Identifying gender-specific risk factors for income poverty in urban Mexican households

Juan Armando Torres Munguía (✉ jtorres@gwdg.de)
Georg-August-Universität Göttingen

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Author:
Juan Armando Torres Munguía*

Affiliation:
* Faculty of Economic Sciences, Georg-August-Universität Göttingen. Göttingen, Germany.

Corresponding author:
* e-mail: jtorres@gwdg.de

* https://orcid.org/0000-0003-3432-6941
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Abstract

In this paper, the aim is to identify a subset of factors for income-to-poverty ratio in urban Mexican households. Special emphasize is paid to examine differences between women- and men-headed families. To this, an original dataset with 45 theoretical factors at the individual/household, community, and regional levels, integrating information from nine sources is created. To these data, additive quantile models are estimated via the boosting algorithm.

From a gender standpoint, the following main contributions come from this paper. First, educational lag is particularly relevant for women-headed households. Second, there is a gendered-life cycle in the income trajectory for poor households with a head holding a medium level of education. Third, it is identified some households, traditionally disregarded, that may be even poorer: those lacking social connectedness, without credit card, with an extended composition, in which the woman head spends a large part of her time on housework, and families headed by a young woman with a medium level of education. Finally, communities and regions where families have a lower income-to-poverty ratio are characterized for having and unequal income distribution, with a low human development, a low women’s economic participation, with a poor quality of services, with low levels of gender-based violence in the public sphere but high levels of gender-based violence in the family context.

Key words: gender bias, income poverty, Mexico, quantile models
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1 Introduction

The 2016 official poverty data indicate that in Mexico, approximately 53.4 million people (50.6% of the total population) had an income below the poverty line. Most of them, about three out of every four persons, lived in urban communities (CONEVAL, 2020). This issue becomes even more dramatic when considering the increasing concentration of people living in cities (CONAPO, 2021), and the phenomena of marginalization, violence, and inequality associated with the urbanization process (CONEVAL, 2010, 2014).

To fight against urban poverty, it is key to identify their specific risk factors. Research on the matter has consistently found that lower income levels are linked to young individuals, with low education levels, indigenous, and living in overcrowding (Garza-Rodriguez, 2016; World Bank, 2005). Findings also indicate that poverty tends to be concentrated in areas whose population is marginalized, deprived, and with an unequal distribution of wealth (CONEVAL, 2010; Székely & Rascón, 2005; Urzúa & Brambila, 2009).

Notwithstanding the relevance of these contributions for the case of urban Mexico, there are still some important aspects lacking empirical analysis. First, gender issues are commonly overlooked even though dissimilarities between sexes have been extensively pointed out (ECLAC, 2004; Munoz Boudet et al., 2018). Moreover, when considering the drivers of poverty, gender-related issues such as time use, political participation, and violence are scarcely examined. International evidence however, indicates that they are linked to poverty (Cash et al., 2005; Gillum, 2019; Merz & Rathjen, 2014; Slabbert, 2017). Another understudied aspect is the association of poverty with some emerging issues such as social connectedness, quality of government, and corruption, which have been found to be significant in previous studies (Aina, 2014; Gupta, 1998; Lubbers et al., 2020). Third, even that it is of larger interest to examine the situation experienced by the people living at the lowest income levels, most of the existing research is based on mean regression models that exclusively analyze the average income or the probability of being poor, disregarding the fact that the poorest face specific adversities, i.e. the effect of the different factors vary with the intensity of poverty (Peng et al., 2019).

Considering these aspects, the goal of this paper is to contribute to the scientific debate about income poverty in urban households in Mexico by identifying a set of risk factors associated with the income-to-poverty ratio, calculated by dividing the family’s income by the corresponding official poverty threshold.

To identify the relevant risk factors, a cross-sectional dataset containing information on 33,073 urban households is used. The set of covariates is composed of 45 variables at the individual / household, community, and regional
levels, and are collected from nine different sources (administrative records, surveys, and censuses). Posteriorly, additive quantile models are applied. This structure enables considering linear, nonlinear, random, spatial, and interaction effects. To pay special emphasize on unmasking heterogeneous effects according to the head’s sex, women- and men-headed households are separately analyzed, and their corresponding estimations are then compared. Furthermore, the quantile approach allows to compute specific parameters for different quantiles of the response variable distribution, and thus, examine the circumstances experienced by the poor and extremely poor families. In this way, it is possible to investigate how these effects vary with the severity of poverty. In sum, four models are estimated: two models are applied to women-headed families and are estimated for the quantiles corresponding to the poor and extremely poor income levels. Similarly, the other two models correspond to poor and extremely poor man-headed households.

The rest of the document is organized as follows. Section 2 reviews the literature on urban poverty in Mexico, presents the data, and the methodology. Section 3 presents the main results and section 4 discusses them and contrast the findings with previous research. Conclusions are presented in section 5.

2 Material and Methods

2.1 Literature review on urban poverty

Risk factors for poverty can be classified into three categories: individual and household characteristics, community characteristics, and regional features (Haughton & Khandker, 2009).

At the individual and household level, it is extensively recognized that women, young people, persons with low education levels, from minority groups, with a poor health condition, without access to credit, lacking of social networks, socially deprived, devoting a large amount of time to housework, and/or members of large families are more likely to be poor (Das, 2019; ECLAC, 2004; Fusco et al., 2011; Haughton & Khandker, 2009; Iacovou, 2013; Munoz Boudet et al., 2018; Peng et al., 2019). Similar findings have been achieved in studies about urban Mexico regarding the age, sex, educational level, indigenous origin, access to credit, social deprivation, and overcrowding (CONEVAL, 2010; Garza-Rodriguez, 2016; Niño-Zarazúa, 2007; Rojas García, 2003). Nevertheless, the effect of other variables such as social networks and time use has not been discussed.

Regarding the community characteristics, literature indicates that higher poverty levels are concentrated in communities socially marginalized, exposed to natural disasters, with high levels of income inequality, with lower participation in industrial activities (oriented to the primary sector), and with significant levels of out-migration (Adelman & Jaret, 1999; Baez et al., 2020; Haughton & Khandker, 2009; McKenzie, 2017). These findings have
been corroborated in research for urban Mexico (CONEVAL, 2010; Iniguez-Montiel & Kurosaki, 2018; Urzúa & Brambila, 2009).

