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Abstract

Mexico is a country with high levels of inequality and low intergenerational social mobility rates for those located at the extremes of the wealth distribution. Although such low rates suggest that at least a share of the observed income inequality may be due to an unequal distribution of opportunities, this conjecture has not been thoroughly tested in the literature. The present article fills this gap estimating the lower bound of the contribution of unequal opportunities to income and wealth inequality in Mexico, with an operationalization of the "ex-ante" approach to the measurement of inequality of opportunity. Relying on a national representative survey designed for the analysis of social mobility (2011 ESRU Survey on Social Mobility in Mexico), we are able to define a broad set of circumstance groups ("types"), encompassing the wealth of the household of origin. This available information reduces the omitted variable bias of previous estimations and allows for a better account of the role of inequality of opportunity in income inequality. Our results show that the lower bound of the contribution of unequal opportunities to total income inequality and total wealth inequality is around 30%, which is substantially higher than previous estimations for Mexico and ranks among the highest values in Latin America.

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1. Introduction

The economics literature on inequality of opportunity has grown substantially since the publication of the works by Van de Gaer (1993) and Roemer (1993 and 1998) both in terms of theoretical developments and empirical applications.[1] One of the several strands in the empirical literature focuses on quantifying different concepts of inequality of opportunity in countries. In addition to illustrating new conceptual proposals, this literature is also interested in regional comparisons, i.e. in identifying low and high opportunity-unequal societies.[2] The use of alternative notions of inequality of opportunity along with alternative sets of variables, and datasets of varying representativeness, means that not all country-level empirical studies are directly comparable to each other even when they are otherwise methodologically identical.

In the case of Latin America, Ferreira and Gignoux (2011; and previous version in Paes de Barros et al., 2009) provided the first comparative assessment of inequality of opportunity among adult citizens, estimating the lower bound of the share of household income and consumption inequality due to inequality of opportunities for Brazil, Colombia, Ecuador, Guatemala, Panama and Peru.[3] They proposed and implemented a parametric operationalization of the "ex ante" approach to inequality of opportunity measurement (Van de Gaer, 1993; Checchi and Peragine, 2010).[4] In such approach, distributional standards (e.g. conditional means) are compared across population groups defined by intersections of circumstances beyond people's control (i.e. the "types" defined by Roemer, 1998). Essentially, the inequality of opportunity measure is the between-group component of an inequality decomposition, which is presented either in absolute or relative (to total inequality) terms.

Ferreira and Gignoux (2011) used the parents' educational attainment, ethnicity, region of birth (urban or rural) and gender as circumstance variables. The highest lower-bound estimates corresponds to Guatemala, where inequality of opportunity represents 33.5% of total income inequality, followed by Brazil, Colombia, Panama, and Peru. The smallest lower-bound corresponds to Ecuador, with 25.9%. Similar studies in Europe (e.g. Marrero and Rodriguez, 2012; Brzezinski, 2015) show lower levels of (lower-bound) inequality of opportunity, although comparability caveats must be borne in mind. Other Latin American studies on adult inequality of opportunity have focused more narrowly on country case studies, e.g. Brazil (Bourguignon et al., 2007), Chile (Nunez and Tartakowsky, 2011),

[1] For recent surveys on theoretical developments and empirical applications see Ramos and Van de Gaer, (2016); Ferreira and Peragine, (2016) and Roemer and Trannoy (2015).
[2] Brunori et al. (2013) survey this literature.
[3] Remarkably, the original book chapter version in Paes de Barros et al. (2009) included Mexico, but the country was mysteriously discarded in the journal article version (Ferreira and Gignoux, 2011). We believe this is due to the shortcomings of the dataset available.
[4] Ferreira and Gignoux (2011) also computed non-parametric alternatives.

Colombia (Ferreira and Melendez, 2012; Galvis and Meisel, 2014), and Mexico (Wendelspiess-Chávez-Juárez, 2015).

In this paper we are interested in estimating inequality of opportunity for Mexico, a country with high levels of inequality (Cortés and Vargas, (2017); Castillo (2017); Bustos and Leyva (2017); Reyes, Teruel and López (2017)) and low social mobility rates for those located at the extremes of the wealth distribution (for a survey of the literature on social mobility in Mexico see Vélez-Grajales and Monroy-Gómez-Franco, 2017).[5] Although the low rates of social mobility suggest that at least a share of the observed income inequality may be due to an unequal distribution of opportunities, this conjecture has not been thoroughly tested in the literature. Wendelspiess-Chávez-Juárez (2015) computed the first estimates of adult inequality of opportunity for the country.[6] His main concern was that, as he showed, considering only one outcome variable as a proxy of economic wellbeing leads to a downward bias in the estimation of the `true' inequality of opportunity, when the latter is understood as access to different capability sets, since the non-realized opportunities captured in other outcome variables are not considered. To diminish this bias he proposed performing a factor analysis on a set of observed outcome variables in order to obtain a latent variable that acts as a better proxy of economic wellbeing. Then he used this variable as the outcome on which inequality of opportunity is estimated. The author found that at least 40% of inequality in Mexico is due to inequality of opportunity. However, as the author duly noted, the survey employed is only representative of male household heads, thereby substantially limiting the external validity of the results for the whole country. Moreover, we note that, since a new outcome variable is used to estimate the degree of inequality, the findings of Wendelspiess-Chávez-Juárez (2015) are not comparable with the rest of the literature based on household monetary measures.

In our understanding, the present paper provides more accurate comparable estimations for Mexico on the lower bound of the share of adult income and wealth inequality explained by inequality of opportunity. We apply the "ex ante approach" to inequality of opportunity measurement as operationalized by Ferreira and Gignoux (2011), relying on the EMOVI 2011 dataset which was explicitly designed to study intergenerational social mobility in Mexico. By contrast to previous efforts: (1) our dataset is a nationally representative survey that ensures the external validity of our results to the whole country; (2) our results are, therefore, comparable to the estimates of Ferreira and Gignoux (2011) for several Latin American countries; (3) our findings include subsets of results based on hitherto unavailable circumstance variables such as the origin household's wealth. Moreover, the income information employed is adjusted to fit the income distribution produced by the

[5] For compilations of works on social mobility in Mexico see Vélez-Grajales, Campos-Vázquez and Huerta-Wong (2015); Campos-Vázquez, Huerta-Wong and Vélez-Grajales, (2012); and Serrano y Torche (2010).
[6] That is the case unless we consider the first version of Ferreira and Gignoux (2011) contained in Paes de Barros (2009). But their results for Mexico were suspiciously low, which, we suspect, might be attributable to shortcomings with the dataset they used. Remarkably, the Mexico estimates are missing in Ferreira and Gignoux (2011).

official survey on household income and expenditures, thus improving the accuracy of our estimations with respect to the (later discarded) estimations presented for Mexico by Paes de Barros et al. (2009).

