidades take advantage of these data, it lacks a sufficient sample size to estimate program impacts on infant mortality. In this dataset there are only two deaths of children under age one in the control areas in the post-intervention period. For this reason I use vital statistics data and a different identification strategy as explained in the following sections. I will take advantage of this dataset in future versions of this paper to investigate what health behavior changes took place that may have led to a decrease in infant mortality in the program areas.

3 The Data

Infant mortality was constructed using 1992-2001 vital statistics data from the Mexican Ministry of Public Health. The mortality data is from a nation-wide database containing information on every registered death in Mexico. The residence of the person who died is identified at the municipality level, but information is available to determine if the death occurred in a rural or urban locality within that municipality.[7] The live birth data is publicly available on the INEGI website for every municipality in Mexico, except the state of Oaxaca in the year 2000.[8] These data are provided yearly by municipality and size of the locality where the mother who gave birth resided. The rural and urban infant mortality data is constructed by linking these two databases by municipality. The rural infant mortality rate is the ratio of the total number of deaths of children under one year of age per 1000 live births in rural areas of the municipality in a given year.[9]

The main impact indicator, the percent of rural households receiving Oportunidades

[7] Locality is one administrative unit lower than municipality. On average there are X localities in a municipality.

[8] While the urban and rural breakdown of the number of live births was missing for Oaxaca the total number of births was available. To fill in the missing values for the number of rural births in 2000 we calculated the average of the ratio of rural to total birth for 1999 and 2001, and multiplied this by the total number of births in 2000. A similar process was used to determine the number of urban births.

[9] Values for municipal rural infant mortality rates greater than 240 were set to missing since there is some measurement error in these data and these outliers take on large values. This affected a total of 58 observations or less than .3 percent of the data.

benefits, is computed using Oportunidades administrative data and INEGI census data. Oportunidades provided yearly administrative data on the number of households registered for the program in December of each year. This information is available for each locality from the inception of the program in 1997 to 2001, Figure 1. Using INEGI census data on the number of rural and urban households in a municipality for 1990, 1995 and 2000 I linearly interpolate to approximate the number of households for each year between 1992 and 2001. The percent of rural households receiving program benefits is simply the ratio of the number of beneficiary households over the number of households in rural areas of a municipality.[10]

The control variables used in the analysis are from a variety of sources. Information on municipality characteristics are from the 1990 and 2000 Census and the 1995 short Census. Data on the size of the municipality in square kilometers is INEGI data but is only available for the municipality as a whole and not the rural areas. The marginality index is publicly available on the CONAPO website for 1990, 1995 and 2000. Health supply data are not publicly available but were collected by the author from the Ministry of Health and IMSS-Oportunidades.

It is important to note that between 1992 and 2001 some municipalities were split into several municipalities while others have been amalgamated into one. I adjust the data to ensure that the boundaries of the municipality remain constant throughout the period of the analysis.

4 Identification Strategy

4.1 Sources of Variation

My objective is to estimate the average treatment effect of Oportunidades on rural infant mortality. Since Oportunidades targeted poor households in rural localities, the intensity of the program varies across localities. I would like to compare the infant mortality rate in treated rural localities with the counterfactual —the infant mortality rate had Oportunidades not been available in the locality. Since the counterfactual is never observed, optimally I would take advantage of the phasing-in of the program over time and use rural localities yet to be treated as the comparison group. The assumption that must hold is

[10] Approximately 2 percent of all positive Shares values are greater than one. We set these values to missing and include a zero one indicator of the missing values in order to perserve the interpretation of this variable. Using the uncleaned version of this variable does not change in the results.

that change in infant mortality observed in the comparison group is the same as in the treated localities had they not received the program. Although I cannot test this assumption, I can test that the pre-intervention trends in infant mortality are the same between localities that joined the program in different years. If the trends are same in the pre-intervention period, they are likely to have been the same in the post-intervention period, in the absence of the program.

The strategy is slightly more complex due to the lack of infant mortality data at the locality level to test this assumption. Instead, I aggregate to the municipality level, the level at which the data is available.[11] I investigate the impact of the program on municipality rural IMR. New municipalities were brought into the program over time between 1997 to 2001 (see Figure 2). One source of variation used to identify the impact is the difference in program intensity between municipalities.

