Layers of inequality: Unequal opportunities and skin colour in Mexico

Monroy-Gómez-Franco, Luis and Vélez-Grajales, Roberto and Yalonetzky, Gastón

The Graduate Center, City University of New York, Centro de Estudios Espinosa Yglesias, Leeds University

March 2021

Layers of inequality: Unequal opportunities and skin colour in Mexico

Luis Monroy-Gómez-Franco[1], Roberto Vélez-Grajales[2] and Gastón Yalonetzky[3].

Abstract

We document the contribution of skin colour toward quantifying inequality of opportunity over a proxy indicator of wealth. Our Ferreira-Gignoux estimates of inequality of opportunity as a share of total wealth inequality show that once parental wealth is included as a circumstance variable, the share of inequality of opportunity rises above 40 per cent, overall and for every age cohort. By contrast, the contribution of skin tone to total inequality of opportunity remains minor throughout.

Keywords: Inequality of opportunity, wealth index, ethnicity, Mexico.

[1] PhD. Candidate in Economics, The Graduate Center of the City University of New York.
[2] Centro de Estudios Espinosa Yglesias.
[3] Leeds University.

1. Introduction

Since the seminal work of Van de Gaer (1993) and Roemer (1993, 1998), the *economics* literature on inequality of opportunity has expanded substantially both in terms of theoretical and methodological developments and empirical applications.[4] And yet one aspect pending to be fully addressed thoroughly is the role of skin colour as a circumstance affecting the access to advantages.[5] So far, most of the empirical studies quantifying the level of inequality of opportunity in different countries and regions[6] focus on the effects of parental education attainment, parental occupation, region of birth (urban or rural) and whether the person speaks an indigenous language.[7] This gap in the literature stems from the unavailability of information on people's skin colour in most countries, especially in developing ones.

A recent wave of studies focuses on identifying the effects of skin-colour-based discrimination on different aspects of life in Mexico. Arceo-Gómez and Campos-Vázquez (2014) show that women with darker skin tones face a lower probability of being called back while looking for employment vis-a-vis their lighter skin-tone equivalents. Using experimental data, Campos-Vázquez and Medina-Cortina (2018) show that skin colour stereotypes have a negative effect on life achievement expectations of female teenagers in middle school. Meanwhile, the literature reports that people with darker skin tones have systematically lower educational attainment and lower earnings than those with lighter skin tones (Flores and Telles, 2012; Telles, 2014 and Villarreal, 2010). At the same time, they are more likely to report having been discriminated against than the other population groups (Aguilar, 2011).

[4] For recent surveys of the literature emphasizing economists' contributions see Ramos and Van de Gaer, (2016); Ferreira and Peragine, (2016) and Roemer and Trannoy (2015).

[5] One noteworthy exception is Marrero and Rodriguez (2013) on the US. Due to data restrictions, the authors consider two circumstances: the father's educational attainment and the interviewee's race (as per the US Census definition), distinguishing the "white" from the non- "white" population.

[6] Brunori et al. (2013) survey this literature.

[7] Although in countries like Mexico there is a correlation between skin colour and speaking an indigenous language, the populations affected by each circumstance are substantially different. Not everyone with a darker skin tone necessarily speaks an indigenous language in countries where there is still a substantial indigenous population.

All this evidence suggests that skin colour is an important circumstance in determining an individual's access to advantages in life in societies where skin colour is among the dimensions of social stratification. In this paper we provide the first estimations of inequality of opportunity in a measure of wealth accounting for skin colour in Mexico, a country with high levels of inequality (Cortés and Vargas, 2017; Castillo, 2017; Bustos and Leyva, 2017; Reyes et al., 2017), low social mobility rates for those located at the extremes of the wealth distribution[8] and for which increasing evidence points to skin colour as an important factor of stratification. Relying on the *Intergenerational Social Mobility Module* (MMSI 2016) of the *National Household Survey*, we provide estimations of inequality of opportunity, which are nationally representative for the Mexican population between 25 and 64 years old.

The existing literature on inequality of opportunity in Mexico documents an unequal distribution of opportunities among the population (Wendelspiess-Chávez-Juárez, 2015; Vélez-Grajales et al., 2018). The estimates that are comparable with those of other Latin American countries suggest that Mexico is among the countries with higher levels of inequality of opportunity in the region. By including skin colour into the set of circumstances analysed, we expect to provide a more accurate estimation of inequality of opportunity in the country. In principle, an existing correlation between skin tone and the wellbeing advantage (whose inequality is being measured) should translate into a higher share of total inequality "explained" by observed circumstances.

We measure inequality of opportunity as a share of total inequality in a proxy measure of wealth, following the method proposed by Ferreira and Gingoux (2011). We find that once the wealth of origin is included as a circumstance variable, alongside both parents' education and father's occupation, inequality of opportunity reaches over 40 per cent, overall and for every age cohort. However, including skin tone barely adds to the overall proportion of inequality of opportunity in total inequality. That is, despite its statistically significant contribution to the level of inequality of opportunity, skin tone is nowhere nearly as important as other circumstance variables in practical terms. Moreover, this minor contribution of skin tone to inequality of opportunity in wealth

[8] For a survey of the literature on social mobility in Mexico see Vélez-Grajales and Monroy-Gómez-Franco, 2017. For compilations of work on social mobility in Mexico see Vélez-Grajales, Campos-Vázquez and Huerta-Wong (2015); Campos-Vázquez et al., (2012); and Serrano y Torche (2010).

remains largely unaffected by the inclusion or omission of parental wealth, education, and occupation in the estimations. Furthermore, it remains minor when the analysis is performed for each ten-year age cohort. Therefore, we are hard-pressed to find any indirect contributions of skin tone to current wealth variation via family background circumstances. These results pose open questions for future research on the mechanisms behind the relationship between variables such as current wealth, the wealth of origin and skin tone.

The rest of the paper proceeds as follows. Section 2 provides a 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

Following Roemer (1998) we partition the population into "types", each of which is defined by a specific combination of circumstances.[9] Then, following Ferreira and Gignoux (2011), we measure inequality of opportunity based on the so-called weak criterion for equality of opportunity, which requires the expected value of each type's conditional advantage distribution to be equalized across all types.[10] Let $\mu^k(y) = \int_0^\infty \quad y dF^k(y)$ be the average level of advantage among individuals of type *k*, then the criterion implies:

$$\mu^k(y) = \mu^l(y) \; \forall \; l, k \mid \; T_k, T_l \in \Pi, \quad (1)$$

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. Then, measuring inequality of opportunity requires quantifying the degree to which the mean advantages differ between types.

[9] For instance, if we had two genders ("male" and "female") and two skin tones ("dark" and "light"), then we would have four types based on their combinations.
[10] This criterion stems from the ex-ante approach to inequality of opportunity (Van de Gaer, 1993; Checci and Peragine, 2010).

