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The Impact of *Oportunidades* on Human Capital and Income Distribution in Mexico: A Top-Down/Bottom-Up Approach[1]

Dario Debowicz* and Jennifer Golan

Abstract

To analyze the effects of the Mexican *Oportunidades* conditional cash transfer program on school attendance and household income distribution, this paper links a microeconometric simulation model and a general equilibrium model in a bidirectional way, so to explicitly take spillover effects of the program into account. Our results suggest that partial equilibrium analysis alone underestimates the distributional effects of the program. Extending the coverage of the program to the poor increases school attendance, reduces child labor supply, and increases the equilibrium wages of children who remain at work. With a relatively low fiscal cost, Mexican social policy could further reduce income inequality and poverty.

Keywords: computable general equilibrium (CGE); microsimulation; Oportunidades; child-work; income inequality; poverty.

JEL classification: O22; D31; D58.

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*Corresponding author. International Food Policy Research Institute, 2033 K Street NW. Washington DC. USA. DarioDebowicz@gmail.com.

1. Introduction

The *Oportunidades* conditional cash transfer (CCT) program is estimated to transfer 14 billion Mexican pesos (Mexico, Ministry of Finance 2011), or 1.1 billion U.S. dollars, per year, reaching 5.8 million households (SEDESOL 2012) and representing a substantial source of income for the poor. As such, it is a major social program of the Mexican government. A successor to PROGRESA (*Programa de Educacion*, *Salud y Alimentacion*, the Education, Health and Nutrition Program), *Oportunidades* has attracted national and international attention (World Bank 2006). The program aims to develop the human capital of poor households (Skoufias 2005) by providing cash transfers under the condition that households behave consistently with the accumulation of human capital. The program has three components—education, nutrition, and health—with education the largest (Azevedo and Robles 2010). The program is operated by SEDESOL (*Secretaría de Desarrollo Social*, the Social Development Secretariat) and seeks to eliminate the intergenerational transmission of poverty. *Oportunidades* cash transfers are individually delivered to the mothers of children of school age and vary depending on the number of children enrolled in school and their grade levels, and their attendance at health centers. All mothers participating in the program are informed with individually delivered pamphlets that the benefits of *Oportunidades* are not conditioned on participation in any political event or voting for any political party, and the rules of the program and the number of beneficiary families by locality, municipality, and state are available on the Internet[2] and in the Federal Register (Levy 2006).

Extensive evaluation of the program (Schultz 2004; Parker 2005; Behrman, Sengupta, and Todd 2005; Levy 2006) has led to a consensus that the program enhances welfare in several dimensions: nutrition (Attanazio and Angelucci 2009; Hoddinot, Skoufias, and Washburn 2003); health (Gertler 2004), and school attendance and incomes of the poor (Azevedo and Robles 2010).

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[2] Available at www.oportunidades.gob.mx.

Azevedo and Robles (2010) examine the effects of *Oportunidades* using the microsimulation model developed by Bourguignon, Ferreira, and Leite (2003) (BFL henceforth) to analyze the partial equilibrium effects of the transfers on children's time allocation, relaxing its identifying assumption, and applying it to *Oportunidades*. They find that increasing school attendance for higher-grade-level students could be relatively expensive, while shifting the subsidies from children in primary education to students in advanced grades could raise overall school enrollment in Mexico with no additional cost for the program.

However, national-scale CCTs in support of the poor can have important indirect general equilibrium effects. Only a combined macro-micro model is able to fully take these effects into account (Bourguignon, Bussolo, and Cockburn 2010). This paper analyzes the impact of the educational *Oportunidades* transfer on child labor supply, income distribution, and poverty by explicitly taking the program's spillover effects into account. To our knowledge, this is the first study to link the BFL behavioral microsimulation model to a countrywide computable general equilibrium (CGE) model that considers the general equilibrium effects of the program. Using this integrated model and a comparative statics approach, our study takes a series of snapshots of observed and counterfactual scenarios in order to shed light on the effects of the *Oportunidades* program—effects that are actually perceived over time by the Mexican inhabitants. Ultimately, this paper hopes to contribute to the design of social policy by informing the decisionmaking process using a combined macro-micro model.

The paper is organized as follows. The next section provides a review of relevant macro-micro modeling approaches. Section 3 develops a macro-micro model that explicitly captures CCTs and allows the macro and micro components of the model to communicate iteratively in a bidirectional way until converging on a joint equilibrium. Section 4 applies the combined macro-micro model to the Mexican *Oportunidades* program. The section also contrasts the general with the partial equilibrium effects of the program. The final section concludes.

2. The Interaction between Micro and Macro Models

Macro- and microsimulation models can be linked in different ways. The link can be made by explicitly including selected micro behavior, typically labor supply or consumption demand, into a macro model (the integrated approach), so that a single model reflects relevant micro and macro behavior in the economy under analysis (Cogneau and Robilliard 2006; Cockburn 2006; Cockburn, Corong, and Cororaton 2010). Alternatively, the macro and the micro models can be "layered" in the sense that the two models are kept as different entities with some degree of communication between them. For instance, simulated percentage changes in factor wages may be endogenous in the macro model and communicated to the micro model, where wages are exogenous. In the layered approach, the microsimulation model can be behavioral, that is, it can reflect individuals' behavior (the "layered behavioral approach"), or not (the "layered nonbehavioral approach"). Layered nonbehavioural models have been applied by Boccanfuso, Decaluwe, and Savard (2008), Vos and Sanchez (2010), and Herault (2010).

In the layered behavioral approach, a functional form is specified for the selected behavior under analysis (for example, labor supply), and the parameters of the model are econometrically estimated. The behavioral approach has been applied in "top-down" and "top-down/bottom-up" fashion. In the top-down approach, the macro model informs the microsimulation model, but there is no feedback from the micro model to the macro model. Applications of this approach include Bourguignon, Robilliard, and Robinson (2004); and Debowicz (2010). In the top-down/bottom-up approach, first suggested by Savard (2003), the communication is bilateral and iterative, from the micro model to the macro model and from the macro model to the micro model. The basic idea of the top-down/bottom up approach is to use the household microsimulation model to capture the behavioral responses of households and the CGE model to generate a vector of commodity prices and factor wages equilibrating the associated markets, which are, in turn, communicated to the microsimulation model. In this case, the micro-household responses are aggregated and fed back into the CGE model, which communicates in an iterative way with the microsimulation model until they converge on a joint equilibrium solution (Savard 2003; Cury et al. 2010).

