

Impact of the Food Subsidy on the Academic Performance of Low-Income Primary Education Students in Mexico

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The Program of Cocinas Comunitarias in the state of Oaxaca, Mexico benefits children aged 6 to 12 who attend primary education schools in low-income municipalities. It is hoped that this food assistance program will allow children to learn better and develop learning skills. In this way, a significant reduction in the grade failure rates and dropout rates is expected, which will be reflected in a higher graduation efficiency rates. In fact, the contribution of this work consists of a methodology for the analysis of the impact of the food subsidy on the academic performance of low-income primary education students. In this sense, a multivariate model was constructed to analyze the interrelationships between grade failure, dropout, graduation efficiency rates, food subsidy, and the socio-demographic characteristics of the population that attends primary education. The Mexican government expects from this program that the more low-income children complete primary education, the more likely that a higher number of adolescents will complete high school education. This scheme is very important for the country's half population living in poverty and especially in Oaxaca State which is one of poorest states.

Keywords: graduation efficiency rates, grade failure rates, dropout rates, multivariate model

Introduction

As a result of the change in the development model in Mexico, at the beginning of the 1980s, social inequality has been increasing and the government has tried to improve the living conditions of the poor sector of the population through economic and food subsidies. This work evaluates the Community Participation Program for Human Development with Food Assistance, whose short name is Program of Cocinas Comunitarias, focused on providing food subsidy to the poor population. This program seeks to have an impact

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on the nutrition, health, and education of this sector, especially in children aged 6 to 12 years. This paper analyzes the interrelationships between the food subsidy and the academic performance of children enrolled in primary education through a multivariate model. Finally, it is hoped to contribute with an efficient methodology for the impact evaluation of government welfare programs.

Social Inequality, Welfare, and Public Policy

However, that feature of the growth of the Mexican economy that concentrates the benefits at the top of the pyramid and with a scarce distribution in the broad base is a recent global process according to Todaro and Smith (2015) and Stiglitz (1998). Economic growth can occur virtually in the absence of development, because the expansion of the economy goes hand in hand with the process of industrialization in which the labor force passes from the agricultural sector to the industrial sector, and the latter captures the highest wages (Kuznets, 1955). This process offers incentives for social mobility, but it also creates inequality among the population, especially in the less developed economies. Likewise, it must consider the space factor to understand that the distribution of economic activities is concentrated in the central zone or in the cities, due to the transition in which the development process is located (Krugman, 1991). In order to promote the balance of the economy, the importance of well-being must be considered, which is beneficial when there is equality of skills among the population, related to the production of jobs and the distribution of income (Kaldor, 1939). In this sense, Scitovsky (1941) considers that welfare economics aims to verify the efficiency of economic institutions that use the productive resources of a community (labor) and also consider the limitations of the population to ensure a permanent, constant, and efficient distribution of resources. When referring to well-being, there is a need to incorporate it into the strategies implemented by the state called public policies which are used to respond to social problems through integrative projects that consider a diversity of topics (Salazar, 2012; Dye 2005; Hintze, 2000; Castro & Evangelista, 1998). This integration is reflected in the development plans that are framed in primordial axes to boost the quality of life of the population from the macro to the micro level. In the state of Oaxaca, most of its population is low income and there are welfare programs that provide monetary or in-kind subsidies to the vulnerable population to cover their basic needs associated with their subsistence according to Maslow (1991). These are: food and health, as well as education considered as the means to economic progress. In fact, knowledge is the predominant force of development (Smith, 1958; Ortega, 2007) since higher levels of education are expected to generate higher incomes (Becker, 1964; Mincer, 1974; Hannum & Buchmann, 2005; Heckman, 2007). Of course, whenever, there are high levels of performance that influence inequality positively or negatively (Wu, D. Zhang, & J. Zhang, 2006; M. Salinas & J. Salinas, 2008). However, the level of knowledge of students is infringed in poor areas; for this reason, the public policies are necessary and, specifically, those that provide food subsidies as a social method to satisfy the physiological needs of the being in a medium different from the household (Lapiente, 2010). Thus, both children and young people spend much of the day in classrooms and their needs for food, recreation and learning become more relevant. In this regard, this paper analyzes the impact of food subsidy on the school performance of low-income primary education students. In addition, it may serve as a basis to measure the importance of human capital formation for economic development in low-income areas in the less developed countries.

