International Journal of Commerce and Management Research
ISSN: 2455-1627; Impact Factor: RJIF 5.22
Received: 19-12-2020; Accepted: 13-01-2021; Published: 08-02-2021
www.managejournal.com
Volume 7; Issue 1; 2021; Page No. 48-54

A study on urban and rural economic inequality in Mexico using the gini index

Jimmy Félix-Armenta[1], Francisco Guillermo Salcido-Vega[2], José Crisóforo Carrazco-Escalante[3*]
[1] Ph.D, Professor, in Economics and Business, Universidad Autónoma de Sinaloa, Mexico
[2] Ph.D. in Sciences, SNI Candidate. Specialty in Regional Development, Centro de Investigación en Alimentación y Desarrollo, CIAD, A.C. Universidad Autónoma de Sinaloa, Mexico
[3] Ph.D, Professor, in Sciences, Specialty in Regional Development, Centro de Investigación en Alimentación y Desarrollo, CIAD, A.C. Universidad Autónoma de Sinaloa, Mexico
* Corresponding Author: José Crisóforo Carrazco-Escalante

Abstract
Poverty and inequality are very important problems since they imply the diagnosis of the population's living standards. The objective of the article is to evaluate the existing inequality in rural and urban areas in Mexico for the period 2000-2018 using the methodology of the Gini index of urban and rural income with data from the ENIGH. Among the limitations is the data availability since the Population Censuses have been modified, which generates complications when making comparisons of the same variable over time. The study shows that in Mexico there has been a reduction, albeit in a limited way, of inequalities in urban and rural areas in recent years, although the levels remain high.

Keywords: inequality, urban, rural, Mexico, gini

Introduction

The study of poverty and inequality is a relevant topic due to the set of public policy strategies that can be designed based on their results. Inequalities have both economic and social implications. The former is due to the fact that certain parts of society are unable to reach their productive potential, which implies a deterioration of economic growth, causing the detriment of human capital, efficiency and contributions to economic development. Secondly, low social mobility leads the settlement of differences in opportunities since people maintain the same status, whether in a privileged or disadvantaged area and tend to inherit them to their descendants (El Colegio de México, 2018) [14].

As expressed by the Organization for Economic Cooperation and Development in the study Latin American Economic Outlook 2017, the richest 10% of the population in Mexico earns 20 times more than the poorest 10% of the population. Furthermore, 7 out of 10 Mexicans are in poverty (OECD, 2017) [24]. It is evident, as Mexico is a country of contrasts, as it has almost 44% of the population in extreme poverty and at the same time a considerable proportion of rich people in the international lists (CONEVAL, 2017) [11]. The evolution of inequality in Mexico in the last four decades presents. A very defined pattern In the eighties and nineties, the Gini coefficient increased, but the trend of said inequality reverted in the two thousand years, albeit slightly (Campos-Vázquez and Rodas-Milian, 2019) [9].

The analysis of inequality can be carried out in different areas and sectors. Particularly, in this study, it is proposed based on a spatial review of rural and urban areas. Therefore, the main objective of this paper is to analyze the evolution of poverty and inequality in urban and rural areas of Mexico in the period 2000-2018 based on the Gini coefficient. Is coefficient was chosen because, apart from being the most traditionally and widely used, it is a tool that allows us to visualize the levels of inequality present in a given region.

The document is divided into five sections in addition to this introduction. In the first, a study is made of the urbanization process in Mexico based on demographic evolution analysis. The second section studies inequality and poverty in urban and rural areas. In the third section, the Gini index methodology is presented and applied to urban and rural levels in the period 2000-2018. In the fourth section, the results of the application of the Gini index are shown. Finally, the fifth section presents the limitations and conclusions of the research.

Mexico's urbanization process

The urbanization process encompasses the spatial, continuous or discontinuous connection of the population with economic activities. The city is understood as a particular organization of interrelationships between people, groups and activities. The adequate management of these interactions is found in understanding the agglomeration phenomenon, i.e., the formation and growth of cities (Cuervo-González, 2000) [13]. From another perspective, for Borja-Sebastià and Castells-Oliván (1995) [8]. the city is a given system of social interactions, culture and, above all, political institutions of self-government.