3. Model

In the case of national-scale CCTs in support of the poor, where “the indirect general equilibrium effects are too significant to be dismissed,” a macro-micro approach is called for to analyze distributional impacts (Bourguignon, Bussolo, and Cockburn 2010, 1). Since one of the main goals of the *Oportunidades* program is to increase human capital by raising school attendance, this transmission channel needs to be taken into account when modeling the distributional impact of the program. In order to capture how changes in the allocation of children’s time lead to general equilibrium effects at the national level, which again affect children’s time allocation, the micro model needs to communicate to the macro model and vice versa.

The combined model must capture two main transmission channels:

1. *Occupational effect*: Changes in the coverage of the program, in the program design, or in child wages lead some households to reallocate the time of their children between school and work. This affects labor supply as well as transfer income and thus total disposable household income.

2. *Wage effect*: As some children withdraw from (or enter into) the labor market—in response to changes in the program design or other factors—the child labor supply falls (rises), excess demand (supply) for child labor will be generated, and, through the equilibrium of the child labor market, the average general equilibrium real wage that children who remain at work are able to receive will rise (fall), with an additional effect on total disposable household income.

While direct effects of changes in the program design on occupation can be captured by a microsimulation model, in order to capture the wage effect we need to link the microsimulation model to a macrosimulation model. The combined model should also account for the effect of the transfers on the fiscal balance and for the effect of changes in child labor supply on production. The IFPRI (International Food Policy Research Institute) Standard CGE Model satisfies these requirements.

The model developed in this paper contributes to linking microsimulations to macroeconomic CGE models in the context of a CCT program. Our combined model allows the identification of the expected direct and indirect effects of the CCTs on children's time allocation, as well as the contemporaneous expected effects on income distribution and poverty.

Our model combines a microsimulation model with a macro CGE model using the top-down/bottom-up methodology developed by Savard (2003). The microsimulation model closely follows Bourguignon, Ferreira, and Leite's (2003) model. The macro model is based on the IFPRI Standard CGE Model (Diao, et al. 2011), a model that captures relevant characteristics of developing economies and allows to track the effects of a variety of counterfactual scenarios on the commodity and factor markets and the income distribution of a countrywide economy.

Our study is in line with Cury et al. (2010), who also use a top-down/bottom-up macro-micro model and apply it to a cash transfer program (*Bolsa Familia* in Brazil). The model used in their study does not capture how the conditionality of the transfers affects children's school attendance. Our microsimulation model explicitly captures the effect of conditionality on the time allocation of potential beneficiary children.

Several recent micro-empirical studies analyze indirect effects of CCT programs using ex post evaluation methods (Angelucci and De Giorgi (2008), Alzúa, Cruces, and Ripani (2012), Skoufias and di Maro (2006), Skoufias and Parker (2001), Gertler, Martinez, and Rubio-Codina (2012)). Our work complements these studies in various ways. First, we are using an ex ante evaluation technique at the micro level that allows us to explore the impact of potential changes to the program design, which would not be possible with an ex post technique. Second, in linking the BFL and IFPRI models bidirectionally, we fully take into account the effects of the conditional transfers on children's time allocation and household income, the subsequent effects on the factor and commodity markets, and the continuous feedback from the countrywide markets to households' behavior and incomes. In our model, the child and adult labor markets are interlinked. Child labor is only imperfectly substitutable with other factors, so potential changes in the program design significantly affect the child labor market-clearing wage without substantially altering the total production of the economy, given the small contribution of child labor to national income. As illustrated in Figure 3.1, we link the IFPRI and BFL models iteratively in the following way:

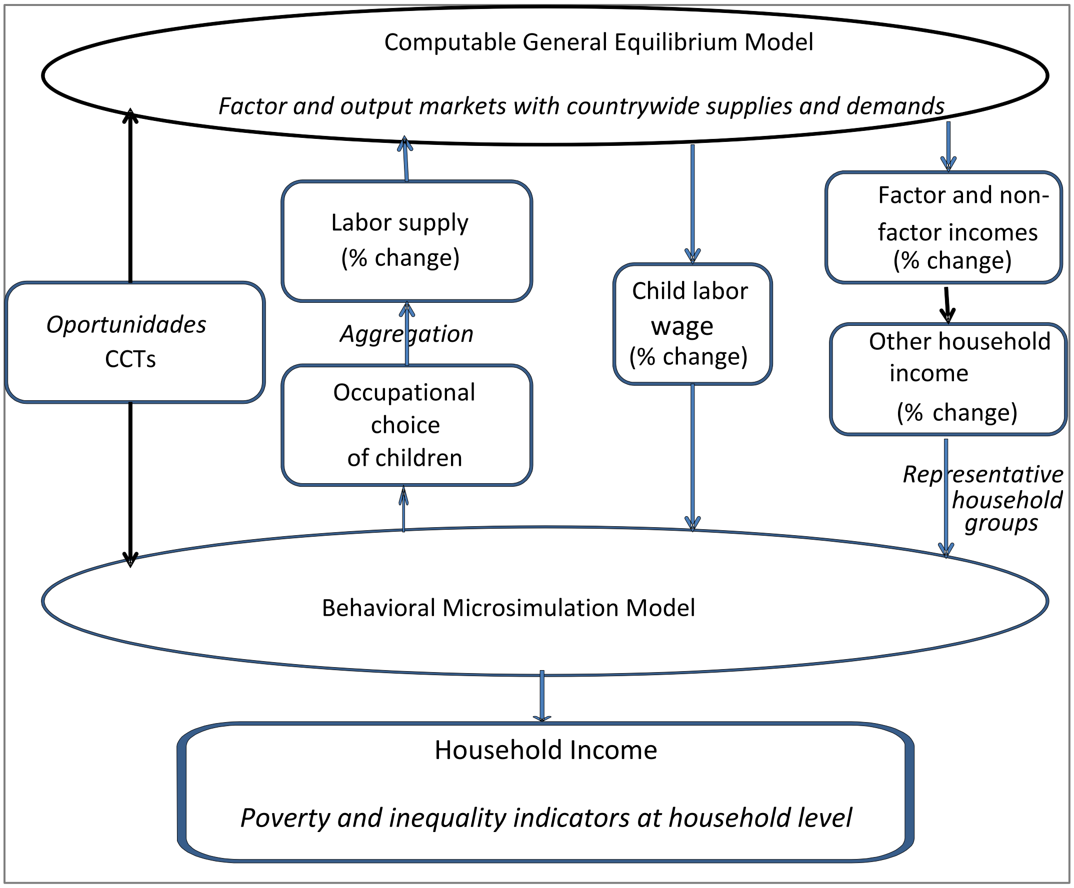
1. Changes in the design of the *Oportunidades* transfers are transmitted to both the macroeconomic CGE and the microsimulation model—the former at the representative household level and the latter at the sampled individual level.