At the regional level, research indicates that households in poverty tend to live in regions with low quality of government, high crime incidence, and experiencing corruption (Aina, 2014; Gupta, 1998; Haughton & Khandker, 2009). Regarding gender issues, Gillum (2019) and Terry (20 found that gender-based violence and poverty are significantly associated. To the best of my knowledge, regional variables have not yet been investigated for urban Mexico.

2.2 Data description and sources

The dependent variable in this study is the household’s income-to-poverty ratio. This ratio is calculated by dividing the total household income by the corresponding poverty threshold according to the number of family members. This ratio has been used in previous poverty studies (Greenwell et al., 2001; Heggeness & Hokayem, 2014; Peng et al., 2019), and has the advantage of capturing how far/close is the household income from the poverty line, i.e. how far/close is the family to be able to afford the cost of their basic needs (Heggeness & Hokayem, 2014).

The information source for income data is the 2016 National Survey of Household Income and Expenditure (ENIGH) carried out by the National Institute of Statistics and Geography (INEGI). For further details see INEGI (2016a). The official criterion for establishing the poverty threshold is set by the National Council for the Evaluation of Social Development Policy (CONEVAL). According to it, a person lives in income poverty if their income is not enough to afford the total cost of both a basic food and non-food baskets (including education, transportation, entertainment, health, etc.). A person is considered to live in extreme poverty if their income is not even sufficient to cover the cost of the basic food basket (CONEVAL, 2019, 2020). In urban communities, the poverty and extreme poverty thresholds were respectively calculated by CONEVAL at MXN$2660.40 and MXN$1310.94 monthly *per capita*. Thus, considering the urban poverty threshold as reference, an income-to-poverty ratio equal to one suggests that the household lives at the poverty line. When the income-to-poverty ratio is less than one, the family is considered to live under poverty. Particularly, if the income-to-poverty ratio is less than 0.493 (1310.94 divided by 2660.40), the family is extremely poor.

The covariates are chosen from literature and include a total of 45 variables at the individual / household, community, and regional levels. The list of variables is shown in Table 1, where column 4 indicates the modeling alternatives considered for each variable. For continuous variables both linear and nonlinear effects are introduced
for each one of them. For instance, for variable head’s age linear, non-linear, and interaction effects with education level, and marital status are considered. See the Electronic Supplementary Material for summary statistics.

Table 1 List of covariates included in the full model

<table>
<thead>
<tr>
<th>Level / household</th>
<th>Variable</th>
<th>Definition</th>
<th>Relationship</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous origin</td>
<td>Indigenous self-identification of the household head. <strong>Categories:</strong> &quot;yes&quot;: if the head self identifies as indigenous; and, &quot;no&quot;: otherwise.</td>
<td>Linear</td>
<td>ENIGH</td>
<td></td>
</tr>
<tr>
<td>Social networks</td>
<td>Degree of perception of the household head on the easiness to obtain support from social networks in six hypothetical circumstances: need of money, care due to illness, help to get a job, to be accompanied to a medical appointment, collaboration to improve neighborhood conditions, and child care assistance. <strong>Categories:</strong> &quot;low&quot;: if obtaining support from social networks in the majority of hypothetical situations is perceived by the head as difficult or impossible; &quot;high&quot;: if obtaining support from social networks in the majority of hypothetical situations is perceived by the head as easy or very easy; and, &quot;medium&quot;: otherwise.</td>
<td>Linear</td>
<td>CONEVAL with data from ENIGH</td>
<td></td>
</tr>
<tr>
<td>Individual / household</td>
<td>Credit card</td>
<td>Holding of a credit card by at least one household member. <strong>Categories:</strong> &quot;yes&quot;: if at least one member holds a credit card; and, &quot;no&quot;: otherwise.</td>
<td>Linear</td>
<td>ENIGH</td>
</tr>
<tr>
<td>Disability</td>
<td>Reported status of disability (having a developmental delay; a mental illness; and/or difficulties, or limitations performing one or more basic/everyday activities such as moving their arms, moving their legs, walking, seeing, hearing, speaking, bathing, toileting, eating, dressing, and/or learning basic skills or concepts) of the household head. <strong>Categories:</strong> &quot;yes&quot;: if the head has a disability; and, &quot;no&quot;: otherwise.</td>
<td>Linear</td>
<td>ENIGH</td>
<td></td>
</tr>
<tr>
<td>Type of household</td>
<td>Type of household based on the number of members, and the relationship between them. <strong>Categories:</strong> &quot;one-person&quot;: consisting of only one member (head); &quot;nuclear&quot;: made up by the head, and their partner; the head, their partner, and their children; the head, and their parents; or the head, and their siblings; &quot;extended&quot;: consisting of the head, their nuclear family (in case of having), and at least another member whose kinship tie with at least one of the other household members is beyond the nuclear family kinship ties (i.e. aunts, uncles, nephews, nieces, grandparents, grandchildren, and/or cousins); and,</td>
<td>Linear</td>
<td>ENIGH</td>
<td></td>
</tr>
</tbody>
</table>
"other": formed by the head, their nuclear family (in case of having), and/or their extended family (in case of having), and at least another member without kinship tie with any of the rest of household members.