Methodology

The units of analysis are: the households of Tepehuaje, Barda Paso de Piedras (which will be named

simply Barda henceforth) and Vicente Guerrero, located in the Valles Centrales region (Figure 1); the primary schools managed by the IEEPO, which is the Oaxaca State Ministry of Public Education; and community kitchens located in the low-income municipalities. The database of community kitchens corresponds to the first semester of 2015 and feeds the variables: allocated budget (*AB*) and endowments delivered from the Program of Cocinas Comunitarias (*ED*). The Oaxaca State System for the Integral Development of the Family (DIF Oaxaca) manages this program and this government bureau has been under tutelage of the first lady of Mexico and in Oaxaca State, by the wife of the governor; literally it takes care of the wellbeing of households by means of various assistance programs. The database of the primary schools covers the school year 2014-2015 and feeds the variables: grade failure rates (*GFR*) and dropout rates (*DR*). Besides, the graduation efficiency rates (*GER*) are taken into account and these refers to the percentage of students that were part of the 2009-2015 generation. The number of kitchens (*NKitchens*), the total number of beneficiary students from the program (*Beneficiaries*) and number of beneficiary students aged 6 to 12 years (*6-12 Beneficiaries*), correspond to data accumulated up to the first semester of 2015. In addition, a household database of the three study localities was collected through a survey whose questionnaire covers the requirements of the social accounting matrix (Gijón-Cruz, Espinosa-Rojas, & Reyes-Morales, 2018) in Tepehuaje (2015), Barda (2014), and Vicente Guerrero (2011). Of these, Vicente Guerrero does not receive food subsidy. The sample size by locality was 24 and 25 households for Tepehuaje and Barda, respectively and 111 for Vicente Guerrero. The total sample was 160 households.

Dependent variables of the academic performance model of low-income primary education students were measured as percentages of the total and these are: *GFR*, *DR*, and *GER*. The first one refers to the number of students who fail to advance to the next grade or educational level and in the system of education obtained a grade below 6.0; and this represents the apparent real achievement of the competencies reached by a student (Ponce, 2007). *DR* regards with the abandonment of school activities before finishing some degree or educational level (SEP, 2004). *GER* represents the percentage of students who complete an educational level within the ideal time established (SEP, 2008). This model determines the degree of association between the dependent variables and independent variables (economic and socio-demographic metric variables, region and micro-region dichotomous variables) by means of linear and nonlinear equations, which were constructed by ordinary least squares. The regression analysis was supported by the curvilinear estimation technique to find non-linear single-variable equations and the overall process was carried out using the SPSS program (Knoke, Buhrsted, & Potter, 2002). The best equations were selected following these criteria (Norusis, 1993; Gujarati & Porter, 2009): (1) The maximum values of the coefficient of multiple determination R^2 and of the corrected R^2 , R^2_{corr} ; (2) the statistic F of the analysis of variance (ANOVA) must be significant ($p < 0.05$); (3) The independent variables must be significant according to the t test ($p < 0.05$); and (4) The regression equations do not present problems of multicollinearity; *i.e.*: the variance inflation factor, VIF, must be < 10 and the condition index, IC < 10 .