In order to estimate the share of total inequality in household wealth accrued by inequality of opportunities, the first step of the parametric estimation method proposed by Ferreira and Gignoux (2011) consists of computing a smoothed distribution of the advantage variable in which each individual's value is substituted with the predicted mean for the individual's type. Formally, this implies estimating a regression of the advantage variable y on the set of circumstance variables considered, that is: $y = C\beta + u$, where C is the vector of circumstances, and u can be considered the element of the advantage accrued to net effort and luck.[11]

Using the estimated coefficients for each circumstance (the vector of $\hat{\beta}$ coefficients), the values of the advantage variable for each individual are replaced by the predicted values for each type, thereby eliminating the individual variance but retaining the group differences, as equation 2 shows:

$$\tilde{\mu}_i = C_i\hat{\beta} \text{ , (2)}$$

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. The last step consists of estimating an inequality index over this counterfactual distribution and then dividing the resulting value by the value of the inequality index over the observed raw distribution of the advantage. This ratio is the lower bound of the share of total inequality represented by inequality of opportunity.

A restriction for the last step is that not all inequality measures fulfil all the properties desirable for a measure of inequality of opportunity. For continuous variables with arbitrary mean and dispersion,[12] Ferreira et al. (2011) show that the OLS regressions' R^2 fulfils all the desirable properties; thus constituting an adequate index for the estimation of the share of total inequality

[11] 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 equation 2 can only be considered a lower bound of the true level of inequality of opportunity (Ferreira and Gignoux, 2011).

[12] 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 those based on test results.

explained by inequality of opportunity.[13] As the advantage variable employed is a wealth index (described below), these measures will be employed.[14]

3. Data

We use the *2016 Intergenerational Social Mobility Module* of the *National Household Survey* (MMSI 2016) conducted by Mexico's National Institute of Statistics and Geography (INEGI). The survey is representative of the Mexican population (all genders) between 25 and 64 years old. The survey has a large set of retrospective questions enabling 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. It also includes a colour palette designed to allow the self-identification of the respondent's skin colour. The palette corresponds to the tone categorization designed for the Project on Race and Ethnicity in Latin America (PERLA; Telles, 2014).

The survey sample consists of 800 observations from each of the 32 states of Mexico. However, the design of the survey is such that it is only representative at the national level with a disaggregation to urban and rural communities. This prevents a state level disaggregation exercise in our analysis.. We restrict the sample to only the observations that have information for the full set of circumstances. This implies a reduction of the sample size from 25,634 observations to 18,927 in the most demanding specification.

Though we are interested in wealth inequality, our data lack information on the financial value of disposable assets. However, with information on the assets available both in the respondent's household of origin when she was 14 and her present household, we can construct wealth indices

[13] As the authors state, when a variable with mean zero is used as an outcome variable, it is not possible to compute relative inequality measures, since they are divided by the mean. Also, if the variable includes zero or negative values, then it is not possible to use logarithmic measures. The variance (involved in the R2) satisfies the population and transfer principles, while being both additively decomposable and translation invariant, 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.

[14] For further related methodological discussion, including alternative equal-opportunity criteria, see Velez-Grajales et al. (2018).

for both households. This type of indices has long been employed for the distributional analysis of economic resources in developing economies (Filmer and Pritchett, 2001; Mckensey, 2005; Wittenberg and Leibbrandt, 2017; Poirier et al. 2019), as well as for the analysis of social mobility (Torche, 2015 and Vélez-Grajales et al. 2013). A key aspect in the construction of this type of indices is that the suitability of the different-dimension reduction techniques used to construct them depends on the type of data used. For binary variables, like those we employ in this paper, a suitable technique is Multiple Correspondence Analysis (MCA); which uses relative frequencies across binary variables to identify an underlying structure, with which one can rank individuals according to resource availability (in this case). This is a departure from the literature reliant on Principal Component Analysis (PCA) to produce the asset index. PCA is not suitable for our case as it requires the minimization of Euclidean distances to calculate the weights used in the computation of the index, which is an inappropriate process for binary data. A suitable alternative to MCA is to perform PCA on a matrix of tetrachoric correlations of binary variables. Although the results presented in the paper are obtained using MCA to construct the wealth indices, we also estimate them using asset indices constructed with tetrachoric correlations as a robustness check. The results are almost identical.

The variables that we employ in the construction of the origin and current household indices are shown in tables 1a and 1b.

Table 1a. Binary variables for the origin household asset index.

The household had access to clean water	The household had a telephone landline
The household had a stove	A member of the household owned the housing facilities inhabited
The household had a TV set	A member of the household owned a shop or other commercial venue
The household had a refrigerator	A member of the household owned a venue for non-commercial uses.

The household had a washing machine	A member of the household owned a car
The household had a blender machine	A member of the household owned a tractor
A member of the household had a bank account	A member of the household had a credit card

Table 1b: Binary variables used to construct the current household asset index.

The household has access to a telephone landline	A member of the household owns a venue for commercial purposes.
The household has a washing machine	A member of the household owns a venue for non-commercial purposes
The household has a computer	A member of the household owns a car
The household has a video player	A member of the household owns a tractor
The household has a microwave	A member of the household has a bank account
The household has cable-tv	A member of the household has a credit card
The household has internet service	A member of the household hired a person to perform housework.
The household has a water heater.	A member of the household owns the housing premises inhabited.

To take full advantage of the data set, we define a set of circumstances as large as possible. We consider the circumstances employed by Ferreira and Gignoux (2011) (parents' education, father's occupational status, indigenous status, sex, and whether the respondent lived in an urban or rural community) to which we add the household of origin asset index and the skin color of the respondent.

We define parental education using six categories: no formal education, incomplete primary education, complete primary education, completed middle school, completed high school, college or graduate education. Father's occupational status is defined in binary terms as agricultural workers and the rest of occupations. Indigenous status is defined as having at least one parent who speaks an indigenous language. The criterion to assign urban or rural status was defined in terms of the respondent's perceived population in the community where she was born. If the perceived population was below 2,500 inhabitants, it is deemed a rural community. Otherwise, the community is considered urban.

As we only present parametric estimations, we use the continuous range of the origin's asset as a circumstances, allowing for a finer partition of the population and a better account of the level of inequality of opportunity. In the case of skin tone, we include the full PERLA scale which classifies skin tones in 11 categories.[15] We include the circumstances in a sequential order, detailed in table 2:

Table 2: Composition of the circumstance sets employed

Circumstance Set	Components	Circumstance Set	Components
1	Sex, skin tone	4	Set 3 + Parental education
2	Set 1+ parents spoke indigenous language	5	Set 4 + Father was an agricultural worker
3	Set 2 + Urban community	6	Set 5 + Household of origin asset index

[15] In the MMSI the scale of colours is inverted, in the sense that the two lightest colours correspond to tones 10 and 11, the intermediate colours go from 7 to 9 and the darkest tones correspond to values 1 to 6. We label all our graphs according to the PERLA scale to make comparison easier with other studies that do not use the MMSI.

Table 3 shows the sample proportions in the survey by specific circumstance categories. Among some noteworthy features, nearly three-quarters of respondents report mestizo skin tones, about half are born in urban areas, and more than half grew up with fathers or mothers without complete primary education.

