LUND UNIVERSITY
School of Economics and Management

Master in Economic Development and Growth

The Effects of Conditional Cash Transfers on Work Incentives of the Mexican Rural Population:

Does Oportunidades Create Income Dependency?

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Abstract:
The Conditional Cash Transfer (CCT) program "Oportunidades" has proven to be effective in improving access to education and health services for the poor in Mexico; however, the studies of the program's impact on the work incentives of its rural indigenous participants are practically inexistent. For this reason, by applying a propensity score matching methodology, this research analyses the impact of Oportunidades on the labor supply of the indigenous and non-indigenous living in rural areas. The Average Treatment Effect estimates suggest that the positive income shock created by the CCT, does not affect the work incentives for any of the rural participants. Therefore, the hypothesis that the program creates the unwanted outcome of people working less and becoming dependent on the transfers (situation that would reduce the likelihood of the program alleviating poverty in the short-term) is rejected.

Key words: Conditional Cash Transfers, income dependency, indigenous, propensity score matching, work incentives.

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Abbreviations and acronyms

ATET	Average Treatment Effect on the Treated
BF	Programa Bolsa Familia
CCT	Conditional Cash Transfers
CIA	Conditional Independence Assumption
CONAPO	National Board of Population / *Consejo Nacional de Población*
CONEVAL	National Board of Evaluation of the Social Development Policy / *Consejo Nacional de Evaluación de la Política de Desarrollo Social*
CS	Chile Solidario
ENIGH	National Household Survey of Income and Expenditure / *Encuesta Nacional de Ingresos y Gastos de los Hogares*
IC	Programa Ingreso Ciudadano
INEGI	National Institute of Statistic and Geography / *Instituto Nacional de Estadística y Geografía*
MWL	Minimum Well-Being Line
NN	Nearest Neighbor Matching
PAF	Programa de Asignación de Familia
PSM	Propensity Score Matching
RPS	Red de Protección Ciudadana
Sedesol	Ministry of Social Development / *Secretaria de Desarrollo Social*
WL	Well-Being Line

Introduction

Since 1997, the Mexican government has been implementing Oportunidades, a program that aims to boost the human development of the population living below the Minimum Wellbeing Line[1] (MWL) for them to break the intergenerational cycle of poverty. In order to achieve this goal, the Ministry of Social Development (Sedesol) provides monetary transfers to women under the condition of their children going to school, visiting periodically health clinics, and them attending communitarian workshops in preventive health related topics. By 2012, Oportunidades has expanded its scope to more than 5.8 million households (Sedesol, 2014), and it is estimated to transfer over 1.1 billion U.S dollars per year to families in both rural and urban areas (Sedesol, 2012) representing a substantial source of income for the poor (IFPRI, 2013).

Since its origins, the Conditional Cash Transfer (CCT) program has been exposed to several evaluations with, overall, good results; Oportunidades has demonstrated to be an efficient strategy to increase the use of education and health services in Mexico (Schultz, 2004), (Behrman, 2000, 2001), (Skoufias, 2001), to reduce child labor (Skoufias, 2006), and to improve the nutritional status of its participants (Attanazio and Angelucci, 2009). However, there have not been many studies evaluating the impact of Oportunidades on the work incentives of its participants; particularly, the literature of the impact of the program on labor supply decisions of the indigenous rural population is practically inexistent.

Inferring about this relation is important because according to the operational rules of the program, Oportunidades is a human development instrument that under its design's logic, when the capabilities in education and heath of those living in poverty are fostered *"incentives are generated for the participants to overcome, self-sufficiently, their precarious situation and then become able to access better levels of living standards*" (Sedesol, 2012).

[1] The minimum wellbeing line is the monetary value of the basic basket of food per person (CONEVAL, 2014) that in the case of urban and rural areas is US$91.82 and $65.5 respectively.

Thus, the present research evaluates whether Oportunidades creates positive incentives for its rural participants to overcome their own situation or if it rather creates the unwanted outcome of people working less and becoming dependent on the transfers, a situation that would reduce the likelihood of the program alleviating poverty in the short-term.

This question becomes relevant in a country in which 43% of the total non-indigenous and 72% (almost three out of every four persons) of the indigenous population still faces some sort poverty and where 62% and 21% of the total rural population lives below the Well-Being Line[2] (WL) and in extreme poverty respectively, double in proportion compared to urban areas; In real numbers, 5.8 million of rural Mexicans live below the Minimum Well-Being Line (Coneval, 2012).

The research exploits the current design of the program (there are eligible households that due to budgetary limitations are not treated yet) and the National Household Survey of Income and Expenditures (ENIGH) - that contains a rich set of variables related to the program participation and labor market outcomes- to conduct a Propensity Score Matching methodology that helps to overcome potential selection bias, and permits to estimate the effects of CCT on the time spent on productive activities (the intensive margin) and on the likelihood of participating in the labor market (the extensive market) for different groups of the population such as men, women, indigenous, non-indigenous in rural areas of Mexico.

Under this framework, the probability of participating in Oportunidades given observed characteristics (variables used by Sedesol to select potential candidates) was predicted and used as an identification strategy. The Propensity Score allowed to match treated and untreated individuals with the same probability of receiving the transfers. Therefore, for those observations in the common support region, after testing for the balancing assumption, the Average Treatment Effect on the Treated (ATET) was estimated using different matching algorithms; the Nearest Neighbor Matching without and with replacement techniques and the Caliper Radius as a robustness check. As a result, the study found no statistically significant effects of the CCT on the labor supply

[2] The Well-Being Line is the monetary value of the basic basket of food, and basic goods and services, while the Minimum Well-Being Line is only the value of the basic basket of food (Coneval, 2012).

of participating rural adults, neither on indigenous nor on non-indigenous men and women.

Since the estimated ATET is not statistically significant, the hypothesis that Oportunidades creates dependency, at least income dependency, on their participants can be rejected. Therefore, the fact that poverty has not been substantially reduced in rural areas is not because the program is creating counter incentives to engage in productive activities nor that participants reduce their time dedicated to work when they receive the transfer but rather because of other determinants that go further to the scope of the present research.

The main contribution of this research is that it presents a more profound analysis of the causal relation between a CCT program and labor supply disaggregated by ethnicity. Although in Mexico 7% of the population speaks one of the native ethnic languages, 26% consider themselves as indigenous[3], and are the most vulnerable group (specially the indigenous women), they have been systematically excluded from previous analysis dealing with the relation between Oportunidades and working incentives. Thus, including them and being able to test if the program creates incentives for them to work less, making them dependent on the transfers, has a great value both in terms of research and for the strategic design of the program.

The paper is divided in 8 sections. **Section 1** gives a program description; **section 2** reviews the literature; **section 3** describes the mechanisms in which the transfers are expected to create incentives to re-allocate time between leisure and labor; **Section 4** introduces the data used and its benefits; **Section 5** goes over the methodology and model used to estimate the causal relation; **Section 6** presents the results and the ATET of the program; **Section 7** entitles the limitations and potential sources of bias; and **section 8** draws the conclusions and the policy implication of the present research.

1. Program description

The national wide program "Oportunidades" aims to foster the development of capabilities associated with education, health, and nutrition of the Mexican population

[3] Estimations made by the author using the ENIGH 2012

living below the Minimum Wellbeing Line (the monthly monetary value of the basic basket of food) for them to be able to break the inter-generational cycle of poverty (Sedesol, 2012). In order to achieve its objectives, it provides monetary transfers to women conditional on children attending to school (maintaining school attendance rate greater or equal to 85% is a condition), visiting periodically health clinics, and attending communitarian workshops in preventive health topics.

The amount of the transfers depends on the number and gender of the offspring, and the educational level that they are attending; giving higher amounts to those families in which the children are going to upper levels of the educational system. Additionally, the households receive a bi-monthly monetary transfer (See appendix A) that aims to contribute to the improvement of the quantity and quality of the family's food intake (Sedesol, 2012).

In order to identify the households that are eligible to participate in the program the Ministry of Social Development –Sedesol- conducts a two stage process: in the first stage, the communities are selected based on the Social Marginalization Index constructed by the National Board of Population -CONAPO[4]-, and on the Index of Social Backwardness established by the National Board of Evaluation of the Development Policy –CONEVAL-. Once the localities are chosen, Sedesol conducts a survey, in the selected communities, on socio-economic information to identify target households. The information collected is then used to estimate the income per capita of the households; those whose income per capita is below the WBL are eligible. Thus, the process of identifying the candidate families is divided into two stages: 1) identification of the localities, and 2) Focalization of the families.

According to Sedesol (2012), when the households are identified, the program gives special priority 1) to households in which the per capita income is below the WBL and have members younger than 22 years, and to 2) Households in which the income is below the WBL and have women in their reproductive ages. Furthermore, when there are households already participating into the program, in order to be eligible to

[4] This marginality index contained the proportion of illiterate population, the proportion of adults working in the agricultural sector, and the proportion of houses without access to water, without a sewage system, without electricity, or with dirt flooring.

continue, their per capita income should persist under the WBL.

The focalization of the program is large in rural areas, 3.4 million people[5]. However, there are still households that even though are eligible (they filled the criteria), they are not part of the program; those families are later incorporated according to the budget disposal of the Ministry of Social Development (Sedesol, 2012).

This budgetary limitation is key in the design of the present research because it allows to identify individuals that have similar characteristics to the participants but do not receive the transfer; Hence, mimicking a counterfactual to estimate the effect is feasible using a data set that contains enough characteristics of the households and in which identifying those who participate into the program is possible, which is the case of the National Household Survey of Income and Expenditures (ENIGH) conducted by the INEGI in 2012.