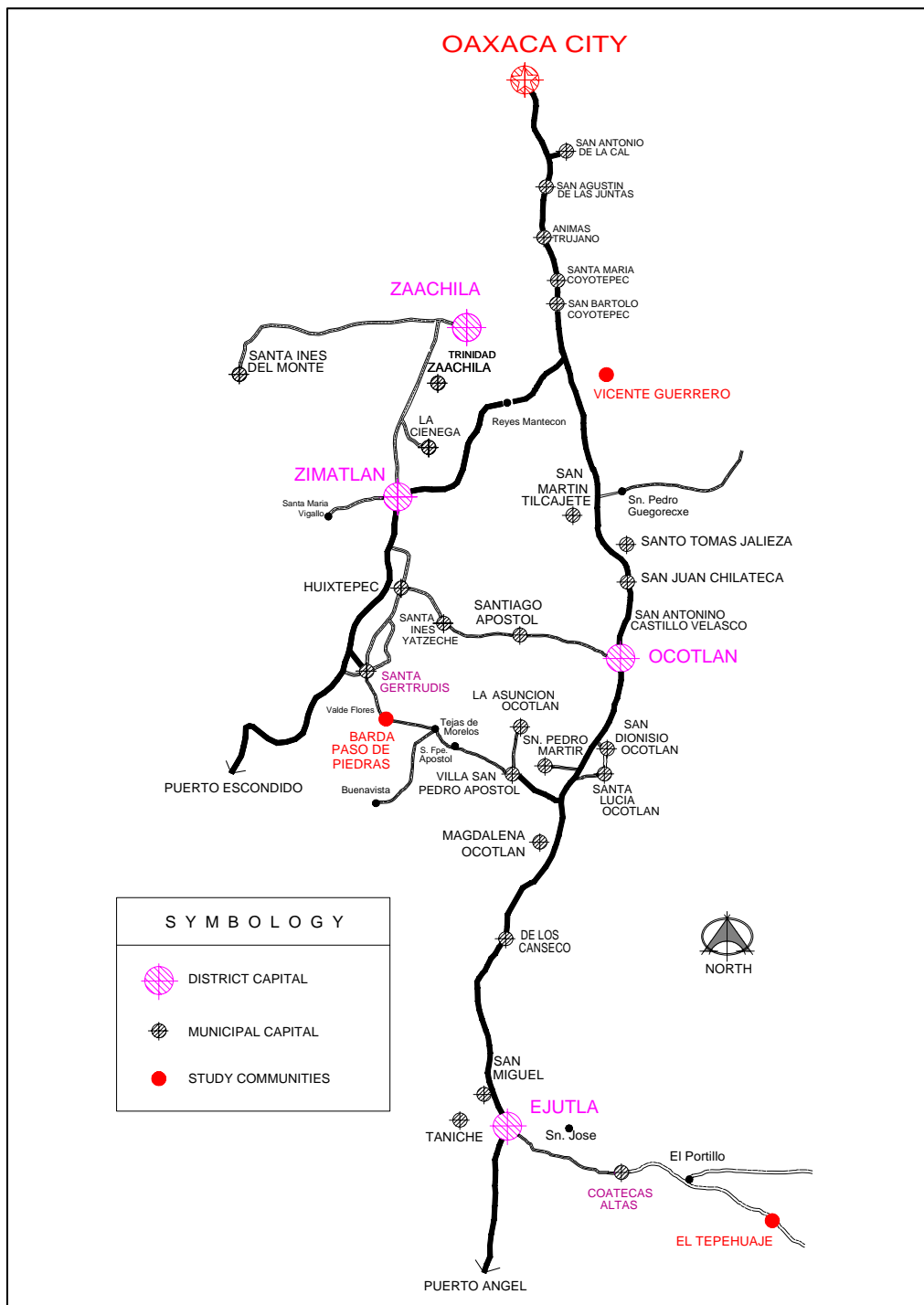


Figure 1. Location of study communities in the Valles Centrales region, Oaxaca State.

Model of Academic Performance of Primary Education

The regression equations of graduation efficiency rates model of in primary education (GER) by locality in low-income municipalities of the state of Oaxaca are: (1), (2), and (3). Their multiple determination coefficients, R^2 have the following values: 0.748, 0.744, and 0.328, respectively; and the corresponding values of their R^2_{corr}

are: 0.747, 0.743, and 0.327, respectively. That is to say, the independent variables that integrate the equations (1), (2), and (3) manage to explain the behavior of the *GER* between 32.7% and 74.7%, of course, if R^2_{corr} is taken as a reference because it is about multiple regression. Values of statistic t and measures of multicollinearity appear in Table 1, while values of significance— t test and beta—appear below the regression equations within curved parentheses and brackets, respectively. As can be seen from equations (1) and (2), if the students receive benefit from the Program of Cocinas Comunitarias (*Beneficiaries*), the number of male students (*Men*) and the number of students enrolled (*NSE*) increase; they induce a positive impact on *GER*. This occurs because the independent variables are directly correlated with *GER* considering their positive coefficients. Although the number of students enrolled (*NSE*) is a cubic variable, it is a directly correlated with *GER* due to its positive coefficient. This is explained through its first derivative which is a quadratic function with an ascending trajectory. On the contrary, the dropout rates (*DR*), as expected, are inversely correlated with *GER* in equation (1), *i.e.*, *DR* must fall down for *GER* can increase. The same effect produces the number of community kitchens (*NKitchens*), which is an indicator of budget allocated or endowments delivered from the Program of Cocinas Comunitarias. Besides, the Costa region (*Costa*) is a positive dichotomous variable and this must be understood that Costa has higher value of *GER* with respect to the other regions. Summarizing, the Program of Cocinas Comunitarias has positive effects on the graduation efficiency rates of primary education and on reducing dropout rates, but it does not reduce grade failure rates as it can be seen from equation (3).

