An index of the indigenous household's representation in Mexican households' income distribution

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Abstract

Poverty determinants in indigenous households have an effect in labor opportunities and welfare well-being of its members. This article measures the indigenous groups' representation in different parts of the income distribution in Mexico. We define indigenous households as those in which the head of household speaks an indigenous language. The index we obtain can be conditioned to a series of income determinants, such as, education, age, household's composition and geographic characteristics. The representation index can be extended to measure the cost of income discrimination of indigenous groups when we weight the index by the monetary cost in pesos. The empirical analysis uses data from the Encuesta Nacional de Ingresos y Gastos de los Hogares in Mexico in 2010.

Key words: Indigenous in Mexico, poverty, probit, Severity and Representation Index.

Resumen

Una medición de la representación del ingreso de los hogares indígenas en la distribución de ingresos de los hogares mexicanos

Los determinantes de la pobreza indígena tienen un efecto en las oportunidades laborales de los hogares y sus niveles de bienestar. Este artículo mide la representación de los grupos de indígenas en diferentes puntos de la distribución de ingresos en México. Definimos los hogares indígenas como aquellos en los que el jefe de familia habla una lengua autóctona. El índice obtenido puede ser condicionado a las características determinantes de los ingresos, tal es el caso de la educación, la edad o las características geográficas. El índice de representación puede extenderse para calcular el costo de la discriminación de los grupos indígenas cuando se pondera por el costo monetario en pesos. El análisis empírico utiliza datos de la Encuesta Nacional de Ingreso y Gastos de los Hogares en México en 2010.

Palabras clave: Indígenas mexicanos, pobreza, probit, índice de representación y severidad.

INTRODUCTION

The economic situation of indigenous people is one of the priority issues in the Mexican public agenda. Indigenous people are the minority group with the most relevance in Mexico's social approach (Comisión Nacional para el Desarrollo de los Pueblos Indígenas, 2010). Their diversity in customs and the social structure that characterizes them is their greatest cultural richness and at once it represents the greatest challenge for the social planner who seeks equality in economic conditions among the members of society. The economic backwardness of these groups regarding the rest of the population has been continually growing in recent years, there is even evidence that the economic situation of indigenous peoples does not improve with positive macroeconomic tendencies (Hall and Patrinos, 2005). This is due to the poor involvement of indigenous families in trade, social and economic relationships of the society in which they live. There is evidence that transformations in labor markets and housing have accelerated backwardness in indigenous households compared with the rest of the population, which produces concern because of the possible negative consequences this implies, among them, chronic and intergenerational poverty and social exclusion (Buvinic, 2004; Renshaw and Wray, 2004; Márquez *et al.*, 2007; Machinea, 2007).

The present article intends to shed light on aspects related to the backwardness of indigenous families in society. In particular, we focus on measuring the representativeness of indigenous households' access to certain regions of income distribution in Mexico. To do so, we utilize the representation index proposed by Pendakur *et al.* (2008), which measures the proportion of the group of indigenous families, whose income is below (or above) a quantile determined by the income distribution of non-indigenous families. Non-indigenous families are the anchor group, this is to say, the subgroup of the population used as a reference to compare the subgroup of indigenous families. The index shows us a photograph of the indigenous families' representativeness at various points of the income distribution of Mexican households. Therefore, we say that the group of indigenous families is overrepresented when the proportion of this group is greater than the quantile of the anchor group; while we speak of underrepresentation when the proportion of indigenous families is below the anchor group's quartile. However, it is important to recognize that the difference between

the monetary incomes of indigenous and non-indigenous families can be the result of many factors. The two populations differ in schooling achievements, distribution of ages and compositions of households, geographic distribution, in specific urban-rural distribution. These indicators are related with income and in some cases they define it. In view of considering the income determinants in the analysis, the conditioned representation index is used, which utilizes regression by quantile, considering a series of income determinants for Mexican households. This way, the representation index that is obtained allows us to quantify in an aggregated and summarized manner the backwardness of indigenous people regarding the rest of the population, taking into account those factors that are determinant in the level of household income. Later on, we used this information to present the (conditioned and non-conditioned) severity index, which adds the households' representativeness including several regions of the income distribution up to a certain quartile that serves as a cut line. This index is similar to a poverty index, only that instead of incomes it uses the representativeness of indigenous families regarding the anchor group. The analysis uses data from the National Survey on Income and Expenditure of Households for the year 2010 (Encuesta Nacional de Ingreso y Gasto de los Hogares, ENIGH). The analysis unit is the household, as it allows counting Mexican indigenous people from series of censual data available in the survey.[1] Indigenous households are classified as those in which the head exclusively speaks an indigenous language. This database is very large and allows a consistent definition of the utilized variables.