I test that the pre-intervention trends in rural IMR between municipalities that joined the program in different years are the same. Defining a set of dummy variables enter$k$, $k = 1998 - 2001$,where enter$k$ equals 1 if the first program locality was phased-in during year k in municipality m and zero otherwise, and a set of year dummy variables year$j$, $j = 1998 - 2001$ the equation used to test the difference in trends is[12]:

$$IMR^r = \beta_0 + \sum_j \beta_j YEARj_t + \sum_j \sum_k \theta_{jk} YEARj_t * ENTERk_m + u_{mt} \quad (1)$$

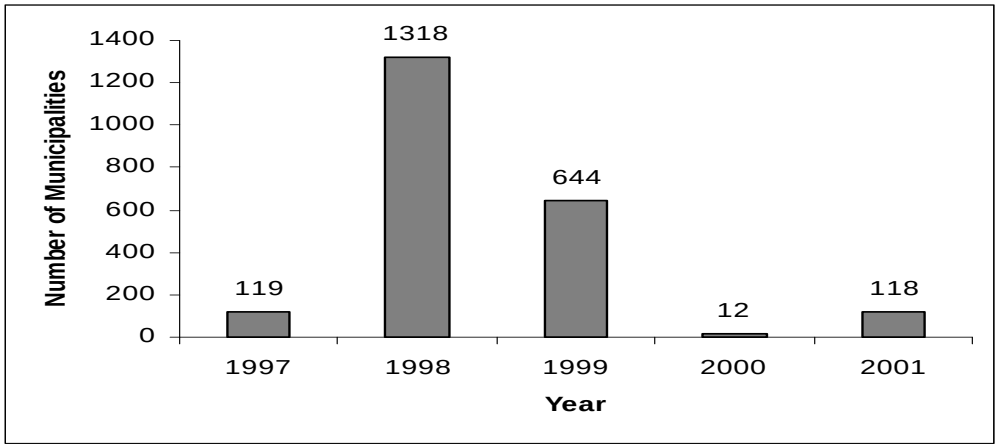
If the coefficients on the θ's are not significantly different from zero then the pre-intervention trends do not statistically differ between municipalities entering the program in different years. Results are reported in Table 3 and show that the pre-intervention trends in the rural IMR are not significantly different with the exception of the group that joined the program in 2001. I do not use this group of municipalities in the analysis.

However, within a municipality not all program localities were brought onto the program during the same year. As a result the program intensity also varies over time within a municipality. For example, Table 1 shows that in 1997 there were 2424 program localities. In 1998, the number of program localities in those same municipalities almost doubled to 4705. This variation in program intensity within a municipality over time is a another source of variation used to identify the program impact.

[11] Municipalities are approximately 10 times larger than a locality with an average number of households of X as compared to Y. There are also on average Z localities in a municipality.

[12] I leave out of the equation phase1997 and year1997.

Figure 2: Numer of New Program Municipalities by Year.



Results may be biased if program localities within a municipality are not similar. One way to reduce these biases is to control for the program phase-in rule. The program phase-in rule was discussed in section 2. It highlights that localities that joined the program in 1997 have better access to permanent health care clinics than those the joined the program later. I will therefore control for changes in the supply of health care in rural municipalities as well as the percent of Oportunidades families with access to a permanent health care clinic.

Ideally I would also like to test that the pre-intervention trends in rural IMR are the same between localities that join the program in different years, what I call different phase groups. Since this data in unavailable I instead examine if locality characteristics in the pre-program period (1995 or 1990), and the change in locality characteristics between 2000 and the pre-program period are the same across phase groups. To the extent that level and change in locality characteristics are correlated with the trends in rural IMR, their similarity across phase groups is an indication that the trends in rural IMR are also likely to have been similar in these localities.

Table 4 presents the difference in locality characteristics across phase group in the pre-intervention period. These differences are significant but arguably small. The means for localities that were incorporated into the program in 1998 (phase group 1998) are in the first row. The differences between the locality characteristics for phase group 1998 and each of the other phase groups are in subsequent rows. The differences between phase

Table 1: Number of New Program Localities By Date Municipality Started Program

Year Municipality	**Number of New Program Localities**				
Entered Program	**1997**	**1998**	**1999**	**20000**	**2001**
1997	2424	4705	5560	5538	5927
1998		28261	35222	440	9413
1999			16726	240	2548
2000				46	23
2001					376

group 1998 and each of the other groups are significant. However, they are small, especially when compared to the differences between localities that never received the program (no treatment) and phase group 1998. With the exception of the percent of population with a soil floor in 1990 and localities that where brought into the program in 2001, means are within 10 percentage points. The last group of localities to join the program (phase group 2001) have a much larger percent of the population without access to electricity and with soil floors. Although I cannot exclude the localities that joined the program in 2001, as a robustness check I estimate the results excluding 2001 data for municipalities that contained any localities in phase group 2001.

The trends in the infant mortality rate between phase group may be more likely to be determined by the changes in locality characteristics rather than the levels. Again while many of the differences in the changes between phase group 1998 and each of the other groups are significant they are small (see Table 4). The exception again is the percent of households with dirt floors. As a robustness I will investigate if adding these variables as covariates changes the results, and include time trends for each municipality.

Inclusion of municipality fixed effects controls for biases due to differences in time-invariant variables across municipalities arising from non-random program distribution (Rosenzweig and Wolpin, 1986). The estimate of the average treatment effect may still be biased if there are unobserved time-varying municipality characteristics that are correlated with the intensity of treatment variable. Since the program targeted rural areas, it should have had no impact on the urban infant mortality rate. If there are important omitted-variable I would expect to find an impact of the program on urban infant mortality due to those unobservables. I test that this is not the case.