$$GER = \begin{matrix} 1.751Men & 7.462NKitchens & 9.111Costa & 0.738DR \\ (0.000) & + & (0.042) & + & (0.044) & - & (0.021) \\ [0.791] & & [0.081] & & [0.038] & & [-0.043] \end{matrix} \quad (1)$$

$$GER = \begin{matrix} 83.755Beneficiaries & 0.00000149NSE^3 & 10.552Costa \\ (0.000) & + & (0.001) & + & (0.017) \\ [0.738] & & [0.116] & & [0.044] \end{matrix} \quad (2)$$

$$GER = \begin{matrix} 1.001GFR^3 \\ (0.000) \\ [0.573] \end{matrix} \quad (3)$$

The regression equations of grade failure rates model in primary education (4) and (5) have following values of R^2 : 0.297 and 0.287, respectively; and their values of R^2_{corr} are: 0.295 and 0.287, respectively. The independent variables provide an explanation degree of up to 29.5% about grade failure rate (*GFR*). These equations are free of multicollinearity as can be seen in Table 2. Equation (4) indicates that Micro-region 3, which contains 52 municipalities with urban localities greater than 15 thousand inhabitants, presents the lower values of *GFR* between micro-regions. In contrast, if the number of female students (*Women*) increases in primary schools, the *GFR* will tend to growth. From this it follows that an increase in the number of male students can increase the *GER*, while at the same time *DR* can decrease (see equation (1)). In fact, the Program of Cocinas Comunitarias fails to reduce *GFR* by either the number of beneficiary students aged 6 to 12 years in equation (4) or being beneficiary of this program in equation (5). Even the information available from this program suggests that the *GFR* could increase due to the existence of direct correlations with *6-12 Beneficiaries*

in equation (4) and with *Beneficiaries* in equation (5).

$$GFR = \frac{0.033Women}{(0.000)} + \frac{0.00000304(6-12Beneficiaries)^3}{(0.023)} - \frac{0.00000027Microrregion3^2}{(0.035)} \quad (4)$$

[0.432] [0.158] [-0.069]

$$GFR = \frac{1.965Beneficiaries}{(0.000)} \quad (5)$$

[0.536]

Table 1

Ordinary Least Squares Multiple Regression Analysis of the Graduation Efficiency Rates Equations: Statistic t and Measures of Multicollinearity

	Equation (1)				Equation (2)				Equation (3)
	Statistic t	Measures of multicollinearity			Statistic t	Measures of multicollinearity			Statistic t
		VIF < 10	Eigenvalues	CI < 10		VIF < 10	Eigenvalues	CI < 10	
Number of male students, <i>Men</i>	20.037	5.831	2.589	1.000					
Number of community kitchens, <i>NKitchens</i>	2.033	5.927	0.695	1.930					
Dropout rates, <i>DR</i>	-2.316	1.29	0.625	2.036					
Costa region, <i>Costa</i>	2.015	1.353	0.091	5.331	2.383	1.275	0.126	4.164	
Being beneficiary student of the program, <i>Beneficiaries</i>					21.297	4.408	2.191	1.000	
Cubic form of number of students enrolled, <i>NSE</i> ³					3.456	4.150	0.682	1.792	
Cubic form of grade failure rates, <i>GFR</i> ³									21.457
<i>R</i> ²		0.748				0.744			0.328
<i>R</i> ² corrected		0.747				0.743			0.327
Statistic <i>F</i>		699.344 (<i>p</i> < 0.000)				910.564 (<i>p</i> < 0.000)			460.383 (<i>p</i> < 0.000)
Degrees of freedom (regression and total)		4 and 944				3 and 944			1 and 944

Notes. There is no correspondence between the eigenvalues and the independent variables. VIF: Variance inflation factor; CI: Condition index. Source: Database of community kitchens corresponds to the first semester of 2015, Sistema DIF Oaxaca; database of the primary schools covers the school year 2014-2015 and period 2009-2015, IEEPO.