A similar publication to ours is that of Patrinos (2000), who estimates that only a half of income differences between non-indigenous and indigenous households are attributable to differences in the characteristics that improve workers' productivity. Psacharopoulos and Patrinos (1994) utilize a series of conventional methods and display the wide breaches existing between indigenous populations and other sectors in Latin American societies.[2] The present analysis extends this research line, since the tool here utilized allows capturing signs of discrimination in specific areas of the income distribution that are not noticed in the traditional methods. The index, besides, shows us a stat of income disparity controlled by a series

[1] Téllez *et al*. (2013) recognize that for the study of indigenous people there are three analytical levels. The first considers the indigenous individual according to their personal characteristics. The second allows counting indigenous people via surveys, in which case the analysis unit is the household. Finally, the third criterion is territorial dimension, which incorporates the indigenous category into all the inhabitants of municipalities and localities.
[2] In Psacharopoulos and Patrinos (1994) the term indigenous refers to municipalities with a percentage of 30 percent or more of households identified as indigenous.

of factors relevant in the generation of monetary incomes. We found that, even controlling for income determinants, indigenous families are ove-rrepresented in 97 percent in the lowest decile of the income distribution and underrepresented in 31 percent in the highest decile. Furthermore, we found that the severity index is greater than the discrimination index all the demographic categories, which indicates that the indigenous families' representativeness is heavily concentrated in the lower section of the income distribution. The situation is critical especially for male heads of indigenous households, who have a severity index almost three times larger than male heads of non-indigenous households. The results show signs of monetary income discrimination against indigenous families, as such backwardness is not explained by differences in educational levels, geographic differences and differences in the urban-rural and other important determinants of income.

The article has the following structure: in section two, the current situation of indigenous households in Mexico is presented. In the third one, by means of binary regression we analyze the determinants of the households' incomes for all the families; the determinants obtained are those factors that predispose the households to obtain low incomes and fall into poverty. Section four presents the representation severity indexes conditioned and non-conditioned to the determinant factors of income we found in section 3. Last section concludes the article.

THE ECONOMIC SITUATION OF INDIGENOUS PEOPLE IN MEXICO

Deruyttere (2004) points out that over the years and searching for consensus on the definition of indigenous peoples, legal instruments for their characterization have been formulated, this by means of the International Labor Organization (ILO), the Organization of American States (OAE) and United Nations. These international agencies define as indigenous to the descendants of the original inhabitants of a geographic region before its colonization, who have retained some or all the linguistic, cultural and organization characteristics, taking as an additional criterion such as how the individual defines themselves. This is why the form in which Renshaw and Wray (2004) mention that such definition should be adapted to the criteria and reality of each country or region. In Mexico, the criterion established by the National Commission for the Development of Indigenous Peoples (Comisión Nacional para el Desarrollo de los Pueblos Indígenas, CDI) considers indigenous people the total of people who live in indigenous households, plus the population who speaks any indigenous language

and lives in an indigenous household. Such definition has also been used by Coneval to estimate wellbeing status and access to social rights of the indigenous population in Mexico. However, for Warman (2003) the indigenous term is mainly utilized by non-indigenous population, this way, generalizing the concept for each of the groups existing in the world would not be optimal, as each of them has a heterogeneous, diverse and complex identity. In Mexico, such identity expresses in the particular ways of social organization that each indigenous group holds and that characterize their own ways of life and political and territorial regulation (Navarrete, 2008).

Many times, in the sources of data there are questions that only intend to identify, in general, people who can be characterized or who identify as indigenous, leaving aside the diversity and complexity which characterize them. In the present work, the analysis unit is household; considering indigenous such ones in which the head spoke an indigenous language, the rest of the households was considered non-indigenous. It is worth clarifying that at indigenous households, according to the definition established by CDI, "are those in which the head and/or spouse or mother of the head and/or father or mother of the head and/or the father- or mother-in-law of the head speak an indigenous language and also those who stated belonging to an indigenous group" (Serrano-Carreto *et al.*, 2002). However, the National Survey on Incomes and Expenditures of the Households does not have data at individual level, so we defined the household head as its representative.

By 2010, the five states that in absolute terms account for the largest number of indigenous households are Oaxaca (303 510), Hidalgo (239 758), Yucatan (201 529), Chiapas (195 556) and Veracruz (191 944); while in relative terms, the five states with the largest number of households regarding their total households are Yucatan (39.52 percent), Hidalgo (39.5 percent), Oaxaca (32.12 percent), Quintana Roo (25.58 percent) and Chiapas (17.64 percent). In figure 1, the location of households in Mexico at the level of state is displayed