According to Anzaldo-Gómez and Barrón-López (2009) [1], the evolution of the urbanization process in Mexico has gone through three periods. From 1900 to 1940, the first period is characterized by a relatively low urban population growth and s superiority of rural areas, i.e., in this stage, there was slow urbanization. From 1940 to 1980, the second period is characterized by rapid growth of the urban population, since the number of urban localities of 100,000 inhabitants or more increased from 6 to 52; this period is

called accelerated urbanization. And finally, the third period, from 1980 to the present, the year 2020, shows a deceleration in the growth rate of the urban population.

Importance of the Urbanization Process

The importance of cities for economic growth is indisputable. It is the area where industrial, commercial and service activities are carried out; in other words, it is the space where employment is produced, capital is accumulated, and the main investments are made (Garza-Villareal 1989) [19]. To understand the magnitude of the importance of urban centers, it should be pointed out that in developing countries, approximately 80% of national production is caused by cities (Armstrong and McGee, 1985) [2].

According to Kunz-Bolaños (1995) [22], there are two essential qualities in the conformation of cities: labor division and the transfer of goods and services. The purpose of the first is to generate the highest levels of production concerning to the increased use of resources or productive factors. The second comes from the needs of urban areas to import goods and services, given that they cannot or do not have the capacity to generate them on their own. Taking a more aggregate view, urban localities perform production, distribution, and consumption (Goodall, 1977) [20]. It is precisely the growth in the size of cities that have given rise to the urbanization process in the country, which has undergone significant changes in the last one hundred and fifteen years, mainly since 1940, in the volume and distribution of the population, since the country ceased to be rural and became an eminently urban process.

In short, it is perceived that the importance of the urbanization process derives from its relationship with economic growth and development, i.e., cities have expanded with the global phenomenon of change in society by bringing together in their territory a large part of secondary and tertiary activities. Consequently, it is necessary to analyze markets, external and urbanization economies, the existence of labor and specialized professional services, as well as to provide criteria for the best orientation of social and basic development investments and facilitate housing programs, among others (Unikel-Spector, 1978) [19].

Demographic evolution and urbanization process

This section reviews Mexico's population growth over the past 110 years, and the urbanization process resulting from this growth. The demographic evolution and the progress of the economy have presented very significant and important changes in the regional distribution of the population and economic activities, reflecting changes in the size, number and location of urban areas that have originated a very marked process of inequality among them.

Table 1 shows the total number of localities for the period 1910-2010 and is broken down into urban and rural areas defined according to the classification proposed by Unikel-Spector (1978) [19]. It is worth mentioning that a rural locality is considered when it has a population of 1 to 2,499 inhabitants and an urban locality when it has a population of 2,500 inhabitants or more. The number of urban localities has increased significantly, from 530 in the initial period to 3,614 in 2010. Meanwhile, the number of rural localities has shown a different pattern, since in spite of the fact that at the beginning of the previous century, it presented an accelerated growth, from 1910 to 1940 the rural areas increased continuously, at the end of the period it is shown how this process is reversed, since by 1995 there were 198,311 rural localities and in 2010 it decreased to 188,631.

Table 1: Number of Urban and Rural localities: 1910/2010

	Localities		
Year	**Total**	**Urban**	**Rural**
1910	70830	530	70300
1920	62879	786	62093
1930	84448	603	83845
1940	105508	686	104822
1950	98325	908	97417
1960	89005	1212	87793
1970	97580	2170	95410
1980	125300	2131	123169
1990	156602	2586	154016
1995	201138	2827	198311
2005	187938	3190	184748
2010	192245	3614	188631

Source: based on Unikel-Spector (1978) and INEGI's general population and housing censuses

Certainly, the continuous increase in the size of cities has led to a process of urbanization in the country, which has experienced, as shown in Table 2, notable changes in the volume and distribution of the population in the last 115 years, as it has ceased to be rural and has become an urban country. In 115 years, the urban population grew very rapidly, from 1.43 million in 1900 to 92 million in 2015, so the country acquired an essentially urban profile. One aspect that ratifies the above is the degree of urbanization or, in other words, the proportion of the total population living in urban localities, since at the beginning of the last century it was 10.56% and in 2015 it rose to approximately 77%.