4.2 Graphical Analysis

The basic idea behind the identification strategy is illustrated in Figures 3 and 4 in the back of the paper. Due to the variation in the intensity of treatment both between municipalities and within municipalities over time it is difficult to show the exact treatment effect graphically. However, graphs can provide suggestive evidence. In Figure 3, trends in average municipality rural IMR are provided for three groups of municipalities. The municipalities are divided into groups based on the year the program was first offered in the municipality (see Figure 2). I only use municipalities that entered the program in 1997, 1998 and 1999.[13]

If Oportunidades is successful one would expect to see a break in the trend in rural IMR soon after the program entered the municipality. Since program intensity varies between municipalities, I only present the means for those municipalities that had a high program intensity (an average of 30 percent over the program period). The program intensity also increased over time within a municipality. Table 2 below presents the mean municipality program intensity by year for each of the three groups. The first group of municipalities began to receive the program in 1997. Only 24 percent of rural households were covered by the program in that year. In 1998, the program was greatly expanded in these municipalities covering 55 percent of rural households. For this reason there may be a larger impact of the program in 1998 rather than 1997 Examining Figure 3 we find that this is indeed the case for group 1. The break in the trends for the two other group occur the year the program entered the municipalities. I verify that these breaks are not due to general trends in the municipality by presenting the same graph but for urban IMR. As expected, there are no breaks in the trend in urban IMR the year the program entered the municipalities (see Figure 4).

4.3 Empirical Model

I develop the empirical model by first considering a cohort of infants that are born alive in year t, in municipality m. The health status of the child, D^*, during that year depends on (i) whether the infant was born in a household registered for Oportunidades benefits or not

[13] As seen in Figure 2 there are not enough observation for the group that entered the program in 2000 and I showed above that the municipalities that entered in 2001 had significantly different time trends in the pre-intervetion period so do not make a good comparison group.

Table 2: Trends in Mean Municipality Program Intensity by Year Municipality Entered Program

Year Municipality Entered Program	**Year 1997**	**1998**	**1999**	**2000**	**2001**
1997 (group 1)	.24	.55	.59	.55	.57
1998 (group 2)		.34	.46	.44	.49
1999 (group 3)			.30	.29	.36

that year, H^t ; (ii) whether the infant's mother was registered for the program during her pregnancy, H^{t-1}, H^{t-2}; (iii) mother and household characteristics, I, and; (iv) municipality characteristics such as the supply of health care or the quality of the environment that are time varying and time-invariant, X. I include time fixed effects to control for time trends. Assuming a linear relationship,

$$D^*_{imt} = \alpha_t + \sum_j \beta_j H^{t-j}_{imt} + \sum_g \phi_g I_{imtg} + \sum_p \phi_p X_{mtp} + \varepsilon_{imt}, \tag{2}$$

where imt indexes infant i born alive in municipality m in year t. Year fixed effects are represented by α_t, and ε_{imt} is the error term which is assumed to have a zero mean and be orthogonal to the independent variables.

There are a number of variables in equation 2 that we do not observe in the data. The health status of the child is a latent variable. Instead, I observe when the health status of the child is so poor ($D^* > 0$) that the child dies ($D = 1$). Although the indicator variable H_{imt} (if child imt is from a program household or not) does not exist at the individual level in our dataset, the probability of treatment at the municipality level does. This probability is the percent of live births to beneficiary households in municipality m in year t, and is the same for all infants in the municipality. Finally, mother and household characteristics of the infant are not available in the Mexican vital statistics.

Given the lack of individual level data and since mortality is identified at the municipality level, I aggregate to the municipality level to perform the analysis.

$$\sum_{i \in I} D_{imt} = N_{mt}\alpha_t + \sum_j \beta_j EB^{t-j}_{mt} + N_{mt} \sum_p \phi_p X_{mtp} + \sum_{i \in I} \varepsilon_{imt}, \tag{3}$$

where N_{mt} is the population of the infants born alive in municipality m and year t. The dependent variable is now the number of deaths among infants born alive in a municipality

in a given year, and the treatment variable is the number of live births in a municipality m in year t to households eligible for Oportunidades in year $t-j$. To make comparisons across municipalities I normalize by the number of live births in each municipality. At the municipality level the equation is written:

$$\frac{1}{N_{mt}}\sum_{i\in I} D_{imt} = \alpha_t + \sum_j \beta_j \frac{EB_{mt}^{t-j}}{N_{mt}} + \sum_p \phi_p X_{mtp} + \sum_{i\in I}\frac{\varepsilon_{imt}}{N_{mt}} \tag{4}$$

Since the data lacks information on the number of eligible births, EB, but does contain the number or eligible households, I assume that the fertility rate remains constant over the period of the program (1997-2001). I redefine $\frac{EB_{mt}^{t-j}}{N_{mt}}$ to be the ratio of the number of beneficiary households over the total number of households in rural areas of the municipality for a given year. I call this redefined variable the Pr*ogram Intensity*, or *Intensity*. We also include municipality fixed effects to control for any municipality characteristics that could be correlated with both infant mortality and the *Intensity* variable due to program placement bias.