2. Literature review and contribution

Oportunidades has been deeply evaluated with considerably good results; the CCTs have proven to be an efficient strategy to increase the use of education and health services in Mexico (Schultz, 2004), (Behrman, 2000, 2001), (Skoufias, 2001), to reduce child labor (Skoufias, 2006), and to improve the nutritional status of its participants (Attanazio and Angelucci, 2009).

However, the literature of the impact of Conditional Cash Transfer Programs on labor supply, while growing, is still limited (Teixeira, 2008). Among the programs in which the relation between CCT and labor supply has been more evaluated is the Brazilian *Bolsa Familia* (BF) that targets families living below the poverty line. According to Soares, Rivas, and Osorio (2010), the transfers caused an increase in labor participation rates for both men and women, finding a greater effect in the later. Moreover, Texeira (2008), using a propensity score method, estimates that "*the program marginally diminishes the supply of weekly work hours of working adults*" and has non-effect on the probability of working, and Foguel and Barros (2010) found no statistically significance on the impact of BF on labor supply.

[5] Sedesol (2012)

Although the Brazilian version of CCT has been the most evaluated regarding labor supply, there have been other programs in which this relation has been also tested. For example, Borraz and Gonzales (2009) used a propensity score matching to evaluate the impact of the Uruguayan CCT program *"Ingreso Ciudadano*[6]*"* in urban areas of Montevideo; they found significant negative effects of the program on the amount of hours worked per week – women reduced 17% while men 5% less hours-. Moreover, "*Chile Solidario" (CS)* that targets indigent households to whom transfers are given conditional only on participation in the program, was evaluated, during its first two years of implementation, by Galasso (2009) who found no statistically significant evidence of CS affecting the labor decisions of its participants.

There have been also evaluations focused on the relation between CCT and incentives to work conducted in Central America. In Nicaragua, the program *"Red de Protección Social" (RPS)* that targets poor households in rural areas was evaluated, using an experimental analysis – randomized at the community level-, by Maluccio (2007). He estimated that RPS has statistically significant negative effects on labor supply for participant families, being the most negatively impacted those who are engaged in agricultural activities. Furthermore, the Honduras' *"Programa de Asignación Familiar"* (PAF), has been estimated to have no statistically significant effects on adult labor supply of adult women but creates very small negative disincentives for males (Galiani, 2012).

There have been also some studies focused on Mexico. Skoufias (2000, 2006, and 2010) found no effect on the labor supply of the participants. However, they did not account for heterogeneity effects or whether Oportunidades impacts labor supply decisions differently to different groups of participants based on ethnicity.

After reviewing the different efforts to estimate the impact of CCT programs on the participant's decisions to supply labor, it is not clear whether they create positive, negative, or zero effects at all on labor participation; *"The base for CCT's impact on adult labor participation is much weaker and less consistent than for child labor"*

6 The *Ingreso Ciudadano* was implemented between April 2005 and December 2007, its target population was people belonging to the first quintile of those below the poverty line (Borraz and Gonzalez, 2009)

(Kabeer et al, 2012) and none of them have estimated the impact based on ethnicity.

Therefore, the key contribution of this paper with respect to the ones mentioned above is that it considers the impact of social protection on native populations (an approach that non of the others papers have done so far), which allows for a more detailed investigation on the causal relation between Oportunidades and labor supply. Including this group in the analysis becomes relevant in a country in which 7% of the population speaks one of the indigenous languages and 26% consider themselves as indigenous[7] and that has the highest rates of poverty among all -72% face some sort of poverty, and 31% live in a situation of extreme poverty[8]-.

3. Mechanism: relation between CCT and allocation of time

The research is centered on the impact of the CCT given by Oportunidades on the labor supply decisions of its rural participants. The estimation of the effect is based on a microeconomic labor supply model that provides a useful framework on how individuals choose between spending more hours of his days on labor remunerating activities to be able to afford a greater bundle of goods and services or supply less labor and consume a greater amount of leisure; it is a model that represents the decision between time devoted to domestic activities and labor time.

According to a simple microeconomic model of time allocation, individuals choose the amount of consumption and leisure according to their preferences (1) and their budget constraint (2) (Becker, 1976); the time allocation decision between working and leisure is a function of wage earned, non-work income, market prices and the household's production function (Ashenfelter & Heckman, 1971), see equation 3. Where p is the market price of consumption goods, C represents all the goods that the consumer consumes, w is the wage rate, l is the total time spent in leisure activities, M expresses all the non-labor income (transfers, remittances, child labor, etc.), and L is the total amount of labor supplied. Thus any exogenous shock affecting any of these elements may cause a new allocation of time that would affect the behavior of the individuals.

[7] Estimations made by the author using the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH) 2012

[8] According to the "Informe de Pobreza en Mexico" published by CONEVAL in 2012

$$U = f(l, C) \quad (1)$$

$$pC + wl = M + wL \quad (2)$$

$$L_i = L_i(w_i, p, M) \quad (3)$$

Hence, the individuals combine market goods and time to produce a set of commodities that maximize their utility (Gronau, 2003). In this sense, by increasing their time allocated into leisure, time spent in household activities that generate products they consume such as cooking, the individuals are also boosting their utility even by maintaining the same level of consumption of market goods and services.

In the case of the CCTs, Oportunidades in this specific case, the transfer represents a positive income shock, or a change in the non-labor income, M, that in turn modifies the individual's relative value of time and a new allocation between paid work and leisure should be established (Texeira, 2008). When M increases via a welfare transfer, the individual can consume the same amount of C and still be able to reduce the labor, L, she supplies. Since leisure can be assumed to be a normal good, as the individuals increase their income, it is expected that they also increase their demand for leisure.

According to the standard model, the transfer represents a pure income effect (Foguel & Barros, 2010); as households receive the transfer, their budget constraints shifts, allowing them to increase their leisure, reduce their labor supply, and still be able to consume the same basket of goods and services, C. Under this particular context, individuals who participate in Oportunidades and receive a positive shock of non-labor income may face disincentives to work, responding either by reducing their amount of time allocated into working hours or, in extreme cases, renouncing to their remunerated labor activities.

On the other hand, a substitution effect is also expected. Under this case, the program's conditionality of children going to school may reduce child labor and consequently the children's contribution to the total household income would diminish M. In response to this, adult labor supply should be expected to rise in order to compensate and still able to consume the same basket of goods as before. It could be the case that both income

and substitution effects move in opposite directions causing them to cancel each other (Parker, 2006).

Thus, the effect of an increase in non-labor income on the labor supply of the participants is ambiguous and it would depend on the strength of the substitution and income effects; the first would increase the amount of hours worked while the later would reduced them.

Additionally, as other members of the community get the treatment and everyone is well informed on the criterion that determines the access to Oportunidades, some non-treated individuals may adjust their behavior in order to increase their likelihood to receive the transfer; *"it is possible that some adults choose to work less, or not work at all so as to meet the income eligibility criterion of the program"* (Foguel & Barros, 2010) or that the conditionalities of the program to comply with periodic visits to the clinics may also decline the labor supply of some members of the household, most likely the women. Thus, there could be three mechanisms in which Oportunidades may affect the labor supply of the individuals: through the income effect, the substitution effect, or via the willing of being part of the program.

However, not every individual's decision of time allocation is expected to be impact with the same strength by an increase in the non-labor income; not all the participants are expected to react uniformly to the transfer. Since the program is thought and designed to alleviate poverty in the long run, it is relevant to study how incentives to work are affected to people with different characteristics based on ethnicity and gender.

Estimating the impact of Oportunidades on the labor supply of different sub-groups is relevant to learn whether the program creates long-term income dependency on the participants or not, a question that is relevant to understand the efficiency of the CCT in breaking the intergenerational cycle of poverty in Mexico.

4. Data

The main source of data used in this research is the Mexican National Survey for Household Income and Expenditures (*ENIGH* 2012), which is conducted bi-annually,

since 1992 by the National Institute of Statistic and Geography (INEGI). It has a national geographical coverage at the rural and urban levels, contains micro data on the amount, structure, and distribution of income and expenditures of the households, and information about education, government transfers, family composition, and the economic activity of every member of the household members

Since the design of the ENIGH is probabilistic and stratified, every observation has a different probability of being sampled; therefore, each household is selected to represent a different number of households in the population. For that reason, to ensure that each sub-group is properly represented, when the survey is used to estimate statistics of the total population, it is necessary to weight the sample data. *"The weights are usually developed in a series of stages to compensate for unequal selection probabilities, nonresponse, non-coverage, and sampling fluctuations from known population values"* (Brick and Kalton, 1996). Therefore, if sample means or percentages are calculated without weighting, the results will be biased estimates of the population. To undo this bias, it is needed to calculate weighted averages to correct for the sample design and be able to obtain unbiased estimates (Deaton, 1997). The ENIGH 2012 contains an inflator factor, which is the inverse of the probability of being selected, that is used for the data to have representation at the national level.

Thus, the use of the weights allows the observations to be representative of the population or a household in the survey to proxy a large numbers of households in the population, and each observation has to be multiplied by the inflation factor, to estimate the total statistics of household with similar characteristics. If this is not done *"simple means will be biased estimators of population means"* (Deaton, 1997).