The additional available information on individual circumstances is expected to reduce the omitted variable bias of previous estimations and allow for a better account of the role of inequality of opportunity in income inequality. As per our findings, the lower bound of the contribution of unequal opportunities to total income inequality and total wealth inequality is around 30%, which is substantially higher than previous estimations for Mexico (Paes de Barros et al., 2009) and ranks among the highest values in Latin America. Additionally, we find that wealth of origin household increases the inequality of opportunity measures between 4 and 6 percentage points.

The rest of the paper proceeds as follows. Section 2 provides the methodological discussion. Section 3 describes the dataset and the variables used. Section 4 presents and discusses our results. Finally, the paper concludes with some remarks.

2. Methodology

As Ferreira and Gignoux (2011) state, the "types method" is a direct operationalization of what they define as the "weak" equality of opportunity criterion derived from Roemer (1998). Although Roemer (1998) never defines equality of opportunity formally, his proposal of an opportunity-equalizing policy implies that equality of opportunity is attained whenever individuals of different types, but in the same percentile of their respective effort distribution, receive the same advantage. Formally, as Ferreira and Gignoux (2011) show, this means:

$$y^k(\pi,\rho) = y^l(\pi,\rho), \forall\, \pi \in [0,1];\ \forall\, T_k, T_l \in \Pi, \quad (1)$$

where $y^k(\pi,\rho)$ is the advantage level enjoyed by a person in quantile π of the effort distribution conditional on being of type k, under the policy rule ρ. Equation 1 must be valid for all types T_k, T_l in the extensive partition Π of the population. Thus, equation 1 states that the advantage level of individuals in the same quintile of the effort distributions must be equal if equality of opportunity is to hold. As shown by Ferreira and Gignoux (2011), from this definition it is possible to derive both a strong and a weak criterion for equality of opportunity. The strong criterion, defined by Bourguignon et al. (2008) and Lefranc, Pistolesi and Trannoy (2008), requires equality of advantage distributions across all types to achieve equality of opportunity. However, the operationalization of this criterion is intensive in its use of observations since it requires a non-parametric estimation of the cumulative distribution functions for each type. Thus, as the number of circumstances employed increases, so does the number of observations required to obtain robust estimations. Due to this limitation, the number of circumstances employed in the studies that follow this approach is rather small (for example, Lefranc, Pistolesi and Trannoy (2008) use only 3 types), leading to a large underestimation bias of the size of inequality of opportunity.

To circumvent this limitation, it is possible to propose an alternative criterion of equality of opportunity. Instead of requiring the advantage distributions to be equal across types, the so-called "weak criterion" only requires the mean of the advantage distribution to be equal across types. This criterion stems from the ex ante approach to inequality of opportunity, originally proposed by Van de Gaer (1993) and operationalized by Checci and Peragine, (2010). As Ferreira and Gignoux (2011) show, this approach is equivalent to the types approach. Let $\mu^k(y) = \int_0^\infty y dF^k(y)$ be the average level of advantage among individuals of type *k*, then the criterion implies:

$$\mu^k(y) = \mu^l(y)\ \forall\ l, k \mid T_k, T_l \in \Pi, \quad (2)$$

where $\mu^k(y)$, $\mu^l(y)$ are the average advantage levels in types *k* and *l* and both types are part of the extensive partition of the distribution Π. Clearly, the weak criterion is implied by the strong criterion of equality of opportunity, but the reverse is not true. Thus, if the weak criterion is not fulfilled, then the strong criterion is also not fulfilled. To identify inequality of opportunity following this criterion, it is necessary to identify the degree to which the mean advantages differ between types.

As Ferreira and Gignoux, (2011) point out, it is very unlikely that the full set of circumstances is available in a data set. Thus, the number of types that can be generated from the combinations of these circumstances will be inferior to the total number of types generated with the full vector of circumstances. This means that our estimations of the share of total inequality due to inequality of opportunities are a lower bound of the true value stemming from the estimation with the full vector of circumstances.

We follow the operationalization of this criterion proposed by Bourguignon, Ferreira and Menéndez (2009) and Ferreira and Gignoux (2011) in order to estimate the share of total inequality in income and wealth that is accrued to inequality of opportunities. The authors propose both parametric and non-parametric estimations methods. The non-parametric estimation of the share of outcome inequality corresponding to inequality of opportunity will be equal to the between-group component of a group-decomposable inequality index, where the groups correspond to the types defined by the circumstance variables.

In the method proposed by Ferreira and Gignoux (2011), the first step of the parametric estimation involves computing a smoothed distribution of the advantage variable in which its value for each individual is substituted with the predicted mean value of the advantage for the individual's type. Formally, the first step estimates a regression of the advantage variable on the set of circumstance variables considered, that is: $ln(y) = C\beta + u$, where C is the vector of circumstances, and u can be considered the element of the advantage accrued to effort and luck.[7] With the estimated coefficients for each circumstance (the vector of coefficients $\hat{\beta}$), the values of the advantage variable for each individual are replaced by the predicted values for each type, which eliminate the individual variance but retain the group differences, as equation 3 shows:

$$\tilde{\mu}_i = exp\left[C_i\hat{\beta}\right], (3)$$

where $\tilde{\mu}_i$ is the counterfactual advantage level of individual i, according to her type, determined by the values observed in the circumstance vector C_i. Once the smoothed distribution is constructed, an inequality index is estimated over that distribution, which gives the value of the lower bound of inequality of opportunity. Dividing this value of the inequality index by the inequality index corresponding to the original advantage distribution yields the lower bound of the share of total inequality represented by inequality of opportunity.

The selection of the inequality index depends on the type of outcome variable analyzed, but it is desirable that the index has two basic properties: additive decomposability and path independence in the sense of Foster and Shneyerov (2000).[8] As Ferreira and Gignoux (2011) show, in the case of variables with continuous and positive values the adequate index is the mean logarithmic deviation (MLD). Thus, the indicator of the lower bound of the share of the total income inequality accrued to inequality of opportunity is the ratio between the mean logarithmic deviation of the smoothed distribution and the mean logarithmic deviation of the original distribution. This is the index used in this paper for the case of household income per capita as indicator of adult income.

For continuous variables with arbitrary mean and dispersion,[9] Ferreira, Gignoux and Aran (2011) and Ferreira and Gignoux (2014) show that the variance is the adequate index.[10] In

[7] It is important to note that if the vector of circumstances is not made of the full set of circumstances, then part of the effect of circumstances on the advantage will be captured by u. Thus, the estimations of inequality of opportunity based on the coefficients in vector $\hat{\beta}$ can only be considered a lower bound of the true level of inequality of opportunity (Ferreira and Gignoux, 2011).