Table 2: Mexico: total and urban population: 1900-2015 (average annual growth rate and degree of urbanization)

Year	Population		TCPA		Level of
	Total	**Urban**	**Total**	**Urban**	**Development**
1900	13607272	1437423	-	-	10.56%
1910	15160369	1782911	1.09	2.18	11.76%

1921	14334771	2100071	-0.51	1.49	14.65%
1930	16552722	2888410	1.61	3.61	17.45%
1940	19653552	3953252	1.73	3.19	20.11%
1950	25791017	7113253	2.75	6.05	27.58%
1960	34923129	13027747	3.08	6.23	37.30%
1970	48225238	22323769	3.28	5.53	46.29%
1980	66846833	34842301	3.32	4.55	52.12%
1990	81249645	47440788	1.97	3.13	58.39%
2000	97483412	59381183	1.84	2.27	60.91%
2010	108710824	77757728	1.09	2.73	71.53%
2015	119530753	92044539	1.91	3.43	77.01%

Source: based on Unikel-Spector (1978), general population and housing censuses and the geometric growth rates proposed in Sobrino-Figueroa (2002)

One of the interesting aspects to highlight in the data included in Table 2 is the continuous growth of the urban stain. In all the years, there has been an increase in the number of inhabitants. The total population shows a similar behavior, except for 1921, when there was a decrease in the Mexican Revolution, the rest of the years observed show constant growth. It is significant to note that at present, the population residing in urban areas represents more than three-quarters of the total population, showing an average growth for the entire period of 3.6% per year. In contrast, the growth rate for the entire population is 1.93%. In other words, the urban area grew at a much higher rate than the total population.

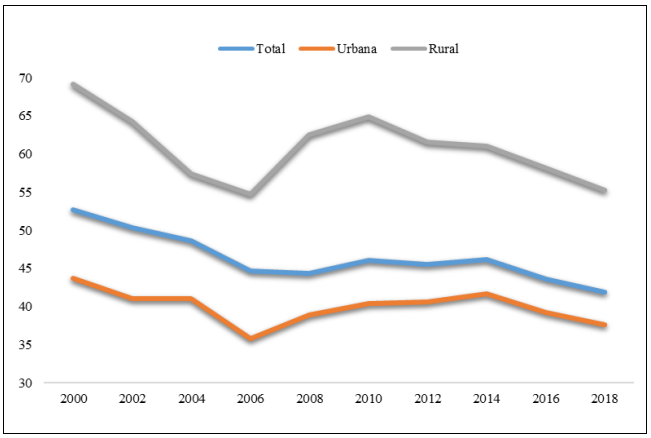
Inequality and poverty in urban, rural areas

In addressing the problem of economic inequality, the disparities in income levels of a group of individuals are shown, making it possible to determine the degree of an existing concentration, estimate the population's standard of living and, therefore, evaluate the performance of a government's administration. In the context of inequality, Mexico presents very different features with evident discrepancies. According to data from the National Council for the Evaluation of Social Development Policy, Coneval (2018) [12], Mexico belongs to the 25% of nations with the highest inequality in the world. This, explained due to the fact that it is presented as a country full of contrasts in terms of income since there is a marked divergence between rich and poor people. In Mexico, the 10 people with the highest incomes are equal to the total income of the poorest 50% of the country.

Although inequalities in Mexico have been very significant, trends show a slight reduction since the 1990s. The explanation for this can be based on the following. On the one hand, Becker (2013) [6] points out as an important factor the transfers made by programs such as Progresa and Oportunidades focused on families with greater needs. On the other hand, Lustig (2010) [23] indicates that the decrease in the wage gap between skilled and unskilled jobs has reduced inequality. Although it is clear that inequality has decreased in recent decades, it is evident that inequality and poverty levels remain high in Mexico.

In Mexico, slightly more than half of the population living in extreme poverty is in the rural sector and the poverty rate is higher in rural localities than in urban localities, at 17.4% and 4.4%, respectively. Likewise, in rural areas, households with access to potable water represent almost 81%, while in urban areas, they represent 96%. Similarly, one in three households in rural localities does not have water daily (FAO, 2018) [17]. However, despite high levels of poverty in the rural sector, both FAO and CONEVAL (2017) [11] agree that from 2010 to 2016 the population in extreme poverty has reduced by 9% going from 26.5% to stand at 17.4%.

Graph 1 shows the percentage of poverty for the urban, rural and national areas in 2000-2018. The data show a reduction in poverty levels, with the rural population showing the greatest reduction of approximately 15 percentage points. For its part, the urban area reduces its poverty levels by 6 percentage points. Thus, at the national level, a decrease of 11 percentage points is obtained.