The economic and social condition of the indigenous peoples in Mexico does not differ from the Latin American reality, where restrictions to the basic determinants for human development and a greater condition of vulnerability, compared with non-indigenous population are an undeniable reality. By and large, Mexico's indigenous population experiences higher poverty levels and more precarious wages than non-indigenous population; moreover, it is less educated and has more difficulties to access basic health-care services (Navarrete, 2008).
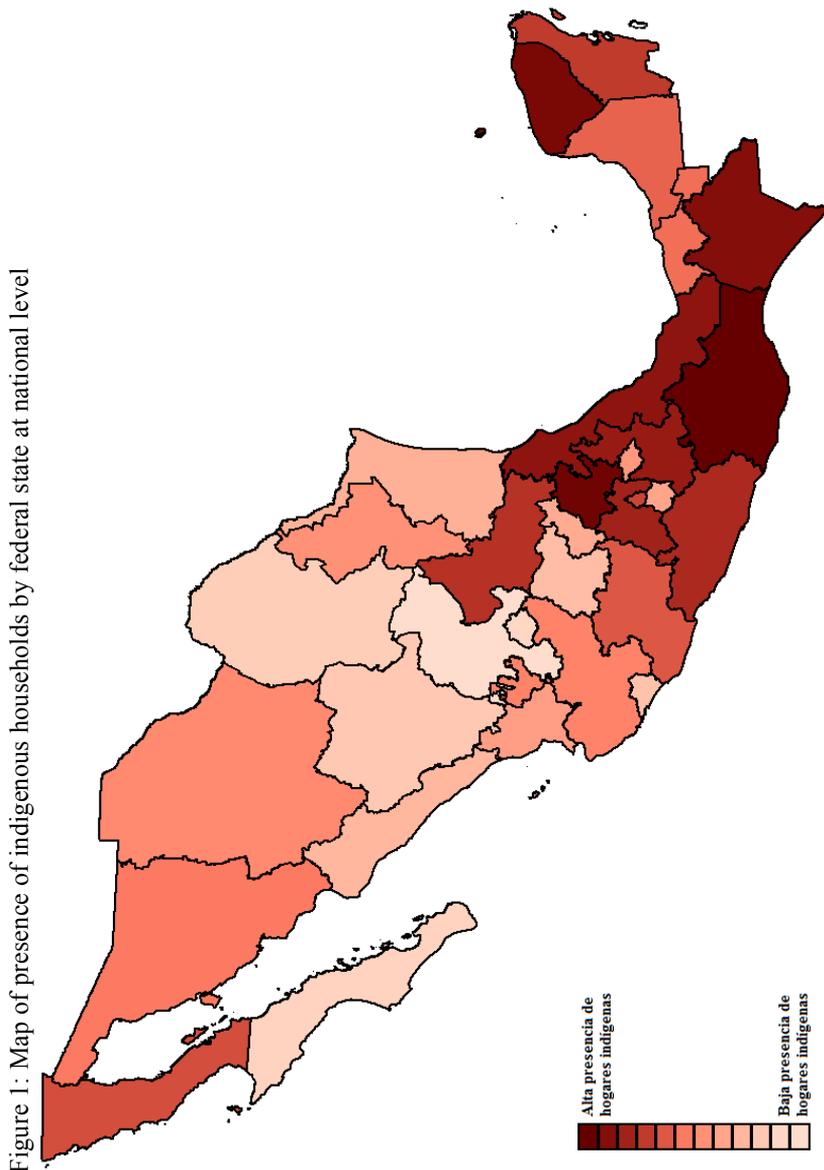
Figure 1: Map of presence of indigenous households by federal state at national level

Alta presencia de hogares indígenas

Baja presencia de hogares indígenas

NB: indigenous households in absolute terms, where only the head speaks an indigenous language.
Source: own elaboration from ENIGH 2010.

Table 1 presents the socioeconomic differences between households according to head at national level, indigenous and non-indigenous. The statistical information used came from the National Survey on Incomes and Expenditures of the Households for the year 2010 (Encuesta Nacional de Ingresos y Gastos de los Hogares, ENIGH). To deflate monetary incomes such as the households' incomes and expenditures, the national consumer price index (NCPI) from INEGI based on December 2010 was used.

Table 1: comparison of socioeconomic data between indigenous and non-indigenous population

Indicators	Population		
	Non-indigenous	Indigenous	P-value
Single-mother head (1)	9.0%	8.5%	0.0262
Households in rural zones (1)	19.4%	45.5%	0.0000
Households in which the head is entitled to some medical institution (1)	48.9%	21.2%	0.0000
Households in which the head is entitled to *Seguro Popular* (1)	25.4%	44.4%	0.0000
Age of the head (2)	48.2	49.5	0.0000
Concluded schooling of the head (2)	5.5	3.6	0.0000
Household size in square meters (2)	3.8	4.4	0.0000
Number of household members younger than 14 years (2)	1.0	1.4	0.0000
Number of members younger than 13 and older than 64 years (2)	1.2	1.6	0.0000
Per capita Current income (3)	4 222.34	2 030.39	0.0000
Per capita current expenditure (3)	3 662.25	1 874.41	0.0000
Proportion of current income per household that corresponds to income from wage (3)	72.09%	71.06%	0.0000
Number of households	26 814 267	2 193 727	29 007 994
Percentage of households	92.44%	7.56%	100%

NB: (1) proportion of households according to population (indigenous and non-indigenous). (2) Average of the indicator by sort of population. (3) Monthly average in MXN in the year 2010. Source: own elaboration from ENIGH 2010.

According to 2010 ENIGH, the number of indigenous households[3] in Mexico amounts to 7.56 percent of the total, while 92.44 percent are considered non-indigenous households. Taking into account the specific characteristics of the head, at non-indigenous households a greater participation of women as heads is noticed (nine percent) than at indigenous households (8.5 percent). The heads at indigenous households are on average 49.5 years of age and one year older than at non-indigenous. On the other hand, indigenous heads have lower schooling, as most only have complete elementary, while among non-indigenous heads complete secondary school prevails. Regarding the incentives for better education, it has been noticed that returns from education for indigenous population have been uneven and lower compared with non-indigenous population (CEPAL, 2007; Hall and Patrinos, 2005; Patrinos, García-Moreno and Álvarez, 2007). Non-indigenous heads approximately earn and spend twice as much as indigenous heads, however, both sorts of households obtained about 70 percent of their incomes from work.

This indicates the impossibility for the development of indigenous peoples and their relative difficulty to generate wealth from good-quality jobs. Regarding health, disparity in entitlement to medical institutions is observed, as shown in table 1. Indigenous heads have lower participation (21.2 percent) than non-indigenous (48.9 percent). However, indigenous heads have a larger entitlement to Seguro Popular (44.4 percent) than non-indigenous heads (25.4 percent).