[8] Additive decomposability refers to the property of some indices to recover the total inequality from the sum of the inequality between groups and the inequality within groups. Adding to this property the path independence requirement implies that the measures of within and between group inequality are the same whether they are estimated directly or as a residual.

[9] By arbitrary we mean that the variables' summary measures depend on the criteria used to construct them. Such is the case, for instance, of wealth indices or indices based on test results.

[10] As the authors state, when a variable with mean zero is used as an outcome variable, it is not possible to compute the relative inequality measures, since most of them are divided by the mean. Also, if the variable includes negative values, then it is not possible to use logarithmic measures. The variance is both additively decomposable and translation invariant,

this case, the share of the total variance due to the circumstances considered (which is the regression's R^2 in the parametric estimation) measures the lower bound of the share of total inequality due to inequality of opportunity. This is the indicator used for the wealth index, due to its measurement characteristics (described below).

3. Data

The main data source employed is the *2011 ESRU Survey on Social Mobility in Mexico* (EMOVI 2011).[11] The survey is representative of the Mexican population (all genders) between 25 and 64 years old. Designed for the study of intergenerational social mobility, the survey has a large set of retrospective questions, which enable it to capture information concerning the characteristics of the household of origin when the respondent was 14 years old, as well as the educational level and work characteristics of the respondent's parents.

With information on the household assets available both in the respondent's household of origin when she was 14 and her present household, we can construct wealth indices for both households. Replicating the exercise by Vélez-Grajales and Stabridis (2015), the indices are constructed using Multiple Correspondence Analysis (MCA) with a set of 10 assets for the index of the origin household and 16 variables for the current household index (see Tables 1a and 1b). MCA is appropriate in this context, unlike Principal Components Analysis (PCA), because all the variables are unordered and non-continuous, violating PCA's requirements. It has to be noted that for the present purposes, the resulting indices were standardised to zero mean.

Although the EMOVI 2011 does have information on the respondent's income, the recovery of such information is not the main objective of the survey, therefore it is not necessarily consistent with what is observed in the official income and expenditure surveys. However, the design of the EMOVI 2011 allows us to match it with the National Survey on Household Income and Expenses 2010 (ENIGH 2010), and thus recover an income variable distribution consistent with the official data. In our analysis, we use the average household income per capita variable reported in Vélez-Grajales, Campos-Vázquez and Huerta Wong (2013, Annex 3) through an imputation process from the ENIGH 2010 to the EMOVI 2011.[12] Velez-Grajales et al. (2013) show that the income distribution recovered from the matching process is very similar to the distribution observed in ENIGH 2010 for the same population (individuals between 25 and 64 years old).

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rendering it suitable for the analysis of inequality of opportunity when variables' domains are not restricted to the strictly positive segment of the real line.

[11] The survey and the documentation are available here: http://www.ceey.org.mx.

[12] The imputation process employed is the one developed by Elbers, Lanjouw and Lanjouw (2003). Their method preserves the variance of the residuals by modelling the distribution of the residuals and using it in the estimation of the parameters used in the imputation regression.

Table 1a. Variables for the wealth index of the origin household

Household had a stove (0,1)	Household had a vacuum cleaner (0,1)
Household had a washing machine (0,1)	Household had an electric toaster (0,1)
Household had a refrigerator (0,1)	Household had clean water (0,1)
Household had a television (0,1)	Household had a toilet inside its premises (0,1)
Household had a boiler (0,1)	Household had electricity (0, 1)

Source: Vélez-Grajales and Stabridis, (2015).

Table 1b. Variables for the wealth index of the current household

Household had a computer (0,1)	Household had an electric toaster (0,1)
Household had a washing machine (0,1)	Household had internet service (0,1)
Household had a refrigerator (0,1)	Household had a toilet inside its premises (0,1)
Household had a DVD (0,1)	Household had a telephone (0,1)
Household had a boiler (0,1)	Household had cable t.v. service (0, 1)
Household had a cellphone (0,1)	Household had a savings account (0,1)
Household had a vacuum cleaner (0,1)	Household had a checks account (0, 1)
Household had a microwave (0,1)	Household had a credit card (0,1)

Source: Vélez-Grajales and Stabridis, (2015).

Table 2 shows the distribution of the population across the different partitions defined by the circumstances. Besides the total population, the sub-sample of individuals between 30 and 50 years old is considered in order to attenuate the biases on the advantage variables (income and the current household wealth index) caused by life cycle effects.[13] As this age range was also used by Ferreira and Gignoux (2011), it is possible to compare our results regarding income inequality for Mexico with those observed in other Latin American countries.

Two sets of circumstance variables are considered. The first set is as similar as possible to that used by Paes de Barros et al. (2009), who present the first ever estimation of the lower bound of inequality of opportunity in Mexico using the types method. The circumstances they consider are parents' education, father's job status, indigenous status, sex, and whether the respondent lived in an urban or rural community. The second set of circumstances adds to the previous set the position of the origin household in the wealth distribution.

[13] Individuals between 25 and 29 years old are starting their work trajectories, and for that reason receive low levels of labour income. On the other hand, individuals older than 51 years old are in the latter part of their work trajectories in terms of income. Thus, the sub-sample of individuals between 30 and 50 years old is the set of individuals that are most likely to be at the highest point in their work trajectories.

Table 2: Partition of the population by circumstances (Population share)

Circumstances	Total sample	30-50 years old sample	Men	Women
Origin household in wealth group 1	15.3%	12.6%	14.7%	15.8%
Origin household in wealth group 2	60.8%	63.9%	60.4%	61.2%
Origin household in wealth group 3	23.9%	23.6%	24.9%	22.9%
Born in urban setting.	60.6%	60.8%	62.7%	58.6%
At least one parent speaks an indigenous tongue.	15.4%	15.2%	15.9%	15.0%
Father was agricultural worker	19.2%	19.3%	18.0%	20.4%
Father with at most incomplete primary education	59.9%	59.8%	58.9%	60.9%
Father with completed primary education.	21.7%	22.7%	21.6%	21.9%
Father with completed secondary education.	14.6%	14.00%	15.17%	13.1%
Father with completed tertiary education.	3.8%	3.48%	3.43%	4.1%
Mother with at most incomplete primary education	61.3%	60.8%	59.9%	62.5%
Mother with completed primary education.	22.2%	24.1%	23.1%	21.4%
Mother with completed secondary education.	14.9%	13.8%	15.4%	14.5%
Mother with completed tertiary education.	1.6%	1.3%	1.6%	1.6%
Women	52.7%	53.3%	--	--

Notes: Wealth groups are defined according to the position of the origin household in the wealth index distribution of origin households. Group 1 households are those in the first quintile of the wealth index distribution, group 2 households are those located in the second to fourth quintile of the distribution, and group 3 class households are those located in the fifth quintile. Born in urban setting is defined as those interviewees that considered the location where they were born as having more than 2,500 inhabitants (subjective response).