2. The microsimulation model generates a childwise time allocation between school and work and communicates it in an aggregated way, as a percentage change in the supply of child labor, to the CGE model, where the child labor supply is treated as exogenous.

3. The CGE model generates a new general equilibrium solution and transmits the percentage changes in the average wage of the children (w_{CHILD}) and in other household incomes (Y_{-i}), to the microsimulation model, where these variables are exogenous.

4. Steps 2 and 3 are repeated iteratively in a loop until the two models converge on a joint solution and the economy reaches a new equilibrium in all its factor and commodity markets.

Figure 3.1—Modeling *Oportunidades* conditional cash transfers (CCTs): Our modeling approach



Source: authors' elaboration based on transmission channels in the macro-micro model.

Microsimulation Model

We adapt the methodology of BFL to the case of *Oportunidades*. In this model, each child i chooses among the following occupational alternatives (j): work (j = 0), work and attend school (j = 1), and attend school (j = 2). Child i will take occupational choice k if and only if the utility of alternative k exceeds that of the other alternatives j:

$$O_i = k \text{ iff } U_i(k) > U_i(j) \text{ for } j \neq k. \quad (1)$$

The utility of each alternative is composed of a deterministic ($F_j(.)$) and a random component (v_{ij}) that reflects unobservable characteristics affecting occupational choice (Amemiya and Shimono 1989). The deterministic component of occupational choice depends on child-specific characteristics (C_i), such as age, and household-specific characteristics (H_i), as well as the sum of the choice-specific income of the child (y_{ij}) and other income of the household (Y_{-i}):

$$U_i(j) = F_j\big(C_i, H_i; y_{ij} + Y_{-i}\big) + v_{ij}. \tag{2}$$

Linearizing the utility function and collecting all nonincome covariates into a single vector (Z_i), we can rewrite the latent utility function of choice j as

$$U_i(j) = Z_i{}'\gamma_j + (Y_{-i} + y_{ij})\ \alpha_j + v_{ij}. \tag{3}$$

The child's contribution to overall household income, y_{ij}, is a function of the market wage, w_i. For children in alternative 0 who work in the market and help at home—for example, by helping in the preparation of goods to be sold in a family business or on domestic tasks that may release time other household members can spend on income-generating activities—w_i would underestimate the children's contribution to overall household income y_{i0}. A way to account for the child's domestic contribution to overall household income is to multiply the market income by a constant (K), so that $y_{i0} = Kw_i$. If $K > 1$, the child's contribution to overall household income exceeds the market income. Given the absence of relevant data to proceed otherwise, we assume that children working in the market and not attending school do not contribute to domestic activities and that their contribution to overall household income is equal to their market wage (that is, $K = 1$), so that:

$$y_{i0} = w_i. \tag{4}$$

For a child working and going to school, his remuneration in the labor market is likely to be below what he would receive if he were only to work, because he spends less time working in the market. To capture how child-specific characteristics and occupational choices affect market wages, we assume that the wage is a log-linear function of child-specific characteristics X_i, of a binary variable that takes the value of 1 if the child is working and attending school, $O_{i1} = 1$, and of unobservable child or household specific characteristics (u_i):

$$ln\, w_i = X_i{}'\, \delta + mO_{ij} + u_i, \tag{5}$$

with j = 0,1. The coefficient m captures the effect on market earnings of children working less than full-time. Accordingly, $M = e^m$ captures the fraction of the market income that the child receives after this reduction. The income contribution of choosing alternative 1 is thus defined as

$$y_{i1} = My_{i0} = Mw_i. \tag{6}$$

A child only going to school is likely to contribute only a fraction (*D*) of the income she could earn in the market working full-time, as attending school does not yield any immediate economic returns to the household and she can only help at home when not attending school:

$$y_{i2} = Dy_{i0} = Dw_i. \tag{7}$$

Rewriting the utility function in terms of the market wage (w_i) to allow the determinants of occupational choice to be common to the available occupational choices yields:

$$U_i(j) = Z'{}_i\gamma_j + Y_{-i}\alpha_j + w_i\beta_j + v_{ij,} \tag{8}$$

where

$$\beta_0 = \alpha_{0,} \tag{9}$$

$$\beta_1 = \alpha_1 M, \text{and} \tag{10}$$

$$\beta_2 = \alpha_2 D. \tag{11}$$

Data and Parameter Estimation

The data we use come from the Mexican *Encuesta Nacional de Ingresos y Gastos de los Hogares* (ENIGH, the National Household Income and Expenditure Survey) 2008, provided by the *Instituto Nacional de Estadística y Geografia* (INEGI, the National Institute of Statistics and Geography). ENIGH 2008 is a national representative household survey that includes information on labor and other factor earnings, transfers, and consumption and allows the identification of households that participate in *Oportunidades*. The survey asks household members about their nonlabor income sources, and it notes whether any child receives a scholarship from the program. This allows us to construct a measure of the scholarship component of the program using the program rules[3].