As for the household economic status, it is observed that non-indigenous households have a smaller housing size (3.8 square meters) compared with indigenous housing (4.4 square meters); as well, indigenous households have a larger number of dependent individuals, on average 1.4 children under 14, 1.6 under 13 years and older than 64 regarding non-indigenous households (1 and 1.2 individuals, respectively). Indigenous households have greater presence in rural localities (45.5 percent) than non-indigenous (19.4 percent).[4] The economic status of indigenous people is affected by both the geographic location and the size of the locality where they live. This is because the families settle in wild regions, sparsely populated and far from the urban centers where active economic life develops, in these places the provision of public services related with decorous housing and access to roads are more expensive to supply, therefore less accessible. As shown in table 1, the condition of belonging to an indigenous group is

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[3] In Psacharopoulos and Patrinos (1994) the term indigenous refers to municipalities with a percentage of 30 percent or more of households identified as indigenous.
[4] Localities with fewer than 2 500 inhabitants.

related to the sort of locality of residence and this with its own geographic location. Téllez *et al.* (2013) produced a municipal classification according to sort of locality with indigenous presence and found that out of the 6.5 million inhabitants residing in localities with high indigenous presence, 73.1 percent lives in the existing 18 800 rural locations.[5] Moreover, of the total localities with marked indigenous presence, 85 percent locates in disperse regions, which implies 3.9 million people in geographic isolation, which have meant worse housing conditions and poor access to opportunities in education and health.[6] The sort of locality where indigenous people live affects not only access to better infrastructure, wage disparities have also been noticed in such regions. Finan *et al.* (2005) found that in the rural zones of Mexico, indigenous people have fewer chances to receive a wage compared with non-indigenous population, linked to the stressed differences in wages that favor the non-indigenous population of these zones.

DETERMINANTS OF INCOME POVERTY IN MEXICAN HOUSEHOLDS

In this section we identify the observable variables that determine the generation of incomes in Mexico by means of a probit model. Once the determinants are obtained, a vector of household characteristics is obtained; it is called X and later on it will be used to find out the representation and severity indexes for indigenous households. For this, we will suppose that the probability that a head is poor in incomes can be expressed in function of the personal characteristics, of the household and of the region where families live, as follows:

$$P_i = P(Y = 1|X) = F(\beta \, X_i) \qquad\qquad (1)$$

Where: P_i is the probability that household i is poor according to the households' equivalent monetary income;[7] Y is the poverty line officially established by Coneval (2010); F is the function of the accumulated nor-

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[5] In the study a criterion of territorial dimension is used to classify the municipalities according to their percentage of population speaker of an indigenous language. The 107 458 localities used in the analysis were classified considering an indigenous population as the one in which 70% or more of its inhabitants of five years or more speak an indigenous language. For their part, predominantly indigenous localities comprised a demographic proportion of between 40 and 70 percent of people who speak an indigenous language. Localities with moderate indigenous presence comprise between 10 and 40 percent of the population who speaks an indigenous language. Finally, localities with sparse indigenous presence were those with less than 10 percent of the population who speaks an indigenous language.
[6] According to the definition by CONAPO (2002), disperse localities are those in zones up to 3 kilometers away from a paved or dirt road, plus those far from a road or population center.
[7] The equivalence scale is that by OECD. The scale is as follows: $(1 + (0.5)(A-1) + (0.3)K)$. This is, the first adult counts 1.0, each additional adult, .05 of the first adult and each child under 14 (or this age) counts as 0.3 of the first adult.

mal distribution; β is the vector of the model's parameters; X_i is the vector of observable characteristics of the *i-th* household, *i.e.*, the determinants of income poverty. This is to say, equation (1) is an association of statistics between the indicator of monetary poverty and the vector with the characteristics identified in each household.

There is abundant literature on the determinants commonly associated with the probability of obtaining low incomes in the families. Finding out such factors is relevant as a first step to measure the effect and weighting that each determinant imprints on the probability of a household to fall into income poverty.

Of the characteristics of the household head, the age is one of the determining factors of the house's wellbeing. Age is related with accumulation of experience and human capital by the individuals, which increases incomes and decreases the probability of falling into poverty (Castillo and Brborich, 2007). The head's educational level is one of the most studied aspects in the literature (Schultz, 1993; Panagides, 1994; Cortés, 1992; Garza-Rodríguez, 2002) owing to the existing relationship and any condition of poverty, as it appears in the link between education returns and better possibilities of employment and incomes these generate (CEPAL, 2007; Hall and Patrinos, 2012; Patrinos and García-Moreno, 2007). The gender of the head is one of the variables in which no consensus has bee reached regarding its relation with the probability of falling into poverty. On the one side, if certain forms of social exclusion against women, related to employment and the sexual division of domestic work, are considered, certain vulnerability at households with a feminine head would be expected (Acosta, 2001; Arriagada, 2005; González de la Rocha, 1988). However, there are theoretical stances and empirical evidence that do not reflect a direct relation between poverty and feminine heads as these households have better management and distribution of resources, this way such reference allows alleviating the negative effects of the market on the opportunities to find a job for a woman (Chant, 1998; Cortes, 1992). The ethnicity of the head is a determining factor to generate incomes because of its effects on the labor market (Gandelman *et al.*, 2011; Duryea and Genoni, 2004). Hall and Patrinos (2000) reveal that belonging to an indigenous group in Mexico increases the probability of being poor in 30 percent more than non-indigenous population.