Our estimation equation is:

$$IMR_{mt}^r = \alpha_t + \tau_m + \sum_j \beta_j Intensity_{mt}^{r,t-j} + \sum_p \phi_p X_{mtp}^r + u_{mt} \tag{5}$$

where I add the r superscript to emphasis that the data is for rural areas of the municipality. Note the dependent variable is now labeled IMR^r since it is a measure of the rural infant mortality rate. The estimate of the average treatment effect of Oportunidades is measured by the β's.

5 Results

5.1 Average Impact of the Program

I start by estimating the average treatment effect of Oportunidades on the rural IMR. Following the empirical model in equation 5, the regression includes municipality and time fixed effects. All results are weighted by the number of rural households in a municipality, and the standard errors are adjusted for heteroskedasticity and serial correlation. Results are presented in Table 7. Columns 1 through 5 present different specifications for the main impact. The lag of the treatment variable, *program intensity*, provides the most

significant results. The mean rural IMR for the sample is 17.5 and the percent of rural households covered by the program in a municipality reached an average of 47 percent. Using this information and the coefficient on program intensity presented in Table 7 column 5, I find that the program led to a 5 percent reduction in the rural IMR. On average over the period of study the rural IMR reduced by approximately 2 percent each year just due to the time trend. So, though small the results are quite important.

5.1.1 Validity Checks

As discussed in section 3, we worry that localities that were phased into the program during 2001 have different locality characteristics from the others and may not make a good comparison group. I test the robustness of the result by excluding municipalities for the year 2001 if any of their localities were brought onto the program in 2001. As shown in column 6 of Table 7, the coefficient on program intensity is very close to the one where these municipalities were included (column 5).

Although the model controls for time-invariant unobserved municipal heterogeneity, it cannot control for unobserved time-varying municipality factors that may be correlated with the treatment variable and infant mortality. I take advantage of the fact that Oportunidades mainly operated in rural localities before 2001 and test whether the program had a significant impact on urban IMR.[14] If there are indeed omitted variables *program intensity* might also impact urban IMR due to these unobservables. Results from Table 7 column 7 show that the program had no significant impact on urban IMR providing some evidence that the results are not driven by unobservables.

A further concern is that during program implementation there was an expansion of health care in rural communities. To control for possible biases, I include information on per capita health care infrastructure and personnel in the regression equation. Although many of these regressors are likely to be endogenous, if their inclusion does not influence the coefficient on the lag of the *program itensity*, it provides some confidence that health care supply is not correlated with the phasing-in of the program. Examining the results in column 1 to 2 of Table 8, the program impact remains unchanged for both rural and urban IMR.

During the first three years of the program, two criteria for choosing localities were

[14] There are a some semi-urban localities that joined the program before 2000. The program did expand to urban localities in 2000 but this should not affect our analysis.

relaxed. After 1997 the condition that beneficiaries had to have access to permanent health-care clinics which were at most 15 kilometers was relaxed. In 1999, localities that had a lower population density and were isolated from other Oportunidades localities were also incorporated in the program. I include a variable which is defined as the percent of rural Oportunidades localities with access to permanent health care to take into account the first change in the phase-in rule. The addition of this control has almost no effect on the estimate of the impact and they is not significantly different from zero (see Table 8 column 3). I would like to also include the average density of the rural population in a municipality to control for the second change in the rules. Due to lack of rural data this is not possible.

Finally, I control for all other observable time-varying municipality characteristics (see Table 9). As discussed in section 4.1, there was a small differences in means and changes in means of locality characteristics across phase-in groups. By including each of these variables at the municipality level I verify that these small differences have do not bias the results. If find that if anything their exclusion may result in an under-estimate of the treatment effect.

5.2 Measurement Error in the Dependent Variable

Under-reporting of both births and deaths is a problem in rural Mexico. This causes measurement error in our dependent variable. As long as this measurement error is not correlated with the lag of *program intensity* the estimates will be unbias. However, one might be concerned that mothers in program areas may be more likely to register their child's birth in hopes of receiving a cash transfer. It is possible could that the results are due to an increase in the number of registered births and not a reduction in mortality. I examine if Oportunidades led to changes in the number of registered lives births per 1000 population in a municipality. Results are presented on Table 10 and show that the program had not impact on the number of live births Thus, I am confident that the estimate of the program impact is indeed a result of the reduction is the number of deaths.

5.3 Heterogeneity of the Treatment Effect

I use 1995 data to examine if the program impacts vary by municipality pre-program characteristics. The results are found on Table 10. Columns 1 through 5 show that there is heterogeneity in the impact. At the 10 percent significance level, the program was

more successful at reducing infant mortality in municipalities that had better access to piped water and electricity before program implementation. The treatment effect does not vary due to municipality differences in the percent of households with sewage, percent of population who speaks an indigenous language, or the literacy rate.