Although the ENIGH2012 only contains data about households once the program has been implemented and individuals were already treated (it is not possible to observe pre-treatment characteristics), it includes a rich set of variables related to program participation and labor market outcomes; additionally, those who receive the transfer and those who does not participate into the program come from the same data source (the same survey was used for both), all the variables of interest are measured and constructed in the same way for both, and are drown from the same labor markets. All

these conditions are crucial for the matching estimators to have a low bias (Smith & Todd, 2005).

Since the research is focused on the labor supply decisions of the rural population, the sample was restricted for individuals between 15 and 64 years old that live in localities with 2,500 or less inhabitants. Additionally, the causal effect of Oportunidades is only estimated for the head and spouse of the household. After these data restrictions, the total sample size was reduced from 33,736 to 4,588 (an estimated rural population, after weighting, of 9,621,290).

Moreover and since ethnicity is a multidimensional and ambiguous concept that includes a variety of characteristics such as origin, culture, race, religion, minority status, tribe, language, or various combinations of these concepts (United Nations, 2008), and in order to avoid difficulties, the present study identifies indigenous as those who in the survey recognize themselves as indigenous[9].

Additionally, in order to test the causal effect of the CCTs on the labor supply decisions, the participants of Oportunidades are identified as those who declare to receive a transfer from the program; the labor supply variables are: a dummy indicating if the person works, and the amounts of hours worked per week.

5. Methodology

5.1 Potential Outcome framework

Since the research is interested on what is the heterogeneous impact of Oportunidades on the labor supply decisions of those who receive the program in rural areas, it is necessary to establish a model that allows inferring the causal effect of the program on the individuals' behavior. For that matter the potential outcome framework is proposed.

Basically, the matter of interest is to know $\Delta_i = Y_{1i} - Y_{01}$, how much the labor supply of an individual is affected by participating in Oportunidades; what might have happened

[9] The ENIGH, 2012 includes the question: *According with your traditions, do you consider yourself an indigenous* person*?* Thus, the present research consider indigenous to those who responded "yes" to that question

to someone who received the cash transfer if that person had not received it. Y_{1i} is the potential outcome if the person participated in the program and Y_{0i} refers to the potential outcome of the same person i if she had not participated in Oportunidades. Thus, the causal effect of being treated would be the difference between Y_{1i} and Y_{0i}. However, it is only possible to observe one potential outcome at a time because the person only lives one life and she is either treated or not. In order to solve this problem, one solution is to compute the average effects of those treated and non-treated as in equation 4 (Angrist & Pischke, 2009).

$$E[Y_i|D_i = 1] - E[Y_i|D_i = 0] = E[Y_{1i}|D_i = 1] - E[Y_{0i}|D_i = 1] + E[Y_{0i}|D_i = 1] - E[Y_{0i}|D_i = 0] \quad (4)$$

However, equation 4 expresses a naive comparison of averages by treatment status which does not tell us anything about potential outcomes; by doing this, the observable effect $E[Y_i|D_i = 1] - E[Y_i|D_i = 0]$ is divided into two: $E[Y_{1i}|D_i = 1] - E[Y_{0i}|D_i = 1]$ which is the Average Treatment Effect on the Treated (ATET) and $E[Y_{0i}|D_i = 1] - E[Y_{0i}|D_i = 0]$ that reflects the selection bias. The first captures the difference in outcomes for those who received the program to their potential outcome if they had not being part of the program $E[Y_{0i}|D_i = 1]$. While the second part of the equation $E[Y_{0i}|D_i = 1] - E[Y_{0i}|D_i = 0]$ is known as the selection bias, the difference between potential outcomes of those who were treated if they had not being treated and the potential outcome as untreated of the ones who were actually non-treated. Maybe those who participate in the program would have different labor supply decisions than those not treated in the first place. Hence, the goal of this empirical economic research is to overcome this selection bias, and therefore be able to say something about the causal effect of a variable like D_i on the labor supply decisions.

Since Oportunidades is, in the present, non-randomized and the data used is not a panel, comparing the outcome means to those treated against the non-treated $[Y_i|D_i = 1] - E[Y_i|D_i = 0]$ would lead to a latent bias in which the potential outcomes of those two groups are not independent of treatment status. Therefore, a strategy to construct a good

counterfactual should be applied to make $E[Y_{0i}|D_i = 1] = E[Y_{0i}|D_i = 0]$ as likely as possible and be able to calculate the causal effect.

5.2 Selection bias; means by status

In order to test whether the treatment and control groups share similar pre-treatment characteristics or not, a mean difference test, for indigenous and non-indigenous living in rural areas, was conducted to compare their characteristics in terms of intra household demographic characteristics, the average education of the head and spouse, the socio-economic region that they live in[10], if they use wood or coal as a fuel to cook, some proxies for the amount of assets they own, the crowding index (the total people living in the dwelling divided by the amount of rooms used for sleeping), the demographic dependency ratio (children plus elder divided by adults in their productive years) the total amount of members younger than eighteen years old, whether the individuals speak a native language or not, and the number of adult women living in the dwelling. All these variables were taken from the model used by the Mexican Ministry of Development to estimate the income of the potential candidates and to evaluate whether they are candidates to receive the program or not (See appendix B).

Tables 1 and 2 show the mean value of these observable variables for both rural indigenous and non-indigenous (men and women), who are either the household's head or the spouse, by treatment status and the number of observations with the calculated population after using weights. In the case of the non-indigenous, among the women, only in two cases, the group's means are not statistically different and for all the other

[10] The socio-economic regions of Mexico were identified according to the division made by INEGI in which the 32 states of the country were grouped in 7 stratus that share similar educational, labor, housing, and other socio-economic indicators. The states placed in a same group have, on average, similar characteristics; they are homogenous and have similar labor markets. Based on this, in strata 7 are placed the better-off states while those in strata 1 are the worse-off in terms of well-being, the aggrupation is the next:
Region 1: Guerrero, Oaxaca, and Chiapas
Region 2: San Luis Potosi, Hidalgo, Puebla, Veracruz, Tabasco, and Campeche
Region 3: Durango, Zacatecas, Guanajuato, Michoacán, and Tlaxcala
Region 4: Sinaloa, Nayarit, Colima, Queretaro, Estado de Mexico, Morelos, Yucatan, and Quintana Roo
Region 5: Baja California Sur, Baja California Norte, Sonora, Chihuahua, and Tamaulipas
Region 6: Coahuila, Nuevo Leon, Jalisco, and Aguascalientes
Region 7: Mexico City (it was excluded because it has non-rural observations)

socio-economic characteristics the treated ones can be considered to be worse off than the untreated; the first have, on average, lower years of formal education, live in regions with lower wellbeing indicators, most of them live in dwellings where wood is used as fuel to cook, their crowding index is higher, and their households have less light bulbs.

Moreover, between the non-indigenous men, 42% receives Oportunidades, the untreated have on average 3.4 more years of formal schooling, 24% of the treated belong to the lowest socio-economic region against 5% of the non-participants, and on average those who receive the transfer have 0.65 more children. All the variables, but two, are statistically different across groups with different status; only the variables region 3 and whether the person speaks a native language are statistically non-different between groups.

On the other hand, for those who consider themselves indigenous, 57% of the women participate in Oportunidades, the difference in years in education is lower than for the indigenous but still statistically significant, 41% of the treated belong to the lowest socio-economic region compared to only 23% of the untreated, 87% of those who receive the transfer use wood or oil to cook against only 45% of the untreated, and there is a large difference in the amount of observations who belong to the medium low socio-economic level. For this same population group, the treated and untreated men also have different means in every variable but in one.

Thus, according to the ENIGH, the groups (treated and untreated) are not identical, at least in these observable characteristics. Those who are part of the program are on average less educated, have a higher demographic dependency index, belong to a lower socio economic level, more use wood or coal as a fuel to cook, and have less assets than those who do not take part into the program for both indigenous and non-indigenous.

As it was expected, in both cases, those who receive the program are on average worse off in terms of these socio-economic characteristics and it is also relevant to comment that the indigenous population have less years of education, a higher proportion belong to the lowest socio economic level, and have higher dependency ratios within the households than the non-indigenous. Among all the subgroups, those who have the lowest indicators are the indigenous women. It is for these observable differences that

studying how the labor supply of different sub-groups of the population respond to the incentives created by the CCTs becomes relevant.

Table 1.