Parental education considers three categories: incomplete primary education, complete primary education, and complete secondary or upper levels of education. Two categories for the father's job status are considered: agricultural workers and the rest of occupations. Indigenous status is defined as having at least one parent that speaks an indigenous tongue. The criterion to assign urban or rural status was defined in terms of the respondent's perceived population in the community where the respondent was born. If the perceived population was below 2,500 inhabitants, it is deemed a rural community. If the perceived population was above that number, the community is considered urban.

For the second circumstance set, we consider two forms of introducing the origin household wealth. The first approach is to divide the wealth index of the origin household into three categories: The first category corresponds to group 1, which comprehends all origin households located in the first quintile of the distribution. The second category, group 2, corresponds to origin households located between the second and fourth quintile of the wealth distribution of the origin households. Finally, the third category, group 3, consists of those households located at the fifth quintile of the wealth distribution of the origin households. This approach is used for the parametric and nonparametric estimations. The second approach considers the origin household wealth as a continuous variable, thus allowing for a fuller partition of the circumstance set. This approach is employed only in parametric estimations due to its data intensiveness.

4. Results

Tables 3 and 4 present the regression coefficients from regressing income (table 3) and wealth (table 4) on the two sets of circumstances. We consider both the whole 25-to-64 years old sample, and the restricted 30-to-50 years old sample. A first indicator of the effect of including the wealth of the household of origin in the circumstance set is the R^2, which expresses the share of the variance that is explained by circumstances and thus, can be considered as an indicator of the share of income inequality explained by inequality of opportunity. In the case of the income regression (table 3), including the wealth of the household of origin increases the share of inequality explained by circumstances by four percentage points, from 27.4% to 32.4% for the whole sample, and by five percentage points for the restricted sample (from 29.5% to 35.5%). When the wealth of the household of origin is introduced as a continuous variable, the share of income inequality increases from 27.4% to 35.6% for the whole sample, and by ten percentage points for the restricted sample (from 29.5% to 39.5%). Including the wealth of the origin household in the regression also diminishes the importance of other circumstances in terms of their effect on incomes; that is the case of the mother's educational level and one of the categories of paternal educational attainment. In the case of the restricted sample, the inclusion of the origin household's wealth diminishes the importance of the father's job status. This points to the importance of the wealth in the origin household as a circumstance that shapes opportunity.

In the case of the wealth index regressions, the same effect is observed. Including the wealth of the origin household as a circumstance variable leads to an increase of around five percentage points in the lower bound of the share of wealth inequality (from 29.3% to 33.9% for the full sample, and from 29.9% to 35.7% for the restricted sample). When the wealth of household of origin is introduced as a continuous variable, the shares of the explained variance increase further to 37.3% (whole sample) and 39.1% (restricted sample). As in the case of income, this increase in the share of explained variance is concomitant to a decrease in the significance of other circumstance variables, namely the educational attainment of the mother and the job status of the father.

Table 3: Regression of Total Current Household Income per capita on circumstances

	Full sample			30-50 years old sample		
Variables	Total	Total + W	Total+W (continuous)	Total	Total + W	Total+W (continuous)
	Dependent variable: Total Current Household Income per capita					
Father with completed primary education.	0.0992** (0.0415)	0.0655 (0.0414)	0.0377 (0.0397)	0.0752 (0.0522)	0.0492 (0.0522)	0.0300 (0.0512)
Father with complete secondary or above education level	0.397*** (0.0551)	0.313*** (0.0563)	0.278*** (0.0577)	0.405*** (0.0732)	0.339*** (0.0751)	0.301*** (0.0783)
Mother with completed primary education.	0.0864** (0.0412)	0.035 (0.0410)	0.00418 (0.0386)	0.124** (0.0512)	0.0669 (0.0507)	0.0356 (0.0484)
Mother with complete secondary or above education level	0.203*** (0.0582)	0.096 (0.0593)	0.042 (0.0595)	0.254*** (0.0778)	0.140* (0.0806)	0.0727 (0.0820)
Born in urban setting	0.327*** (0.0342)	0.247*** (0.0326)	0.206*** (0.0331)	0.341*** (0.0444)	0.250*** (0.0416)	0.192*** (0.0404)
At least one parent speaks an indigenous tongue.	-0.127*** (0.0363)	-0.091*** (0.0347)	-0.065* (0.0331)	-0.174*** (0.0427)	-0.139*** (0.0403)	-0.0981** (0.0398)
Sex	-0.0186 (0.0290)	-0.014 (0.0278)	-0.0108 (0.0269)	-0.0844** (0.0369)	-0.0749** (0.0346)	-0.0658** (0.0329)
Father was agricultural worker	-0.158*** (0.0422)	-0.097** (0.0411)	-0.0316 (0.0406)	-0.121** (0.0556)	-0.0542 (0.0532)	0.0198 (0.0521)

Origin wealth group 2		0.251***			0.312***	
		(0.0364)			(0.0475)	
Origin wealth group 3		0.567***			0.645***	
		(0.0515)			(0.0659)	
Origin household wealth			0.247***			0.280***
			(0.0187)			(0.0234)
Constant	7.506***	7.291***	7.590***	7.505***	7.225***	7.576***
	(0.0328)	(0.0394)	(0.0320)	(0.0431)	(0.0506)	(0.0401)
Observations	8,431	8,431	8,431	3,975	3,975	3,975
R-squared	0.274	0.324	0.356	0.295	0.355	0.395

Notes: The omitted variables are origin wealth group 1, mother with incomplete primary education and father with incomplete primary education. Wealth groups are defined according to the position of the origin household in the distribution of origin households. Group 1 households are those in the first quintile of the distribution, group 2 households are those located in the second to fourth quintile of the distribution, and group 3 class households are those located in the fifth quintile. Born in urban setting is defined as those interviewees that considered the location where they were born as having more than 2,500 inhabitants. Robust standard errors reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Regression of Current Household Wealth Index on circumstances