Our analysis concentrates on children aged 6 to 17. If a child is not attending school we classify her into occupational alternative 0 (“Work”), if he attends school but also reports a wage into category 1 (“Work and School”) and if he only attends school into category 2 (“School”). We find that out of a total of 26.9 millions of children, 3.2 million (11.8%) of them only work, and 1.4 million (5.3%) of them work and study, with the remaining 82.9% only studying. While most of the children study and do not work, the occupational composition varies significantly by age group: around age 12, the choice composition shifts toward increased labor market participation, and the percentage of children who do not attend school increases (not tabulated, see also Azevedo and Robles 2010).

For the microsimulation model, we need to estimate potential wages for those who do not report a wage. Prior to estimation, we convert all the income figures into monthly thousands of Mexican pesos. Table 3.1 summarizes the results of the estimation of Equation (5) by ordinary least squares (OLS). Column 1 reports the results for all children and Column 2 for those aged 12 and above. We find that, controlling for

[3] Available at Secretaría de Desarrollo Social, Diario Oficial, December 29, 2008. www.normateca.gob.mx/Archivos/46_D_1786_.pdf.

observable characteristics, children who go to school and work earn 64 percent less income than those who only work. Accordingly, our parameter estimate of M is M = exp(-0.644) = 0.525.

In the next step, we estimate a multinomial logit model (MNL) to explain children's occupational choice. We choose "Work" as the base category in the analysis that follows. The results of the MNL are summarized in Table 3.2. The signs of the estimates are as expected. Increasing household income increases the likelihood of studying, as it increases the probability of choosing alternative 1 or 2 relative to alternative 0. We also find intrahousehold difficulties, as captured by a divorce of the household head, to decrease the probability of studying and that increasing (potential) wages reduces the likelihood of studying relative to working.

Once the wage and the occupational choice equations have been estimated, the parameters and initial values of the microsimulation model can be determined. The conditional cash transfer, CCT_{ij}, raises other household income Y_{-i} of school attendants (alternatives 1 and 2). Assuming that children not attending school receive no transfer, and each school attendant receives a transfer (T_i) that varies by age and gender, then $CCT_{i0} = 0$ and CCT_{i1} = CCT_{i2} = T_i, Equation (8) can be rewritten as

$$U_i(j) = Z_i\gamma_j + \left(Y_{-i} + CCT_{ij}\right)\alpha_j + w_i\beta_j + v_{ij} \text{ with } CCT_{i0} = 0 \text{ and } CCT_{i1} = CCT_{i2} = T_i. \qquad (12)$$

The MNL allows identifying $(\gamma_j - \gamma_0), (\alpha_j - \alpha_0), (\beta_j - \beta_0)$ for nonalternative specific covariates. Following BFL, and using the OLS parameter estimate of M and Equations (9) to (11), we can recover $\alpha_j, \beta_j,$ and γ_j for $j = 0,1,2$. Our parameter estimates of household income Y_{-i} in alternatives 1 and 2 are $a_1 = \alpha_1 - \alpha_0 = 0.019$ and $a_2 = \alpha_2 - \alpha_0 = 0.022$, respectively. M = 0.5254, and our estimates of potential wages in alternatives 1 and 2 are $b_1 = \beta_1 - \beta_0 = -0.416$ and $b_2 = \beta_2 - \beta_0 = -0.062$,

Table 3.1—Ordinary least squares (OLS) child earnings estimates

Dependent variable: log wage		
	6 to 17 years old	12 to 17 years old
Work and school	-0.644***	-0.593***
	(0.060)	(0.058)
Years of schooling	0.009	0.153***
	(0.044)	(0.047)
Years of schooling^2	-0.001	-0.012***
	(0.003)	(0.003)
Age	0.389***	0.366
	(0.090)	(0.334)
Age^2	0.001	-0.001
	(0.003)	(0.011)
Male	0.214***	0.213***
	(0.048)	(0.053)
Female head	0.135***	0.127**
	(0.052)	(0.056)
Rural	-0.243***	-0.326***
	(0.051)	(0.054)
Log state wages	0.346***	0.438***
	(0.064)	(0.072)
Noreste region	0.219	0.096
	(0.152)	(0.166)
Noroeste region	0.306***	0.337***
	(0.100)	(0.108)
Occidente region	0.151	0.167
	(0.103)	(0.111)
Oriente region	-0.062	0.053
	(0.112)	(0.115)
Centronorte region	0.122	0.110
	(0.099)	(0.104)
Centrosur region	0.178*	0.206**
	(0.101)	(0.105)
Sureste region	-0.023	0.141
	(0.100)	(0.107)
Constant	-5.882***	-5.086**
	(0.528)	(2.484)
Observations	3,021	2,285
R-squared	0.596	0.262

Source: authors' estimation based on ENIGH 2008.

Note: standard errors in parentheses. *: p < 0.1, **: p < 0.05,***: p < 0.01.

Table 3.2—Multinomial logit regression of children's time allocation, all children