The regression equations of the dropout rates model, (6) and (7) present the following values of $R^2 = 0.249$ and 0.212, respectively, which are low as those of their R^2_{corr} : 0.245 and 0.211, respectively. All equations of the model of academic performance in primary education surpass the major tests of multicollinearity according these statistics: variance inflation factor and condition index (See Tables 1 and 2). The equations show that the Program of Cocinas Comunitarias cannot counteract dropout rates especially in female students, Micro-region 3, Papaloapan and Costa planning regions. However, the dropout rates can decrease if the allocated budget (*AB*) is increased since there is an inverse relationship between these two variables. In this way, it is possible to reduce the percentage of primary school students who desert before completing a school year in low-income localities. As in the equations of grade failure rates, female students have a lower performance compared to male students.

$$DR = \begin{matrix} 0.055 & 2.721 & 1.350 & 2.46 \times 10^{-6} & 9.7 \times 10^{-9} \\ \text{Women} & \text{Papalopan} & \text{Costa} & \text{Micro-region 3} & \text{AB} \\ (0.000) & (0.000) & (0.011) & (0.031) & (0.041) \\ [0.400] & [0.110] & [0.097] & [0.087] & [-0.084] \end{matrix} \quad (6)$$

$$DR = \begin{matrix} 3.044 \\ \text{Beneficiaries} \\ (0.000) \\ [0.460] \end{matrix} \quad (7)$$

Equation (7) only confirms the inability of the Program of Cocinas Comunitarias to reduce dropout rates and again this seems that it promotes them. Summarizing the findings, unlike the equations of dropout rates, those of grade failure rates show a reduction at least in the Micro-region 3, while the equations of graduation efficiency rates indicate good results, in particular, in male students and in the Costa region. Nevertheless, it is not possible to reduce the *GFR*.

Participation of the Program of Cocinas Comunitarias in Household Wellbeing

Table 3 shows the percentage share of spending on food, education, and health in the household wellbeing budget of three low-income communities in the Valles Centrales region. Tepehuaje and Barda are rural communities where primary schools receive food subsidies from the Program of Cocinas Comunitarias. The sources of income that weigh the most on household wellbeing are: internal remittances and wages. Vicente Guerrero is a semi-urban community located in the southern periphery of the metropolitan area of the Oaxaca city and surrounds the metropolitan dump. The households of this community receive most their income from government transfers. Barda and Vicente Guerrero allocate a greater proportion of their wellbeing budget to food and education but less to health. Vicente Guerrero is a community made up of poor households that resided in the city of Oaxaca and most of them came in search of cheap land to self-build a precarious dwelling. Part of its income is obtained from the garbage products. The household members of these two communities have very low levels of schooling. Tepehuaje has an opposite behavior both in spending wellbeing (food, education, and health) and its level of schooling. As it is observed, the expense in education is greater in the households of Vicente Guerrero due to the proximity to Oaxaca city, since the education expenses include: bus ticket, Internet, didactic materials, meals, school voluntary fee, among other expenses. The households of Tepehuaje and Barda expend less in these items, because they produce part of their food and also receive the provision of hot meals which include: beans, rice, soup, lentils, tuna, sardines, soy products, among others. In addition, their access to information technologies is very limited and availability of didactic materials is scarce. The spending on wellbeing in Vicente Guerrero is 1.3 times that of Tepehuaje and 1.6 times that of Barda. Although its education spending is the highest between the three communities, its average level of schooling is only 4.5 years as in Barda. Vicente Guerrero spends Mex \$4,123.5 more than Tepehuaje, whose average level of schooling is 6.12 years; this figure covers complete primary education and in some cases part of secondary education. The low efficiency in the education investment as already indicated before is due to fact that it is the result from a recent increase.

With regard to feeding, the impact of the benefit received from the Program of Cocinas Comunitarias is clear in Tepehuaje whose feeding spending is the lowest. Households of Barda are in the same conditions, but their pattern of consumption is greatly influenced by the countrymen who have immigrated to the United States.