Table 3: Partition of the population by circumstances

Circumstances	Total sample
Skin colour group I (Categories 6-11 of PERLA scale)	20.3%
Skin colour group II (Categories 3-5 of PERLA scale)	72.7%
Skin colour group III (Categories 1-2 of PERLA scale)	7.0%
Born in urban setting.	51.1%
At least one parent speaks an indigenous tongue.	15.1%
Father was agricultural worker	25.9%
Father with no formal education	22.9%
Father with at most incomplete primary education	29.7%
Father with complete primary education.	21.9%
Father with complete secondary education.	11.3%
Father with complete tertiary education.	7.3%
Father with complete college education or more	6.9%
Mother with no formal education	27.3%
Mother with at most incomplete primary education	26.1%
Mother with complete primary education.	24.9%
Mother with complete secondary education.	11.4%
Mother with complete high school	6.5%
Mother with complete college education or more	3.8%
Women	52.5%

Notes: 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). Total number of observations: 22,063 respondents

4. Results

The first subsection provides the inequality of opportunity analysis. In the second subsection we delve into the role played by skin colour in determining inequality of opportunity, and its relationship with the other circumstance variables.

4.1. Inequality of opportunity.

Table 4 shows results for the share of total inequality in the household assets distribution explained by inequality of opportunity.[16] Estimations are performed with six different sets of circumstances (see details in Table 2), which sequentially expand the set of circumstances under consideration. Our sequential approach to the inclusion of circumstances allows us to obtain some evidence on the weight of each circumstance in determining the total level of inequality of opportunity. As it is clear, considering only circumstances such as skin tone and indigenous status leads to a small amount of total inequality being accrued to inequality of opportunity.[17] The inclusion of variables such as the type of community of origin, parental educational achievement and the origin household wealth index raises the contribution of circumstances substantially. The contribution of these circumstances implies moving from a society where at least less than 10% of total inequality is produced by factors outside the individuals' control, to a society in which at least 43% of total inequality is produced by circumstances.

[16] The OLS regressions required for the first part of the estimation of inequality of opportunity appear in the Appendix.

[17] Although included in the analysis, we do not provide an interpretation for the low contribution of sex to the total level of inequality of opportunity. As Ferreira and Gignoux (2011) point out, using as an outcome variable a measure of economic resources at the household level leads to a severe mechanical underestimation of intra-household inequalities, among which gender inequality plays a significant part

Table 4: Parametric estimations of inequality of opportunity

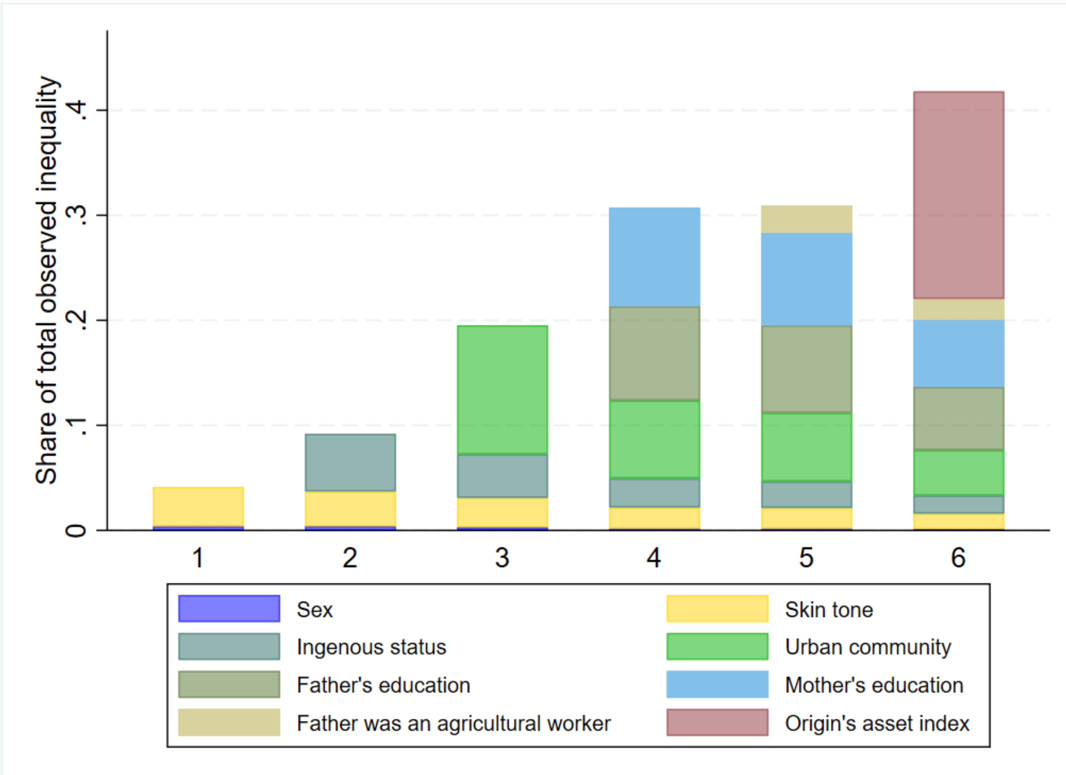
Set of circumstances	Set 1	Set 2	Set 3
IOR_{VAR}	0.04146 (0.0025)	0.0920 (0.0037)	0.1952 (0.0048)
Set of circumstances	**Set 4**	**Set 5**	**Set 6**
IOR_{VAR}	0.3075 (0.0057)	0.3093 (0.0056)	0.4181 (0.0058)

Notes: IOR_{VAR} stands for the ratio of the variance explained by the circumstances to the total variance of the household asset distribution. That is, the R^2 of the regression of the household index on the circumstance variables. Bootstrap standard errors are shown in parentheses, calculated with 1,000 repetitions. The estimation tables for these results are in the appendix.
Source: Authors' calculations using MMSI 2016.

Figure 1 shows the contribution of each circumstance to inequality of opportunity in all sets according to the Shapley decomposition method.[18] We knew from Table 4 that including wealth of origin increases the share of inequality of opportunity in total wealth inequality, but now comparing the columns of sets 6 against all the others, we note that wealth of origin features the largest contribution to inequality of opportunity among the observed circumstances in the set. By contrast, all sets point to a small, yet statistically significant contribution of skin tone to total inequality of opportunity, accruing to less than two percentage points in the final set.

[18] For explanations of the Shapley decomposition method see, inter alia, Sastre and Trannoy (2002), Chantreuil and Trannoy (2013), and Shorrocks (2013).

Figure 1: Shapley decomposition of inequality of opportunity by circumstance.



Note: The contribution of each circumstance adds up to the share of total inequality explained by inequality of opportunity. Circumstances are defined as indicated in the data section of the paper.
Source: Authors' calculations using MMSI 2016.

Considering the previous results of the literature regarding the role of skin tone discrimination in different life outcomes, its small contribution to total inequality of opportunity is surprising. This leads us, first, to question whether skin tone actually provides new information to the estimation in statistically significant terms, i.e. above and beyond the information captured by household of origin's wealth and the rest of circumstance variables.

To do so, we perform three likelihood ratio tests. First, we consider as the restricted model the one that includes all circumstances except for the household of origin asset index and the skin tone variable, while the unconstrained model includes the origin's asset index. The second test considers as the restricted model the same as in the previous tests, but considers as the unrestricted one the model that includes the skin tone. Finally, the third test considers as the unrestricted model the one that includes simultaneously the asset index and the skin tone scale. The results of these tests are shown in table 5.