	(1)	(2)	(3)	(4)	(5)
	Coefficients		Marginal effects		
	Work & School	School only	Work	Work & School	School only
Potential wage	-0.416***	-0.062***	0.005***	-0.016***	0.011***
	(0.035)	(0.008)	(0.000)	(0.001)	(0.001)
Years of schooling	0.000	-0.093***	0.006***	0.004***	-0.010***
	(0.037)	(0.025)	(0.002)	(0.001)	(0.002)
Years of schooling^2	0.008**	-0.002	0.000	0.000***	-0.000***
	(0.003)	(0.002)	(0.000)	(0.000)	(0.000)
No. children 0≤age≤5	-0.058	-0.122***	0.008***	0.002	-0.010***
	(0.042)	(0.026)	(0.002)	(0.002)	(0.002)
No. children 6≤age≤12	0.297***	0.289***	-0.018***	0.001	0.017***
	(0.034)	(0.022)	(0.001)	(0.001)	(0.002)
No. children 13≤age≤17	-0.613***	-0.705***	0.044***	0.002	-0.046***
	(0.043)	(0.025)	(0.002)	(0.002)	(0.002)
No. people age≥18	-0.278***	-0.240***	0.015***	-0.002*	-0.013***
	(0.034)	(0.019)	(0.001)	(0.001)	(0.002)
Male	0.493***	-0.206***	0.011***	0.031***	-0.042***
	(0.063)	(0.040)	(0.003)	(0.002)	(0.003)
Rank of child	0.355***	0.396***	-0.025***	-0.001	0.026***
	(0.036)	(0.022)	(0.001)	(0.001)	(0.002)
Other household income	0.019***	0.022***	-0.001***	-0.000	0.001***
	(0.004)	(0.003)	(0.000)	(0.000)	(0.000)
Educatio head	0.101***	0.169***	-0.011***	-0.002***	0.013***
	(0.009)	(0.006)	(0.000)	(0.000)	(0.001)
Age head	0.006*	0.019***	-0.001***	-0.001***	0.002***
	(0.003)	(0.002)	(0.000)	(0.000)	(0.000)
Head divorced	-0.137	-0.321***	0.022***	0.008*	-0.030***
	(0.108)	(0.071)	(0.006)	(0.005)	(0.007)
Rural	-0.412***	-0.211***	0.015***	-0.009***	-0.005
	(0.073)	(0.045)	(0.003)	(0.003)	(0.004)
Log state wages	0.411***	-0.157***	0.008**	0.025***	-0.033***
	(0.089)	(0.054)	(0.003)	(0.003)	(0.005)
Noreste region	-0.160	-0.289**	0.020**	0.005	-0.025**
	(0.205)	(0.115)	(0.009)	(0.009)	(0.012)
Noroeste region	0.618***	0.076	-0.007	0.029***	-0.023***
	(0.135)	(0.082)	(0.005)	(0.007)	(0.009)
Occidente region	0.371***	-0.153*	0.008	0.027***	-0.035***
	(0.144)	(0.087)	(0.006)	(0.008)	(0.010)
Oriente region	0.253	0.171*	-0.010**	0.004	0.006
	(0.154)	(0.090)	(0.005)	(0.006)	(0.008)
Centronorte region	0.112	-0.068	0.004	0.008	-0.012
	(0.138)	(0.080)	(0.005)	(0.006)	(0.008)
Centrosur region	0.042	0.153*	-0.009*	-0.004	0.013*
	(0.140)	(0.080)	(0.005)	(0.005)	(0.007)
Sureste region	0.631***	0.108	-0.008*	0.029***	-0.020**
	(0.136)	(0.081)	(0.005)	(0.008)	(0.009)
Constant	-0.736**	0.821***			
	(0.332)	(0.205)			
Observations	30,331	30,331	30,331	30,331	30,331

Source: authors' estimation based on ENIGH 2008.
Note: Standard errors in parentheses. *: $p < 0.1$, **: $p < 0.05$, ***: $p < 0.01$.

respectively. Solving for the parameters of interest yields $\alpha_1 = (a_1 - b_1)/\,(1 - M) = 0.9158, \alpha_2 =$ $\alpha_1 + a_2 - a_1 = 0.9188, \alpha_0 = \alpha_2 - a_2 = 0.8968,$ and $D = (b_2 + \alpha_0)/\,\alpha_2 = 0.9089$.

Once the elements in the deterministic part of the utility function are identified, and assuming for convenience that $U_i(0) = 0$, we draw the unobservables $v_{ij} - v_{i0}$ randomly from an MNL distribution, assuring consistency with the observed child's occupational choices. The determinants of the latent utility are identified for each child and occupational choice, and the utility function allows the simulation of child labor supply responses to changes in the design of CCTs or changes in other determinants of utility such as children's wages or other household income.

Computable General Equilibrium Model

Following general equilibrium theory, representative consumers (households) and producers in our model are treated as individual economic agents. Households maximize a Stone-Geary utility function, such that their consumer behavior is driven by a linear expenditure system (LES) taking income and commodity prices as given. Sector-specific producers have a CES value-added function with arguments given by child labor, other labor, capital, and land, and choose factor inputs to maximize their expected profits assuming wages and prices are given.

Import and export world prices are given for domestic agents. Domestically produced goods, imports, and exports are assumed to be imperfect substitutes. Imports are determined to minimize the cost of domestic absorption given import and domestic prices, and exports are determined to maximize producers' profit given export and domestic prices. Commodity-specific domestic price changes equilibrate the commodity markets, and factor-specific wage changes equilibrate the factor markets. Households' incomes are the sum of factor and nonfactor (*Oportunidades* and other transfer) income.

Regarding macroeconomic closures, the model has (1) savings-driven investment with exogenous marginal propensities to save for the households and endogenous investment, (2) exogenous public expenditures and tax rates with endogenous public savings, and (3) exogenous foreign savings with an endogenous real exchange rate. The numeraire of the model is given by the consumer price index (CPI).

The Mexican CGE model includes 14 sector-specific producers, 15 production factors, 16 representative household groups, and 10 other accounts (including the *Oportunidades* program). Child labor is a specific production factor, and the rest of labor is categorized into production factors according to gender, skill level, and formal or informal status. Households are classified according to poverty status, region, gender of the household head, and whether they initially benefit from the *Oportunidades* program.

The parameters of the model are calibrated in light of factor use informed by analysis of ENIGH microdata; the social accounting matrix (SAM) was especially prepared for our study and captures the Oportunidades transfers[4]; and production, trade, and consumption elasticities present in previous CGE analysis of PROGRESA CCTs in Mexico by Coady and Harris (2001). The factor demand is assumed to be inelastic, with a CES factor substitution elasticity of 0.6, for which we conduct sensitivity analysis given its centrality for the analysis at stake. We find that our results do not hinge on the elasticity of substitution among factor inputs assumed in the model[5]. Imports and exports are elastic, with Armington and CET elasticities taking values between 2 and 4 (4 for agriculture, livestock, forestry, fishing, and hunting; 3 for mining, electricity, water and gas provision, construction, manufacturing, trade, transport, mail, and storage; and 2 for the remaining activities). The income elasticity in the LES household consumption of commodities is lower for primary goods (0.8) than for industrial goods (1.0) and even lower than for services (1.2), and the Frisch parameter is unitary.