Source: based on Coneval 2009 y 2019

Graphic 1: Measuring poverty in Mexico: 2000/2018 (in percentage terms)

These results can be explained as follows: The social programs implemented in the country have been characterized by being fundamentally focused on reducing poverty in rural areas by making monetary transfers to households in extreme poverty, thus leaving aside or in the second instance the fight against poverty in urban areas (Bracamontes-Nevares and Camberos-Castro, 2012) [7]. Undoubtedly, the establishment of social programs marks a before and after in Mexico's public policy, since they signify the willingness to reallocate public resources to the low-income population, most of them located in rural areas. According to Coneval (2018) [12] the percentage of poor people moved from 44.4% in 2008 to 41.9% in 2018, which means an average annual reduction of 0.24%. Likewise, the population in extreme poverty condition decreased by 2.6% in the same period, going from 11 to 7.4%.

Likewise, Barba-Solano (2018) [5] emphasizes that the social programs implemented in the last two decades have incorporated the poorest population reaching a wide coverage in the social protection systems with the fundamental purpose of reducing poverty. In the same sense, Escobar-Latapi and González-De la Rocha (2002) point out that the implementation of social programs has

been oriented towards coverage and the application of resources whose evaluation is based on the scope in terms of the number of beneficiaries and not on the social impact to mitigate inequality. However, despite the efforts of social programs to redistribute income, it can be said that their effects have been limited. Scott (2008) [27] states that the Gini coefficient in Mexico was reduced by 1 point, while the effects in industrialized countries when applying the same transfer process reached a reduction of 10 points in the Gini index. Therefore, although progress has been made in reducing poverty, have been insufficient to counteract the significant inequalities existing in the country.

Materials and Methods

Application of The Gini Index

As Foster and Sen (1997) [18] state, to establish a measurement that is considered robust and consistent. It must have the capacity to produce the following axioms or properties:

1. Transfer. Any transfer of income from an individual with greater resources to an individual with fewer resources results in a reduction in inequality.
2. Symmetry. It establishes that if an individual has the same income level as another individual, this other individual must have the same income as the first individual.
3. Scale independence. This property takes care of the variable population, although the size of the population is a variable, the Lorenz curves seem to make sense in comparisons of average welfare. However, the problem of man variable income remains. In this case it is simple to point out that any possibility of making distributional judgments independently of the level of income would make sense only if the relative ordering of the welfare levels of the distributions were strictly neutral to the operation of multiplying everyone's income by a given number.
4. Invariant or population replication. Having a set of individuals with the same level of income and multiplying it by the same scalar, the result of the index should be the same. By generalizing this reasoning, the social welfare function of a set of n inhabitants can be expressed axiomatically as follows:

$$W = Fn(y1, \ldots \ldots, yn) \quad (1)$$

The axiom of symmetry for the population (ASP) in any income distribution (y1…, yn), we consider the distribution x among nr persons such that xi = x2i=...= xri = yi for 1 ≤ i ≤ n, where r is any integer, then:

$$Fnr(x) = rFn(y) \quad (2)$$

Thus, it is required that if the axiom is for r countries with the same population and equal income distribution, they should be considered as a whole because the average welfare of the whole should be the same as the average welfare of each part (Sen, 1997) [18].

In addition, the measure must be additively decomposable (Shorrocks, 1980) [28] and show inequality aversion, i.e., when analyzing the context of income distributions, the relationship between inequality measures and social welfare functions, with Yaari (1987) [30] approach, distribution functions play a fundamental role in social preferences. These functions include normative aspects or value judgments always present in evaluating both magnitudes, welfare and inequality. Their properties determine The degree of preference for equality (or aversion to inequality) of the measure used, which conditions its behavior when certain income distribution changes occur. (Atkinson, 1970) [3]. To measure inequality in this paper, the Gini index is used because it is easy to interpret and can be decomposed. The usefulness of this index lies in the possibility of exploring new avenues for future observations on the characteristics of each member of a family and investigating how much it contributes to explaining the causes of inequality. Thus, the Gini index measures the extent to which the distribution of income among individuals or households within an economy departs from a perfectly equal distribution.