The characteristics of the household are also fundamental in low wages. Size tends to be a factor positively related with poverty (Garza-Rodríguez, 2002; Székely, 1998). Lanjouw and Ravallion (1995) analyzed that the

most numerous households tend to be the poorest because the parents, having little savings and deficient social security, from using more resources on their dependents, ultimately opt for having more children so that these support them in advanced age. However, some studies establish that the size should be a balance between the needs to satisfy and the household resources (Cuéllar, 1990) and should not be directly related with poverty, for it is insensitive to the vital cycle, *i.e.*, there is no distinction between two adults and two children (Cortés, 1992). The location of the households, mainly those in the rural sphere, as it has been demonstrated to be a determinant of poverty because these regions are associated with an economic activity of very low productivity and little incomes for the families that work there (Cortés, 1992; Rodríguez and Smith, 1994; Boltvinik, 1995; Garza-Rodríguez, 2002).

Table 2 presents the results from the estimation of equation (1) for the total population. At a first glance, the estimations show agreement between the variables and the aforementioned literature. The age of the head is inversely related with the probability of falling into poverty, as mentioned by Castillo and Brborich (2007), owing to the accumulation of human capital that formally or informally the individuals build up and so it increases the capacity to generate income. We found that the more schooling of the head, the lower the probability that the household is poor. This fully agrees with a large number of studies that have analyzed the topic (Schultz, 1993; Cortés, 1992; Garza-Rodríguez, 2002). Evidence was also found in the results that the feminine gender of the head does not increase the probability that the household is poor. This may be explained by the fact that head women were more efficient in the management and use of resources (Chant, 1988) or because they received resources from non-labor incomes or from source alien to the household (Cortés and Rubalcava, 1995; Echarri, 1995). Results also show a positive relationship in the case that the head belongs to an indigenous group (ethnicity) and the probability of being considered poor in monetary terms. This phenomenon agrees with the above-mentioned literature, in which it is distinguished that indigenous groups tend to generate lower incomes due to their scant participation in high-quality jobs (Duryea and Genoni, 2004).

Household size is among the characteristics with most relevance in the determination of incomes. Households composed of fewer members decrease the possibility of obtaining lower incomes, households in which the head lives with their partner (marital status) increase the probability of falling into poverty.

Table 2: Probability of a household to fall into income poverty

Variable name	Household head indicator	Coeff.	P>|z|
EDAD	Age	-0.019	0.000
EDUC	Highest schooling	-0.247	0.000
TAM_HOG	Household size	0.527	0.000
ETNIA	Speaker of an indig language	0.373	0.000
RURAL	Lives in the rural sphere	0.164	0.000
EDO_CIVIL	Lives with spouse or partner	0.137	0.000
GENERO	Gender (woman=1, man =0)	-0.042	0.000
Constant		0.019	0.000
Prob > χ^2		0	
Pseudo R^2		0.3721	
Log likelihood		-12 614 476	

NB: see annex 1 to consult the construction of the variables.
Source: own elaboration from ENIGH 2010.

This situation discloses a dynamic that reflects a heavier economic supportive responsivity for the heads of each household if not only size is considered but also the necessities to meet and the resources demanded by each member (Chayanov, 1974), especially if they are not capable of working to generate their own incomes. In like manner, the location of the household in rural zones increases the possibility of poverty. This mainly occurs because rural households have displayed heavier dependency on agriculture, an economic activity recognized by its low productivity (Rodríguez and Smith, 1994; Boltvinik, 1995).

REPRESENTATION AND SEVERITY INDEXES FOR INDIGENOUS HOUSEHOLDS IN MEXICO

Representation index

In this section we measure the representation of the indigenous households' income referred to non-indigenous ones in the income distribution. To do so, we utilized the representation index proposed by Pendakur *et al.* (2008), which measures the representation of group in a region in an income distribution ordered by quantiles. The representation index can be non-conditioned or conditioned to the income determinants discussed in the previous section. The non-conditioned index is exclusively supported on the income levels of indigenous households regarding the income level of the reference anchor group at various specific points of the income distribution. On the other side, the conditioned index make such comparison but considers that determinants of income in both population groups.

This is to say, we suppose that $i = 1, 2, \ldots, n$ denotes the number of households of the sample. Each household is a member of group $j = 1, 2, \ldots, k$, which has n_j members. The equivalent income of the head is y, while the vector of the household characteristics is X. The joint distribution of income and household characteristics in the members of the group is written as $f_j(y, X)$ and we suppose that $f(y, X)$ is the joint distribution of the reference group is the non-indigenous population, a group with which the situation of the indigenous households is compared.

The simple form of the representation index is an unconditioned measurement, *i.e.*, that which is obtained only ordering the data at equivalent income levels y to obtain quartile number τ of the sample, this is, $q^{\wedge}(\tau)$. The index result of a particular sample can be written as:

$$\hat{R}_j(\tau) = \frac{1}{n_j} \sum_{i \in j} I[y_i < \hat{q}(\tau)] \qquad (2)$$

$Rj^{\wedge}(\tau)$ is the proportion of the group whose income levels are below quantile $q^{\wedge}(\tau)$. We see the interpretation of the index in Figure 1. The figure shows three accumulated income distributions: the accumulated income distribution of a hypothetical population (F_{pop}, solid line); the accumulated distribution of the indigenous group (F_{ind}); and the accumulated distribution of the reference group (F_0). For a certain level of quantile τ, there is a difference in income levels between the group of indigenous people and the reference group, this difference is in the δ^τ_{ind} graph, which is the horizontal distance between F_{ind} and F_0. In like manner, for any given quantile τ, the difference between the representation of the two groups y_τ is the vertical distance between F_{ind} and F_0. For example, if we estimate the representation index of the heads of indigenous families in the first decile of the population and obtain the following result: $R^{\wedge}(0.10) = 0.25$, it means that 25 percent of the indigenous heads obtains lower incomes than the reference groups, this is to say, the group of indigenous heads is overrepresented in the first decile of the reference population. On the other side, $R^{\wedge}(0.90) = 0.92$ means that in the upper part of the distribution there is a 20-percent underrepresentation.