Counterfactual Scenarios to Analyze the Program Effects on Schooling, Income Distribution, and Poverty

[4] The SAM is available with full documentation at www.ifpri.org/dataset/2008-social-accounting-matrix-mexico.
[5] Results are available from the corresponding author upon request.

To evaluate the short- and long-term effects of the *Oportunidades* program, starting from a base scenario in which we observe *Oportunidades* transfers received by households in the ENIGH 2008 household survey, we analyze the following three counterfactual scenarios.

In the first scenario ("No Program"), we simulate the absence of all *Oportunidades* (conditional and unconditional) transfers. In comparison to the benchmark scenario, in which the program is in operation under the present rules, this scenario allows us to estimate the effects that the actual program is having on schooling, income distribution, and poverty.

In the second scenario ("Program Expansion"), we extend the coverage of the conditional transfers to all the moderately poor children, applying the existent rule for the amount transferred as a function of grade and gender. This means that any existent transfer is left unchanged, but the coverage of the available CCT is further expanded, with $CCT_i = f(\text{school grade}, \text{gender})$ for the moderately poor who initially are not CCT recipients. For children who are not attending school, we design the CCT according to their gender and the school grade they would be attending if they were to attend school, given their latest schooling level and grade completed.

The third and final scenario ("Program Skilling") accounts for the lagged human capital effect of the existing transfers. In particular, we model that *Oportunidades* increases the average years of schooling of the child population and contributes to increasing the skills of the future workforce, particularly of the households benefitting from the program. We model the lagged human capital effect of the program in a very simple way, assuming that the closest child projection into the future is, where available, the child's same-gender parent (see McKee and Todd (2009) for a more elaborate application with a different dataset). The program has been found to increase the years of schooling by an additional 0.72 and 0.64 years for girls and boys, respectively (Skoufias 2005). Building on this finding, we add the assumed increment in schooling to the observed years of schooling of each matched parent and round it to a new integer level, generating an adult labor force with a new education structure. We use the resulting measure of schooling to reclassify adults by skill category (unskilled, semiskilled, and skilled). We then simulate the general equilibrium effects of the change in the education structure of the adult labor force[6]. For this, we use the associated percentage changes in gender-specific adult labor supply by skill level to inform the exogenous labor supply parameter of our static CGE model and compare a simulated snapshot using the new adult labor force with the initially observed one. We account for the changes in child and adult wages, and the changed incentives of going to school once the postschool wage has fallen for more educated workers given the increase in their supply due to the program.

For each of the three counterfactual scenarios, we translate the simulated changes in the *Oportunidades* transfer and lagged human capital, and the resulting changes in earnings, into changes in income at the level of the observed households, and compute population-weighted changes in school attendance, household income, poverty indicators, and the Gini index considering both partial equilibrium (for the first two simulations) and general equilibrium (for all simulations) effects.

While the first two simulations focus on the contemporaneous partial and general equilibrium distributional effects, the last simulation focuses on the distributional effects that the existing program may have at some point in the future where the effects of the program on the skill composition of the adult labor force have been fully developed, and the program remains in operation with the existing characteristics, albeit not in a dynamic way.

In principle, there could be significant program effects in the short term on the level of social production and the fiscal balance. Given the small share of child labor income in national income, and the small share of *Oportunidades* transfers in the total expenditure of the Mexican government, these effects turn out not to be first-order effects as, for example, extending the program to all the moderately poor increases public expenditure by only 1.3%. If the *Oportunidades* program leads more children to attend school, the

[6] For an interesting analysis of how the effects of increasing education on the economy depend on the level of physical investment, see Jung and Thorbecke (2003).

government will probably need to increase spending on public education to maintain educational quality. Our model can only capture public expenditure increments that are directly linked to the program.

School Attendance

Table 4.1 reports changes in the time allocation of children associated with the different counterfactual scenarios. The table is organized as a transition matrix: the columns depict the original occupational choices and the rows the simulated choices generated by the partial equilibrium (first three columns) and general equilibrium (last three columns) effects. The table shows that the effect on time allocation of withdrawing all *Oportunidades* transfers ("No Program") is very small, both ignoring and factoring in the general equilibrium effects of the program. Ignoring general equilibrium effects, only 0.1 percent of those initially only attending school, and 0.3 percent of those originally combining work with school, drop out of school. Incorporating general equilibrium effects, the additional child labor supply allows the economy to increase its output marginally in the short run,[7] lifting some households' income, and so some households (0.1 percent of those originally combining work and school—in other words, an insignificant 0.003 percent of the total children) stop sending their children to work. In partial equilibrium, extending the program to all the children in moderately poor households ("Program Expansion") does lead to a substantial increase in school enrollment: 12.6 percent of the children who initially were out of school enroll, and 11.8 percent leave the labor market.

Table 4.1—Transition matrix for time allocation of children by simulation and type of equilibrium

No Program:	**Partial Equilibrium**			**General Equilibrium**		
	Base Choice			Base Choice		
Simulated Choice	Not Studying	Work and School	School Only	Not Studying	Work and School	School Only
Not Studying	100.0	0.3	0.1	100.0	0.0	0.0
Work and School	0.0	99.7	0.0	0.0	99.9	0.0
School Only	0.0	0.0	99.9	0.0	0.1	100.0

[7] The effect on the child labor wage proves to be negligible.

Program Expansion:						
Simulated Choice						
Not Studying	87.4	0.0	0.0	87.9	0.5	0.1
Work and School	0.8	100.0	0.0	0.5	96.4	0.0
School Only	11.8	0.0	100.0	11.6	3.1	99.9
Program Skilling:						
Simulated Choice						
Not Studying	--	--	--	99.8	0.0	0.0
Work and School	--	--	--	0.0	99.9	0.0
School Only	--	--	--	0.2	0.1	100.0

Source: authors' calculation based on ENIGH 2008 and model results.