Mean difference by treatment status

Non-indigenous women

	Treated	Control	difference	Std.err	t	p>|t|
Head and spouse average years of formal education	4.495	7.508	-3.031***	-0.197	-15.41	0.00
Household's head age	45.579	42.976	2.693***	-0.68	3.961	0.00
Socio-economic region 6	0.060	0.130	-0.0708***	-0.016	-4.307	0.00
Socio-economic region 5	0.062	0.122	-0.0597***	-0.016	-3.704	0.00
Socio-economic region 4	0.140	0.219	-0.0785***	-0.021	-3.697	0.00
Socio-economic region 3	0.187	0.214	-0.0284	-0.022	-1.287	-0.20
Socio-economic region 2	0.325	0.260	0.0652***	-0.025	2.625	-0.01
Socio-economic region 1	0.226	0.055	0.172***	-0.018	9.667	0.00
Speaks a native language	0.010	0.015	-0.00475	-0.006	-0.765	-0.44
Fuel=1 if use wood or oil to cook	0.635	0.238	0.400***	-0.025	16.17	0.00
# of members younger than 18 years old	2.163	1.558	0.604***	-0.076	7.917	0.00
Demographic Dependency Ratio	0.887	0.755	0.130***	-0.037	3.534	0.00
Crowding Index	2.880	2.348	0.533***	-0.071	7.482	0.00
# of light bulbs in the dwelling	4.746	6.588	-1.847***	-0.225	-8.208	0.00
Microwave=1 if owns a microwave	0.133	0.363	-0.229***	-0.023	-9.787	0.00
Observations	563	801				
Weight	1,226,518	1,645,680				

Non-indigenous men

Head and spouse average years of formal education	4.635	8.031	-3.429***	-0.204	-16.770	0.000
Household's head age	44.940	40.984	4.105***	-0.658	6.235	0.000
Socio-economic region 6	0.054	0.139	-0.0843***	-0.018	-4.697	0.000
Socio-economic region 5	0.064	0.128	-0.0629***	-0.018	-3.514	0.000
Socio-economic region 4	0.142	0.215	-0.0750***	-0.023	-3.246	-0.001
Socio-economic region 3	0.193	0.207	-0.0107	-0.024	-0.449	-0.653
Socio-economic region 2	0.309	0.257	0.0498*	-0.027	1.865	-0.062
Socio-economic region 1	0.238	0.054	0.183***	-0.020	9.413	0.000
Speaks a native language	0.021	0.013	0.00743	-0.008	0.974	-0.330
Fuel=1 if use wood or oil to cook	0.636	0.216	0.419***	-0.026	15.840	0.000
# of members younger than 18 years old	2.262	1.606	0.653***	-0.083	7.838	0.000
Demographic Dependency Ratio	0.857	0.702	0.158***	-0.036	4.378	0.000
Crowding Index	2.976	2.418	0.554***	-0.079	7.027	0.000
# of light bulbs in the dwelling	4.676	6.653	-1.934***	-0.237	-8.163	0.000
Observations	475	690				
Weight	1,043,491	1,426,743				

However, due to the differences between groups, it is plausible to believe that that there is some selection bias, $E[Y_{0i}|D_i = 1] \neq E[Y_{0i}|D_i = 0]$, and estimating the causal effect only by comparing the difference in outcomes by status, as in equation 4, would lead to bias estimations of the effect that Oportunidades has on labor supply decisions for both indigenous and non-indigenous men and women.

Table 2.

Mean difference by treatment status

	Treated	Control	difference	Std.err	t	p>|t|
Indigenous women						
Head and spouse average years of formal education	4.353	6.533	-2.193***	-0.208	-10.560	0.000
Household's head age	46.255	41.641	4.638***	-0.777	5.971	0.000
Socio-economic region 6	0.018	0.063	-0.0397***	-0.011	-3.544	0.000
Socio-economic region 5	0.036	0.037	-0.00127	-0.012	-0.110	-0.912
Socio-economic region 4	0.100	0.182	-0.0843***	-0.021	-4.082	0.000
Socio-economic region 3	0.057	0.163	-0.107***	-0.018	-5.869	0.000
Socio-economic region 2	0.375	0.323	0.0512*	-0.029	1.759	-0.079
Socio-economic region 1	0.413	0.232	0.181***	-0.028	6.433	0.000
Speaks a native language	0.599	0.262	0.339***	-0.029	11.900	0.000
Fuel=1 if use wood or oil to cook	0.872	0.454	0.421***	-0.025	16.790	0.000
# of members younger than 18 years old	2.193	1.664	0.526***	-0.095	5.530	0.000
Crowding Index	3.012	2.637	0.366***	-0.092	3.995	0.000
share bathroom with no access to water with other dwelling	0.433	0.620	-0.187***	-0.030	-6.261	0.000
Car=1 if someone in the household owns a car	0.021	0.143	-0.123***	-0.015	-7.992	0.000
Observations	654	470				
Weight	1,353,951	998,385				
Indigenous men						
Head and spouse average years of formal education	4.528	6.659	-2.105***	-0.218	-9.646	0.000
Household's head age	44.645	40.500	3.894***	-0.771	5.052	0.000
Socio-economic region 6	0.029	0.050	-0.0204	-0.013	-1.591	-0.112
Socio-economic region 5	0.036	0.038	-0.00376	-0.013	-0.299	-0.765
Socio-economic region 4	0.113	0.177	-0.0556**	-0.023	-2.424	-0.016
Socio-economic region 3	0.050	0.173	-0.123***	-0.020	-6.168	0.000
Socio-economic region 2	0.360	0.346	0.0118	-0.032	0.367	-0.714
Socio-economic region 1	0.412	0.216	0.191***	-0.031	6.215	0.000
Speaks a native language	0.603	0.291	0.310***	-0.032	9.777	0.000
Fuel=1 if use wood or oil to cook	0.888	0.491	0.397***	-0.027	14.630	0.000
# of members younger than 18 years old	2.260	1.749	0.520***	-0.106	4.913	0.000
Demographic Dependency Ratio	0.863	0.726	0.136***	-0.041	3.314	-0.001
Crowding Index	3.072	2.744	0.344***	-0.103	3.327	-0.001
share bathroom with no access to water with other dwelling	0.450	0.630	-0.177***	-0.033	-5.392	0.000
Observations	542	393				
Weight	1,112,563	811,467				

5.3 Alternative to solve the Conditional Independence Assumption (CIA)

Therefore, in order to estimate the causal effect of Oportunidades on the labor market decisions it is necessary to overcome the selection bias problem but as it was said above, we can only observe one individual at a time and a counterfactual should be constructed in order to make $E[Y_{0i}|D_i = 1] = E[Y_{0i}|D_i = 0]$ and be then able to estimate the Average Treatment Effect on the Treated (ATET) and say something about how much the labor supply is affected, on average, for the persons who were selected into the program. One possibility to overcome the selection bias, or at least to reduce it, is the use of the Propensity Score Matching (PSM) methodology that attempts to find non-participants who are similar to participants in all relevant pre-treatment observable characteristics in order to achieve the Conditional Independence Assumption (CIA);

making the potential outcomes independent of treatment assignment conditional on a vector of covariates X_i(equation 5) that then allows to estimate differences among groups that can be attributed to the program.

$$(Y_{0i}, Y_{1i}) \perp D_i | X_i \qquad (5)$$

However, the ENIGH2012 is a considerable big data set that contains plenty of observable characteristics both at the household and at the individual level. Therefore, controlling for all relevant covariates is not feasible because *"as the number of covariates increases linearly, the data demands increase geometrically (...) making it difficult to find controls with identical or near identical values on more than a small number of variables"* (Smith, 1997). Thus, the CIA can be re-written as $(Y_{0i}, Y_{1i}) \perp D_i | p(x)$ where $p(x) = \Pr(D_i = 1 | X_i) = E(D_i = 1 | X_i)$. This is feasible because according to the propensity score theorem if potential outcomes are independent of treatment status conditional on covariates X_i, then potential outcomes are also independent of treatment status conditional on a scalar function of covariates, the propensity score $p(x)$ (Angrist & Pischke, 2009).

Under this framework, the probability of participating in Oportunidades given observed characteristics is estimated and used as an identification strategy. The Propensity Score ensures that there are treated and non-treated individuals with the same probability of being treated. Therefore, for those individuals that share the same probability of participating but have different treatment status, their potential outcomes can be assumed to be independent of treatment assignment conditional on the balancing score $p(x)$ if the other observable and unobservable covariates are also balanced (Caliendo, 2005).

Since the CIA requires that the potential outcomes must be independent of treatment status conditional on the propensity score, the PSM requires a set of variables 'X' that credibly satisfies this condition: *"only variables that are unaffected by participation, or the anticipation of it, should be included to estimate the scores"* (Caliendo, 2005). Since the variables should be relevant for determining treatment but not affected by Oportunidades, the propensity score was estimated using those variables that are used

for the program to select individuals and that are unlikely to be affected by treatment status.

It is also relevant to mention that for the potential outcome to be independent of whether the individuals receive or not Oportunidades, the two groups most have statistically equal pre-treatment observable and unobservable characteristics, meaning that in order to create a valid counterfactual *"the set of factors on which people are matched must be sufficiently comprehensive that there are no remaining differences between the treatment and comparison group that might be correlated with the outcome of interest"* (Glennerster & Takavarasha, 2013). In the case of the PSM, the groups are matched based only on observable characteristics so the distribution of unobservable characteristics could emerge as a concern to estimate the effect of the program; However, this research was realized having this potential source of bias in mind so the variables chosen to match are thought to reduce this potential source of statistical noise (See section 8).

As the main interest of the research is to estimate how sensitive different sub-groups of the rural population are to a positive non-labor income shock (the transfer), the significant differences in socio-economic characteristics between rural men and women both indigenous and non-indigenous (shown in Section 5.2) must be taken in consideration when the probability of being treated is estimated. One alternative would be to include variables that control for all these differences; however, Heckman (1998) claims that the most efficient way to estimate heterogeneous effects is to conduct the matching steps separately for each demographic group and then test all the matching assumptions separately.

5.4 Base line estimations

In order to get some baseline estimates that are later helpful to compare with the matching estimates, a mean comparison in the labor supply measured in weekly hours spent in remunerated activities was conducted by treatment status. According to the ENIGH 2012, the non-indigenous women living in rural areas work on average 29.7 hours a week but those who receive the transfer dedicate 9.8 less hours to these activities than the untreated ones. For the men of this subgroup, the average hours

worked per week is 46.5 and also the non-participants work less hours a week (although this difference is not statistically significant).

In the case of those who declare being indigenous, the average weekly hours worked per week for females is 29.2 and for males 44.3. In both cases the treated individuals work, on average, less hours than those who do participate into the program; the difference is 8.8 for females and 3.2 for males, both statistically significant.