The coefficient on the intensity of treatment variable is almost tripled in municipalities where at least 70 percent of the rural households have access to piped water. Approximately half the municipalities fall in this group. The mean rural IMR over the sample period for this group of municipalities is 17 as compared to 18 in areas with less access. The average percent of beneficiary rural households in municipalities for these same groupings in 1999 is actually quite different at 50 as compared to 37. Using these averages, the program leads to a 5 percent reduction in rural IMR in those municipalities with less access to piped water. However, there is a 10 percent reduction in those municipalities where at least 70 percent of households had piped water in 1995. I also find that reductions in the rural IMR remained around 5 percent in those municipalities with less electricity infrastructure. However, the program led to a 7.5 percent reduction in areas where at least 92 percent of the households in rural areas had electricity prior to program implementation.[15]

6 Conclusions

The conditional cash transfer program, Oportunidades, led to an improvement of child health in rural Mexico. Estimates of the average treatment effect show that the program resulted in a 5 percent reduction in the rural IMR. Program effects were even greater in those areas that had better access to piped water and electricity two years before the start of the intervention. In particular, municipalities where more than 70 percent of households had access to piped water experienced a 10 percent reduction in the rural IMR. In municipalities where at least 92 percent of households had electricity the program gave rise to a 7.5 percent reduction in the rural IMR.

I presented evidence of the internal validity of these results. I showed that the program did not led to a reduction in the urban IMR which might be the case if the phasing-in of

[15] Note about 45 percent of the municipalities in the estimation sample has good electricity infrastruture. The mean rural IMR over the sample period is similar for those municipalities with "poor" versus "good" electrical infrastructure, at 18 and 17 respectively. The share of rural households that are part of the program differs for these two groups. Approximately 51 percent of rural households received benefits in areas with less electricity and 37 percent in areas with better access to electricity. .

the program over time was correlated with other municipality trends. I also controlled for the change in the supply of free health care in the rural areas. This is important since Oportunidades worked closely with other ministries to ensure an adequate supply of health care. In addition, I tried to provide evidence that the localities which were phased into the program is different years are similar and provide good treatment and comparison groups.

The findings reported here are important because they show that the large conditional cash program in Mexico has been effective at significantly improving the health of children in rural Mexico. The intervention was not only meant to provide an income transfer but also improve the utilization of health care by the poor. It is sometimes feared that when there is a large influx in the utilization of services, that the quality of health care will suffer. There was an effort on the part of Oportunidades from the outset to try to minimize such effects by working with the varies ministries responsible for health to improve the supply of health care. The results show that these efforts were successful.

The main finding of this paper, that the conditional cash transfer program in Mexico reduce infant mortality, may not be generalizable to other countries due to differences in context. However, what may be useful for other countries implementing similar policies is the heterogeneity of the impact. While there is no data on the access to safe drinking water, the percent of households with access to piped water may be a good proxy. If this is the case, the results point to the need to have access to safe drinking water and electricity before the program to improve its success.

While these results are important, it is also of interest to investigate the pathways that led to these reductions in infant mortality. Future versions of this paper will examine this question by taking advantage of the randomized treatment and control database to explore what kind of health behavior changes occurred as a result of the program. For example, among other factors I will explore if treated mothers as compared to untreated received more prenatal care, were more likely to have their delivery attended by a medical attendant, had better knowledge of how to make oral rehydration salts, or if treatment households were more likely to purify their water.

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Table 3: Pre-Intervention Trends in Rural Infant Mortality Rate.

Year	Mean for Municipalites that Entered in 1997	Differences in Means Between Municipalites that joined in later years and those in 1997				
		No Treatment-1997	1998-1997	1999-1997	2000-1997	2001-1997
1991	-3.704***	5.813	0.99	0.462	17.876	3.793
	[0.903]	[6.765]	[0.999]	[1.349]	[22.539]	[2.534]
1992	-3.758***	-3.436	-1.809*	-1.065	16.823	2.415
	[0.863]	[4.660]	[0.952]	[1.305]	[12.120]	[2.612]
1993	-4.605***	-5.882	-1.289	-0.495	-3.135	-0.148
	[0.892]	[4.626]	[0.979]	[1.301]	[10.327]	[2.435]
1994	-4.624***	**-10.010****	-0.822	0.31	-5.713	2.221
	[0.908]	**[4.346]**	[0.996]	[1.330]	[11.242]	[2.354]
1995	-4.519***	**-12.081*****	-0.54	-1.182	2.781	**5.315****
	[0.871]	**[4.192]**	[0.960]	[1.324]	[12.304]	**[2.557]**
1996	-4.609***	**-10.494****	-1.45	-1.07	20.293	-2.145
	[0.905]	**[4.194]**	[0.991]	[1.344]	[29.969]	[2.204]
Observations 14883						
R-squared .068						

Notes:

1. Standard errors in brackets

2. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Differences in Means of Pre-Program Locality Charactertics By Phase Group.