| **Access to food** | Reported status of the access to nutritious and quality food. The respondent is asked if in the last three months, due to lack of money or lack of other resources, at least one of the household members aged 18 or older experienced the following six circumstances: had a diet based on a very small variety of foods; stopped having breakfast, lunch or dinner; ate less than he/she considers should eat; was left without any food; felt hungry but did not eat; and/or ate just once a day or stopped eating for a whole day. Households having at least one member aged under 18 are asked the same questions to separately capture the information for this particular age group.  
**Categories:**  
"yes": a household without members aged < 18 is considered having access to nutritious and quality food if the respondent answered affirmatively to less than three out of the six questions made (i.e. less than three circumstances experienced in the last three months). Less than four for households having at least one member aged < 18 years.  
"no": otherwise. | Linear | CONEVAL with data from ENIGH |
| **Access to health services** | Reported status of the access to public health services.  
**Categories:**  
"yes": if the head is ascribed or affiliated directly or by kinship to one of the public health institutions or programs; and,  
"no": otherwise. | Linear | CONEVAL with data from ENIGH |
| **Dwelling with adequate quality and sufficient space** | Reported status of the access to a dwelling with adequate quality and sufficient space. This indicator takes into account four dwelling's conditions: if the floor is made of concrete or is coated; if the roofs are made of concrete slab or slab joists with roof, wood, metal sheet, asbestos, or any superior quality; if the walls are made of concrete, brick, block, stone, or any superior quality; and/or, if the number of household members per room (including the kitchen, but excluding hallways and bathrooms) is at most 2.5.  
**Categories:**  
"yes": a household is considered having a dwelling with adequate quality and sufficient space if the dwelling meets the four conditions abovementioned; and,  
"no": otherwise. | Linear | CONEVAL with data from ENIGH |
| **Educational lag** | Reported status of the educational lag of the head. It indicates if the head is lagging behind the compulsory level of education according to their age.  
**Categories:**  
"yes": the head has an educational lag if he/she was born before 1982 and has not yet completed the elementary school level; or, if he/she was born on or after 1982 and has not yet completed the secondary level school; and,  
"no": otherwise. | Linear | CONEVAL with data from ENIGH |
<p>| <strong>Access to basic housing services</strong> | Reported status of the household’s access to basic services. It takes into account four basic services: piped water within the dwelling (or outside, but within the dwelling grounds); drainage connected to the public service (or to a septic tank); electricity; and, use of | Linear | CONEVAL with data from ENIGH |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to social security</td>
<td>Reported status of the access to social security of the head. This indicator takes into account four circumstances: if the head is economically active and has access to social security (public health services and to the pension system); if the head is not economically active but has access to social security due to direct kinship; if the head is retired and receives a pension; and/or, if the head is 65-years old or older and receives a monetary transfer from a public program.</td>
<td>Linear; CONEVAL with data from ENIGH</td>
</tr>
<tr>
<td>Education level</td>
<td>Degree of formal education level completed by the head. Categories: “low”: if the maximum completed level by the head is primary education; “medium”: if the head has minimum secondary education and a maximum of high school; and, “high”: if the head has completed at least a university degree.</td>
<td>Linear; and/or interaction with age; ENIGH</td>
</tr>
<tr>
<td>Marital status</td>
<td>Marital status of the household head. Categories: “single”; “open-union”; “married”; “separated”; “divorced”; and, “widowed”</td>
<td>Linear; and/or interaction with age; ENIGH</td>
</tr>
<tr>
<td>Age</td>
<td>Age in years of the household head.</td>
<td>Linear; non-linear; interaction with education level; and/or interaction with marital status; ENIGH</td>
</tr>
<tr>
<td>Weekly housework hours</td>
<td>Time in hours spent on housework (washing, ironing, cooking, etc.) by the household head per week.</td>
<td>Linear; and/or non-linear; ENIGH</td>
</tr>
<tr>
<td>Social marginalization</td>
<td>Degree of social marginalization in 2015 of the Municipality of household residence. This indicators</td>
<td>Linear; CONAPO</td>
</tr>
</tbody>
</table>
takes into account nine socioeconomic indicators at the Municipal level: percentage of the population aged 15 years and over who are illiterate; percentage of the population aged 15 years and over who have not completed elementary school; percentage of the population living in dwellings without drainage nor toilet; percentage of the population living in dwellings without electricity; percentage of the population living in dwellings without piped water; percentage of the population living in overcrowding conditions (number of household members per room, including the kitchen, but excluding hallways and bathrooms, is greater than 2.5); percentage of the population living in dwellings with dirt floor; percentage of the population living in settlements with fewer than 5000 inhabitants; and, percentage of the employed population having an income of up to two minimum wages. The official methodology elaborated by CONAPO applies the principal component analysis to the data and reduces their dimensionality to a single variable, which is then categorized.

**Categories:**
"very low"; "low"; "medium"; "high"; and, "very high"

<table>
<thead>
<tr>
<th>Emergencies due to weather</th>
<th>Average annual number of declarations of emergency, disaster or contingency due to weather between 2010 and 2015 in the municipality of household residence.</th>
<th>Linear; and/or non-linear</th>
<th>CENAPRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini index</td>
<td>Gini index in 2015 of the municipality of household residence.</td>
<td>Linear; and/or non-linear</td>
<td>CONEVAL</td>
</tr>
<tr>
<td>Human development index</td>
<td>Human development index in 2015 of the municipality of household residence.</td>
<td>Linear; and/or non-linear</td>
<td>PNUD</td>
</tr>
<tr>
<td>Municipal functional capacities</td>
<td>Local functional capacities index in 2015 of the municipality of household residence. This is a composite indicator taking into account five functional capacities of the municipal public administration: capacity to involve relevant stakeholders; capacity to diagnose; capacity to formulate public policies and strategies; capacity to budget, manage, and implement; and, capacity to evaluate.</td>
<td>Linear; and/or non-linear</td>
<td>PNUD</td>
</tr>
<tr>
<td>Women-to-men ratio of housework hours</td>
<td>Number of hours spent by women aged 12 years and over doing housework per hour spent by men aged 12 year and over doing housework in 2015 in the municipality of household residence.</td>
<td>Linear; and/or non-linear</td>
<td>ENIGH</td>
</tr>
<tr>
<td>Women’s political participation</td>
<td>Share of senior positions in the local public administration held by women in 2015 in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Census of Municipal and Delegational Governments</td>
</tr>
<tr>
<td>Migration of women</td>
<td>Share of the 2015 women’s population aged 5 years and over in the municipality of household residence who lived in another state or country in 2010. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Migration of men</td>
<td>Share of the 2015 men’s population aged 5 years and over in the municipality of household residence who lived in another state or country in 2010. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women’s household headship</td>
<td>Share of the 2015 population living in women-headed households in the municipality of household residence.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women’s economically active population</td>
<td>Share of the 2015 women’s population aged 12 years and over who were economically active in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Region</td>
<td>Description</td>
<td>Methodology</td>
<td>Source</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Men’s economically active population</td>
<td>Share of the 2015 men’s population aged 12 years and over who were economically active in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women working in the primary sector</td>
<td>Share of the 2015 women’s working population aged 12 years and over who were employed in the primary sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Men working in the primary sector</td>
<td>Share of the 2015 men’s working population aged 12 years and over who were employed in the primary sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women working in the secondary sector</td>
<td>Share of the 2015 women’s working population aged 12 years and over who were employed in the secondary sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Men working in the secondary sector</td>
<td>Share of the 2015 men’s working population aged 12 years and over who were employed in the secondary sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women working in the trade sector</td>
<td>Share of the 2015 women’s working population aged 12 years and over who were employed in the trade sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Men working in the trade sector</td>
<td>Share of the 2015 men’s working population aged 12 years and over who were employed in the trade sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Women working in the service sector</td>
<td>Share of the 2015 women’s working population aged 12 years and over who were employed in the service sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Men working in the service sector</td>
<td>Share of the 2015 men’s working population aged 12 years and over who were employed in the service sector in the municipality of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>Intercensal Population Survey</td>
</tr>
<tr>
<td>Municipality of residence</td>
<td>Municipality of household residence.</td>
<td>Random</td>
<td>ENIGH</td>
</tr>
<tr>
<td>Centroid coordinates</td>
<td>Longitude and latitude of the centroid of the municipality of household residence.</td>
<td>Spatial</td>
<td>INEGI</td>
</tr>
<tr>
<td>Corrugion</td>
<td>Share of the 2015 population aged 18 years and over who considered corruption a common or very common problem in their region of residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey of Quality and Governmental Impact</td>
</tr>
<tr>
<td>Satisfaction with public services</td>
<td>Share of the 2015 population aged 18 years and over who were satisfied with the basic and on-demand public services provided in their region. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey of Quality and Governmental Impact</td>
</tr>
<tr>
<td>Gender-based violence against women and girls at school</td>
<td>Share of the 2016 women’s population aged 15 years and over who were victims of psychological, physical, and/or sexual gender-based violence at school between October 2015 and October 2016 in the region of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey on the Dynamics of Household Relationships</td>
</tr>
<tr>
<td>Gender-based violence against women and girls in the workplace</td>
<td>Share of the 2016 women’s population aged 15 years and over who were victims of psychological, physical, and/or sexual gender-based violence in the workplace between October 2015 and October 2016 in the region of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey on the Dynamics of Household Relationships</td>
</tr>
<tr>
<td>Gender-based violence against women and girls in the family context</td>
<td>Share of the 2016 women’s population aged 15 years and over who were victims of economic, psychological, physical, and/or sexual gender-based violence in the family context between October 2015 and October 2016 in the region of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey on the Dynamics of Household Relationships</td>
</tr>
<tr>
<td>Gender-based violence against women and girls by an intimate partner</td>
<td>Share of the 2016 women’s population aged 15 years who were victims of economic, psychological, physical, and/or sexual gender-based violence by an intimate partner between October 2015 and October 2016 in the region of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey on the Dynamics of Household Relationships</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>Gender-based violence against women and girls in the public sphere</td>
<td>Share of the 2016 women’s population aged 15 years who were victims of psychological, physical, and/or sexual gender-based violence in the public sphere (perpetrated by a friend, an acquaintance or a stranger with whom the victim has no family nor intimate relationship, the perpetrator is not her co-worker nor her schoolmate) between October 2015 and October 2016 in the region of household residence. Expressed in decimal form.</td>
<td>Linear; and/or non-linear</td>
<td>National Survey on the Dynamics of Household Relationships</td>
</tr>
<tr>
<td>State of residence</td>
<td>Region of household residence.</td>
<td>Random</td>
<td>ENIGH</td>
</tr>
</tbody>
</table>