The representation of the interest group over the income distribution regarding the reference group can certainly vary; it is possible to find an overrepresentation of the interest group in the lowest deciles accompanied by an underrepresentation at the uppermost deciles regarding the reference groups. In this situation, discrimination can be referred to at income levels

that the interest group experiences regarding what may be interpreted as bad characteristics it has. Owing to this, it is very important to make the estimation of the representation index of the minority group *j* conditioned to a group of sociodemographic characteristics in the determination of household income (Figure 2).

Figure 2: differential in quantiles and representation
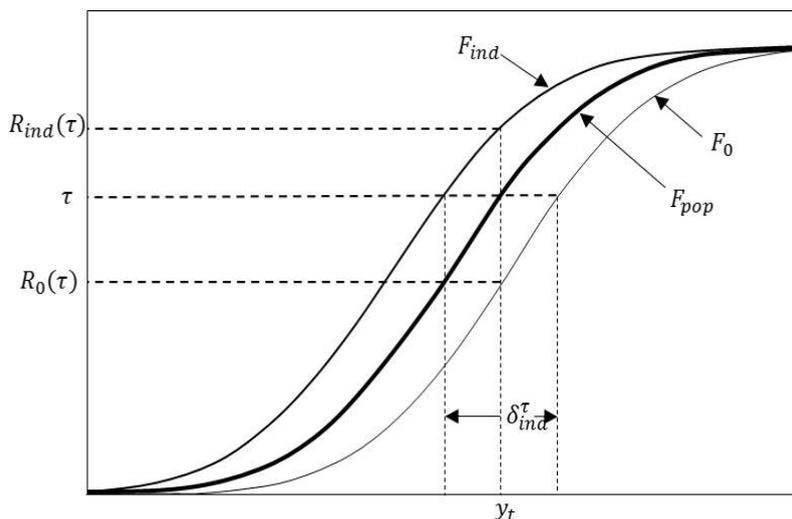
In order to find he representation index conditioned to certain characteristics X, we define $F_j(y \mid X)$ as the function of equivalent income distribution conditional to the characteristics for the members of group *j*, while for $F(y \mid X)$ is the equivalent income distribution conditional to the same characteristics for the reference group. This way, it is possible to obtain the quantile τ of the income distribution of the reference group with characteristics X, *i.e.*, $q(\tau, X)$. A function of conditional representation $r_j(\tau, X)$ is thus defined as the proportion of the members of group *j* with characteristics X whose incomes are below the quantile $q(\tau, X)$ of the reference distribution. This is,

$$r_j(\tau, X) = F_j(q(\tau, X) \mid X) \qquad (3)$$

The representation function $r_j(\tau, X)$ depends on X, so its magnitude for any given X does not reveal the representation of a group in its entirety. It is necessary to add all the information of all the groups in the sample, to obtain the conditional representation index. The index is written as:

$$r_j(\tau) = \frac{1}{n_j} \sum_{i \in j} r_j(\tau, X) \qquad (4)$$

It is that $r_j(\tau)$ is the mean representation of the group *j* below quartile τ of the reference distribution. If $r_j(\tau)$ exceeds the value of τ, then we say that given the characteristics X, group *j* is overrepresented below quartile τ of the reference distribution. On the contrary, if $r_j(\tau)$ is lower than the value of τ, then we way that it is overrepresented in that region of the distribution.

The advantage of the representation index in equation (3) regarding the unconditioned index (1) is precisely its usefulness to estimate the over- and underrepresentation of groups of interests controlling for the individual characteristics that can directly contribute to generate incomes in a particular household. Moreover, the estimation of the conditioned representation index needs a more complex estimation process than mere data ordering, as it is for the case of the non-conditioned index. The estimation of the conditioned representation index $rj(\tau)$ requires two stages. The first is to estimate the conditioned quartiles for the anchor group via the regression of the quantile of determinants X, which we define as $Q(\tau,)$. In the second stage, the values estimated in the conditioned quartile regression are utilized to build the estimated values $Q^{\wedge}(\tau,)$ of each *i* of group *j*. The sample estimator of the conditioned representation index is

$$\hat{r}_j = n_j^{-1} \sum_{i \in j} I[y_i < \hat{Q}(\tau, X_i)]$$

Where *I* is an indicator function. The file Stata.do to perform the estimations of the representation index using regressions by quantiles is available at http://www.sfu.ca/~pendakur.

Table 3 presents the results of the representation index by demographic groups and includes the representation of the group of indigenous families referred to the group of non-indigenous families in the first, fifth and ninth income deciles. Beginning with the lowest decile, by definition, ten percent of the anchor or reference distribution earns ten percent less, *i.e.*, $q^{\wedge}(0.1)$. The two first rows refer to the total population of non-indigenous and indigenous heads, respectively. As regards this reference point in the income

distribution, the representation index for the group of indigenous families is R(0.1) = 0.2974, which means that indigenous families are overrepresented in 197 percent in the lowest decile of income distribution. At the other end, the highest decile (τ = 0.9), we notice an utterly different situation. By and large, indigenous people are underrepresented in 75 percent $R^{\wedge}(0.9) = 0.9755$. If we consider these two ends, they give us an indication of the backwardness in terms of incomes experienced by indigenous households regarding non-indigenous ones. This backwardness as indicated by Duryea and Genoni (2004) rests upon the difficulty these households have to generate wealth, as they have poor participation in high-quality jobs, they present poor schooling and backwardness in determinants of household incomes. To control for such differences, in the last three columns of table 3, the representation index conditioned to the series of income determinants discussed in the previous section is compared.