Table 3.

Base line estimates and regressions controlling for observable characteristics

	Non-indigenous				Indigenous			
	Women		Men		Women		Men	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Number of hours worked per week				Number of hours worked per week			
Oportunidades=1 if treated	-9.827***	-4.333**	-3.423	0.454	-8.798***	-5.679*	-3.177*	-0.486
	(2.543)	(2.180)	(2.161)	(1.843)	(3.202)	(3.186)	(1.850)	(2.005)
Head and spouse average years of formal education		0.777***		0.190				0.00170
		(0.278)		(0.251)				(0.341)
Household's head age		-0.0558		-0.0337		0.0585		-0.279***
		(0.0997)		(0.108)		(0.0923)		(0.0662)
Socio-economic region 6		-4.954		-3.661		-8.214		0.570
		(4.747)		(2.970)		(5.138)		(7.641)
Socio-economic region 5		2.575		2.238		1.615		4.410*
		(5.431)		(2.967)		(7.959)		(2.264)
Socio-economic region 4		1.668		8.015***		-5.699		5.674**
		(6.102)		(2.269)		(4.118)		(2.319)
Socio-economic region 3		-4.785		4.106		-2.180		1.344
		(4.413)		(2.651)		(4.837)		(3.466)
Socio-economic region 2		-3.065		0.00424		-2.554		3.993*
		(4.170)		(2.496)		(3.191)		(2.273)
Speaks a native language		-10.77**		-0.190		-0.623		-0.525
		(5.179)		(4.551)		(4.109)		(2.088)
Fuel=1 if use wood or oil to cook		-4.925*		-5.236***		-9.843***		-2.502
		(2.780)		(1.457)		(3.744)		(2.325)
# of members younger than 18 years old		0.375		0.962		-0.158		1.992**
		(1.042)		(1.184)		(0.972)		(0.931)
Demographic Dependency Ratio		1.293		-1.360				-3.159
		(2.232)		(2.628)				(2.334)
Crowding Index		-1.557*		-0.337		-1.222		-0.327
		(0.859)		(0.933)		(1.222)		(0.561)
# of light bulbs in the dwelling		-0.437*		0.129				
		(0.256)		(0.229)				
Microwave=1 if owns a microwave		4.806						
		(2.958)						
		(7.446)						
Average years of formal education						0.414		
						(0.285)		
share bathroom with no access to water						-2.313		2.241
						(3.539)		(2.007)
Car=1 if someone in the household owns a car						-7.129*		
						(3.909)		
# of women in reproductive age						1.296		
						(1.590)		
Constant	34.67***	37.71***	48.19***	45.98***	33.61***	40.03***	45.99***	53.94***
	(1.978)							
Observarions	562	552	984	959	549	549	804	804
Weights	1,202,896	1,176,492	2,099,029	2,045,950	1,147,788	1,147,788	1,650,849	1,650,849
R-squared	0.051	0.123	0.007	0.056	0.037	0.089	0.007	0.063

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

Once the observable socio-economic characteristics are used as controls, the difference is reduced but still significant at least at the 90% level for both indigenous and non-indigenous women, the first reduce their labor time by 14% and the later by 19%. Thus,

by only comparing the impact on labor supply using an OLS framework and not taking in consideration selection bias, the program seems to affect negatively the amount of time spent by women in remunerated activities but men are unaffected; after adding the control variables, the impact of the program on men is, in both cases, statistically insignificant.

Nevertheless, a simple comparison of labor supply by treatment status lead to a biased estimation of the effect of the program (it was previously tested that $E[Y_{0i}|D_i = 1] \neq E[Y_{0i}|D_i = 0]$) so we cannot take these results as unbiased or causal because we could still be facing a self-selection problem in which we can mistakenly conclude that Conditional Cash Transfers given to the rural poor have a negative impact on the amount of hours dedicated to work, which could be interpreted as an indicator of the program creating income dependency on the participants when it might be the case that does who do receive the transfer worked less in the first place.

5.5 Estimation of the propensity scores

Therefore, a propensity score to reduced potential bias, was estimated using a probit model for indigenous and non-indigenous, men and women, separately, that regressed treatment status (a dummy that identifies participants) on variables that are assumed to remain unaffected by the program and that are also used by the Mexican Ministry of Social Development to estimate the per capita household income of the potential candidates -the Ministry estimates the income of potential participants through a series of socio-economic and demographic variables- (see appendix B). Thus, candidates for treatment are those whose estimated per capita household income stands below than the Minimum Well-Being Line (Sedesol, 2014).

As a result of the probit model, every individual in the sample has an estimated probability of being treated given her observed characteristics and the comparison between groups with similar likelihood of participating, hypothetically, is feasible to be done; it has to kept in mind that the main purpose of estimating the propensity sore is not to predict selection into treatment as good as possible but to balance all covariates (Augurzky and Schmidt, 2000)

The outcomes of the probit model (See Appendix C) indicate that the average years of formal education and owning more assets, proxied by having a car or a microwave, decrease the probability of being treated for all the groups. On the other hand, the household's head age, living in a dwelling where wood or oil is used to cook, and the number of members below eighteen years old increase it. An interesting outcome is that the socioeconomic regions are statistically significant for non-indigenous men and women (belonging to poorer socio-economic regions increase the probability of being treated) but not all them are significant for the indigenous population. These results are consistent with the criterion of the program and to the intuitive characteristics of the variables.

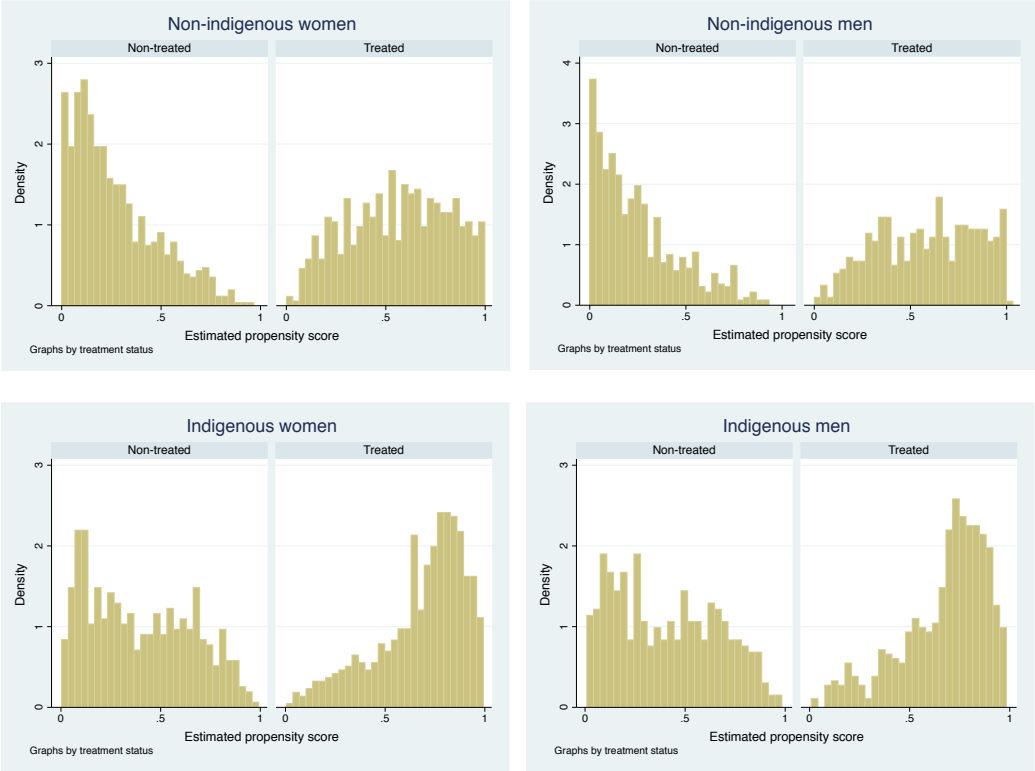
5.6 The overlap assumption

Once the propensity scores were estimated, the overlap assumption that states that for some values of the propensity score there are participants and non-participants with the same probability of being treated, $0 < \Pr(D_i = 1 | p(x_i)) < 1$, was tested. In order to visually examine if there are any insights of the overlapping assumption, the histograms, for all groups, of the probability of being treated given the observable characteristics were inspected (See graphic 1).

The histograms confirm that given the estimated propensity scores there is an overlap in the probability distribution between groups; for different values of the probability of participating in Oportunidades there are both treated and non-treated individuals, in all the four cases. Thus, the overlapping assumption seems to be fulfilled at the probability region [0.014, 0.99] for the non-indigenous women and at [0.005, 0.99] for the males of this group. Additionally, for the indigenous women and men the common support regions are [0.036,0.99] and [0.038, 0.98] respectively.

Therefore, in order to reduce the difference in potential outcomes between groups and to construct a more efficient counterfactual, $E[Y_{0i}|D_i = 1]$, the sample was restricted to those regions for each one of the population's sub-groups. By doing that, the potential bias in the estimation of the causal effect between Oportunidades and labor supply has been hypothetically reduced (at least in observable characteristics).

Graphic 1.



Although there is a common support region for all groups, it is clear that the propensity score distributions are dissimilar between those who receive and not receive Oportunidades. In the case of the indigenous, most of the treated observations are placed on the right of the distribution while the untreated are located on the left; many treated have a high probability of being treated but few untreated have those values of $p(x_i)$. On the other hand, the distributions for the non-indigenous (both men and women) are more evenly distributed for the treated but most of the untreated have low probabilities of being part of Oportunidades. Thus, while there is a common support region, it is relevant to take into account these differences in distributions when the causal effects are estimated later on.

