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Study of the Progressivity of Personal Income Taxes for Individuals in Mexico

Estudio de la progresividad del Impuesto Sobre la Renta de personas Físicas en México

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Abstract

The inequality in income distribution is a constant that is repeated throughout the world to a greater or lesser extent, industrialized countries are generally less inequitable than developing countries, one of the instruments that are frequently used to try to reduce inequality and better distribution are direct taxes and particularly those for people as they can be designed in such a way that they are progressive, but the dilemma with progressivity has to do with the magnitude and how much is maintained given the income increases of people. As a result of the SAT (Tax Administration Service) opening the information of the tax returns anonymously, it is possible to analyze the progressivity in Mexico for different types of taxpayers in this document, the ISRPF (Income Taxes of Individuals) for the years from 2010 to 2015, the results offer evidence of progressivity and changes in the concentration and distribution of income even when they are insufficient to modify the distribution of income in the medium term.

JEL Code: D31, E62, H24
Keywords: income tax; progressivity; income distribution

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Resumen

La inequidad en la distribución del ingreso es una constante que se repite en todo el mundo en mayor o menor medida, los países desarrollados generalmente son menos inequitativos que los países en vías de desarrollo. Uno de los instrumentos que son utilizados con frecuencia para intentar reducir la inequidad y mejorar la distribución son los impuestos directos, particularmente los destinados a las personas, ya que pueden diseñarse de tal manera que resulten progresivos. La disyuntiva en el tema de la progresividad impositiva tiene que ver con la magnitud y qué tanto se mantiene, dados los incrementos del ingreso de las personas. A raíz de que el SAT (Servicio de Administración Tributaria) apertura la información de las declaraciones fiscales de forma anónima, es posible analizar la progresividad en México para diferentes tipos de contribuyente. En este documento se optó por el ISRPF (Impuestos Sobre la Renta de Personas físicas) para los años de 2010 a 2015, los resultados ofrecen evidencia de progresividad y cambios en la concentración y distribución del ingreso aun cuando resultan insuficientes para modificar la distribución del ingreso en el mediano plazo.

Código JEL: D31, E62, H24
Palabras clave: impuesto sobre la renta; progresividad; distribución del ingreso

Introduction

In recent years the issue of income distribution has taken on broad importance, as denoted by the work done by Stiglitz (2012), Atkinson (2015), Deaton (2015), Mullainathan and Shafir (2016), and of course, Piketty (2014). Likewise, various international organizations such as ECLAC (ECLAC 2018; Castillo, 2015), the World Bank (Massina & Silva, 2017; Lange et al., 2018), and OXFAM (Fuentes-Nieva, 2014; Esquivel, 2015; Hardoon et al., 2016; Hardoon, 2017) have also contributed to the discussion. In all cases, there is broad agreement on the progress of income concentration and the effects or inconveniences that this generates, in addition to establishing elements that are considered key to explaining the phenomenon and that have to do with political, institutional, social, and economic factors. Alternative solutions have also been proposed to help reverse the concentration of income.

Income concentration in Mexico, as in many countries and regions of the world, is a reality inherent to the dynamics of the market economy itself. Therefore, it is crucial to have economic policy instruments that can mitigate and reverse this situation. In terms of fiscal policy, there is a crucial instrument for income distribution called progressive taxation, whose main purpose is to generate an income distribution pattern that is less inequitable than the one achieved by the market.

The idea of progressive taxes is not new, and, according to Goldschmidt (1941a), such taxes are a necessary contribution in times of explosive crises such as those resulting from wars and their consequences. Therefore, they can be seen as an emergency tax. Thus, as the author points out, if there have been wars since the origins of humanity, it is possible to think of emergency taxation since then.

In the years following its independence, Latin America turned to direct taxation to participate in income distribution and promote economic development. Nevertheless, these first steps had little success due to the lack of experience, the presence of corruption, and the lack of an organized land registry (Pinto, 2012). Currently, most countries provide for direct taxes with a certain level of progressivity in their tax systems (Estrada & Gonzalez, 2014). The problem is that progressive taxes are a secondary component of their collection, so in general terms, the collection is regressive (Mahon et al., 2015).