Table 5: Log likelihood ratio test

Models tested	**X^2 value**	**Probability**
Unconstrained model: circumstance set 6, excluding skin tone and origin's asset index. Constrained model: circumstance set 6, excluding skin tone.	4434.67	0.0000
Unconstrained model: circumstance set 6, excluding skin tone and origin's asset index. Constrained model: circumstance set 6, excluding the origin household's asset index.	403.81	0.0000
Constrained model: circumstance set 6 excluding the origin household's asset index Unconstrained model: circumstance set 6	4231.20	0.0000

Note: Authors' calculations using data from MMSI 2016.

Our test results show that including both the origin household wealth and the skin colour variables add information to the model, so that they should be included in the analysis of inequality of opportunity. Although this was clear from our decomposition analysis for the case of the origin-household wealth, our test shows that including skin colour adds new information. Therefore, even though skin colour determines the unequal distribution of wealth opportunities in Mexico, it seems to be only a residual determinant. This begs the question as to why skin tone plays a less relevant role in producing inequality of opportunity.

We now check whether the inclusion of an additional circumstance variable leads to an upward bias of the lower bound of inequality of opportunity in Mexico. As discussed in previous sections, the impossibility of accounting for all the circumstances exerting an influence on a person's life generates a downward bias in the estimations, as the effect of the missing circumstances ends up being accrued by the individual variation instead of the between-types variation. However, as Brunori et al. (2016) point out, increasing the number of variables measuring circumstances may generate an upward bias in the estimations due to the positive effect of ensuing finer sample partitions on the variance. 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. Table 6 presents the mean square errors of each model. The minimum square error is minimized with the model that includes both skin colour and the household of origin's wealth index. Thus, we can conclude that the estimations do not suffer from an upward bias.

Figure 6: Mean Square Error

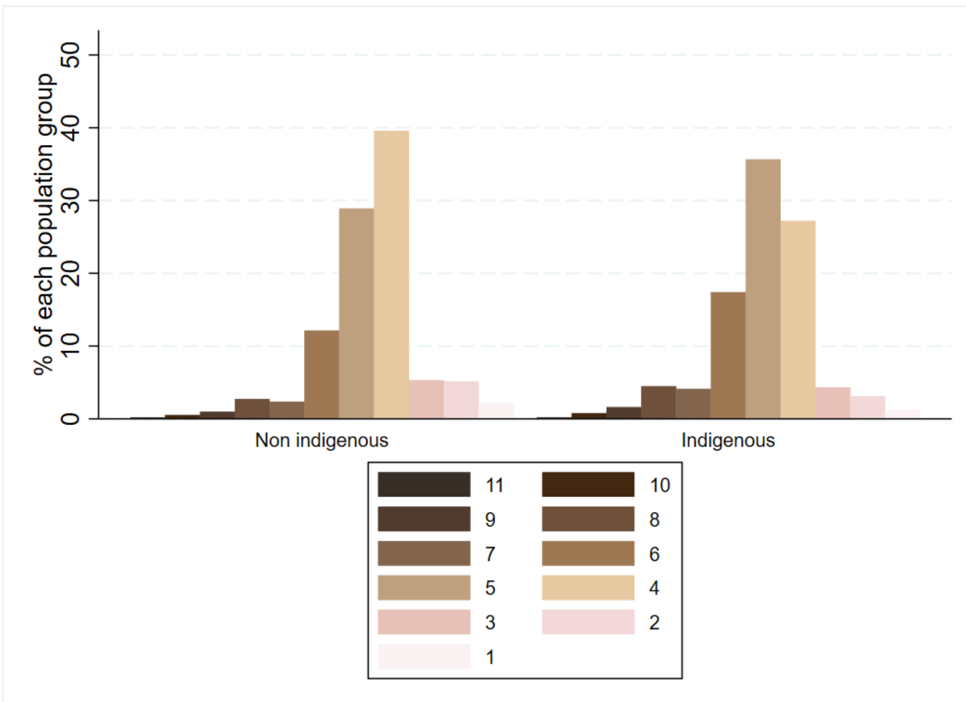
Set 1	**Set 2**	**Set 3**
0.9864	0.9615	0.9043
Set 4	**Set 5**	**Set 6**
0.8490	0.8478	0.7803

Source: authors' calculations using data from MMSI 2016.

It is possible, however, that the circumstance variables are not orthogonal to each other. This would bias both the coefficients associated to each circumstance (and as a consequence the Shapley decomposition) and the estimation of the share of total inequality explained by circumstances due to overfitting and imperfect collinearity. This concern is particularly plausible for the case of the skin tone and indigenous status variables, as it is possible that the indigenous population is concentrated among the darkest skin tones of the scale. Should that be the case, then the skin tone variable might be actually capturing part of the effect associated to indigenous status.

To check if this is the situation, we plot the distribution of skin tones for both the population with parents that spoke an indigenous language and for the rest of the Mexican population. As figure 2 shows, in both cases all skin tonalities are present, and the indigenous population is not concentrated around the darkest skin tones. However, it is worth noting that, as expected, the share of the population with the lightest tonalities is smaller within the indingeous population than in the rest of the population.

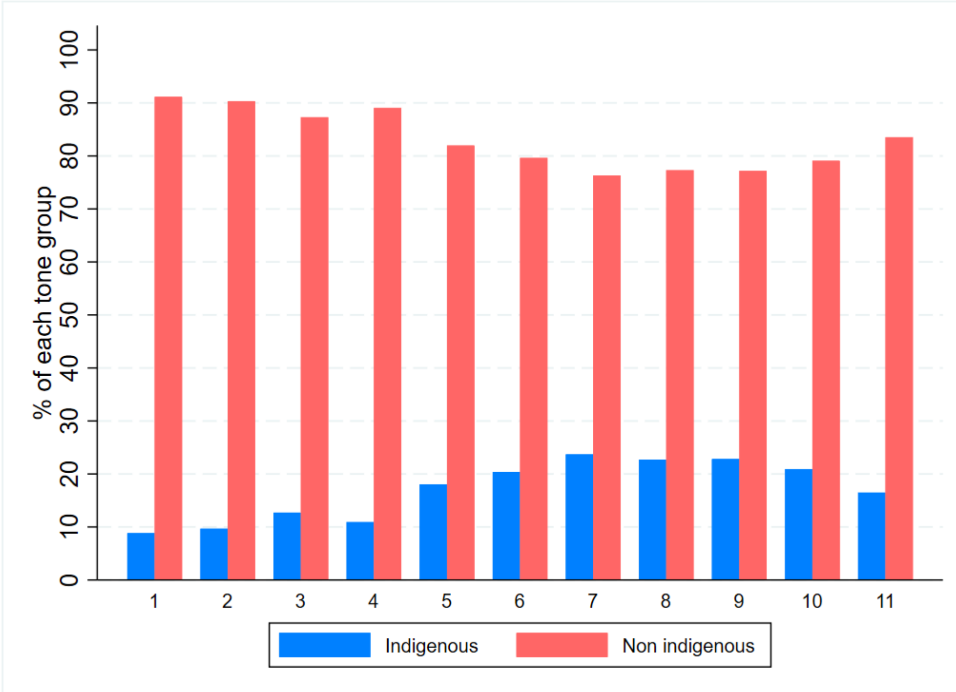
Figure 2: Skin tone distribution of indigenous and non indigenous populations



Note: Authors' calculations using data from MMSI 2016.