In this sense, the Gini index measures the Lorenz curve area and a hypothetical line of absolute equity, expressed as a percentage of the maximum area below the line. The index is bounded between 0 and 1, hence its ease of interpretation and usefulness in measuring inequality. A Gini index of 0 represents perfect equity, while 1 represents total inequality (Banco Mundial, 2012) [4]. Namely, it is a measure derived from the Lorenz curve. It records the cumulative percentages of total income received with respect to the cumulative number of recipients whose starting point is from the person or household with the lowest income. In such a way that the Gini index can be decomposed and posed through the following equation:

$$G = \sum_{h=1}^{m} \pi_h P_h G_h + \sum_{k=2}^{m} \sum_{h=1\, k>h}^{m-1} \pi_h P_k \left[\frac{\tilde{y}_k - \tilde{y}_h}{\tilde{y}_h}\right] + Efecto$$

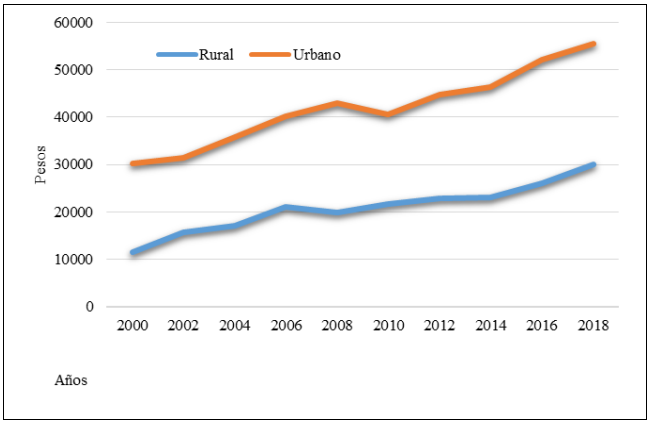
Where:
m = Number of groups
πh = Percentage of income of group h
ph = Percentage of the population of group h
Gh = Gini coefficient of group h
yh = Mean income of group h

As the equation establishes, the Gini index is broken down into three main factors that allow us to determine the degree of inequality. The first factor refers to income inequality within each class into which the population is segmented. The second is related to the fraction corresponding to the inequality resulting from the discrepancies between the average incomes of the different classes. The third refers to the circumstances in which inequality is manifested in family units in the low-income bracket, which is higher than units belonging to the middle-income bracket. In this way, by decomposing the Gini index, it is possible to revalidate the results in terms of the relationships between the variables used in the study of the income distribution.

Results

Figure 2 shows the average income levels of the rural and urban areas of Mexico in the period 2000-2018. The data show significant differences in income levels between urban and rural áreas. At the beginning of the period, 2000 the population living in cities had an income of $30,149 while the rural population had an income of $11,423. In other

words, the average income in cities was 2.6 times higher than in urban areas. Meanwhile, at the end of the study period, the year 2018, the urban areas had average incomes of $55,495 and the rural areas reached an average income of $30,016 which means that the average incomes of the cities were 1.84 times more than the rural areas.



Source: based on ENIGH´s (2000-2018)

Graphic 2: Rural and Urban Income Levels in Mexico: 2000/2018

Continuing with the analysis of income levels, we can see how the 2008 world financial crisis affected the income of both zones by reducing their growth rates by around 3%. We can also see how it took four years for both urban and rural areas to return to growth. That is, despite the crisis that arose in the United States due to the marked interdependence with its northern neighbor, Mexico's economic activity contracted considerably, which was reflected in income levels at both the urban and rural groups.

Once the comparative exercise of urban and rural income levels over 18 years has been carried out, the following considerations can be expressed. The figures reflect important differences in the average incomes of urban and rural areas.

Namely, there are significant inequalities between urban and rural localities in Mexico, wich indicates the high concentration of income. However, an interesting aspect to highlight is that this inequality has been reducing over time, since the growth rate of the urban area over the entire period was 3.45% per year, while that of the rural area was 5.51%. Improvements in the fight to reduce poverty have marked gradual progress, manifesting moderate growth rates, around 2.2% on average in 2000-2018, combined with notable differences in income levels. In this sense, Table 4 presents the Gini index at the national, urban and rural levels in Mexico in the period 2000-2018. The data show a limited reduction in poverty since at the beginning of the period, 2000, the coefficients are 0.526, 0.469, and 0.428 at the national, urban and rural levels, respectively. While at the end of the period, the year 2018, the coefficients decrease to 0.459, 0.421 and 0.420. Expressing the data in percentages means that poverty levels in the urban area after 18 years have decreased by 4.8%, while in the rural area, it has decreased by 0.8% and at the national level by 6.7%.