In Mexico, social indicators regarding income distribution and poverty in recent years have presented a behavior that can be described as unsatisfactory despite certain advances. In 2010 the GINI coefficient was 45.3, while in 2016, it was 43.4, the lowest level in the entire period. Regarding poverty in 2010, it was recorded that 46.10% of the population was below the poverty line at the national level, while in 2016, this figure had been reduced to 43.6%. With the opening of information on tax returns by the SAT (Tax Administration Service), this document aims to provide evidence on the progressivity of the personal income tax (ISRPF), assessing whether it contributes to improving income distribution. To this end, the document includes section (II), which reviews the theory regarding progressive taxes and then continues with (III) the exploration of taxes in the country and the figures related to income distribution. Subsequently, using the data on tax returns available on the SAT portal, a study is made for 2010 to 2015 (IV) on the progressivity of the tax, and finally, a conclusion is offered in this regard.

Review of the literature

There is a persistent controversy regarding progressive taxes; for the vast majority, their use obeys the need for income distribution within society since even when markets are competitive and society is relatively homogeneous, there will always be some margin of inequality (Friedman, 1948), denoted in some cases by vulnerable groups such as children, the sick, and the elderly (Goldschmidt, 1941a). For this reason, progressive taxation implies a condition in which some people could generate negative taxes while others would face higher average tax rates (Musgrave 1966).

The issue is addressed by Goldschmidt (1941a, 1941b), who wrote a dissertation on progressive taxation linked to the class struggle, in which the owners of the means of production are ready to resort to any kind of action within their reach to avoid paying a tax that is considered unjust, a theft, a tax on savings, or a fine on success. According to Goldschmidt (1941a), if the functioning of the capitalist system sustains its dynamics in the accumulation of capital, except in exceptional conditions, it should accept the implementation of a progressive tax with the necessary care so that it does not hinder the accumulation process. Nevertheless, according to the author, "to date, the spectacle has not been granted of seeing any speculator die of starvation due to the progressive tax." Nowadays, one of the main objections to

progressive taxes lies in the negative impact they have on growth and the reduction of public revenues, as has been studied by Koester and Kormendi (1989), who provide evidence on the reduction of tax progressivity and its effect on the improvement of economic growth. Engen and Skinner (1999) find a negative relation between average tax rates and economic growth, as do Padovano and Galli (2007), Widmalm (2001), and Arnold (2008) for OECD countries.

According to Biswas et al. (2017), the impact of a progressive tax on economic growth is related to the effect of such taxes on people's incentives to employ, invest, and consume. Incentives are asymmetric and change according to income level. Therefore, Biswas et al. (2017) study the effect of reducing household inequality on growth, distinguishing between low- and middle-income households and high- and middle-income households. Reducing poverty improves growth, but reducing the gap between middle and high incomes reduces growth. The difference in the impact on growth stems from the fact that poverty reduction increases the female labor supply, improves the performance of small companies, and increases consumption, but in the second case, the female labor supply is reduced, as well as the growth of small companies and job creation.

In turn, Rick et al. (2018) analyze the effect of the progressive tax on work motivation. According to experimental evidence, they establish that the result will depend on people's valuation and alignment with distribution and government intervention. For those who identify with these elements, taxes will be a source of motivation and positively impact productivity levels, but those who do not identify with these elements may feel demotivated to work.

According to Doerrenberg and Peichl (2013), a person's tax morale increases as the tax system becomes more progressive and the effect is diluted as the person's income is lower; in a society where tax morale is on the rise, tax evasion will be lower, so it can be inferred that the greater the progressivity, the lower the tax evasion. Based on a similar thesis, Castañeda (2017) provides evidence for some Latin American countries on the disincentives people have to pay taxes to the extent that they perceive their tax systems to be more inequitable.

From the field of sociology, Bradley (2018) tries to establish the impact that personal taxes have had on income distribution in recent years in the United States, demonstrating that tax relief has generated a concentration of benefits for upper-class white men, which instead of decreasing existing inequalities has exacerbated them, thereby undermining the redistributive power of progressive tax systems. In contrast to Bradley, Splinter (2018) mentions that changes in U.S. tax policy have generated greater progressivity in individual income taxation.

Finally, the literature regarding progressive taxes comes from many different approaches, such as establishing taxes with a greater impact on income and wealth distribution, as in the case of inheritance tax (Piketty & Saez, 2013; Pedersen, 2018), highly progressive income taxes that tax wealth (Slemrod,

1998; Piketty & Qian, 2009; Scheve & Stasavage, 2016), and the role of progressive taxes as automatic stabilizers (Dromel & Pintus, 2004 and 2008; Krajewski & Pilat, 2017), in addition to new ways of measuring progressive taxes' effect on income distribution (Du & Zhong, 2018).