As shown in Table 1, in addition to using the ENIGH, data from the 2015 National Census of Municipal and Delegation Governments (INEGI, 2015a), the 2015 Intercesal Population Survey (INEGI, 2015b), the 2015 National Survey of Quality and Governmental Impact (INEGI, 2015c), the National Population Council (CONAPO, 2016), the 2016 National Survey on the Dynamics of Household Relationships (INEGI, 2016b), the microdata for poverty estimation (CONEVAL, 2018), the human development index (UNDP, 2019), and the National Center for Prevention of Disasters (CENAPRED, 2020) are integrated. A description of the data integration process can be found in the Electronic Supplementary Material. Original datasets are freely available at www.coneval.org.mx, www.inegi.org.mx, www.datos.gob.mx, and www.mx.undp.org. The data (and metadata) used in this paper, i.e. after combining all the sources and omitting missing cases, is publicly available from Figshare at https://figshare.com/s/b2326294b122fab8cb2d. These data are composed of 10,503 women-headed households and 22,570 men-headed households.

### 2.3 Empirical strategy

The additive quantile regression models are applied to examine how and to what extent the covariates are linked to the income-to-poverty ratio of the urban Mexican households. This approach has two advantages. First, instead of establishing *a priori* a particular functional shape to describe the linkage between the income-to-poverty ratio and a given covariate, the additivity structure enables to simultaneously introduce different alternative effects, such as linear, non-linear and interaction effects, and posteriorly, select the most appropriate form (Hastie & Tibshirani, 1986, 1999). Second, the quantile approach estimates regression parameters for specific quantiles of the distribution of the income-to-poverty ratio, which enables focusing on the effects on the income-to-poverty ratio of the quantiles corresponding to poor and extremely poor households (Fenske et al., 2011; Koenker, 2010).
All in all, four additive quantile models are estimated. Two models analyze women-headed families and are estimated for the quantiles corresponding to the poor and extremely poor families. Analogously, the other two models are applied to data on poor and extremely poor households headed by a man. By doing this, it is possible to posteriorly compare and examine whether the association between the income-to-poverty ratio and the covariates differs by head’s sex and poverty level.

To formally express the preceding paragraphs, let $y_{	au i}^{sex}$ be the income-to-poverty ratio of household $i$ at quantile $\tau$, for $sex = \{woman, man\}$, according to the head’s sex. The vectors $w_i := (1, w_{i1}, ..., w_{ip})'$ and $z_i := (z_{i1}, ..., z_{iq})'$, represent the $p$ categorical and $q$ continuous covariates. Then, both for women- and men-headed households, the model corresponding to the quantile $\tau$ of the income-to-poverty ratio is expressed as:

$$y_{\tau i} = w_i'\beta_\tau + \sum_{k=1}^{q} s_{kr}(z_{ik}) + \sum_{s=1}^{2} \varphi_s(sp_i) + \varepsilon_{\tau i} \quad (1)$$