	Full sample			30-50 years old sample		
Variables	Total	Total + W	Total+W (continuous)	Total	Total + W	Total+W (continuous)
Dependent variable: Current Household Wealth Index						
Father with completed primary education.	0.122*	0.0704	0.0203	0.0667	0.0283	-0.00182
	(0.0695)	(0.0705)	(0.0668)	(0.0875)	(0.0886)	(0.0867)
Father with complete secondary or above education level	0.687***	0.545***	0.489***	0.671***	0.555***	0.507***
	(0.0910)	(0.0910)	(0.0907)	(0.121)	(0.122)	(0.123)
Mother with completed primary education.	0.124*	0.0459	-0.0118	0.154*	0.0682	0.0146
	(0.0695)	(0.0702)	(0.0667)	(0.0861)	(0.0867)	(0.0841)
Mother with complete secondary or above education level	0.389***	0.213**	0.122	0.454***	0.266**	0.166
	(0.0970)	(0.0973)	(0.0961)	(0.127)	(0.130)	(0.130)
Born in urban setting	0.533***	0.407***	0.327***	0.580***	0.435***	0.335***
	(0.0549)	(0.0534)	(0.0544)	(0.0706)	(0.0683)	(0.0677)
At least one parent speaks an indigenous tongue.	-0.259***	-0.200***	-0.150***	-0.341***	-0.290***	-0.223***
	(0.0591)	(0.0580)	(0.0547)	(0.0666)	(0.0633)	(0.0627)
Sex	0.0324	0.0350	0.0387	-0.0347	-0.0275	-0.0165
	(0.0475)	(0.0461)	(0.0446)	(0.0600)	(0.0568)	(0.0552)

Father was agricultural worker	-0.249***	-0.162**	-0.0463	-0.187**	-0.0888	0.0334
	(0.0665)	(0.0661)	(0.0650)	(0.0873)	(0.0856)	(0.0840)
Origin wealth group 2		0.331***			0.386***	
		(0.0526)			(0.0691)	
Origin wealth group 3		0.884***			0.994***	
		(0.0769)			(0.0991)	
Origin household wealth			0.412***			0.453***
			(0.0270)			(0.0336)
Constant	-0.249***	-0.536***	-0.0960*	-0.250***	-0.605***	-0.120*
	(0.0512)	(0.0583)	(0.0510)	(0.0681)	(0.0762)	(0.0671)
Observations	8,379	8,379	8,379	3,953	3,953	3,953
R-squared	0.293	0.339	0.373	0.299	0.357	0.391

Notes: The omitted variables are origin wealth group 1, mother with incomplete primary education and father with incomplete primary education. Wealth groups are defined according to the position of the origin household in the distribution of origin households. Group 1 households are those in the first quintile of the distribution, group 2 households are those located in the second to fourth quintile of the distribution, and group 3 class households are those located in the fifth quintile. Born in urban setting is defined as those interviewees that considered the location where they were born as having more than 2,500 inhabitants. Robust standard errors reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

It is important to note that, both for income and wealth, the sex characteristic is not statistically significant. This is due to the construction of both outcome variables, which are defined over the current household income or wealth. Thus, they are insensitive to any intra-household inequality, including gender inequality, which is deemed very important (Eswaran, 2014).[14]

Using the estimated parameters from the regression in table 3, we estimate the smooth distribution of income. As described above, this yields a distribution of income in which the individual dispersion is eliminated while only the type dispersion is retained. With such distribution, a parametric estimation of the lower bound of the share of income inequality accrued to inequality of opportunity using the mean log deviation is generated. For wealth inequality, the regression in table 4 is used to estimate the R^2 as indicator of the lower bound of the share of wealth inequality due to inequality of opportunity. Both estimations are presented in table 5.

[14] We ran the analysis for separate samples of men and women. The results do not differ from those of whole population, due to the reason explained.

Table 5: Parametric estimations of inequality of opportunity.

	Total sample			30-50 years old sample		
Set of circumstance variables	Ferreira and Gignoux (2011)	Ferreira and Gignoux (2011) with categories of wealth of origin	Ferreira and Gignoux (2011) with continuous wealth of origin	Ferreira and Gignoux (2011)	Ferreira and Gignoux (2011) with categories of wealth of origin	Ferreira and Gignoux (2011) with continuous wealth of origin
Wealth index						
IOR_{VAR}	0.293	0.339	0.373	0.299	0.357	0.391
	(0.0214)	(0.0221)	(0.0217)	(0.0259)	(0.0258)	(0.0264)
Observations	8,431	8,379	8,379	3,953	3,953	3,953
Total household current income per capita						
IOL	0.0618	0.0729	0.0788	0.0660	0.0792	0.0867
	(0.0018)	(0.0022)	(0.0023)	(0.0026)	(0.0032)	(0.0034)
IOR_{MLD}	0.284	0.335	0.362	0.305	0.366	0.401
	(0.0104)	(0.0123)	0.0116	(0.0149)	(0.0175)	(0.0171)
Observations	8,431	8,431	8,431	3,975	3,975	3,975

Note: IOR_{VAR} stands for the ratio of the variance explained by the circumstances to the total variance of the wealth index distribution. IOL stands for the value of the mean log deviation (MLD) of the smoothed distribution; IOR_{MLD} is the ratio of the MLD of the smoothed distribution to the MLD of the original income distribution. Bootstrap standard errors in parentheses, calculated with 1000 repetitions.

Table 6 shows the non-parametric estimations. However, it is worth noting that due to the sample size and the number of circumstances considered, the non-parametric estimates are highly imprecise. In order to refine this estimation, a larger dataset is required. Consequently, the discussion is based on the parametric estimations. That said, the results obtained from the non-parametric estimations point in the same direction as the parametric estimates.

For the lower bound of the share of income inequality explained by circumstances, including the wealth of the origin household increases the point estimate by five percentage points. If the origin wealth is introduced as a continuous variable, the point estimate increases another three percentage points. Thus, the inclusion of the origin household wealth increases the lower bound of the share of income and household wealth inequality due to inequality of opportunities by about eight percentage points. This means that at least one third of the income inequality observed for Mexicans between 25 and 64 years old is due to unequal opportunities. These results are very similar to the ones obtained for wealth inequality, in which at least 30% of the inequality is due to inequality of opportunity. Both results hold when the sample is restricted to the subsample of individuals between 30 and 50 years old.

Table 6: Non-parametric estimations of inequality of opportunity.

	Total sample		30-50 years old sample	
Set of circumstance variables	Ferreira and Gignoux (2011)	Ferreira and Gignoux (2011) with wealth of origin	Ferreira and Gignoux (2011)	Ferreira and Gignoux (2011) with wealth of origin
Wealth index				
IOR_{VAR}	0.296 (0.0224)	0.357 (0.0213)	0.306 (0.0262)	0.387 (0.0244)
Observations	8,074	8,074	3,817	3,817
Total household current income per capita				
IOL	0.0600 (0.00505)	0.0728 (0.00540)	0.0620 (0.00603)	0.0784 (0.00674)
IOR_{MLD}	0.284 (0.0185)	0.344 (0.0194)	0.295 (0.0241)	0.373 (0.0251)
Observations	8,113	8,113	3,837	3,837

Note: IOR_{VAR} stands for the ratio of the variance explained by the circumstances to the total variance of the wealth index distribution. IOL stands for the value of the mean log deviation (MLD) of the smoothed distribution; IOR_{MLD} is the ratio of the MLD of the smoothed distribution to the MLD of the original income distribution. Bootstrap standard errors in parentheses, calculated with 1000 repetitions.