Taxes and income distribution in Mexico

There are a few issues in Mexico on which the vast majority of economists can agree, one of which is the country's poor performance in terms of tax collection. No matter the criteria or comparison, the result always points in the same direction. Figure 1 provides information on revenue collection in relation to GDP for the years 2008 to 2016 for the country, as well as the average for a large group of countries worldwide for which the World Bank reports information. Until 2012, it seemed that the collection had fallen into a trap that prevented it from surpassing the 10% barrier.

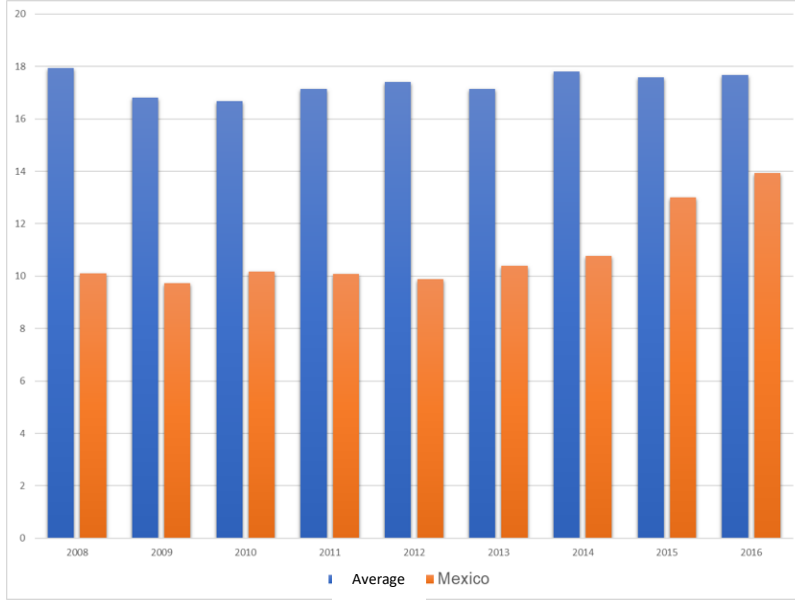

Figure. 1. Tax collection in relation to GDP (2008-2016)[1]
Source: created by the author with data from the World Bank

[1]The average corresponds to countries of all income levels and its number changes each year, since the average includes all those countries that submitted information. This number can be seen in Figure 2.

The tax structure in Mexico has undergone minimal changes that cannot be considered a tax reform. In 2007, new taxes were added to the system and repealed in 2014. In 2010 the marginal rates of the three main taxes were increased. In 2012 the system of referenced payments was implemented, which allowed the consolidation of a taxpayer registry; and in 2014, the system of referenced payments was made mandatory for individuals and corporations, which aided in the reduction of tax evasion and expanded the taxpayer registry (Ramírez 2007, 2012, 2013, 2019).