Incorporating the variables from Table 1:

$$y_{\tau i} = \beta_{0\tau} + \sum_{j=1}^{14} w_{ij}'\beta_{jr} + \sum_{k=1}^{28} s_{kr}(z_{ik}) + \sum_{l=13}^{14} \delta_{lr}(z_{i28}, w_{il}) + \sum_{s=1}^{2} \varphi_s(sp_i) + \varepsilon_{\tau i} \quad (2)$$

where $\beta_{0\tau}$ is the model intercept, and $\varepsilon_{\tau i}$ represents the regression errors. Equation (2) has five components at the right-hand-side. First, $\sum_{j=1}^{14} w_{ij}'\beta_{jr}$ is introduced to capture the linear effects of the categorical covariates. Second, $\sum_{k=1}^{28} s_{kr}(z_{ik})$ estimates the effect of the continuous variables included in Table 1. Here, parameters $s_{kr}(z_{ik})$ are smooth functions that can be decomposed into a linear part and a non-linear polynomial modelled by P-splines (Eilers & Marx, 1996). This decomposition allows to leave a priori the functional shape of the continuous variables unspecified. Accordingly, the effect of each of the continuous covariates can have three alternative results: a non-significant effect, a purely linear effect, and a non-linear effect (Hofner et al., 2014). Component $\sum_{l=13}^{14} \delta_{lr}(z_{i28}, w_{il})$ captures the interaction effects, which enables estimating how the relationship between income-to-poverty ratio and head’s age differs with education level and marital status. Fourth, $\sum_{s=1}^{2} \varphi_s(sp_i)$ captures random effects from the unobserved heterogeneity across municipalities and states due to the hierarchical
data structure. Finally, $\varphi_1(s_p) \tau_1$ is introduced for the geospatial effects, estimated by bivariate tensor product P-splines (Kneib et al., 2009).

Since model in equation (2) has a high-dimensional structure, traditional inference methods cannot find a solution. To overcome this situation, a methodology based on three steps is executed. First, the boosting algorithm for estimation. This algorithm is a computer-intensive iterative process combining estimation with automatic variable selection and model choice (Hothorn et al., 2020). To avoid overfitting and to optimize the prediction accuracy it is used cross-validation. By doing this, multicollinearity problems are also avoided (Hofner et al., 2014). Posteriorly, stability selection as proposed by Shah & Samworth (2013) is used to prevent the falsely selection of non-relevant variables. Finally, 95% confidence intervals are computed by drawing 1000 random samples from the empirical distribution of the data using a bootstrap method based on pointwise quantiles (Hofner et al., 2016). All computations are implemented in the R package “mboost” (Hothorn et al., 2020). The code for replicating these estimations can be found in the Electronic Supplementary Material and is also publicly available from Figshare at https://figshare.com/s/b2326294b122fab8cb2d.

### 3 Results

Table 2 reports the estimates of the selected covariates for the income-to-poverty ratio of women- and men-headed households living either in poverty or in extreme poverty in urban Mexico. Coefficients indicate the effect of each covariate on the response while other variables remain unchanged. Specifically, they quantify the size of the effect as a proportion of the poverty line, i.e. as a share of the income required to cover the cost of the basic food and the non-food baskets. In the context of quantile regression, coefficients are interpreted as in other regression models. For categorical covariates, coefficients show the variation in the estimated effect of a particular category with respect to the estimated effect of the reference category. For continuous covariates with purely linear effects, the coefficient captures the change in the income-to-poverty ratio per unit change in the covariate. Interpretation of the nonlinear effects is best done by visualizing the respective plots. By comparing the estimations between the models, it is possible to analyze of how the effects differ with the intensity of poverty and by head’s sex. By way of example, the coefficient for extremely poor women-headed households that do not have a credit card is -0.207. It suggests that the income-to-poverty ratio for them is 0.207 units lower than the estimated income-to-poverty ratio of those having a credit card. This parameter can also be understood as the size of the effect as percentage of the \textit{per capita} monthly cost of the basic food and the non-food baskets, i.e. 20.7% of the MXN$2660.40 (poverty line), which is equivalent to MXN$550.71 per household member per month.
Table 2 Estimated coefficients for significant covariates and their 95% confidence intervals (CI) *  

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>Extremely poor</th>
<th></th>
<th>At the poverty line</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Women-headed</td>
<td>Men-headed</td>
<td>Women-headed</td>
<td>Men-headed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coef. 95% CI</td>
<td>Coef. 95% CI</td>
<td>Coef. 95% CI</td>
<td>Coef. 95% CI</td>
</tr>
<tr>
<td>Social networks</td>
<td>(reference category: low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>0 [-0.024, 0.03]</td>
<td>-0.032 [-0.051, -0.016]</td>
<td>-0.055 [-0.081, -0.027]</td>
<td>-0.05 [-0.067, -0.029]</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>0.101 [0.071, 0.132]</td>
<td><strong>0.067 [0.051, 0.084]</strong></td>
<td>0.133 [0.097, 0.167]</td>
<td><strong>0.132 [0.109, 0.155]</strong></td>
</tr>
<tr>
<td>Credit card</td>
<td>(reference category: yes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>-0.207 [-0.247, -0.17]</td>
<td>-0.211 [-0.233, -0.187]</td>
<td><strong>-0.382 [-0.427, -0.337]</strong></td>
<td>-0.407 [-0.438, -0.379]</td>
</tr>
<tr>
<td>Type of household</td>
<td>one-person</td>
<td>0.07 [0.037, 0.104]</td>
<td>0.195 [0.138, 0.256]</td>
<td>0.159 [0.121, 0.205]</td>
<td><strong>0.649 [0.569, 0.731]</strong></td>
</tr>
<tr>
<td></td>
<td>extended</td>
<td>-0.048 [-0.072, -0.026]</td>
<td>-0.021 [-0.04, -0.003]</td>
<td>-0.147 [-0.172, -0.124]</td>
<td>-0.09 [-0.111, -0.069]</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>0.036 [0.008, 0.068]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to food</td>
<td>(reference category: no)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>0.095 [0.069, 0.125]</td>
<td>0.102 [0.082, 0.124]</td>
<td>0.198 [0.17, 0.228]</td>
<td>0.15 [0.129, 0.172]</td>
</tr>
<tr>
<td>Educational lag</td>
<td>(reference category: no)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>0.067 [0.037, 0.098]</td>
<td></td>
<td>0.083 [0.047, 0.118]</td>
<td></td>
</tr>
<tr>
<td>Access to social security</td>
<td>(reference category: no)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>0.171 [0.141, 0.199]</td>
<td>0.218 [0.197, 0.239]</td>
<td>0.235 [0.202, 0.268]</td>
<td>0.271 [0.248, 0.296]</td>
</tr>
<tr>
<td>Age by education level</td>
<td>medium</td>
<td>0.06 [0.04, 0.09]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>0.53 [0.45, 0.61]</td>
<td>0.44 [0.4, 0.48]</td>
<td>1.04 [0.93, 1.17]</td>
<td>1.03 [0.96, 1.1]</td>
</tr>
<tr>
<td>Age by marital status</td>
<td>married</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>separated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>divorced</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>widowed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>open union</td>
<td>-0.13 [-0.17, -0.08]</td>
<td></td>
<td>-0.21 [-0.27, -0.16]</td>
<td></td>
</tr>
<tr>
<td>Weekly housework hours</td>
<td></td>
<td>Linear (slope: -0.001)</td>
<td></td>
<td>Linear (slope: -0.002)</td>
<td></td>
</tr>
<tr>
<td>Gini index</td>
<td></td>
<td>Linear (slope: -1.047)</td>
<td></td>
<td>Linear (slope: -1.528)</td>
<td></td>
</tr>
<tr>
<td>Human development index</td>
<td></td>
<td>Linear (slope: 1.074)</td>
<td>Linear (slope: 0.998)</td>
<td>Linear (slope: 1.987)</td>
<td>Linear (slope: 2.219)</td>
</tr>
<tr>
<td>Migration of men</td>
<td></td>
<td>Linear (slope: 1.748)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women’s economically active population</td>
<td></td>
<td>Linear (slope: 0.347)</td>
<td></td>
<td>Linear (slope: 0.379)</td>
<td></td>
</tr>
<tr>
<td>Women working in the trade sector</td>
<td></td>
<td>Linear (slope: 0.578)</td>
<td></td>
<td>Linear (slope: -0.565)</td>
<td></td>
</tr>
<tr>
<td>Satisfaction with public services</td>
<td></td>
<td>Linear (slope: 0.089)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender-based violence against women and girls in the public sphere</td>
<td></td>
<td>Linear (slope: 0.191)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender-based violence against women and girls in the family context</td>
<td></td>
<td>Linear (slope: -2.235)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Coefficients in **bold letters** suggest that the estimated effect differs with income level, i.e. keeping the head’s sex unchanged, the 95% confidence intervals of the estimated coefficients for the extremely poor and the poor families do not intersect. Correspondingly, coefficients emphasized in __ suggest that the effect on the income-to-poverty ratio statistically varies with the head’s sex, i.e. keeping poverty level unchanged, the 95% confidence intervals of the estimated coefficients for the women- and men-headed families do not intersect. For categorical covariates,
estimations specify the change in the coefficient for a category in relation to the reference (shown in parenthesis next to the name of the covariate). For continuous covariates with linear effects, only the mean coefficient is shown, see Hofner et al. (2016) for further details on pointwise bootstrap confidence intervals. Empty cells indicate that the respective variable (or category) is not stability selected for that particular model, and in consequence their coefficient is set to zero; see Hofner et al. (2015) and Shah & Samworth (2013) for further details on stability selection.