To test whether the inclusion of the position of the origin household in the wealth distribution produces measures of inequality of opportunity that are statistically different from those estimated without this variable, we followed two procedures. In the case of income, we generated an empirical distribution of the differences between the estimated indices using bootstrap methods. The difference is defined as the value of the index estimated with the circumstance variables used in Ferreira and Gignoux (2011) minus the value of the index estimated adding the position of the origin household in the wealth distribution in the circumstance variables. Then, we estimated the cumulative probability distribution of that difference. If the cumulative probability evaluated at zero is above 0.95, then we reject the null hypothesis that the indices are equal in favour of the alternative that the index estimated without the variable measuring wealth of origin is lower than the index with that same variable. The figures in the Appendix show the test results for differences in absolute and relative measures of inequality of opportunity. Clearly, in all cases we reject the null hypothesis in favour of the alternative of significantly larger inequality when the wealth of origin household is included in the estimation.[15] For the case of the inequality of opportunity measures based on the wealth index, we performed a traditional likelihood-ratio test. The results in table A1 (in the Appendix) provide evidence in favour of a statistically significant effect from including the wealth of origin household.

As Brunori et al. (2016) point out, even though increasing the number of circumstance variables reduces the downward bias due to omitted circumstances, upward bias may emerge due to the increase in variance caused by ensuing finer partitions of the sample. As a criterion to choose the best specification, they propose to perform a cross-validation test and select the model that minimizes the mean square error. Following this criterion leads us to choose the model that includes the position of the origin household in the wealth distribution, thus confirming the importance of considering this dimension in inequality of opportunity analysis. The cross-validation test results are available in Table A2 (Appendix).

Comparing the results of income inequality without considering the position of the origin household in the wealth distribution to the ones obtained by Ferreira and Gignoux, (2011) for other six Latin American countries puts Mexico within the group with the highest lower bound for the share of inequality of opportunity in the region. This group, which is comprised by Guatemala, Brazil, Panama and Mexico, has a share of income inequality due to inequality of opportunity of around 30%. The rest of the countries have a value near 25%. If the results that include the position of the origin household in the wealth distribution are considered, then Mexico comes at the top of the list in terms of the share of inequality explained by inequality of opportunity.

Paes de Barros et al. (2009) estimate inequality of opportunity for Mexico using the same circumstance set and method as Ferreira and Gignoux (2011), thus being methodologically comparable to our present estimations. According to Paes de Barros et al. (2009) the lower bound of the share of income inequality explained by inequality of opportunities in Mexico is 20%. The difference between this result and this paper’s probably comes from the substantial differences in data sources employed. More research using different but compatible datasets is needed in order to be able to provide a better identification of where the lower bound of inequality of opportunities lies in the Mexican case.

[15] We perform the same test for the case of the regressions in which the origin household wealth index is treated as a continuous circumstance variable. In said case, the difference is estimated as the difference between the inequality measure estimated considering the origin household wealth in terms of the position in the wealth distribution (using three categories), and the inequality measure when the continuous index is used. For the full sample it is clear that the estimates are different, while for the restricted sample (30-50 years old) there seems to be no difference in the estimates.

5. Conclusion

What is the level of inequality of opportunity in Mexico? The answer to this question depends on several conceptual and methodological issues. For instance, which advantage or wellbeing indicator we have available? Which circumstance set has to be considered? Which inequality indices should be estimated? But even among studies using the same advantages and circumstance sets, and the same estimation methods, differences in results may emerge due to alternative datasets and sample definition criteria.

This explains why our results markedly differ from those of Paes de Barros et al. (2009), despite otherwise very similar variables and methods. While Paes de Barros et al. (2009) found Mexico to have a relatively low lower-bound of inequality of opportunity vis-à-vis other Latin American nations, we uncovered a less flattering picture putting Mexico on top of the league of opportunity-unequal countries in Latin America. We are more confident about our results based on the better quality of the two datasets that we combined.

More importantly, our paper highlighted the importance of computing inequality of opportunity with datasets particularly tailored for the study of social mobility, for these include rich information on respondents' family background, i.e. key characteristics beyond their control and for which they cannot be held responsible. Adding the wealth position of the household of origin increased the estimated lower bound of inequality of opportunity for both income and wealth indicators, in a manner that was both statistically significant, and (more importantly) practically significant (at least four percentage points).

Future research should replicate these estimations with high-quality datasets in order to confirm the relative position of Mexico in Latin America concerning inequality of opportunity among adults. Moreover, as shown by this paper, best-practice estimations of inequality of opportunity across the world should ideally rely on datasets with rich information on family and parental background.

Several dataset alternatives are available now in Mexico. For example, the Mexican National Statistics Institute (INEGI) has recently conducted a survey on intergenerational social mobility. The "Module on Intergenerational Social Mobility 2016" (MMSI-2016) is a nationally representative sample that includes over 25,000 individuals between 25 and 64 years old. With similar information than the one included in the EMOVI-2011 and due to a larger sample, the MMSI-2016 will allow us to contrast and probably improve the estimations by using the non-parametric models. Moreover, the MMSI-2016 includes information on self-reported skin colour, which can be added to our model as another circumstance variable. On this point it has to be noted that skin colour is an uncommon variable in Mexican surveys.

Two further analyses can be followed in the future. On one hand, by using both the MMSI-2016 and a matched sample built by Vélez-Grajales, Stabridis and Minor (2017), inequality of opportunity estimations can be disaggregated at regional or even for the 32 Mexican States. On the other hand, by using the Survey on Social Mobility 2015 conducted by El Colegio de México (Campos-Vázquez, 2016), it is possible to analyse the role played on inequality of opportunity by differences in parenting styles. On this matter, it has to be noted that the small sample size of this survey results in a potential drawback for the strategy followed in the present paper.

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Appendix

Table A1: Likelihood ratio test results.

Likelihood ratio test results		
	χ^2 value	Probability
Full model: Circumstance variables include origin household wealth Restricted model: Circumstance variables does not include origin household wealth	566.42	0.0000
30 to 50 years old sample		
Full model: Circumstance variables include origin household wealth Restricted model: Circumstance variables does not include origin household wealth	337.64	0.0000

Table A2: Cross-validation test results.

Cross-validation test results	
	Mean square error.
Income	
Full Sample	
Model with origin household wealth included	0.552
Model without origin household wealth	0.571
30-50 years old sample	
Model with origin household wealth included	0.535
Model without origin household wealth	0.559
Wealth index	
Full Sample	
Model with origin household wealth included	0.912
Model without origin household wealth	0.0946
30-50 years old sample	
Model with origin household wealth included	0.895
Model without origin household wealth	0.935

Figure A1: Cumulative distribution of the difference between the Inequality of opportunity relative index without considering origin household wealth and the index estimated considering said circumstance.