Table 3: Index of representation by demographic groups

	Unconditioned			Conditional		
	T = 0.1	T = 0.5	T = 0.9	T = 0.1	T = 0.5	T = 0.9
Household heads:						
Non-indigenous	0.0838	0.4781	0.8938	0.0919	0.4887	0.8975
Indigenous	0.2974	0.7666	0.9755	0.1972	0.6358	0.9312
Non-indigenous woman	0.0833	0.4800	0.8943	0.0944	0.4923	0.8981
Indigenous woman	0.3136	0.7625	0.9733	0.1706	0.6043	0.9351
Non-indigenous man	0.0800	0.4772	0.8935	0.0917	0.4872	0.8974
Indigenous man	0.2910	0.7695	0.977	0.1974	0.6496	0.9302

Source: authors with estimations from ENIGH 2010.

This is to say, if we control for age, schooling level, marital status and gender of the head, besides size and geographic location of the household, we find that the tendency of results in the first three columns remains but with smaller percentages. This is to say, in the lowest decile the group of indigenous families is still overrepresented in 97 percent (R(0.1) = 0.1972); while in the highest, these families are underrepresented in 31 percent (R(0.9) = 0.9312). These results are an evidence of the discrimination in monetary incomes suffered by indigenous households. De la Torre (2010) recognizes that the fact that an individual participates in the process to generate local wealth and has access to education and quality health care, regardless of their characteristic features, are indicators that

should glimpse the level of equality in opportunities existing in society. Our results find a significant bias that is not explained by the income determinants and that underlay lack of equality in opportunities for indigenous households in Mexico. The last four rows of table 3 disaggregate results by gender and we find that there is no substantial difference between indigenous households with a man or woman as a head.

Severity index

While the representation index gives us information at various parts of income distribution (for example, in the first decile of income distribution), the severity index adds the representation of a group in all the quantiles up to the quartile of interest that we defined as cut line. This is to say, the severity index focuses on the cut quartile and responds to the representativeness level of a particular group regarding the anchor group for all the quantiles below the cut. There exist many ways to add poverty in the literature.[8] One of the most commonly used in empirical applications is to weight the severity index per quantile with a monetary function of the distance in relation to the cut quartile. Expectil function (Newey and Powell, 1987) is a convenient way to weight the representation to each quartile in the income distribution. Expectil function defines a cut line e(τ, X) such that the proportion of weighted density of income below e(τ, X) is τ. The weight is then the monetary value of the distance regarding the cut line |e(τ, X) - y|. Therefore, we have that the conditioned severity index is defined as:

$$s_j(\tau, X) = \frac{\int_0^{e(\tau,X)} |e(\tau, X) - y| f_j(y, X) dy}{\int_0^{\infty} |e(\tau, X) - y| f(y, X) dy} \qquad (5)$$

The severity index has a simple interpretation. Since x, the severity function of the anchor distribution is τ, therefore, if $s_j(\tau,)$ is greater (less) than τ, then the representation of group j below the anchor expectil τ is greater (less) than the anchor group.

The sample estimator of the severity index for the members of group *j* is the average sample of the weighted representation below the cut defined as the function of estimated expectil regression, $\hat{E}(\tau, i)$:

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[8] A review of the literature with the most important indexes can be found in Zheng (2014) and Foster and Sen (1997).

$$s_j(\tau) = \frac{\sum_{i \in j} \max\{\hat{E}(\tau, X_i) - y_i, 0\}}{\sum_{i \in j} \left| \hat{E}(\tau, X_i) - y_i \right|} \qquad (6)$$

Finally, we know that the representation function, $s_j(\tau, X)$, depends on X, thereby it is convenient to obtain a measure that averages on X, so we define a severity index $s_j(\tau)$, such that:

$$s_j(\tau) = \frac{1}{n_j} \sum_{i \in j} s_j(\tau, X_i). \qquad (7)$$

In Table 4, we present the results of the severity index for the case of indigenous people in Mexico. The table presents the results for the unconditioned and conditional analyses of the characteristics maintaining various levels of quantiles as a cut point in the analysis. In the analysis the group of non-indigenous households is maintained as the anchor group. We notice that the results in Table 4 show that by and large for the indigenous families the estimator is larger than the obtained in Table 3, which means that the incomes of indigenous families are more concentrated at the lower part of the distribution. The depth of backwardness is more alarming when it is weighted by the difference between the cut point and the household income. If we take as a cut point the first income decile, we notice that for the cases of indigenous woman and men, they are overrepresented in the poorest decile of the income distribution; however the situation is ever more critical for the indigenous man if we consider that the unconditioned severity index is on average up to three times higher than for the non-indigenous group. This tells us that such population group tends to heavily concentrate at the lowest incomes of the distribution. Moreover, we notice that there is a different case for the indigenous man regarding indigenous woman, if we compare with Table 3 that shows that indigenous women have a slightly more backward than indigenous men; this result reverts in Table 4.