Table 2

Ordinary Least Square Multiple Regression Analysis of Grade Failure Rates and Dropout Rates Equations: Statistic t and Measures of Multicollinearity

	Grade failure rates equations				
	Equation (4)				Equation (5)
	Statistic t	Measures of multicollinearity			Statistic t
		VIF < 10	Eigenvalues	CI < 10	
Number of female students, <i>Women</i>	6.030	6.860	2.336	1.000	
Cubic form of number of beneficiaries aged 6 to 12 years, <i>(6-12 Beneficiaries)</i> ³	2.275	6.446	0.585	1.999	
Cuadratic form of Micro-region 3, <i>(Micro-region 3)</i> ²	-2.116	1.431	0.079	5.425	
Being beneficiary student of the program, <i>Beneficiaries</i>					19.501
<i>R</i> ²	0.297				0.287
<i>R</i> ² corrected	0.295				0.287
Statistic <i>F</i>	132.741 (<i>p</i> < 0.000)				380.279 (<i>p</i> < 0.000)
Degrees of freedom (regression and total)	3 and 944				3 and 944
	Dropout rates equations				
	Equation (4)				Equation (5)
	Statistic t	Measures of multicollinearity			Statistic t
		VIF < 10	Eigenvalues	CI < 10	
Number of female students, <i>Women</i>	8.786	2.594	2.653	1.000	
<i>Micro-region 3</i>	2.159	2.011	1.040	1.597	
Papaloapam region, <i>Papaplopan</i>	3.960	1.106	0.711	1.932	
Costa region, <i>Costa</i>	2.557	1.814	0.342	2.784	
Allocated budget, <i>AB</i>	-2.050	2.080	0.254	3.232	
Being beneficiary student of the program, <i>Beneficiaries</i>					15.908
<i>R</i> ²	0.249				0.212
<i>R</i> ² corrected	0.245				0.211
Statistic <i>F</i>	62.297 (<i>p</i> < 0.000)				53.049 (<i>p</i> < 0.000)
Degrees of freedom (regression and total)	5 and 944				1 y 944

Notes. There is no correspondence between the eigenvalues and the independent variables. VIF: Variance inflation factor; CI: Condition index. Source: Database of community kitchens corresponds to the first semester of 2015, Sistema DIF Oaxaca; database of the primary schools covers the school year 2014-2015 and period 2009-2015, IEEPO.

Table 3

Spending Budget on the Household Wellbeing of a Household Sample Surveyed in Tepehuaje, Barda Paso de Piedras, and Vicente Guerrero, Oaxaca State (Constant Prices, Base Year = 2014)

Locality	Average annual values in Mexican pesos, Mex\$ (Percentages)				Average schooling (years)
	Household Wellbeing	Feeding	Education	Health	
Tepehuaje	38,523.2 (100.0)	17,259.9 (44.8)	1,991.8 (5.2)	3,885.8 (10.1)	4.5
Barda Paso de Piedras	31,404.3 (100.0)	18,354.1 (58.4)	2,659.4 (8.5)	469.0 (1.5)	6.1
Vicente Guerrero	49,561.4 (100.0)	27,117.8 (54.7)	6,115.3 (12.3)	986.3 (2.0)	4.5

Source: Database of probabilistic socioeconomic survey applied to a sample of households carried out during 2015 in Tepehuaje, 2014 in Barda Paso de Piedras, and Vicente Guerrero in 2012, Oaxaca State.

Conclusions

The relationship between the food subsidy and the school performance of children enrolled in primary education, who are beneficiaries of the Program of Cocinas Comunitarias, was demonstrated through the equations of the academic performance model. The graduation efficiency rates are enhanced, directly, through the food subsidy using these indicators: to be a beneficiary of the program and rural localities with community kitchens. In contrast, the grade failure rates (*GFR*) equations show that there is no direct correlation between this variable and the food subsidy. Namely, the *GFR* in beneficiary primary schools does not decrease and rather seems to increase. In the same way, the dropout rates (*DR*) equations only indicate that the assigned budget to community kitchens (*AB*) contributes to reducing *DR*; this can be seen through an inverse relationship between these two variables in equation (6). Equation (7) confirms the inability of the Program of Cocinas Comunitarias to reduce *DR*; and, according to database available, this program at this stage promotes it. The *GFR* equations show a reduction in this variable, at least, in the Micro-region 3, while the graduation efficiency rates equations show good results from the program, in particular, in male students and in the Costa region despite the fact that it is not possible to lower the *GFR*.

Spending on education and food is lower in the beneficiary localities and especially in rural localities. This is due not only to the food subsidy and food production but also to lower consumption of school supplies, because the rural localities have a limited access to school supplies and Internet. In contrast, education spending in Vicente Guerrero—located within the metropolitan area of the central city of Oaxaca State—is considerably higher. In a low-income state such as Oaxaca, Program of Cocinas Comunitarias has proved to have a positive impact even on the small cities considered in Micro-region 3 where offer of goods and services is not really wide.

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