(Full sample)

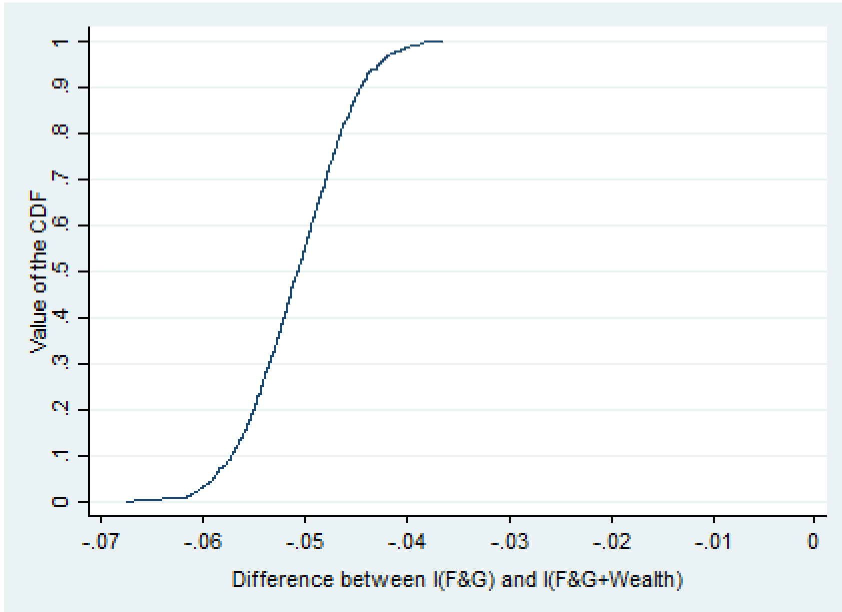

Figure A2: Cumulative distribution of the difference between the Inequality of opportunity absolute index without considering origin household wealth and the index estimated considering said circumstance.

(Full sample)

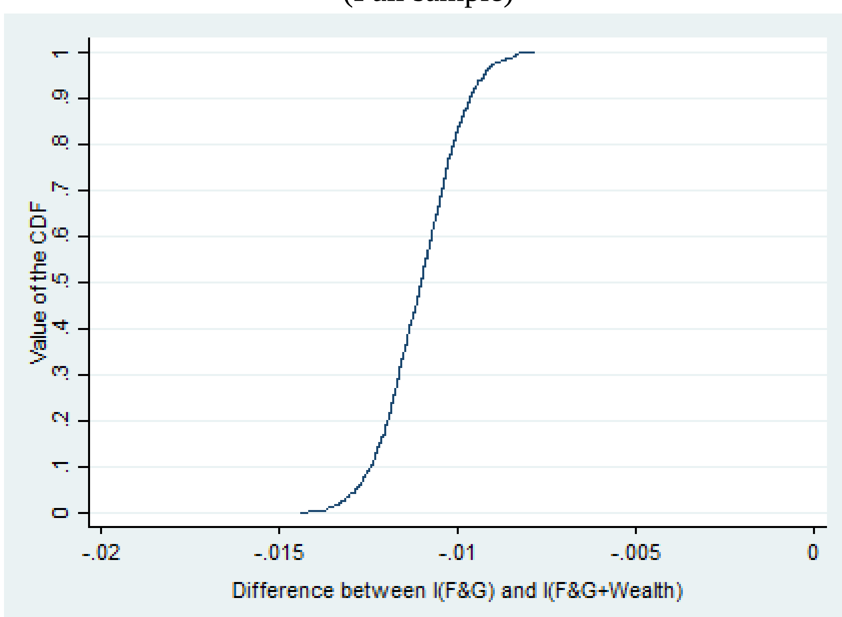

Figure A3: Cumulative distribution of the difference between the Inequality of opportunity relative index without considering origin household wealth and the index estimated considering said circumstance.
(30-50 years old sample)

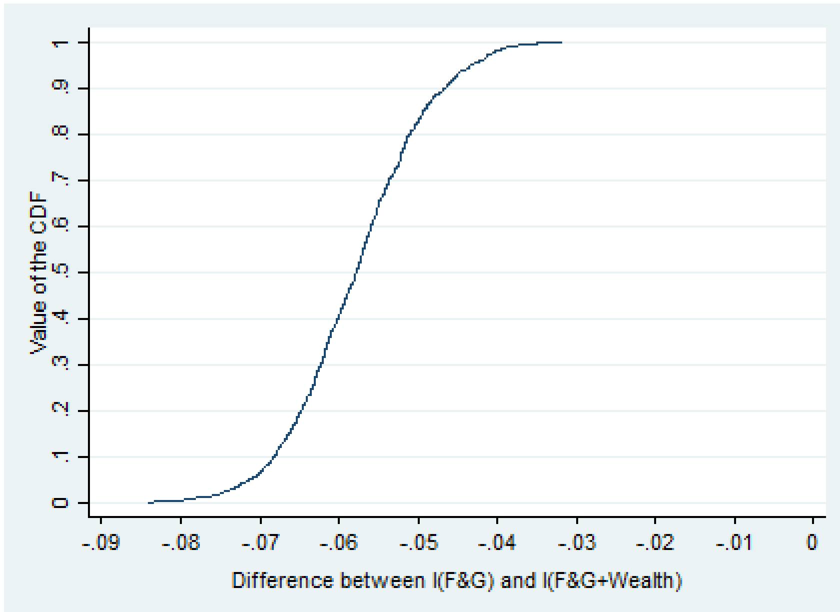

Figure A4: Cumulative distribution of the difference between the Inequality of opportunity absolute index without considering origin household wealth and the index estimated considering said circumstance.
(30-50 years old sample)