Overall, results reveal two different effects. On the one hand, gender-unbiased effects, occurring when the estimated covariate effect on income-to-poverty ratio does not statistically differ between women- and men-headed households. On the other hand, gender-biased effects, which are observed when the estimated coefficient for women-headed households is statistically different than the one estimated for their men-headed counterparts. To determine if an effect varies with the head’s sex, 95% confidence intervals of their respective estimated coefficients within the same poverty level must be compared to see if the intervals overlap or not. Importantly, for each of these two effects it is possible to identify effects varying with the family poverty level. In the following lines all these results are commented in detail.

### 3.1 Gender-unbiased effects

Evidence on non-significant gender differences between women- and men-headed households is observed in eight covariates, namely social networks, credit card, type of household, access to food, access to social security, education level, community’s human development, and the share of women working in the trade sector.

Regarding the perception of social networks, a high degree of connectedness is associated with a greater income-to-poverty ratio compared to families whose head has a low or medium degree of social networks. For the extremely poor families with a head having a high degree of social networks, the estimated parameters are 0.1 and 0.067 for women-and men-headed households, respectively. For poor families with a head having a high degree of social networks, the coefficient for those headed by a woman is 0.133 and for men-headed households is 0.132. For men-headed families the parameter for a high degree of social networks significantly increases as family income goes from extreme poverty up to the poverty level.

Findings indicate that urban families in which a member holds a credit card tend to exhibit a greater income-to-poverty ratio. For extremely poor families, the coefficient for households without access to credit cards and with a woman as the head is -0.207, and for their men-headed counterparts the coefficient is -0.211. Only for women-
headed families the magnitude of the effect varies across poverty levels. Poor households without a credit card have an income-to-poverty ratio lower in 0.382 when they are headed by a woman, and 0.407 units when they are headed by a man.

In extremely poor extended families (composed of a nuclear family group and other family members, such as aunts, uncles, grandparents, cousins, etc), those headed by a woman have an income-to-poverty ratio of approximately 0.05 units lower than the ratio of nuclear families. For men-headed families this difference is of about 0.021 units.

Lacking access to adequate food is linked to poorer households. No evidence of gender dissimilarities is found. For extremely poor households, it is expected that both women- and men-headed families having access to adequate food have approximately an income-to-poverty ratio 0.10 units greater than households lacking access to it. At the poverty level, women-headed households with access to food have an income-to-poverty ratio between 0.17 and 0.23 units higher than the ratio of families deprived from food. For men-headed households, this difference is between 0.13 and 0.17 units for households with access to food.

Access to social security is also found to have a gender-unbiased effect. Households deprived from the social security system tend to be poorer than those accessing the social security. Both for women- and men-headed households, the size of the coefficient is expected to be larger for families at the poverty line.

Education level is strongly linked to income-to-poverty ratio. In fact, among the parametric effects for categorical variables, the larger coefficients are observed in the correlation of this covariate for families headed by a person with a high level of education (at least a university degree). Keeping poverty level constant, correlation of education level with income is not gendered. For extremely poor households, families with a highly educated woman head have an income-to-poverty ratio between 0.45 and 0.61 units greater than families with a woman head with a low educational attainment. For extremely poor men-headed households, this difference is between 0.4 and 0.48 units. Coefficients are larger for families whose income is at the poverty line. For these households, income-to-poverty ratio of families with a highly educated head is approximately 1 unit greater than households with a head with a low level of education.

The estimated parameter for the association of the human development index in the four models indicates a linearly increasing effect without evidencing gender differences between women- and men-headed households, nor between poverty levels.
Regarding the link of the income-to-poverty ratio with the share of women working in the trade sector, the effect is described by a linear decreasing trend significant only for poor households. The effect for women- and men-headed families is not statistically different.

### 3.2 Gender-biased effects

Evidence of heterogeneous effects between women- and men-headed families is found in eleven covariates. These are type of household, educational lag, age by education level, age by marital status, weekly housework hours, Gini index, migration of men, women’s economically active population, satisfaction with public services, and gender-based violence both in the public sphere and in the family context.