	Percent of			Average	Marg.	Percent of Households With				
	Workers In the Primary Sector (1990)	Indigenous Speakers (1995) /1	Iliteratates (1995) /2	Number of Occupants in a Household (1995)	Grade (1995) /3	Dirt Floor (1990)	Dirt Floor (2000)	Piped Water (1995)	Sewerage (1995)	Electricity (1995)
Mean for Phase Group 1998	78.7***	18.1***	28.0***	5.5***	4.6***	57.3***	50.7***	37.6***	11.2***	60.7***
	[0.1]	[0.1]	[0.1]	[0.0]	[0.0]	[0.2]	[0.1]	[0.2]	[0.1]	[0.2]
Differences in Means Between Phase Group 1998 and other Groups										
Phase 1997 - Phase 1998	-2.3***	4.0***	-1.2***	-0.1***	0	13.3***	-1.2*	4.3***	2.7***	4.5***
	[0.6]	[0.8]	[0.4]	[0.0]	[0.0]	[0.8]	[0.6]	[1.0]	[0.6]	[1.1]
Phase 1999 - Phase 1998	-5.3***	-2.3***	-2.2***	-0.2***	-0.5***	-14.4***	-7.0***	8.0***	8.0***	2.5***
	[0.2]	[0.2]	[0.1]	[0.0]	[0.0]	[0.3]	[0.3]	[0.4]	[0.2]	[0.4]
Phase 2000 - Phase 1998	-3.2**	-1.8**	-2.2***	-0.3***	-0.5***	-18.0***	-10.2***	6.5***	8.5***	3.8**
	[1.3]	[0.8]	[0.7]	[0.1]	[0.1]	[1.6]	[1.3]	[2.2]	[1.2]	[1.8]
Phase 2001 - Phase 1998	-0.7**	-1.7***	0.5**	-0.3***	-0.2***	-19.9***	-0.4	-3.6***	3.7***	-14.9***
	[0.3]	[0.2]	[0.2]	[0.0]	[0.0]	[0.4]	[0.3]	[0.4]	[0.3]	[0.5]
No Treatment - Phase 1998	-29.5***	-3.4***	-7.8***	-0.5***	-2.2***	-25.8***	-18.3***	33.3***	40.7***	16.9***
	[0.4]	[0.2]	[0.2]	[0.0]	[0.0]	[0.4]	[0.3]	[0.5]	[0.4]	[0.4]

Notes:

1. Percent of over 4 year olds
2. Percent of over 14 year olds
3. Marg. Is the marginalization index provided by CONAPO. It ranges from 0 to 5 with 5 being the most marginalized
4. Robust standard errors in brackets
5. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5 : Change in Mean Locality Charactertics Between 2000 and Pre-Program Time Period, By Phase Group

	Percent of			Average	Marg.	Percent of Housholds With			
	Workers In the Primary Sector (00-90)	Indigenous Speakers (00-95) /1	Iliteratates (00-95) /2	Number of Occupants in a Household (00-95)	Grade (00-95) /3	Dirt Floor (00-90)	Piped Water (00-95)	Sewerage (00-95)	Electricity (00-95)
Mean for Phase Group 1998	-10.2***	-0.1**	-2.9***	-0.4***	-0.4***	-7.6***	8.0***	8.7***	12.6***
	[0.1]	[0.0]	[0.1]	[0.0]	[0.0]	[0.2]	[0.2]	[0.1]	[0.2]
Differences in the Change Between Phase Group 1998 and the other Phase Groups									
Phase 1997 - Phase 1998	-0.1	-0.2	0.4	0	-0.0**	-13.6***	-0.1	-1.9**	-0.7
	[0.6]	[0.2]	[0.3]	[0.0]	[0.0]	[0.9]	[0.8]	[0.7]	[1.0]
Phase 1999 - Phase 1998	0.7***	-0.1	0.7***	0.0***	0.4***	6.7***	-4.6***	-0.9***	-4.2***
	[0.3]	[0.1]	[0.1]	[0.0]	[0.0]	[0.3]	[0.4]	[0.3]	[0.3]
Phase 2000 - Phase 1998	0.7	-0.4	-0.4	0.1	0.3***	6.9***	-5.6***	-1.7	-4.2***
	[1.3]	[0.4]	[0.5]	[0.1]	[0.0]	[1.6]	[2.0]	[1.4]	[1.4]
Phase 2001 - Phase 1998	2.5***	0	0.7***	0.1***	0.2***	18.1***	-4.9***	-2.5***	-1.9***
	[0.4]	[0.1]	[0.1]	[0.0]	[0.0]	[0.5]	[0.4]	[0.3]	[0.4]
No Treatment - Phase 1998	1.2***	0.1	1.0***	0.1***	1.1***	5.2***	-9.9***	-3.2***	-8.5***
	[0.3]	[0.1]	[0.1]	[0.0]	[0.0]	[0.3]	[0.4]	[0.4]	[0.3]