Furthermore, figure 3 shows that the share of each skin tone's population that is indigenous is relatively constant across tones, fluctuating between slightly less than 10% and slightly more than 20%, never constituting a majority in any of them. Although this serves to strengthen the case that skin tone and indigenous status are variables that codify different sets of information, it does not allow us to ascertain the presence of collinearity between any other variables. In order to attend this concern, we calculate the variance inflation factors (VIF) for each circumstance set.

Figure 3: Distributions of indigenous status in each skin tone



Source: Authors' calculations based on data from MMSI 2016

The variance inflation factor provides a measure of the increase in the variance of an estimated regression coefficient due to the collinearity between the associated variable and the rest of covariates in the model. The closer it is to one, the lower the influence of collinearity in the estimation of the parameters. As table 7 shows, the VIF of all variables across the six models remains close to one. This result attenuates our concerns of imprecision in the estimation of each circumstance coefficient due to collinearity among the circumstances.

In the specific cases of skin tone and indigenous status, the values are very close to one across all regressions. Together with figures 2 and 3, this helps dispel any concerns of possible model overfitting in our estimations.

Table 7: Variance Inflation Factor for different circumstance sets

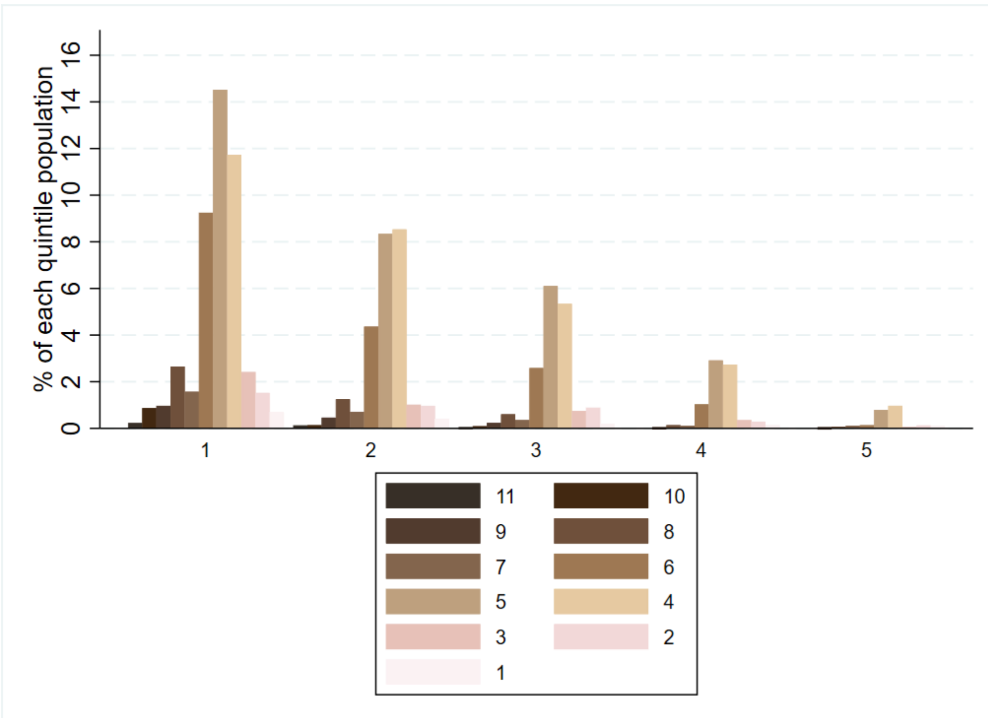
Variable	Variance Inflation Factor					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
Sex	1.02	1.02	1.02	1.03	1.03	1.03
Skin tone	1.02	1.03	1.04	1.05	1.05	1.07
Indigenous status	-	1.01	1.05	1.07	1.10	1.13
Urban community	-	-	1.06	1.20	1.33	1.48
Father's education	-	-	-	2.04	2.07	2.16
Mother's education	-	-	-	2.06	2.07	2.15
Father was an agricultural worker	-	-	-	-	1.33	1.35
Origin household asset index	-	-	-	-	-	1.87

4.2. Layers of inequality of opportunity: skin colour and household wealth.

So far, our results indicate that once considered jointly with other circumstances, skin colour plays a minor role in generating inequality of opportunity. This is true both for the net effect, identified in the sixth set of circumstances, and any indirect effect through other circumstances. This second type of effect, suggested by Navarrete (2016) would imply that in the sequential inclusion of circumstances, the addition of the skin-tone scale should produce a level of inequality of opportunity similar to the one observed once the whole set of circumstances is included. As figure 1 shows, this is not the case. As a result, the underestimation hypothesis is not supported by the data under the selected model specifications.

An alternative hypothesis is that skin colour acts as a second-order stratifier in Mexican society. That is, skin colour matters in terms of inequality of opportunity after disparities in education and wealth have stratified Mexican society (as shown in Figure 1). To provide some evidence on this matter, Figures 4 and 5 decompose the population with origins at both extremes of the wealth-index distribution by their skin colour and their current quintile.

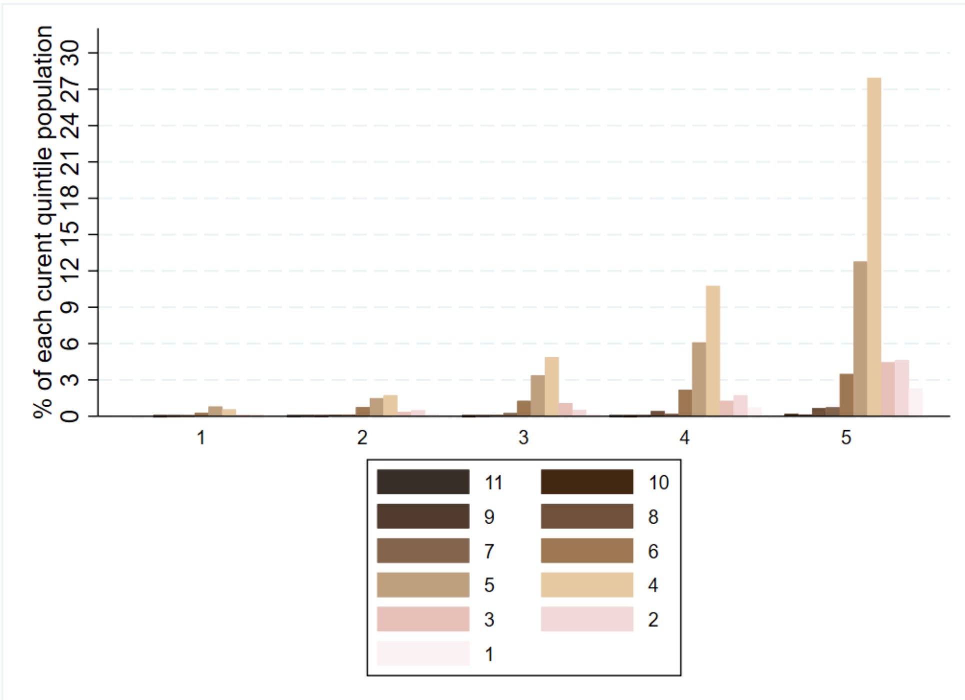
Figure 4: Distribution of the population at the bottom quintile of the origin wealth distribution by skin tone and current quintile of wealth