Concerning the type of household, greater income-to-poverty ratios are expected in households composed of only one person, followed by other type of household (households composed of unrelated individuals), nuclear families and extended households (nuclear family group and other family members such as aunts, uncles, grandparents, and cousins). There are marked gender differences regarding the type of household, i.e. having the same family structure, households headed by a woman have an expected income-to-poverty ratio statistically lower than households headed by a man. Among one-person households, the coefficient for men is much larger than the coefficient of women, almost three times for extremely poor families and approximately four times for the case of households at the poverty line. For extended families, there are gender differences only for poor families, disproportionally affecting those headed by a woman: extended women-households headed show an income-to-poverty ratio 0.15 units lower than the ratio of nuclear households and 0.31 points less than the ratio of one-person families.

Educational lag is significant only for women-headed households. This correlation indicates that families with a woman head lagging behind the compulsory level of education show a lower income-to-poverty ratio, approximately 0.07 points for extremely poor families and about 0.08 points for those at the poverty line.

For the age and education level interaction, only the effect for households at the poverty line with a head with a medium education level is selected with a nonparametric linkage, depicted in Fig. 1. Here, it is possible to observe the dynamic of poverty over the course of lifetime and how it is gendered. Approximately between 20 and 40 years old, income-to-poverty ratio of men-headed households is about 0.3 units greater than the corresponding ratio of their counterparts headed by a woman. At this life stage both curves follow different trajectories, an increasing trend for families with a woman as head, and a decreasing curve for men-headed households. Both curves meet at around 40 years old and then they follow a similar increasing path up to around 60 years old. After around 60 years
old, the income-to-poverty ratio of women-headed households seems to stabilize. For men-headed households, income-to-poverty ratio seems to decrease with age from 60 years old. However, considering the 95% confidence intervals, after 60 years old both curves are not statistically different.

**Fig. 1** Income-to-poverty ratio and age in poor households with a head with medium education level by head’s sex

<table>
<thead>
<tr>
<th>a) Women-headed households</th>
<th>b) Men-headed households</th>
</tr>
</thead>
</table>

Results indicate the existence of gender differences in the estimated effects when 95% confidence intervals for women- and men-headed households do not overlap. Medium level of education refers to heads having a minimum of lower secondary education and a maximum of upper secondary.

On marital status, among men-headed households those with a head living in open union are expected to be poorer than those whose head has another marital status. A larger income-to-poverty ratio is observed in households with a separated man head. For separated women-headed households, a linear increasing effect is selected as significant for families living in poverty, the income-to-poverty ratio of these households rises as age increases at a constant factor of 0.005 per year.

As can be seen in Table 2, housework time is only associated with women-headed households. The linkage between time of housework in hours and income-to-poverty ratio is described by a constantly decreasing line, indicating that for families headed by a woman, devoting more time to housework is associated with a lower income-to-poverty ratio.

Regarding the Gini index, a larger income-to-poverty ratio of men-headed families is correlated with communities with better income distribution among its households. This association is described by a linear declining effect having a larger coefficient size for households at the poverty line (coefficient equal to -1.528) than those in extreme poverty (-1.047). For women-headed households no association with the Gini index is found.
The immigration of men in the community is selected as an influential variable exclusively for poor households headed by a man. For these families, municipalities with larger shares of men who lived in another state or country in the previous five years (recent immigrants) are associated with a better income-to-poverty ratio. For men-headed households, the share of women economically active in the municipality is positively associated with income-to-poverty ratio. The coefficient for this effect is similar both for households in extreme poverty and for those at the poverty line. Moreover, as the share of the population satisfied with the basic and on-demand public services provided in their region increases, the income of extremely poor men-headed households linearly increases.

Furthermore, higher income-to-poverty ratios in extremely poor women-headed households are expected in regions with larger proportions of women victims of gender-based violence in community settings (public transportation, streets, parks, etc.). Likewise, regions with larger shares of women victims of violence in family contexts are linked to a lower income-to-poverty ratio for poor households headed by a man.

4 Discussion

It is important to analyze the results in the context of the existing research aiming to extract potential explanations. It is noteworthy to mention, that all the findings in the previous section estimate statistical associations between the covariates and the response, and although they do not indicate causality, they do provide insights about important aspects for the analysis of income poverty in urban Mexican families.

Social networks can be both a cause and an effect of poverty. On the one hand, a supportive social network plays a role in addressing poverty by providing goods and services the poor need but cannot afford (access to job opportunities, help in childcare, financial support or help in emergencies). On the other hand, poor people can also be socially excluded due to time and financial restrictions, or stigma. These findings are in line with previous work from different countries (Lubbers et al., 2020; Marques, 2015; Rosas, 2001).

The correlation between holding a credit card and income-to-poverty ratio can be understood as follows. First, not having access to credit can be a limiting factor for household income, especially because poor families do not have enough resources to invest in income-generating activities, smoothing consumption, or having savings to face economic hardships. But similarly, poverty could be at the same time a barrier to access financial services. A further discussion on this regard is found in Das (2019) and Karlan & Zinman (2010).

As found in Munoz Boudet et al. (2018) and in Musgrove (1980), a reasoning behind the effect of type of household is related to the number of family members depending on the same income. Other type of household shows the
second largest income-to-poverty ratio, probably because they are unrelated individuals having each of them their own income source, situation that may not occur in nuclear or extended families.

Results provide evidence on the linkage between monetary and non-monetary poverty (social deprivations). Regarding access to food, it may indicate a two-way effect. On the one hand, having a nutritious diet involves allocating sufficient money for buying adequate food, which can be a challenge for families struggling with income. On the other hand, consumption of nutritious food helps to maintain good health status, and in turn, it improves the ability of people to take part in the labor force. These results match well with earlier findings (Battersby & Watson, 2018; Cook & Frank, 2008).

Educational lag is found to be associated with a lower income-to-poverty ratio of women-headed households. This fact could be connected to the key role played by elementary and secondary school in poor women, possibly linked to woman empowerment due to a better access to knowledge about different life choices that do not conflict with their well-being or information on health issues at this life stage, and, in turn, helping them to delay getting pregnant or married (King & Hill, 1993; Klasen, 2002; Subbarao & Raney, 1995). Viewing educational lag as an effect of poverty points to the fact that woman heads without basic education did not have the chance to attend school because they probably come from adverse economic contexts making difficult or impossible to afford education.

Our results also support the existence of a consistent positive relationship between income and access to the social protection system. It is important to mention, that social security is granted to workers in formal jobs, which are normally better paid than informal jobs in Mexico (INEGI, 2021).