This tendency maintains along all the cut quantiles for the unconditioned severity index. If controlling for the individual characteristics of indigenous people the overrepresentation of the overrepresentation of the group is somewhat mitigated, even though the estimators are still higher than those obtained in table 3, which verifies that the monetary incomes of indigenous households tend to accumulate at the lower part of the income distribution.

Table 4: severity index by demographic groups

| | Total current income | | | | | |
| | Unconditioned | | | Conditional | | |
	t = 0.1	t = 0.5	t = 0.9	t = 0.1	t = 0.5	t = 0.9
Household heads:						
Non-indigenous	0.0775	0.4532	0.8860	0.0905	0.4815	0.8953
Indigenous	0.3987	0.8492	0.9828	0.2210	0.6700	0.9405
Non-indig woman	0.0817	0.4645	0.8904	0.0946	0.4904	0.8982
Indigenous woman	0.3654	0.8111	0.9696	0.1776	0.6140	0.9208
Non-indig man	0.0759	0.4492	0.8846	0.0899	0.4793	0.8943
Indigenous man	0.4112	0.8605	0.9858	0.9858	0.6916	0.9459

Source: authors' elaboration based on ENIGH 2010 (INEGI, 2010a).

The non-conditioned severity index obtains results very similar to those of other studies in the literature (Navarrete 2008; Finan *et al.*, 2005; Patrinos, 2012); however, according to Renshaw and Wray (2004) it is unfair to compare differences between indigenous and non-indigenous population incomes, as these are received in different ways and in utterly different social contexts. The advantage of the proposed methodology is that it allows controlling for a series of factors relevant to determine the individuals' incomes and nevertheless we find substantial differences. This is to say, indigenous households with a head with certain education level, number of members and other relevant characteristics face worse income opportunities than non-indigenous households with similar characteristics. The results presented here show us a concerning degree of discrimination in monetary incomes against indigenous households in Mexico. Our results agree with those by Gandelman *et al.* (2011), who conclude that race and ethnicity, *i.e.*, skin and appearance, severely restrict the opportunities to choose where to work and affect the possibilities of finding a job and even entering the labor market.

Conclusions

Social lacks and economic precariousness experienced by indigenous households in Mexico make them the minority with the most vulnerability in the country. The economic situation of indigenous households is characterized by low incomes, worse educational levels and poor capacity to generate incomes regarding non-indigenous households.

In this study we measured the representation of indigenous households at various points of the income distribution using the index proposed by Pendankur *et al.* (2008). Differences in monetary incomes between indi-

genous and non-indigenous families can be the result of many factors. If we consider the determinants of household incomes, the indigenous households' conditioned representativeness regarding the non-indigenous families is obtained. Estimating the conditioned representativeness index and assessing the indicator for the first, fifth, and tenth decile of the income distribution, the results indicate that at the lowest decile there is a conditioned representativeness index of 0.1972, which means there is an overrepresentation of 97 percent of the members of the indigenous group regarding non-indigenous families. On the other side, considering the highest decile in the distribution, it is estimated that indigenous people, in general, are underrepresented in almost 31 percent. The severity index aggregates information on the households' representativeness in each quantile of the income distribution up to a cut quantile. The severity index shows us that differences in monetary incomes between indigenous and non-indigenous households are not necessarily attributed to observable individual, familial or regional, characteristics. It is noticed that the severity index is twice as much for male indigenous heads regarding non-indigenous. This reveals the stressed differences in opportunities these households have to generate incomes, which demonstrates a latent discrimination for this group in particular. Social policies have to aim at better social inclusion for indigenous people, as stated by Gandelman *et al.* (2011), for race and ethnicity restrict the opportunities to find a job and even entering the labor market. The design of public policies shall pay close attention to the differences in the opportunities in the market the indigenous families have. Merely increasing financial resources for indigenous families will not be enough to bridge the gap in monetary incomes, for the markets are capable of perpetuating these differences reducing the ability of economic integration of the families in the mid and log terms.

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ANNEX

Annex 1: Construction of variables used in the estimated model

AGE	Age of the household head.
EDUCA	The highest schooling received by the head. It uses the scale established by ENIGH: 1=No schooling; 2=kindergarten; 3=incomplete elementary; 4=complete elementary; 5=incomplete secondary; 6=complete secondary; 7=incomplete high-school; 8=complete high-school; 9=undergraduate, 10=graduate; and 11=postgraduate.
TAM_HOG	Amount of people who live in the household.
ETNIA	Dichotomic variable that identifies if the head speaks an indigenous language. 1=speaks an indigenous language, 0=does not speak and indigenous language.
RURAL	Dichotomic variable that identifies if the household is at the urban or rural sphere. 1=rural sphere, 0=it is not in the rural sphere.
EDO_CIVIL	Dichotomic variable that identifies if the head lives with their spouse or in free union. 1=lives with their partner, 0=does not live with their partner.
GENERO	Dichotomic variable that identifies the gender of the head. 1=woman, 0=man.
POBRE	Dichotomic variable that identifies if the head is considered poor or not according to urban and rural poverty lines by CONEVAL (2010), applying equivalence scales. 1=poor, 0=not poor.

Annex 2: Scale of the marginalization index of CONAPO

Classification	Scale
Very high	1
High	2
Mid	3
Low	4
Very low	5

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Annex 3: Scale of the highest schooling of the head

Schooling	Scale
No instruction	1
Kindergarten	2
Incomplete elementary	3
Complete elementary	4
Incomplete secondary	5
Complete secondary	6
Incomplete high-school	7
Complete high-school	8
Undergraduate	9
Graduate	10
Postgraduate	11