Table 4: Gini Index for Urban and Rural Areas in Mexico: 2000-2018

Year	National	Urban	Rural
2000	0.526	0.469	0.428
2002	0.501	0.430	0.472
2004	0.500	0.441	0.419
2006	0.489	0.450	0.452
2008	0.499	0.459	0.450
2010	0.472	0.433	0.448
2012	0.487	0.442	0.432
2014	0.487	0.446	0.397
2016	0.483	0.449	0.421
2018	0.459	0.421	0.420

Source: Own calculations based on Income from Inegi-Enighs (2000-2018)

Continuing with the results, once the Gini index equation has been applied, the following conjectures are shown. An interesting aspect to note is that thoughout the study period there are ups and downs in the coefficients, with the highest for the urban area in 2008 with an index of 0.459, which is explained by the consequences of the global financial crisis originating in the United States and its considerable effects on the Mexican economy. On the other hand, the lowest coefficients are presented for the urban area in 2018 with an index of 0.421 and for the rural area in 2014 with an index of 0.397, which could be due to the favorable results of the continuity of the social programs applied in the country, such as prospera and oportunidades. The modest reductions in poverty are associated with low GDP growth rates. The use of resources has been inefficient, combined with high rates of informality and limited capital accumulation, resulting in very limited returns in productivity levels. Likewise, the duality existing between the economic activities that are developed, since at one extreme are the northern entities with modern and technified industry and, on the other hand, the southern entities with low, competitive levels, scarce technification, and traditional activities that reflect economic backwardness.

Esquivel-Hernández (2015) [16]. points out that inequality in Mexico has been reduced due to the following factors. First, a significant increase in remittances coming mostly from the United States to families in rural communities. Secondly, the greater efficiency and focus of social programs – Oportunidades, Progresa and Prospera- implemented by recent governments to combat poverty. And, thirdly, the increase in salary levels has led to a reduction in inequalities. This may have been favored by the process of trade liberalization and the association with northern neighbors, which has translated into gradual wage increases.

Limitations of the work and conclusions

This section presents the main limitations that arose at the time of conducting the research. These restrictions are

mainly related to the availability and processing of the data. On the one hand, the methodology applied in the Population Censuses has been modified over the years, which generates complications when trying compare the same variable over time. On the other hand, the ENIGH, National Household Income, and Expenditure Survey, is usually conducted every two years; ideally, it would be possible to apply it annually, but this study presents observations due to this restriction every two years, which is a limitation.

It should be noted that since there is no urban and rural price index, the price index calculated by INEGI was used to process the information and to have the income levels of the urban and rural population at constant prices. Nevertheless, beyond mentioning the above limitations, it can be pointed out that the series obtained from homogeneous sources are quite reasonable and show great congruence with the process carried out by the rural and urban areas of Mexico in terms of both the number of inhabitants and income levels.

In terms of conclusions, the following final reflections are presented. Urbanization is one of the most important processes that make economic growth possible, so it is a priority to make it work properly. Urbanization has been a key element in Increasing the production of godos and services as it allows countries to diversify into new industries, learn and develop new things. People gain access to better living conditions. As cities grow, productivity levels tend to increas faster, as they are produced on a broader basis.

In the case of Mexico, the urbanization process has occurred in three very marked stages. From 1900 to 1940, the first stage is defined as slow-growth urbanization, in which rural settlements are more representative. In the second stage, from 1940 to 1980, there was an accelerated growth of urbanization, since there was a demographic expansion in the cities, mainly in Mexico City, Guadalajara and Monterrey. Finally, from 1980 to date, 2019, the third stage is characterized by moderate growth in urbanization, the expansion of medium-sized cities, and the country becoming predominantly urban.

Based on the Gini index analysis applied in this paper, it is posible to infer that there has been a reduction, albeit limited, of inequality in urban and rural áreas in México. Several factors can explain this. Monetary transfers through social programs have been an important element in supporting the poorest families in rural areas. The reduction in the wage gap between skilled and unskilled jobs has mitigated inequality among the population. And remittances coming mostly from the United States to rural localities are another compensatory element that has reduced of inequalities.

Based on the above, it can be said that the levels of inequality have decreased in recent years, although not significantly, and are still high for an economy such as Mexico's. Therefore, there is still a long way to go to reduce inequality. Therefore, there is still a long way to go due to the conditions that exist in the country. On the one hand, there is the deep concentration of income and, on the other, the great informality of employment. Undoubtedly, these are the issues that will have to be resolved to improve the welfare of the population in the future.

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