Consistent results both for women- and men-headed families indicate that households whose head completed at least university have a higher income, which is a commonsense result (Haughton & Khandker, 2009). For poor households with a head having a medium level of education (a minimum of lower secondary education and a maximum of upper secondary), it is corroborated the existence of a cycle of poverty. Approximately between 20 and 40 years old, income-to-poverty ratio of men-headed households is greater than the corresponding ratio of their counterparts headed by a woman. Among other reasons, it could be due to the existence of difficulties in entering the labor market or the effect of childcare disproportionately affecting women as indicated by INEGI (2019). At this life stage both curves follow different trajectories that meet at around 40 years old and then they follow a similar increasing path up to around 60 years old, the retirement age. A potential explanation for this growing segment of the curve between 40 and 60 years old is that children reach an age enough for working and contributing to family income or they leave home, reducing the number of dependents. After around 60 years old,
the mean income seems to stabilize, but the large variability at this life stage may also indicate very different situations experienced by elderly women. Similar findings have been achieved in previous research (Munoz Boudet et al., 2018).

Results confirm significant differences according to marital status. Nevertheless, in contrast to other studies indicating that lower-income levels are observed in families that experienced a dissolution (Haughton & Khandker, 2009; McManus & DiPrete, 2001), a greater income-to-poverty ratio is observed for households with a separated head, independently of their sex.

It is particularly interesting the effect of housework hours on income, given that it reflects the existence of a kind of trade-off between the time devoted to paid and unpaid work that is exclusively affecting women-headed families, i.e. the woman head cannot increase her housework time without reducing the household income-to-poverty ratio. Comparable conclusions have been obtained in previous studies on time use (Cash et al., 2005; Merz & Rathjen, 2014).

About the community level, the Gini and the human development indexes reflect the quality of life in a municipality, and their linkage with income-to-poverty ratio must be understood as a two-way causality. More equal and most developed communities may offer better income-generating opportunities to its inhabitants. Yet, income improvements for the poor and extremely poor households in turn can propel income equality and development in the community.

On the effect of immigration of men, this linkage could be indicating that the presence of poor households with a relatively better income-to-poverty ratio is influencing households’ residential decisions, attracting more men. In addition to this, the recent immigration of men could be leading to a dynamization of the labor markets, more taxes contributions and a supplement to the stock of human capital in communities, which finally could impact on an increase of income of the poor men-headed families.

Results indicate that men-headed families living in urban communities where an important proportion of women is involved in the economy have on average a better income-to-poverty ratio. Some possible explanations can be that the inclusion of women in the economically active population helps addressing labor market imbalances in urban communities, expands the working-age population or contributes boosting the human capital. Regarding the link of the income with the share of women working in the trade sector, the effect is described by a linear decreasing trend significant only for poor households.

Findings suggest that the quality of the public provision of goods and services is positively associated with the income-to-poverty ratio. On the one hand, it can indicate that extremely poor households generally have a
residence in states with lower quality of public services, which are in turn more likely to have a lower cost of living. Furthermore, families having an income sufficient to afford the cost of living tend to reside in a region with better provision of public services. On the other hand, it may also indicate that the provision of public services impacts the income of the families via an improvement in their quality of life (Bramley, 2018; Hewett & Montgomery, 2001).

Finally, regarding gender-based violence against women and girls, based on previous analysis (Gillum, 2019; Slabbert, 2017; Terry, 2004) there are some potential explanations for these results. First, maybe due to financial and time restrictions, lower income levels are linked to lower social interactions, keeping the likelihood of victimization in the public space at low levels. As income of extremely poor woman heads improves, their interactions increase, including the contact with more potential perpetrators. In this regard, despite the greater economic empowerment of women within the family, there could be still some obstacles to gender equality in other spheres of public life; thus, stereotypes and traditional gender roles are manifested in acts of violence against women in different public contexts. Concerning the linkage with violence in family contexts, it can be hypothesized that lower levels of violence against women by family members indicate a lower domination experienced by women in the private sphere, and in this way, in men-headed households, women can better contribute to the household, by engaging in paid or unpaid work, increasing household income.

5 Conclusions

In this paper, the aim was to detect a subset of significant factors for income-to-poverty ratio of urban families in Mexico. Special focus is paid to dissimilarities between women- and men-headed families, and variations according to their depth of poverty.

From a gender standpoint, findings provide evidence on two important aspects in the analysis of poverty in urban Mexico. First, a subset of factors is found to be consistently linked to income-to-poverty ratio regardless of the head’s sex and regardless of the poverty level. These covariates are having a high level of social networks, holding of a credit card, access to food, access to social security, high level of education, and human development index of the community of residence. Second, there are some factors whose linkage with the response variable differs by sex, and this effect is significant both for poor and extremely poor households. These covariates are living in a one-person household, educational lag, having a medium level of education, families whose head lives in open-union, weekly housework hours, municipal Gini index, and women’s economically active population.
Results provide five main contributions. First, educational lag of the head is particularly relevant for women-headed households. Second, evidence supports the existence of a gendered-life cycle in the trajectory of income-to-poverty ratio for poor households with a head holding a medium education level. Third, some of the relevant effects vary with family’s depth of poverty, for instance access to food, and access to social security. Fourth, by controlling by a large set of covariates, findings allow to underscore the circumstances in which women- and men-headed households face disadvantages. In this regard, it is observed that some households, traditionally disregarded, may experience even worse situations in relation to poverty. These are, among others, families lacking social connectedness, without access to credit card, extended households, households in which the woman head spends more time on housework, and families headed by a young woman with a medium level of education. Finally, results indicate that communities and regions where families have a lower income-to-poverty ratio are characterized for being unequal, with a low human development, having a low economic participation of women, with a poor quality of services, with low levels of gender-based violence against women and girls in the public sphere but high levels of gender-based violence in the family context.

Even though the response variable, income-to-poverty ratio, allows to examine how the effect of different risk factors varies with the severity of poverty, further studies should also consider different poverty indicators or examine other distributional parameters. Limitations of this study are related to the inherent features of cross-sectional data. Estimations only apply to urban Mexico in the period of reference. In addition, income poverty is both a cause and an effect of many covariates included in this research, and it is difficult to determine causality.

Declarations

*Ethical Approval
- Not applicable

*Competing interests
- The author has declared that no competing interests exist.

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- Not applicable

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- The code and data used in this paper is publicly available from Figshare at https://figshare.com/s/b2326294b122fab8cb2d.

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