5.7 Balancing tests

Additionally, in order to test if the CIA holds, once the overlap in the probability distribution between groups has been proved, the covariates 'X' should be balanced for treated and untreated observations. For that matter, to estimate the difference in means by status, the data set was restricted to the area of common support for all the groups and t-tests were conducted to prove that they are balanced; if there are no statistical

significant difference between means, the Average Treatment Effect on the Treated (ATET) could be estimated $ATT_{PSM} = E_{p(x)|D=1}\{E[Y(1)|D = 1, p(x)] - E[Y(0)|D = 0, p(x)]\}$ that in words is simply the mean difference in outcomes over the common support area (Caliendo, 2005).

Table 4.

Balancing test: Mean diffrence by treatment status within the common support region

	Non-indigenous women				
	Mean				
Variable	Treated	Control	Difference	t-test	p>t
Head and spouse average years of formal education	5.245	4.967	0.278	0.87	0.386
Household's head age	45.551	44.738	0.813	0.78	0.438
Socio-economic region 6	0.042	0.079	-0.037	-1.62	0.106
Socio-economic region 5	0.051	0.093	-0.042	-1.68	0.094
Socio-economic region 4	0.201	0.122	0.079	2.24	0.025
Socio-economic region 3	0.215	0.280	-0.065	-1.57	0.117
Socio-economic region 2	0.336	0.313	0.023	0.52	0.607
Socio-economic region 1	0.154	0.112	0.042	1.28	0.201
Speaks a native language	0.009	0.005	0.005	0.58	0.563
Fuel=1 if use wood or oil to cook	0.607	0.565	0.042	0.88	0.378
# of members younger than 18 years old	1.841	2.042	-0.201	-1.38	0.167
Demographic Dependency Ratio	0.817	0.879	-0.061	-0.85	0.393
Crowding Index	2.639	2.742	-0.103	-0.73	0.465
# of light bulbs in the dwelling	4.879	4.692	0.187	0.77	0.443
Microwave=1 if owns a microwave	0.168	0.229	-0.061	-1.58	0.116
Car=1 if someone in the household owns a car	0.093	0.150	-0.056	-1.78	0.076
# of women in reproductive age	1.341	1.257	0.084	1.1	0.271
	Non-indigenous men				
	Mean				
Variable	Treated	Control	Difference	t-test	p>t
Head and spouse average years of formal education	5.459	5.069	0.390	1.73	0.084
Household's head age	44.402	44.884	-0.482	-0.58	0.559
Socio-economic region 6	0.077	0.124	-0.047	-2.1	0.036
Socio-economic region 5	0.080	0.096	-0.017	-0.78	0.433
Socio-economic region 4	0.185	0.198	-0.014	-0.47	0.638
Socio-economic region 3	0.264	0.237	0.028	0.86	0.393
Socio-economic region 2	0.281	0.273	0.008	0.25	0.804
Socio-economic region 1	0.113	0.072	0.041	1.93	0.055
Speaks a native language	0.022	0.036	-0.014	-1.11	0.269
Fuel=1 if use wood or oil to cook	0.556	0.584	-0.028	-0.75	0.454
# of members younger than 18 years old	2.055	2.121	-0.066	-0.64	0.52
Demographic Dependency Ratio	0.788	0.866	-0.078	-1.74	0.082
Crowding Index	2.739	2.881	-0.142	-2.25	0.451
# of light bulbs in the dwelling	4.719	4.606	0.113	0.61	0.545
Microwave=1 if owns a microwave	0.182	0.215	-0.033	-1.12	0.265
Car=1 if someone in the household owns a car	0.094	0.138	-0.044	-1.86	0.064
# of women in reproductive age	1.320	1.298	0.022	0.35	0.725

Table 4 presents the results of the t-test for differences between control and treatment groups within the common support region (see appendix D for the t-test of indigenous). If the common support assumption was fulfilled, observations in both groups should be very similar and no systematic differences should be observed. According to the tests,

it can be assumed that the balancing property was achieved and that potential selection bias has been systematically reduced; every difference in means in the socio-economic characteristics is not statistically significant at the 5% level, and for the variables that control for different regions of the country there are no general differences between groups. Thus, estimating the ATET of Oportunidades on the labor supply decision seems feasible at least within the common support region.

6. Estimation of the impact

Since the common support and the CIA assumptions have been fulfilled, it could be assumed that the treatment and control groups, after "trimming" the data, are on average statistically identical on the observable covariates; the potential bias has been significantly reduced and the ATET could be estimated using the created counterfactual without the need to control for any other variable (See section 7 for limitations).

In the regression model, the labor supply decision is measured with the probability of working (the extensive margin) and the weekly hours worked (the intensive margin) while the non-labor income shock is expressed as dummy that identifies those who receive a CCT from the program. In order to measure the heterogeneous effects and the sensitivity of the impact caused by the positive income shock, an identical regression was run for each one of the four groups (indigenous/non-indigenous, men/women) where the coefficient of interest is the one that identifies the treatment status.

$$L_i = ß_0 + ß_1 T_i + u_i \qquad (6)$$

Where L_i is the weekly hours worked, T_i is a dummy that identifies the Oportunidades' participants. The coefficient of interest is $ß_1$, which is the Average Treatment Effect of the Treated, the mean difference in outcomes (labor supply) between control and treated individuals in the common support area. In the case of the extensive margin a similar model is estimated with the difference that the dependent variable is a dummy variable that identifies whether the individual works or not. Thus a model, identical to equation 6 is estimated with the only difference that the $ß_1$ coefficient estimates the ATET of Oportunidades on the probability of working.

The relevance of running separate regressions for each one of the groups, is that it allows estimating heterogeneous effects, meaning that it serves to know whether different groups of the population respond differently to the transfer.

Since the distribution of the propensity scores is different by treatment status for all groups (there are a lot of treated individuals with high probability of being treated and vice versa for the untreated), the ATET estimators would differ depending on how the matching neighborhood is defined. The first alternative is to match a person who receives Oportunidades with the closest untreated in terms of propensity scores (see equation 7). This is known as nearest neighbor matching (NN) without replacement[11].

$$C(P_i) = min_j \parallel P_i - P_j \parallel, j \in I_0 \qquad (7)$$

However, if matching without replacement is done, the chances of potential bias would increase because a treated person with high propensity score would be, most likely, matched to a comparison with low propensity score (Smith & Todd, 2005), meaning that two individuals with different characteristics and therefore dissimilar potential outcomes are compared leading to bias estimations of the effect of the program on labor supply.

Nevertheless, and in order to overcome this potential bias problem, a person who is part of the untreated group could be used more than once for matching purposes. This later approach, known as nearest neighbor matching with replacement, increases the quality of the matching but reduces the amount of observation used. Thus, there is a trade-off between bias and the estimator variance

Table 5 presents the ATET estimates, on the intensive margin, using different methods. The first row of every group shows the estimated impact of Oportunidades on the participant's hours worked per week by only comparing means between treatment statuses within each group's common support region. When this method is used, the estimated impact is negative and statistically significant for all the groups except for the

[11] Following Smith and Todd (2005): $C(P_i)$ defines the neighborhood for each i in the sample, P_i is the propensity score of a treated observation, P_j for an untreated one, and I_0 expresses the set of non-participants.

indigenous men. The most sensitive group, according to these estimates is the one of the indigenous women that by participating into the program reduce their hours worked 27%, on average.

Table 5.

Intensive Margin. Estimation of the Average Treatment Effect on the Treated using different matching methods

	ATET	S.E	t-statistic	treated	untreated
Non-indigenous women					
Mean Comparison without matching	-6.58	1.85	-3.56	214	327
Nearest-Neighbor Matching without replacement	-3.332	2.07	-1.61	214	214
Nearest-Neighbor Matching with replacement	-4.23	3.3	-1.28	214	327
Caliper Radius (0.1)	-5.13	2.62	-1.96	214	327
Caliper Radius (0.01)	-2.94	2.75	-1.07	188	327
Caliper Radius (0.001)	-0.97	3.44	-0.28	91	327
Non-indigenous men					
Mean Comparison without matching	-4.53	1.34	-3.38	363	568
Nearest-Neighbor Matching without replacement	-2.71	1.54	-1.76	363	363
Nearest-Neighbor Matching with replacement	-3.79	2.51	-1.51	363	568
Caliper Radius (0.1)	-3.56	1.88	-1.89	363	568
Caliper Radius (0.01)	-3.24	2.11	-1.54	346	568
Caliper Radius (0.001)	-0.64	2.33	-0.27	193	568
Indigenous women	ATET	S.E	t-statistic	treated	untreated
Mean Comparison without matching	-7.35	1.91	-3.85	211	211
Nearest-Neighbor Matching without replacement	-7.88	2.21	-3.56	211	211
Nearest-Neighbor Matching with replacement	-3.55	3.43	-1.04	320	211
Caliper Radius (0.1)	-4.85	2.75	-1.76	320	211
Caliper Radius (0.01)	-3.42	2.98	-1.14	311	211
Caliper Radius (0.001)	-0.1	3.48	-0.03	100	211
Indigenous men					
Mean Comparison without matching	-2.63	1.28	-2.05	476	341
Nearest-Neighbor Matching without replacement	-1.84	1.42	-1.3	341	341
Nearest-Neighbor Matching with replacement	-2.45	2.32	-1.06	476	341
Caliper Radius (0.1)	-1.86	1.71	-1.09	476	341
Caliper Radius (0.01)	-1.13	1.93	-0.59	476	341
Caliper Radius (0.001)	-0.13	2.35	-0.06	476	341

However, these estimates could not be taken as causal because even within the common support region there can be significant differences in the comparison groups; the distributions are uneven and a person with high probability could be compared with one with low likelihood of participating. Thus, the nearest neighbor approach with no replacement and replacement were also estimated. According to these two matching strategies, the Conditional Cash Transfer (the positive income shock) has no statistically significant impact in neither of the groups –except for the indigenous women that have a negative impact using the NN without replacement- and we saw in the previous

section that these results can be more accurate because selection bias was, assumed, to been reduced significantly by improving the matching quality.