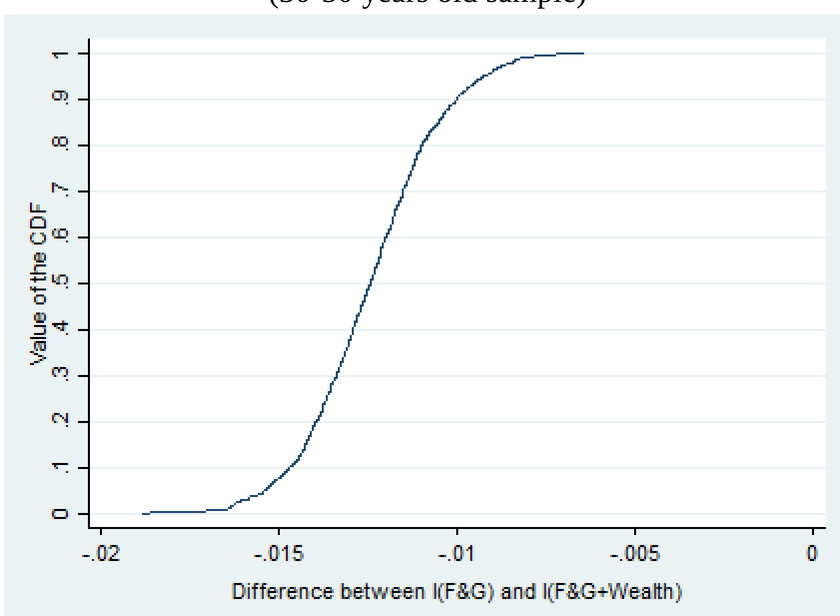

Figure A5: Cumulative distribution of the difference between the Inequality of opportunity absolute index considering the origin household wealth in positional terms and the index estimated considering said circumstance as a continuous variable.
(Full sample)

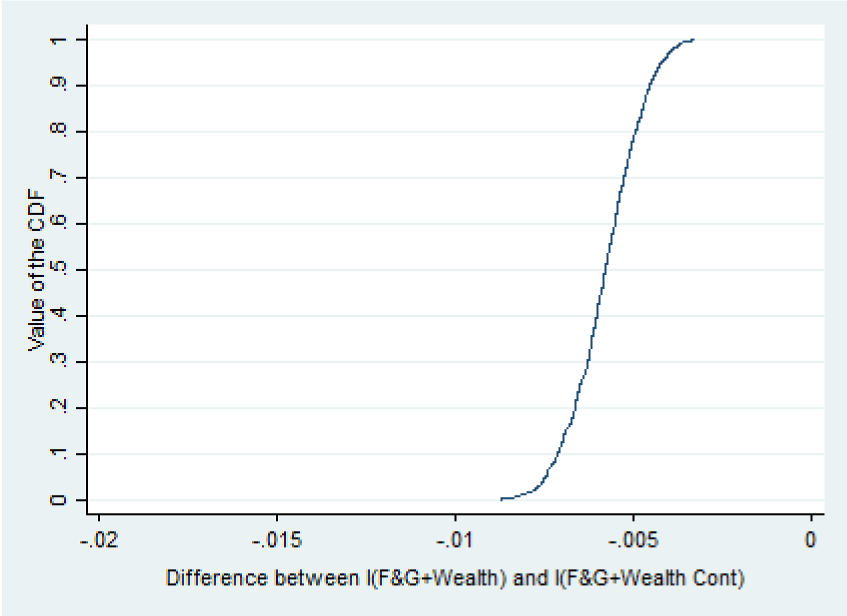

Figure A6: Cumulative distribution of the difference between the Inequality of opportunity relative index considering the origin household wealth in positional terms and the index estimated considering said circumstance as a continuous variable.
(Full sample)

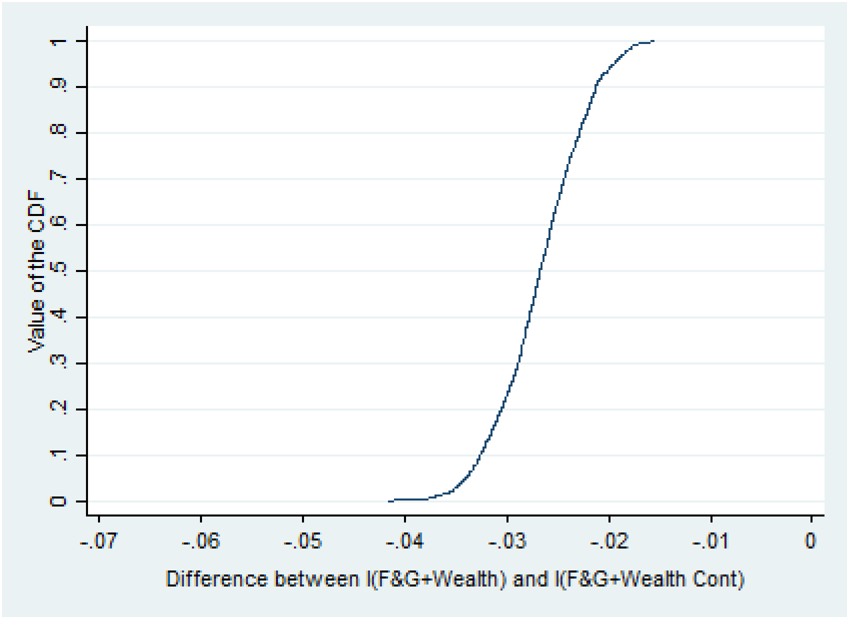

Figure A7: Cumulative distribution of the difference between the Inequality of opportunity absolute index considering the origin household wealth in positional terms and the index estimated considering said circumstance as a continuous variable.
(30-50 years old sample)

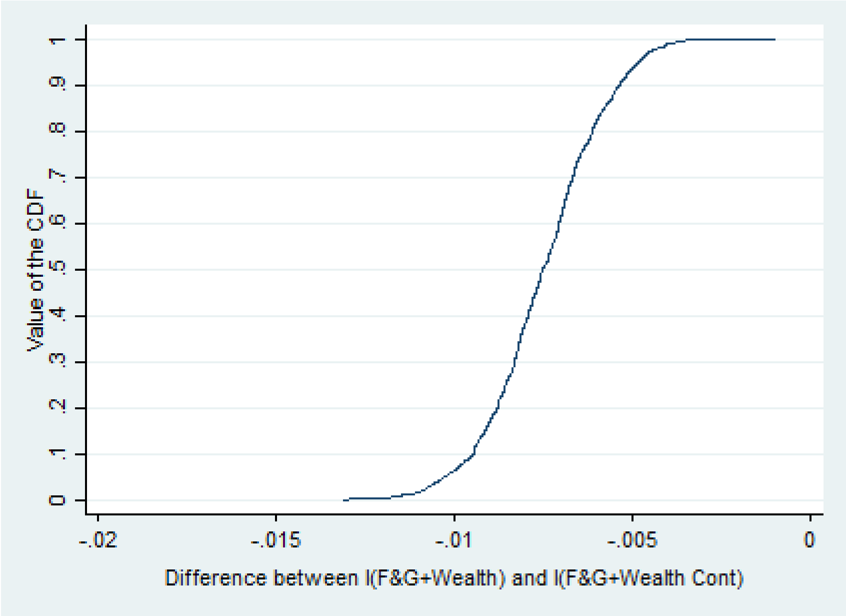

Figure A8: Cumulative distribution of the difference between the Inequality of opportunity relative index considering the origin household wealth in positional terms and the index estimated considering said circumstance as a continuous variable.
(Full sample)