Notes:

1. Percent of over 4 year olds
2. Percent of over 14 year olds
3. Marg. Is the marginalization index provided by CONAPO. It ranges from 0 to 5 with 5 being the most marginalized
4. Robust standard errors in brackets
5. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Descriptive Statistics

Panel A: Municipality Level Means for Estimation Sample By Year

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rural IMR	18.79	18.58	19.25	19.06	18.63	17.78	17.97	16.36	15.84	14.29
Share	0.00	0.00	0.00	0.00	0.00	0.01	0.25	0.42	0.40	0.46
Rural population	10379	10456	10533	10610	10654	10698	10743	10787	10831	10876
Urban population	18926	19585	20245	20907	21330	21753	22176	22599	23022	23447
Rural households	1982	2020	2058	2095	2133	2171	2209	2247	2284	2322
Urban Households	3745	3895	4045	4195	4345	4496	4646	4796	4946	5096

Panel B: Trends is Supply of Health Care at The National Level

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Number of :										
Rural Clinics	6518	6565	6758	7006	7151	7476	7682	8194	8630	8804
Hospitals	276	350	373	391	396	453	489	508	523	533
Mobile Clinics	29	28	90	308	486	819	1140	1342	1380	1386
Rural Doctors	559	607	674	771	522	757	713	772	865	918
Rural Nurses	594	659	710	794	485	753	638	705	744	816
Rural Residents	312	290	334	357	355	388	415	412	461	494

Panel C: Rural Muncipality Mean in Preintervention Period For Estimate Sample
(year the data is from in parenthesis)

	Mean
Percent of rural population age 5 and over that speaks an indigenous Language (1995)	22.50
Percent of rural households with electricity (1995)	81.48
Percent of rural households with piped water into house (1995)	61.00
Percent of 15 year olds and older that are illiterate in rural areas (1995)	24.07
Percent of rural households with sewage (1995)	27.33
Average number of occupants in rural households (1995)	5.10
Percent of rural households with a dirt floor (1990)	45.87

Table 7: Impact of Oportunidades on the Rural and Urban Infant Mortality Rate (IMR)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
			Rural IMR				Urban IMR
Program Intensity	-0.631	0.35	0.368				
	[0.690]	[0.629]	[0.629]				
Lag of Prog. Intensity		-2.012**	-1.911*	-4.146*	-1.807**	-2.050**	0.623
		[0.821]	[0.770]	[2.255]	[0.840]	[0.859]	[1.161]
Lag of Lag of Prog. Intensity			-0.236				
			[0.739]				
Lag of Prog. Intensity Square				3.122			
				[2.819]			
Observations	19723	19723	19723	19723	19723	18885	12663
R-squared	0.62	0.62	0.62	0.62	0.62	0.63	0.61
Mean of Share	17.69	17.69	17.69	17.69	17.69	17.56	19.03
GR2001 Taken Out /7	NO	NO	NO	NO	NO	YES	NO

Notes:

1. Standard errors in brackets and are robust and clustered at the municipality level.
2. * significant at 10%; ** significant at 5%; *** significant at 1%
3. All regressions are weighted by number of rural/urban households in municipality.
4. Program intensity is define as the proportion of rural household receiving Oportunidades benefits in December given year.
5. All regressions have municipality and time fixed effects.
6. IMR=infnat mortality rate, it is the number of deaths before the age of 1 per 1000 live births.
7. Municipalities that had any localities phased in during 2001 are taken out of the analysis for 2001.

Table 8: Main Impact of Oportunidades on IMR Controlling for Health Supply

	[1]	[2] Rural IMR	[3]	[4] Urban IMR
Lag of Program Intensity	-1.871**	-1.999**	-2.001**	0.461
	[0.867]	[0.861]	[0.862]	[1.147]
% of rural Opp localities with free health clinic			0.002	0.033
			[0.025]	[0.037]
Number of Per Capita in Municipality of:				
Clinics in rural areas	0.298	0.366	0.358	-0.288
	[0.435]	[0.440]	[0.438]	[1.915]
Hospitals	6.614*	6.506*	6.522*	0.139
	[3.945]	[3.888]	[3.893]	[13.019]
Mobile clinics	-1.04	-1.4	-1.374	4.667
	[1.738]	[1.736]	[1.729]	[6.026]
Doctors in contact with patient in rural areas		-0.025	-0.033	1.312
		[0.812]	[0.804]	[1.658]
Residents in rural areas		-1.469	-1.475	-4.749**
		[1.128]	[1.136]	[2.314]
Nurses in contact with patient in rural areas		0.9	0.901	0.115
		[0.620]	[0.619]	[1.112]
Specialty Residents		-3.639***	-3.628***	1.063
		[1.213]	[1.208]	[5.208]
Non-moving beds in rural area		-0.535*	-0.534*	0.138
		[0.290]	[0.291]	[0.257]
No. of moving beds		-0.284	-0.286	-1.320*
		[0.424]	[0.424]	[0.799]
ORS rooms in rural areas		1.218	1.203	1.994
		[0.802]	[0.820]	[1.497]
Delivery rooms in rural areas		-0.475	-0.49	-4.376
		[1.238]	[1.253]	[2.993]
Observations	18940	18940	18940	12176
R-squared	0.63	0.63	0.63	0.61