Source: Authors' calculations using data from MMSI 2016

Figures 4 and 5 show two important features in support of the role of skin color as a second stratifier. First, the majority of those who start at the bottom and the top quintile remain in the same position when they reach adulthood. This suggests a prominent role of economic resources at origin in determining the current position of individuals. Secondly, light-skinned individuals represent a larger proportion of the population that starts at the top, than of the population that starts at the bottom. Thirdly, individuals with lighter skin tones are less likely to fall through the distribution than their darker skinned peers, while they also experience a higher probability of moving upwards when starting at the bottom. However, notice that only a very small proportion of those who start at the bottom manage to climb the whole distribution. Likewise, only a small fraction of those who start at the top fall all the way down to the bottom.

Figure 5: Distribution of the population at the top quintile of the origin wealth distribution by skin tone and current quintile of wealth



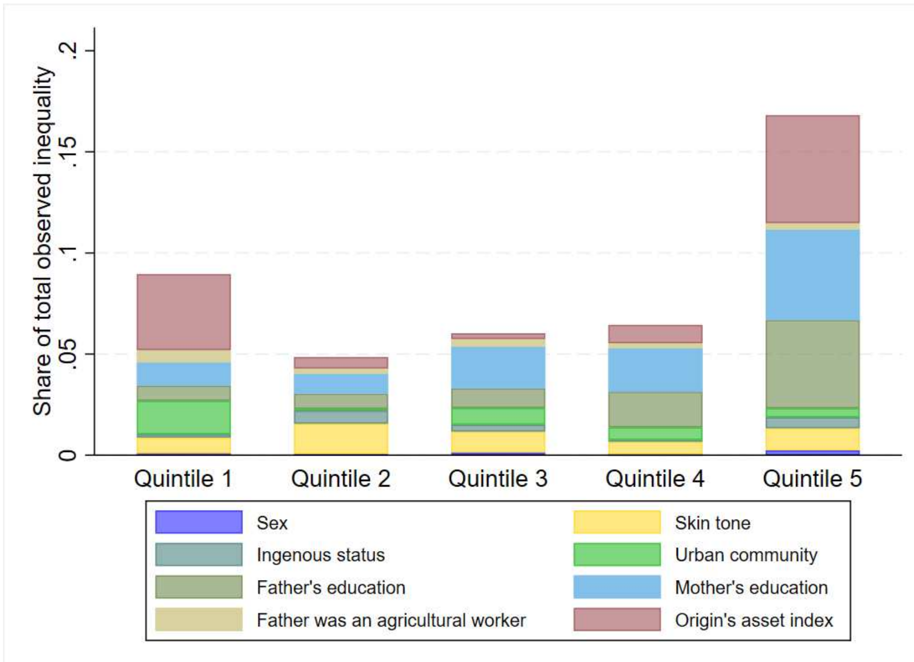
Source: Authors' calculations using data from MMSI 2016

Together with the results on the components of inequality of opportunity presented in the previous section, these results imply that the primary stratifier of wealth in Mexican society are the economic resources available. It is more than likely, given Mexico's colonial past, that the historical origins of this stratification by economic resources are linked to ethnicity and skin colour. However, and as a direct consequence of the high levels of intergenerational persistence of wealth status, we can claim that the role of the available economic resources as an independent stratifier crystalized through time until it became the main stratifier of Mexican society in the present.[19]

[19] Mobility matrices and rank-to-rank mobility regressions based on this dataset are available from authors upon request.

To observe how skin tone acts as a stratifier once the principal effect of household wealth is removed, we proceed to calculate the share of inequality inside each quintile of the origin asset index "explained" by circumstances. The results of this exercise are presented in figure 6.

Figure 6: Share of intra-quintile inequality explained by circumstances



Source: Authors' calculations using data from MMSI 2016

First, note that the lower bound of within-quintile inequality of opportunity is relatively small even in the case of the top quintile, which has the highest value (slightly above 15%). This suggests that once the starker difference in terms of the household of origin's wealth is controlled for, individuals inside each quintile have relatively similar circumstances of origin. However, note that both at the bottom and at the top, household wealth remains the circumstance contributing the largest share of inequality of opportunity. Secondly, the effect of skin tone varies with the observed quintile, but in all cases remains small compared with other factors such as parental education and being originally from an urban community.

The persistent yet small contribution of skin tone to inequality of opportunity suggests that the hypothesis of skin colour acting as a secondary element upon which Mexican society is stratified is not far from reality. This is in line with recent research by Monroy-Gómez-Franco and Vélez-Grajales (2020) who find that differences in social mobility by skin color are significant yet small once regional differences in economic development are considered.

It is worth noting that the vast majority of the Mexican population between 25 and 60 years old belongs in the intermediate skin tone group (nearly three quarters, table 3), which translates into their ubiquitous presence in all quintiles. Thus, individuals from both the darkest and the lightest skin tones constitute a minority of the population. This is another possible driver of the small effect of skin-tone colour on inequality of opportunity.

4.3 Cohort analysis.

In order to investigate potential differences across cohorts in our sample, we calculate inequality of opportunity for five cohorts in our sample: 25-30, 30-40, 40-50, 50-60 and 60-65 years old. The results appear in table 8.

Table 8: Inequality of opportunity by cohort.

Cohorts		Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
25-30	Inequality of Opportunity	0.0532 (0.0077)	0.1140 (0.0100)	0.2086 (0.0131)	0.3717 (0.0144)	0.3745 (0.0154)	0.4914 (0.0129)
	Total inequality explained by skin color	0.0434	0.0395	0.0343	0.0230	0.0227	0.0172
30-40	Inequality of Opportunity	0.0395 (0.0047)	0.0925 (0.0064)	0.1992 (0.0079)	0.3377 (0.0099)	0.3396 (0.0096)	0.4417 (0.0097)
	Total inequality explained by skin color	0.0369	0.0341	0.0284	0.0184	0.0178	0.0140

40-50	Inequality of Opportunity	0.0327	0.0807	0.01855	0.3070	0.3098	0.4002
		(0.0044)	(0.0065)	(0.00585)	(0.0107)	(0.0103)	(0.0112)
	Total inequality explained by skin color	0.0315	0.0269	0.0229	0.0169	0.0165	0.0180
50-60	Inequality of Opportunity	0.0481	0.0981	0.2009	0.3219	0.3205	0.4005
		(0.0062)	(0.0008)	(0.0112)	(0.0127)	(0.0138)	(0.0134)
	Total inequality explained by skin color	0.0424	0.0356	0.0292	0.0187	0.0179	0.0138
60-65	Inequality of Opportunity	0.0579	0.0994	0.2029	0.3525	0.3576	0.4036
		(0.0114)	(0.0145)	(0.0189)	(0.0249)	(0.0245)	(0.0246)
	Total inequality explained by skin color	0.0432	00422	0.0343	0.0253	0.0247	0.0208

Note: The circumstance sets correspond to those defined in table 2. Author's calculations using information from MMSI 2016.