Whereas allowing replacement has reduced the bias, it is still necessary to test for the quality of the matching and the potential bias that might arise by using matches that are far away from each other in the distribution. Thus, a radius approach was conducted in which a maximum propensity score distance (τ) was imposed for comparability reasons.

$$C(P_i) = \| P_i - P_j \| < \tau \, , \; j \in I_0 \qquad (8)$$

Under this approach, if the difference in propensity scores of the nearest neighbor is higher that the desired radius (τ), those observations are not used for matching and are excluded from the analysis; only observations whose propensity score is sufficiently similar are compared to each other. Rows four, five, and six show the results using τ =0.1 .01 and .001.

The imposition of a radius causes the ATET estimates to decrease in magnitude (See rows 4,5, and 6 of table 5) –the smaller the radius, the lower the estimates and their significance-, and although there is a trade-off between bias and variance (when decreasing the radius, only very similar individuals are compared which reduces the bias but observations are lost as the radius becomes smaller) these outcome can be read as a test for the quality of the nearest neighbor matching. In this case there is a slight increase in the standard errors as τ shrinks and the magnitude and significance of the estimators is reduced as more similar individuals are compared; this supports the results of Oportunidades not affecting the labor supply decision, at the intensive margin, of the rural participants.

Although, it has been estimated that the intensive margin is not affected by Oportunidades, it is still relevant to measure how the program impacts the actual decision of engaging in a remunerating labor activity. Thus, whether Oportunidades has an impact on the probability of working was also estimated for each one of the population sub-groups; Table 6, shows the ATET on the probability of working using the same algorithms that were used to estimate the impact on the intensive margin.

Table 6.

Extensive Margin. Estimation of the Average Treatment Effect on the Treated using different matching methods

	ATET	S.E	t-statistic	treated	untreated
Non-indigenous women					
Mean Comparison without matching	0.03	0.28	0.96	505	788
Nearest-Neighbor Matching without replacement	0.04	0.31	1.27	505	505
Nearest-Neighbor Matching with replacement	-0.15	0.05	-0.32	505	788
Caliper Radius (0.1)	0.16	0.04	0.43	505	788
Caliper Radius (0.01)	0.01	0.04	0.31	485	788
Caliper Radius (0.001)	-0.01	0.43	-0.2	320	788
Non-indigenous men					
Mean Comparison without matching	0.02	0.01	1.6	411	683
Nearest-Neighbor Matching without replacement	0.02	0.018	1.3	411	411
Nearest-Neighbor Matching with replacement	0.02	0.03	0.73	411	683
Caliper Radius (0.1)	0.03	0.02	1.26	411	683
Caliper Radius (0.01)	0.03	0.02	1.44	396	683
Caliper Radius (0.001)	0	0.03	0.31	454	683
Indigenous women					
	ATET	S.E	t-statistic	treated	untreated
Mean Comparison without matching	0.11	0.03	3.53	470	470
Nearest-Neighbor Matching without replacement	0.08	0.03	2.5	470	470
Nearest-Neighbor Matching with replacement	0.07	0.05	1.37	640	470
Caliper Radius (0.1)	0.09	0.04	2.18	640	470
Caliper Radius (0.01)	0.1	0.04	2.25	621	470
Caliper Radius (0.001)	0.03	0.05	0.69	325	470
Indigenous men					
Mean Comparison without matching	0	0.01	-0.5	524	391
Nearest-Neighbor Matching without replacement	0	0.01	-0.34	391	391
Nearest-Neighbor Matching with replacement	-0.02	0.02	-1.05	524	391
Caliper Radius (0.1)	0	0.02	-0.52	524	391
Caliper Radius (0.01)	-0.01	0.02	-0.61	524	391
Caliper Radius (0.001)	0	0.02	-0.17	251	391

As it can be seen in the results (table 6), there are no statistically significant differences in labor participation rates across treated and untreated individuals even after limiting the matching to the most rigorous specifications. The only group that has close to statistically significant difference is the one of the indigenous women; however, the direction of the impact, if there is one, is positive.

Consequently, after reducing the original selection bias and comparing individuals that are assumed to have, on average, similar potential outcomes, it is feasible to conclude that Oportunidades does not create a non-labor income dependency on its participants, neither at the intensive nor at the extensive margin. At least not for indigenous and non-indigenous men and women living in rural areas and the fact that poverty has not being

reduced has not to do with the program creating counter incentives for people to engage in productive activities.

7. Limitations

Although the process of inferring the causal effect that Oportunidades has on the labor supply decisions of its rural participants has been conducted following a rigorous Propensity Score Matching methodology, it is important to consider that there are still, both, data and methodological limitations to ensure that the results strictly represent an unbiased estimations of the impact. Having these in mind is necessary when the conclusions of the research are drawn.

The first thing to consider is that at the present stages, Oportunidades does not assign treatment in a randomized way[12]. Hence, treated and untreated individuals are not necessarily statistically identical (as it was proved in section 5.2). Moreover, the ENIGH2012 (the data set used) collected data about households once the program has been implemented and individuals were already treated. Thus, it contains information about the levels of different variables in 2012 but pre-treatment characteristics are impossible to observe.

It is because of these data and program design constraints that the present research attempted to mimic a counterfactual in order to know what would have happened to the labor supply of those who receive the transfer if they had not receive it. In order to do so, socio-economic characteristics such as household's head age, education, amount of assets, and the socio-economic region, among others were used to predict the probability of participating in the program. Then, each participant was matched with a non-participant that had the same propensity to participate.

The main advantage of this method is that it allows to give more weight on those untreated who are very similar to those in the treatment group based on observable

[12] In the first stages of the program, during the pilot and first years of implementation, the treatment was assigned randomly in order to be able to estimate the impact of Oportunidades on different variables; However, once that the program proved to be efficient, the allocation of transfers was based to those whose income was estimated to be below the wellbeing line and live in areas in which the program has coverage. Thus, the assignment is not random any more and there are individuals that accomplish the selection criteria but do not receive the CCT.

characteristics and who are predicted to be likely to be part of Oportunidades but are not. The disadvantage is that unobservable characteristics such as motivation or cultural believes –for example- are left aside. Therefore, it is needed to assume that the matching was made based on enough observable characteristics that are correlated with unobservable characteristics that there is no difference left (Glennerster & Takavarasha, 2013).

As it can be seen in Section 5.5, the estimation of the propensity score matching was based on socio-economic characteristics and in regional divisions of Mexico, these last attempted to group individuals not only in wellbeing indicators but in cultural regions of the country. By doing this, it was expected to reduce the bias arose from omitted unobservable differences. Additionally, since the estimations were conducted separately for men/women and indigenous/non-indigenous, it is also feasible that the observable characteristics included into the model are sufficiently enough to avoid the remaining of existing differences across groups.

However, since by nature the unobservable characteristics are impossible to observe it is not possible to test this and the way to proceed is to assume that the counterfactual that was created is a valid one.

Another important assumption is that there is nothing correlated with access that also has an effect on the labor supply outcomes (Glennerster & Takavarasha, 2013). This is important because although Oportunidades has a large coverage there are still individuals that have a high probability of receiving the program but live in villages in which the program has no presence yet; in some cases, the matching would compare people with equal probability than those who are treated but who live in areas where there is no access to the program. Nevertheless, since the groups are balanced in observable characteristics at the common support region, it is unlikely that the villages with access and non-access are systematically different and it could be assumed that the potential bias was sufficiently overcame.

All these limitations were considered in the design of the model, and the selection of the variables used to estimate the probability of participating was based in all the potential sources of selection bias that could lead to mistaken estimations of the impact of the

program. Therefore, the results could be taken as an empirical evidence that Oportunidades does not create disincentives on their participants for them to reduce the amount of labor they supply, which, in this case, is an indicator of the program not creating income dependency on those who receive the transfer.

8. Conclusions and policy implication

Oportunidades aims to boost the human development of the population living below the Minimum Well-Being Line to break the inter-generational cycle of poverty. Through monetary conditional transfers, the program attempts to encourage household's investments in education, health, and nutrition. Although it has been deeply evaluated and proven to be an efficient strategy to improve these conditions, its success at reducing poverty depends, at a great extent, on whether the transfers do not affect adult work incentives in a negative direction.

Due to the high rates of poverty in rural Mexico and specially across the indigenous population (three out every four persons face poverty, and 21% live in extreme poverty), the research investigates whether Oportunidades has created incentives to increase the time dedicated to productive activities and the probability of working, of adult participants living in rural locations with less than 2,500 inhabitants, or if it rather generates a non-labor income dependency that would produce the socially undesirable outcome of making beneficiary adults to work less which consequently would reduce the likelihood of alleviating poverty in the long-term.