The significant change in child labor supply generated by the expansion of the program is not inconsistent with the small change in labor supply generated by the withdrawal of the program, as a significant number of children are in the benchmark only marginally included in the "Work" alternative; in other words, their observable and unobservable characteristics are such that a slight increase in the attractiveness of the school alternative make them enter school. This translates into a 1.5 percentage point increase in the overall school attendance rate, given that the initial figure of children out of school is 11.8 percent (Table 3.2). The effect varies by gender (not tabulated): 1.1 percent of boys who were initially working now also go to school and 11.1 percent go to school only; only 0.3 percent of girls initially working now also go to school and 12.7 percent stop working to attend school.

When we account for the general equilibrium effects of the program, the extension of the coverage has two conceptually different effects. As in partial equilibrium, some children return to school, attracted by the CCT. On top of this schooling effect, more children attending school implies a measurable reduction in child labor supply—of around 12 percent—(occupational effect), which, in turn, leads to an equilibrating rise in the average earnings of children, of 17.8 percent (wage effect). These results are robust to a range of different substitution elasticities among factors in the production functions of the

CGE model[8]. By raising the opportunity cost of schooling, increases in wages ultimately make attending school unintentionally less attractive. The results of the combined macro-micro model on time allocation—summarized in the central part of the table—indicate the presence of two competing forces. First, the transfer increases the attractiveness to households of sending the children to school (given $\alpha_2 > \alpha_1 > \alpha_0 > 0$). Second, a wage effect indirectly generated by the program works in the opposite direction, driving households to send children to work (as $b_1, b_2 < 0$).

While we find that the wage effect leads some children to drop out of school, the magnitude turns out to be insignificant, generating *ceteris paribus* a drop in the attendance rate of less than 0.1 percent, as 0.5 percent of those originally working and studying and 0.1 percent of those originally only studying leave school. For most of the children, the direct occupational effect of *Oportunidades* on time allocation more than offsets the indirect wage effect: 12.1 percent of those initially not studying start going to school, and 3.1 percent of those originally combining work with school stop working to only study. Overall, we find that in general equilibrium an eventual expansion of the coverage of the program would increase the attendance rate by 1.4 percentage points. This finding is only slightly below the 1.5 percentage point increase in school attendance predicted by the partial equilibrium model.

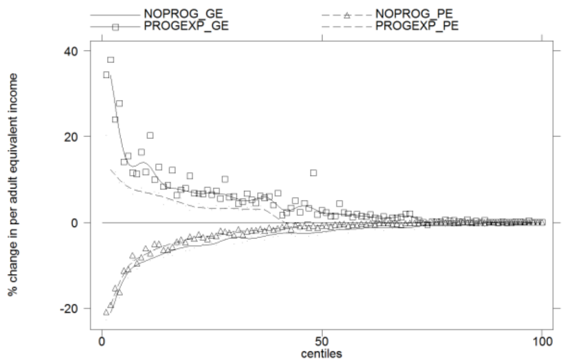
The lagged skilling effect of the *Oportunidades* program ("Program Skilling") operates through changes in the productivity of the labor force and changes in the real wage in the adult labor market, reducing the adult skill premium but increasing the wages of those who acquire skills, as discussed in more detail below. The transition matrix is close to an identity matrix, reflecting that the future change in the skill composition of the adult labor force is not expected to affect the future time allocation of the children in a significant way.

Poverty and Income Distribution

[8] We repeated the analysis with factor substitution elasticities of 0.4 and 0.8, finding very similar results.

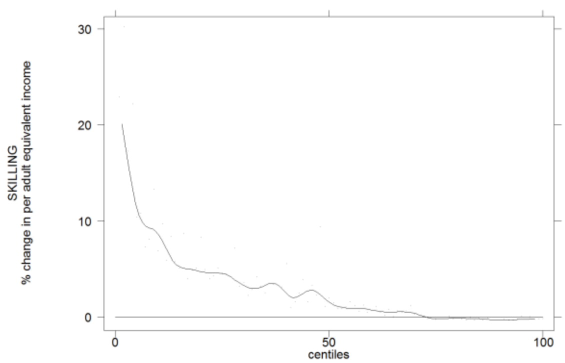
Given the progressive design of the program, the contemporaneous and lagged impacts of the program on income distribution are also progressive, as illustrated in Figures 4.1 and 4.2. The figures show the percentage changes in household income for each centile of adult equivalent income due to the program. In the figures, we order households from poor to rich in terms of adult equivalent income. The different lines in the figure illustrate the simulated impacts on each centile of the income distribution. If a line were to coincide with the horizontal axis, the simulation is not estimated to alter the income distribution. The shape of the depicted lines suggests that the effect on income is substantial for the poorest households but converges towards zero for households at the top of the income distribution. Dropping the program reduces the average income of the poorest households by 23 percent, while extending the program to all the moderately poor increases incomes by 34 percent, a result of the combination of the increase in the number of poor households receiving the transfer and the positive wage effect benefitting those who keep their children at work. By increasing the future human capital stock of beneficiary households ("Program Skilling"), poor households benefit in two ways. The poor households that increase their human capital benefit directly (given the positive skill premium in the new equilibrium), and the poor household members who remain unskilled also benefit due to the increase in the relative scarcity of unskilled labor in the new equilibrium due to the program. Combining these effects, the program raises the average income of the poorest households by around 23 percent.

Figure 4.1—Change in household per adult equivalent income by centile, no-program and program-expansion simulations, partial and general equilibrium.



Source: authors' calculation based on model results.

Figure 4.2—Change in household per adult equivalent income by percentile, program-skilling simulation, general equilibrium Source: authors' calculation based on model results.



Source: authors' calculation based on model results.

Figure 4.1 suggests that the simulated program effects are more pronounced when accounting for the general equilibrium effects of the program. The figure shows that the lines generated by the general equilibrium model are further away from the horizontal axis than those in the partial equilibrium model. An extension of the coverage of the program not only increases the income of beneficiary households but indirectly also increases the marginal productivity and the real wage of child labor in Mexico (wage effect), raising the incomes of the households who keep their children at work. Withdrawing the program would not only generate a direct reduction in household incomes, but by increasing child labor supply and reducing the equilibrium child wages (negative wage effect), it would further reduce the incomes of the poor.