Some key results are worth highlighting. Firstly, the contribution of skin tone toward wealth inequality remains small and similar across all cohorts, yet statistically significant, ranging between 1.38% and 2.08% in the most complete set of circumstances. This confirms our finding that skin colour is a stratifier in Mexican society yet not the main one. Secondly, the (lower bound) share of inequality of opportunity ranges between 40% (40-50 cohort) and 49% (youngest cohort), namely nine percentage points. That is, circumstances beyond people's control explain at least 40% of the variance in household assets, highlighting the persistent levels of inequality of opportunity in Mexico even among the relatively least unequal cohorts. Moreover, remarkably, inequality of opportunity remains fairly constant at 40% for all the cohorts with people older than 40 years. Finally, we must note that, due to the characteristics of the dataset, we cannot fully disentangle the effect of the life-cycle stage from the cohort effects.

5. Conclusion

We sought to analyse the role played by skin colour as a circumstance variable (partially) explaining the share of inequality of opportunity in total wealth inequality in Mexico. Our results show that the contribution of skin tone to inequality of opportunity in wealth is statistically significant but small (particularly vis-a-vis other circumstance variables). Meanwhile, when added, origin-household wealth substantially increases the share of inequality of opportunity, and becomes its most important contributor.

While only suggestive, our results do not point to a major role of skin tone as a source of inequality of opportunity in wealth in Mexico (even when the analysis is performed on age-cohort subsamples). Neither directly nor indirectly through its correlation with family background circumstances like wealth, parental education or occupation. Rather, we find indicative evidence that skin tone plays a secondary role in promoting further inequality of opportunity once family background variables, chiefly origin-household wealth but also parental education, have exerted their stratifying effects.

However, we should caution that our results just document the small (but statistically significant) conditional association between a specific "survey instrument" for skin tone, namely the PERLA palette, and one specific measure of wealth. The association between alternative measures of skin tone and alternative measures of material wealth may or may not be similar in magnitude. Future research should test the robustness and concomitant empirical validity of our results to alternative methodological choices for the measurement of both skin tone and wealth. Furthermore, future research should prioritise datasets enabling a full disentanglement of life-cycle effects from birth-cohort effects. In the same vein, it is necessary to prioritise datasets with information at the level of the individual that allow for a full assessment of the contribution of sex to inequality of opportunity. This remains an area in need of urgent exploration by the literature on the subject.

Should further research ascertain the robustness of our results, then unlike the neighbouring country north of the Rio Grande, suppressing colour discrimination in Mexico could have at best a minor instrumental role in reducing inequality of opportunity in wealth (while being intrinsically warranted and necessary). Rather, directly tackling the socioeconomic inequalities in family circumstances (wealth, parental background, etc.) appears to be a more promising route.

References

Aguilar, Rosario (2011). "The Tones of Democratic Challenges: Skin Color and Race in Mexico." Centro de Investigación y Docencia Económicas (CIDE), Working Paper No. 231.

Arceo-Gomez, Eva, and Raymundo M. Campos-Vazquez (2014). "Race and Marriage in the Labor Market: A Discrimination Correspondence Study in a Developing Country." *The American Economic Review*, vol. 104, no. 5, pp- 376-380.

Bhattacharya, Debopam and Bhaskar Mazumder (2011) "A nonparametric analysis of black-white differences in intergenerational income mobility in the United States" *Quantiative Economics*, vol. 2, no. 3, pp. 335-379.

Brunori, Paolo; Francisco H.G. Ferreira, and Vito Peragine (2013) "Inequality of opportunity, income inequality, and economic mobility: some international comparisons", chapter 5 in Paus, Eva (editor) *Getting development right*, Springer.

Brunori, Paolo; Vito Peragine and Laura Serlenga. (2016). "Upward and downward bias when measuring inequality of opportunity" ECINEQ Working Paper #2016-406, ECINEQ.

Bustos, Alfredo and Gerardo Leyva (2017) "Towards a More Realistic Estimate of the Income Distribution in Mexico", vol. 8, no. 1, pp. 114-126.

Campos-Vázquez, Raymundo and Eduardo Medina-Cortina (2018). "Identidad social y estereotipos por color de piel. Aspiraciones y desempeño en jóvenes mexicanos" *El Trimestre Económico,* vol. 85, no. 1, pp. 53-79.

Campos-Vázquez, Raymundo and Eduardo Medina-Cortina (2019). “Skin Color and Social Mobility; Evidence from Mexico” *Demography*, vol. 56, no. 1, pp. 321-343.

Campos-Vázquez, Raymundo; Juan Huerta-Wong y Roberto Vélez-Grajales, *Movilidad social en México: constantes de la desigualdad*, México: Centro de Estudios Espinosa Yglesias

Carvalho, Alexandre, and Marcelo Neri (2000), "Mobilidade Ocupacional e Raça: Origens, Destinos e Riscos dos Afro-Brasileiros". *Ensaios Econômicos*, nº 392, EPGE/Fundação Getulio Vargas Editora

Castillo Negrete Rovira, Miguel (2017) “Income inequality in Mexico, 2004-2014” *Latin American Policy,* vol. 8, no. 1, pp. 93-113.

Chantreuil, Frederic and Alain Trannoy (2013) “Inequality decomposition values: the trade-off between marginality and efficiency”, *Journal of Economic Inequality*, vol. 11, pp. 83-98.

Checchi, Daniele and Vito Peragine. (2010). “Inequality of Opportunity in Italy” *Journal of Economic Inequality*, vol. 8, no. 4, pp. 429-150.

Costa, Carlos (2006). “Class, race, and social mobility in Brazil” *Dados*, vol. 49, no. 4, pp. 833-873.

Ferreira, Francisco H.G. and Jeremie Gignoux (2011) “The measurement of inequality of opportunity: Theory and an application to Latin America” *Review of Income and Wealth*, vol. 57, no. 4, pp. 622-657.

Ferreira, Francisco H.G. and Vito Peragine. (2016). “Individual responsibility and equality of opportunity” in Adler, Matthew and Marc Fleurbaey (eds.) *The Oxford Handbook of Well-being and Public Policy*, Oxford: Oxford University Press, pp. 746-784.

Ferreira, Francisco H.G., Jeremie Gignoux and Meltem Aran. (2011). "Measuring Inequality of Opportunity with imperfect data: The case of Turkey" *Journal of Economic Inequality*, vol. 9, no. 4, pp. 651-680.

Ferreira Sergio and Fernando Veloso (2006) "Intergenerational mobility of wages in Brazil" *Brazilian Review of Econometrics*, vol. 26, no. 2, pp. 181-211.

Filmer, Deon and Lant Pritchett (2001) "Estimating wealth effects without expenditure data-or tears: an application to educational enrollments in states of India, *Demography*, vol. 38, no.1, pp. 115-132.

Flores, René, and Edward Telles (2012). "Social stratification in Mexico disentangling color, ethnicity, and class." *American Sociological Review*, vol. 77, no. 3, pp. 486-494.