In order to test if the transfers create disincentives to work (a proxy to non-labor income dependency), a Propensity Score Matching method was conducted taking advantage of the current design of the program, the big sample contained in ENIGH, and on a basic microeconomic model of time allocation.

The main findings are that there are not statistically significant effects of the CCT on adult labor supply decisions in rural areas neither for the non-indigenous nor for the indigenous population; Therefore, it can be said that Oportunidades does not create dependency on their rural participants, at least not a non-labor income one.

Consequently, the fact that poverty has not been significant reduced in rural areas, and specifically across the indigenous population, is not because the program is creating counter incentives to the amount of weekly hours spent at work (the intensive margin) nor that participants become less likely to participate in the labor market (the extensive margin) when they receive the transfer but rather because of other determinants that are outside of the scope of the present research.

Likewise, it can be said that the already, deeply, evaluated benefits of the program in terms of education, health, and nutrition are not diminished by the program creating dependency and it might be that the rise in human capital would be translated in a decrease of long-term poverty once those children who increased their years of education, health, and nutrition conditions become economically active.

Finally, the main contribution of this research is that it presents a more profound analysis of the causal relation between a CCT program and work supply disaggregated by ethnicity. Although in Mexico, 7% of the population speaks one of the native ethnic languages and 26% consider themselves indigenous, they have been systematically excluded from previous analysis that deal with the relation between Oportunidades and working incentives. Thus, including them and being able to reject the hypothesis that the CCT create incentives for them to work less and make them dependent of the transfers has a great value both in terms of research and for the strategic design of the program.

Appendix A: Monthly monetary value of the transfers

Monthly monetary value of transfers	
Nutrition	US$17.20
Electricty	US$4.60
Food "Vivir Mejor"	US$9.17
Children "Vivir Mejor"	US$8.03
Eldery "Vivir Mejor"	US$22.31

Monthly monetary value of scholarships		
Primary school	Boys	Girls
1st grade	US$11.50	US$11.50
2nd grade	US$11.50	US$11.50
3rd grade	US$11.50	US$11.50
4th grade	US$13.40	US$13.40
5th grade	US$17.20	US$17.20
6th grade	US$22.90	US$22.90
Secondary Schol	Boys	Girls
1st grade	US$33.63	US$35.50
2nd grade	US$35.50	US$39.36
3rd grade	US$37.45	US$43.18
High School	Boys	Girls
1st grade	US$56.56	US$64.97
2nd grade	US$60.76	US$69.17
3rd grade	US$64.20	US$73.37

Source: Operational Rules of the program Oportunidades 2012

Appendix B: Variables used by the Mexican Ministry of Development to estimate income and identify eligible candidates

Variables used by Oportunidades to estimate per capita income and select potential candidates to participate	Rural Model
Demographic dependency index: (#0-15+#>64) / #16-64	X
Logarithm of the total amount of household members	X
Average schooling of the head and spouse with complete primary but incomplete secondary education	X
Average schooling of the head and spouse with complete secondary or higher education	X
# Members within the household with subordinated work	X
# Members within the household with independent work	X
Food insecurity complemented: any of the two cases	X
At least one member of the household has access to medical service because of her job	X
The households' head is an independent worker and at least one of the members has access to medical service because of her job	X
The household receives remittances	X
Rent the house	X
Number of rooms in the house, not including the kitchen, aisles, nor bathrooms	X
Indicator of exclusive use of a bathroom with access to water	X
Indicator of solid floor in the major part of the house	X
Indicator of "recubrimiento" floor in the major part of the house	X
Use of fuel like wood, coal, or oil to cook	X
Does not have a refrigerator	X
Do not own a car	X
Do not have video player nor DVD	X
Do not have an electric hoven nor a microwave	X
Index of social backwardness at the municipal level	X

Source: Oportunidades' web site 2014

Appendix C: Outcomes of the Probit Model

Probit model for the estimation of the propensity score

	Non-indigenous		Indigenous	
	Women	Men	Women	Men
	(1)	(2)	(3)	(4)
VARIABLES	Oportunidades=1 if treated			
Head and spouse average years of formal education	-0.115***	-0.137***	-0.0342*	-0.0615**
	(0.0178)	(0.0177)	(0.0186)	(0.0246)
Household's head age	0.00640	0.0142**	0.0191***	0.0183***
	(0.00540)	(0.00672)	(0.00493)	(0.00590)
Socio-economic region 6	-0.936***	-1.128***	-0.364	0.0363
	(0.206)	(0.203)	(0.228)	(0.222)
Socio-economic region 5	-0.997***	-1.170***	-0.210	-0.248
	(0.236)	(0.247)	(0.213)	(0.270)
Socio-economic region 4	-0.901***	-1.025***	-0.416**	-0.426**
	(0.245)	(0.219)	(0.205)	(0.208)
Socio-economic region 3	-0.927***	-1.026***	-0.610***	-0.913***
	(0.166)	(0.163)	(0.200)	(0.218)
Socio-economic region 2	-0.588***	-0.726***	0.0775	-0.132
	(0.169)	(0.177)	(0.161)	(0.155)
Speaks a native language	-0.986***	-0.565*	0.293**	0.260*
	(0.364)	(0.306)	(0.139)	(0.147)
Fuel=1 if use wood or oil to cook	0.566***	0.581***	0.794***	0.850***
	(0.102)	(0.117)	(0.148)	(0.138)
# of members younger than 18 years old	0.403***	0.449***	0.205***	0.144**
	(0.0483)	(0.0767)	(0.0498)	(0.0604)
Demographic Dependency Ratio	-0.280***	-0.293		0.258
	(0.0932)	(0.190)		(0.170)
Crowding Index	-0.0942**	-0.133**	-0.0722	-0.0990*
	(0.0472)	(0.0542)	(0.0521)	(0.0540)
# of light bulbs in the dwelling	-0.0615***	-0.0859***		
	(0.0207)	(0.0247)		
Microwave=1 if owns a microwave	-0.348***			
	(0.121)			
share bathroom with no access to water			-0.191	-0.188
			(0.124)	(0.131)
Car=1 if someone in the household owns a car			-0.710***	
			(0.231)	
# of women in reproductive age			0.135*	
			(0.0687)	
Constant	0.859**	0.855*	-1.228***	-0.862*
	(0.404)	(0.467)	(0.378)	(0.481)
Observations	1,326	1,137	1,124	932
Weight	2,796,411	2,409,511	2,352,336	2,352,336

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

Appendix D: Balancing test for the indigenous population.

Balancing test: Mean diffrence by treatment status within the common support region

	Non-indigenous women				
	Mean				
Variable	Treated	Control	Difference	t-test	p>t
Head and spouse average years of formal education	5.245	4.967	0.278	0.87	0.386
Household's head age	45.551	44.738	0.813	0.78	0.438
Socio-economic region 6	0.042	0.079	-0.037	-1.62	0.106
Socio-economic region 5	0.051	0.093	-0.042	-1.68	0.094
Socio-economic region 4	0.201	0.122	0.079	2.24	0.025
Socio-economic region 3	0.215	0.280	-0.065	-1.57	0.117
Socio-economic region 2	0.336	0.313	0.023	0.52	0.607
Socio-economic region 1	0.154	0.112	0.042	1.28	0.201
Speaks a native language	0.009	0.005	0.005	0.58	0.563
Fuel=1 if use wood or oil to cook	0.607	0.565	0.042	0.88	0.378
# of members younger than 18 years old	1.841	2.042	-0.201	-1.38	0.167
Demographic Dependency Ratio	0.817	0.879	-0.061	-0.85	0.393
Crowding Index	2.639	2.742	-0.103	-0.73	0.465
# of light bulbs in the dwelling	4.879	4.692	0.187	0.77	0.443
Microwave=1 if owns a microwave	0.168	0.229	-0.061	-1.58	0.116
Car=1 if someone in the household owns a car	0.093	0.150	-0.056	-1.78	0.076
# of women in reproductive age	1.341	1.257	0.084	1.1	0.271

	Non-indigenous men				
	Mean				
Variable	Treated	Control	Difference	t-test	p>t
Head and spouse average years of formal education	5.459	5.069	0.390	1.73	0.084
Household's head age	44.402	44.884	-0.482	-0.58	0.559
Socio-economic region 6	0.077	0.124	-0.047	-2.1	0.036
Socio-economic region 5	0.080	0.096	-0.017	-0.78	0.433
Socio-economic region 4	0.185	0.198	-0.014	-0.47	0.638
Socio-economic region 3	0.264	0.237	0.028	0.86	0.393
Socio-economic region 2	0.281	0.273	0.008	0.25	0.804
Socio-economic region 1	0.113	0.072	0.041	1.93	0.055
Speaks a native language	0.022	0.036	-0.014	-1.11	0.269
Fuel=1 if use wood or oil to cook	0.556	0.584	-0.028	-0.75	0.454
# of members younger than 18 years old	2.055	2.121	-0.066	-0.64	0.52
Demographic Dependency Ratio	0.788	0.866	-0.078	-1.74	0.082
Crowding Index	2.739	2.881	-0.142	-2.25	0.451
# of light bulbs in the dwelling	4.719	4.606	0.113	0.61	0.545
Microwave=1 if owns a microwave	0.182	0.215	-0.033	-1.12	0.265
Car=1 if someone in the household owns a car	0.094	0.138	-0.044	-1.86	0.064
# of women in reproductive age	1.320	1.298	0.022	0.35	0.725

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