Table 4.2 summarizes the effect of the program on different poverty measures using the national moderate and extreme poverty lines provided by the *Consejo Nacional de Evaluación de la Politica del Desarrollo Social* (CONEVAL, the National Council for Evaluation of Social Development Policy) for rural and urban areas, and household adult equivalent incomes (Teruel, Rubalcava, and Santana 2005). The table also summarizes poverty in terms of poverty lines set at US$1.25 and US$2 per day. We use the purchasing power parity (PPP) conversion factor provided by the World Bank (2011) to convert the national figures into international terms. While international poverty measures using the US$1.25- and US$2-a-day poverty lines are close to our base estimates (World Bank 2011), the national figures deviate. This may be because of differences in the aggregation methodology, for instance, or the use of consumption as opposed to income. Our average quarterly incomes are, however, very close to those reported in official documents using ENIGH 2008, at 36,325 Mexican pesos compared to 36,694 (INEGI 2009).

Table 4.2—Simulated poverty and inequality indicators by simulation and type of equilibrium

Indicator	Base	No Program		Program Expansion		Program Skilling
FGT(0)		Partial	General	Partial	General	General
National extreme poverty line	6.7	8.3	8.9	5.7	5.3	5.8
National moderate poverty line	29.2	30.3	31.1	27.4	26.5	27.8
US$1.25-a-day line	1.7	2.8	3.1	1.2	1.1	1.2
US$2-a-day line	5.2	6.6	7.0	4.4	4.0	4.4
FGT(1)						
National extreme poverty line	1.9	2.7	2.9	1.5	1.3	1.5
National moderate poverty line	9.9	11.0	11.5	9.0	8.5	9.0
US$1.25-a-day line	0.4	0.9	1.0	0.3	0.3	0.3
US$2-a-day line	1.5	2.3	2.5	1.2	1.1	1.2
FGT(2)						
National extreme poverty line	0.8	1.3	1.4	0.6	0.5	0.6
National moderate poverty line	4.8	5.7	6.0	4.2	3.9	4.2

US$1.25-a-day line	0.2	0.4	0.5	0.1	0.1	0.1
US$2-a-day line	0.6	1.1	1.3	0.5	0.4	0.5
Gini	0.512	0.520	0.521	0.506	0.501	0.504

Source: authors' calculation based on ENIGH 2008 and model results.

The results are consistent with our previous findings and also suggest larger effects in general equilibrium than in partial equilibrium: withdrawing the program increases the poverty rate by 1.1 (US$1.25-a-day poverty line) to 1.6 (national extreme poverty line) percentage points in partial equilibrium, and by 1.8 to 2.2 percentage points in general equilibrium. Expanding the program to all the moderately poor is estimated to significantly reduce the poverty rate, by 1.8 (partial equilibrium) or 2.7 (general equilibrium) percentage points in the case of the national moderate poverty line. Accounting for the lagged human capital effect of the program yields a lagged reduction in the poverty rate of an additional 1.4 percentage points. The table also suggests that poverty incidence, poverty severity, and inequality also decrease significantly with the program, both in the present and in the future, independently of the measure chosen. Finally, withdrawing the program increases the Gini coefficient from 0.512 to 0.520 (partial equilibrium) or 0.521 (general equilibrium), while increasing the availability of the program to all the moderately poor allows it to drop to 0.506 (partial equilibrium) or 0.501 (general equilibrium). Increasing the skills of the future workforce reduces inequality to 0.504.

4. Conclusions

National-scale CCT programs in support of the poor can have significant indirect general equilibrium effects. Only a combined macro-micro modeling approach is able to take these effects fully into account when estimating the economic impact of this type of program. This paper combines a microsimulation model with a general equilibrium model, both of which are well established, and solves for an equilibrium that jointly satisfies the utility-maximizing decisions regarding children's time allocation and the equilibrium of the countrywide factor and commodity markets. Applying the combined model to the

Oportunidades CCT program in Mexico, we find that the program improves household income distribution and poverty indicators in Mexico, and that an extension of the coverage of the program to all moderately poor households could improve these indicators further. Our results suggest that disregarding general equilibrium effects, which is typically the case in program evaluation, may underestimate the distributional effects of the *Oportunidades* program, and similar types of programs (as appropriate recalibration of the parameters of the model allows its application to other national-level CCT programs in developing countries). In particular, we find that by raising the opportunity cost of work through the provision of transfers conditional on school attendance, an expansion of the *Oportunidades* educational transfer to all the moderately poor could reduce child labor supply and increase the wages earned by children at work, by a double-digit magnitude. The incremental increase in child earnings indirectly benefits poor households that keep their children at work and thus improves contemporaneous poverty and income distribution indicators to a greater extent than partial equilibrium analysis suggests. While a partial equilibrium analysis suggests that the program extension would lead to a 1.8 percentage point contemporaneous decrease in poverty, the poverty-reducing effect of *Oportunidades* reaches 2.7 percentage points once the general equilibrium effects are also taken into account.

Our estimates imply that it would be advisable for the Mexican government to extend the program, given that this would lead to a substantial improvement in school attendance and a reduction in poverty at only a moderate cost in terms of public expenditure. We also find that an increase in the skills of the future workforce, generated by lagged human capital acquisition through the existing *Oportunidades* program, could increase the future incomes of poor households, reducing the poverty rate by approximately 1.4 percentage points in the long term. By including not only the *Oportunidades* transfers, but also overall household income as determinants of child labor supply in our model, our results suggest that for fighting the worst forms of child labor, policy makers need to adopt integrated responses that include social protection as well as jobs and decent work for parents that help to keep girls and boys in school, which is in line with the ILO Convention 182 (ILO 1999).

While advantageous in various ways, the combined model has three serious limitations that future research could overcome. First, the model is static and, as such, does not allow us to trace the time path of the income changes triggered by the program and the corresponding changes in lifetime income. Second, our model does not provide a cost estimate of the additional expenses the government would have to take into consideration so to maintain educational quality in the Mexican society if intending to roll out the existing program. Third, the microsimulation model does not capture existing intrahousehold decisionmaking mechanisms that are potentially important in the determination of children's time allocation and indirectly in determining the distributional effects of the program.

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