Formby, John, James Smith and Buhong Zheng (2004) "Mobility measurement, transition matrices and statistical inference", *Journal of Econometrics*, 120: 181-205.

Hasenbalg, Carlos and Nelson do Valle Silva(eds.). (1988), Estrutura Social, Mobilidade e Raça. Rio de Janeiro: Iuperj/Vérti

Hasenbalg Carlos; Marcia Lima, Márcia and Nelson do Valle Silva (1999), Cor e Estratificação Social. Rio de Janeiro, Contracapa.

Lefranc, Arnaud; Nicolas Pistolesi and Alain Trannoy. (2008). "Inequality of Opportunities vs. Inequality of Outcomes: Are Western Societies All Alike?" *Review of Income and Wealth,* vol. 54, no. 4, pp. 513-546.

Marrero, Gustavo and Juan Rodriguez (2013) "Inequality of Opportunity and Growth" *Journal of Development Economics*¸vol. 104, pp. 107-122.

Mazumder, Bhashkar (2014). “Black-White differences in intergenerational economic mobility in the U.S.” Economic Perspectives, no. 38, pp. 1-18.

McKenzie, David (2005). “Measuring Inequality with Asset Indicators.” *Journal of Population Economics*, vol. 18 no. 2, pp. 229–60.

Monroy-Gómez-Franco, Luis and Roberto Vélez-Grajales, (2020) “Skin Tone Differences in Social Mobility in Mexico: Are We Forgetting Regional Variance?”. *Journal of Economics, Race and Policy* https://doi.org/10.1007/s41996-020-00062-1

Navarrete, Federico (2016), México racista. Una denuncia. Mexico City, Mexico: Grijalbo.

Poirier, Mathieu, Karen Grepin and Michel Grignon (2020) “Approaches and alternatives to the wealth index to measure socioeconomic status using survey data: a critical interpretive synthesis, Social Indicators Research, vol. 148, pp. 1-46.

Ramos, Xavier and Dirk van de gaer. (2015). “Approaches to inequality of Opportunity: Principles, measures and Evidence” *Journal. of Economic Surveys,* vol. 30, no. 51, pp. 855-883.

Reyes, Miguel; Graciela Teruel and Miguel López. (2017). “Measuring true income inequality in Mexico”, *Latin American Policy,* vol. 8, no. 1, pp. 127-148.

Roemer, John. (1993). “A Pragmatic Theory of Responsibility for the Egalitarian Planner.” *Philosophy & Public Affairs,* vol. 22, no. 2, pp. 146-166.

Roemer, John. (1998). *Equality of Opportunity*. Cambridge, MA: Harvard University Press.

Roemer, John and Alain Trannoy. (2015). “Equality of Opportunity” in Atkinson, Anthony and Francois Bourguignon (ed.). *Handbook of Income Distribution*, Amsterdam, Holland: Elsevier, vol. 2, pp. 217-300.

Sastre, Mercedes and Alain Trannoy (2002) “Shapley inequality decomposition by factor components: some methodological issues”, *Journal of Economics*, vol. 77, pp. 51-89.

Serrano, Julio and Florencia Torche (eds.) (2010). *Movilidad social en México: Población, desarrollo y crecimiento*” México, D.F.: Centro de Estudios Espinosa Yglesias.

Shorrocks, Anthony (2013) “Decomposition procedures for distributional analysis: a unified framework based on the Shapley value”, *Journal of Economic Inequality* vol. 11, pp. 99-126.

Telles, Edward (Ed.) (2014). Pigmentocracies: Ethnicity, Race, and Color in Latin America. The University of North Carolina Press.

Torche, Florencia (2015). “Intergenerational Mobility and Gender in Mexico.” *Social Forces*, vol. 94, no. 2, pp. 563-587.

Van de Gaer, Dirk. (1993). “Equality of Opportunity and Investment in Human Capital.” Ph.D. dissertation. Katholieke Universiteit Leuven.

Vélez-Grajales, Roberto and Luis Monroy-Gómez-Franco. (2017). “Movilidad social en México: Hallazgos y pendientes”, *Revista de Economía Mexicana. Anuario UNAM*, no. 2, pp. 97-142.

Vélez-Grajales, Roberto, Luis Monroy-Gómez-Franco and Gastón Yalonetzky (2018). “Inequality of Opportunity in Mexico”, *Journal of Income Distribution,* vol 27, no. 3-4, pp. 134-158.

Velez-Grajales, Roberto, Raymundo Campos-Vazquez and Juan E. Huerta-Wong (2014). *Report on Social Mobility in Mexico: Imagine Your Future*. Mexico: The Espinosa Yglesias Research Centre (CEEY).

Vélez Grajales, Roberto; Juan Enrique Huerta Wong y Raymundo Campos Vázquez (eds.) (2015). *México: ¿El motor inmóvil?,* México, Centro de Estudios Espinosa Yglesias

Villarreal, Andrés (2010). “Stratification by Skin Color in Contemporary Mexico.” *American Sociological Review,* vol. 75, no. 5, pp. 652–78.

Wendelspiess-Chávez-Juárez, Florian. (2015). “Measuring Inequality of Opportunity with Latent Variables”, *Journal of Human Development and Capabilities: A Multi-Disciplinary Journal of People Centered Development,* vol. 16, no. 1 pp. 106-121.

Wittenberg, Martin and Murray Liebbrandt (2017) “Measuring inequality by asset indices: a general approach with application to South Africa”, *Review of Income and Wealth*, vol. 63, no. 4, pp. 706-730

Appendix:

A1: Regression of household wealth index of the respondent on different sets of circumstances

Variables	Set 1	Set 2	Set3	Set 4	Set 5	Set 6
	Dependent variable: Household wealth index of the respondent					
Sex	0.1717	0.1679	0.1311	0.0910	0.0935	0.0740
	(0.0210)	(0.0209)	(0.0196)	(0.0190)	(0.0189)	(0.0169)
PERLA scale	-0.1484	-0.1318	-0.1083	-0.0802	-0.0798	-0.0545
	(0.0075)	(0.0075)	(0.0070)	(0.0068)	(0.0067)	(0.0059)
At least one parent speaks an indigenous tongue		-0.6619	-0.4656	-0.3268	-0.3036	-0.1135
		(0.0266)	(0.0258)	(0.0267)	(0.0268)	(0.0248)
Born in urban setting			0.7064	0.4316	0.3935	0.1134
			(0.0200)	(0.0217)	(0.0231)	(0.0219)
Mother's educational attainment.				0.1631	0.1592	0.0857
				(0.0102)	(0.0102)	(0.0092)
Father's educational attainment.				0.1503	0.1437	0.0720
				(0.0095)	(0.0096)	(0.0088)
Father was agricultural worker					-0.1419	-0.0306
					(0.0235)	(0.0211)
Origins household wealth index						0.4866
						(0.0112)
Constant	0.7230	0.7526	0.2706	-0.5165	-0.4396	-0.1119
	(0.0365)	(0.0365)	(0.0370)	(0.0419)	(0.0443)	(0.0402)
Observations	21,875	21,293	21,293	18,927	18,927	18,927
R-squared	0.0452	0.0975	0.2073	0.3321	0.3347	0.4519