Notes:

1. Standard errors in brackets and are robust and clustered at the municipality level.
2. * significant at 10%; ** significant at 5%; *** significant at 1%
3. All regressions are weighted by number of rural/urban households in municipality.
4. Program intensity is define as the proportion of rural household receiving Oportunidades benefits in December given year.
5. All regressions have municipality and time fixed effects.
6. IMR=infnat mortality rate, it is the number of deaths before the age of 1 per 1000 live births.
7. Health clilnic information for SSA and IMSS-SOL only. This is health infrastructure for the uninsured.

Table 9: Main Impact of Oportunidades Controling for Other Municipality Characteristics

		[1]	[2]	[3]	[4]	[6]	[7]	[8]	[9]
					Rural IMR				Urban IMR
Lag of Program Intensity	-2.001**	-2.448***	-2.479***	-2.452***	-2.399***	-2.262**	-2.389***	-2.210**	0.337
	[0.862]	[0.883]	[0.897]	[0.879]	[0.879]	[0.891]	[0.865]	[0.881]	[1.215]
Percent of Rural Households With:									
Piped Water		0.003						0.005	-0.037
		[0.023]						[0.023]	[0.033]
Electricity			0.016					0.023	0.079
			[0.048]					[0.049]	[0.052]
Sewerage				-0.007				-0.005	-0.018
				[0.020]				[0.020]	[0.030]
Percent of:									
Rural population >4 that speaks an indigenous language					0.118			0.057	0.723***
					[0.145]			[0.151]	[0.246]
Rural populaiton >14 that is illiterate						0.141		0.174	0.231
						[0.129]		[0.140]	[0.211]
Average number of occupants in rural households.							1.78	1.972	-2.658
							[1.692]	[1.774]	[2.420]
Observations	18940	18832	18832	18832	18832	18832	18832	18832	12077
R-squared	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.61
Health Supply Included	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes:

1. Standard errors in brackets and are robust and clustered at the municipality level.
2. * significant at 10%; ** significant at 5%; *** significant at 1%
3. All regressions are weighted by number of rural/urban households in municipality.
4. Program intensity is define as the proportion of rural household receiving Oportunidades benefits in December given year.
5. All regressions have municipality and time fixed effects.
6. IMR=infnat mortality rate, it is the number of deaths before the age of 1 per 1000 live births.

Table 10 : Impact of the Program on the Number of Registered Live Births Per 1000 Population

	[1]	[2]	[3]
	Rural IMR		Urban IMR
Lag of Program Intensity	0.3	0.2	-1
	[1.3]	[1.3]	[0.8]
Observations	20922	20842	12709
R-squared	0.54	0.55	0.67
With Controls	NO	YES	YES

Notes:

1. Standard errors in brackets

2 * significant at 10%; ** significant at 5%; *** significant at 1%

3. All regressions are weighted by number of rural/urban households in municipality.

4. Program Intensity is define as the proportion of rural household receiving Oportunidades benefits in December given year.

5. All regressions have municipality and time fixed effects.

Table 11: Heterogeneity of Impact on Infant Mortality with Pre-Intervention Municipality Characteristics

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
			Rural IMR					Urban IMR		
Lag of Program Intensity	-2.496***	-2.088**	-2.349***	-2.420***	-2.355**	-0.596	-0.65	-0.765	-1.224	-1.163
	[0.885]	[0.893]	[0.886]	[0.880]	[0.928]	[1.542]	[1.616]	[1.603]	[1.292]	[1.430]
Interaction of the Lag of Program Intensity with an indicator variable that:										
30-100% of rural households have drainage in the household	0.747					0.798				
	[0.921]					[1.752]				
70-100% of rural households have piped water into household /6		-3.020***					0.664			
		[0.885]					[1.744]			
90-100% of rural households have electricity in the houseold			-1.606*					0.988		
			[0.949]					[1.795]		
80-100 % of over 15 year olds are literate in municipality				-0.428					3.748*	
				[0.971]					[2.115]	
0-20% of municipality population speaks indigenous language only					-0.194					1.19
					[0.875]					[1.511]
Observations	18940	18940	18940	18940	18802	12048	12048	12048	12048	12048
Adjusted R-squared	0.59	0.59	0.59	0.59	0.59	0.56	0.56	0.56	0.56	0.56
Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes:

1. Standard errors are in brackets. They are robust and adjusted for serial correlation.
2. * significant at 10%; ** significant at 5%; *** significant at 1%
3. All regressions are weighted by number of rural/urban households in municipality.
4. Share is define as the proportion of rural household receiving Oportunidades benefits in December given year.
5. All regressions have municipality and time fixed effects.