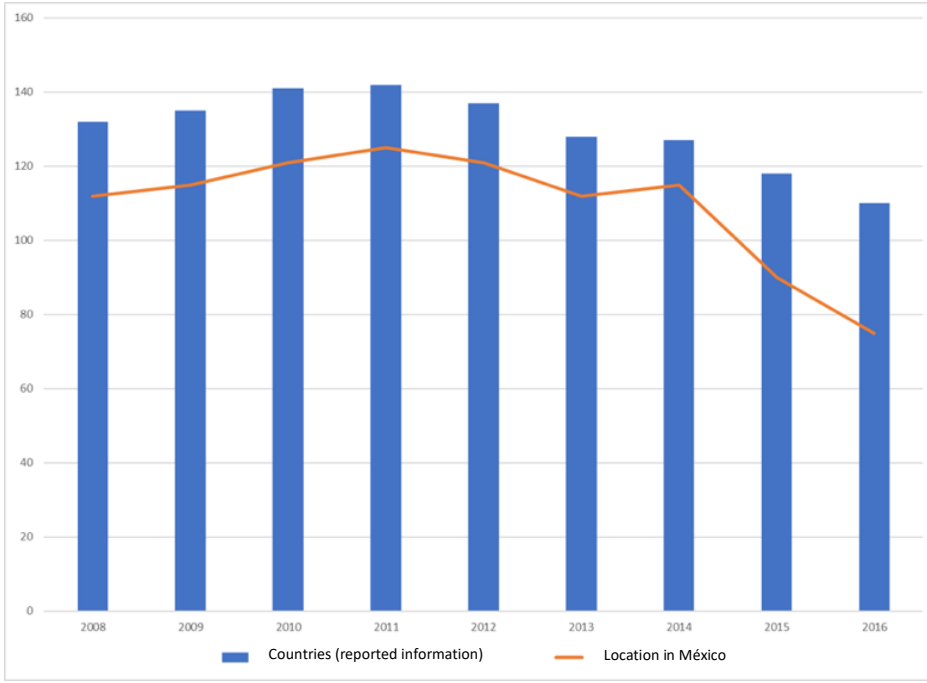

Figure. 2. Number of countries that submitted information on their tax collection and Mexico's position (2008-2016)
Source: created by the author with World Bank data

Unlike the other measures implemented, the obligatory nature of the referenced payments had the virtue of breaking the 10% trap, as can be seen in Figure 1. To give an idea of the country's progress compared to other economies, Figure 2 shows in the bars the number of countries that presented information on their tax collection in relation to GDP, and in the line, Mexico's ranking in terms of tax collection. As can be seen, in 2012, out of 137 countries, Mexico ranked 121st. In 2016 out of 110 countries, it ranked 75th.

In Mexico, the main tax collection is through two taxes, ISR (Income Tax) and VAT (Value Added Tax), which on average over the last 36 years have accounted for just under 85% of all tax revenues, with the former accounting for just over 50% and VAT for the rest. As VAT is an indirect tax, in theory and practice it is regressive, which is why an attempt is being made to reduce its negative effect by differentiating rates for certain forms of consumption, as is the case of the zero rate for medicines and food. Nonetheless, some have questioned this measure, arguing that it makes the tax more regressive, favors tax avoidance and evasion, and increases tax expenditures. According to Tanzi (2003), VAT is a tax meant to raise revenue, and if it is to be used, it should be kept as general as possible to achieve its purpose[2]. In this regard, Malo and Vélez (2012), as well as Ramírez (2013), have made some estimates on the expansion of VAT regressivity.

Regarding Income Tax, the tax is imposed in two main categories, individuals and corporations. In the second case, a general marginal rate is established for everyone, with some exceptions. In contrast, in the first case, differentiated rates are set for different income brackets, the idea being that as income increases, people contribute more than proportionally to the State, thus generating a redistribution of income. In the next section, an estimate of the progressivity of the ISRPF will be made, but not before describing what is happening in terms of income distribution in the country[3].

According to the 2013 Gini Coefficient[4] before taxes and transfers, Mexico is among the top 15 OECD countries with the best distribution. Nevertheless, if valued with the Gini Coefficient after income and transfers, it is among those with the lowest distribution, only surpassed by Chile, which is evidence of the government's capacity or margins of maneuver to improve the general welfare of society. Among the most significant problems observed by the IMF (International Monetary Fund) (2017) for Mexico is the persistence of poverty and inequality, as well as its low levels of tax collection.

According to the IMF, poverty in Mexico afflicts more than 40% of the population, with the Gini persistently hovering at values close to 0.5, while OECD countries average 0.3. Collection, even though improved, is still low, and this, among other things, can be attributed to the fact that many companies do not pay taxes, either because they are in the informal sector or because they have the economic and political power to do so (OXFAM, 2015).

[2]Maintaining tax collection at certain levels makes it necessary to accompany tax structures with indirect taxes, as mentioned by Barreix and Roca (2007) for the case of Uruguay, where half of its tax burden in 2005 originated from such taxes.
[3]This system was popularized according to Barreix and Roca (2007) as the Nordic dual system that taxes capital income at proportional rates and labor income at progressive rates.
[4]A measure for estimating unequal distribution, normally used to measure income inequality within a country.

Analysis of ISRPF progressivity

This section will analyze the income distribution of individuals for the years 2010 to 2015, in addition to estimating the progressivity of the ISRPF and its distributive effect. For this purpose, the databases on the annual declaration of this tax that comply with the nineteenth transitory Article of the Federal Revenue Law 2017, made available by the SAT, will be used.

Data

The data used in the analysis were obtained from the database published by the SAT as of December 20, 2017, in which the annual tax returns of individuals and corporations are compiled, encompassing the tax years from 2010 to 2015. These databases contain all taxpayers' tax returns for the corresponding year, although they are anonymized, i.e., they do not show the taxpayers' personal information, so it is impossible to link the income and tax payment figures to any taxpayer.

According to the SAT (2018), the databases are presented at the micro data level, are confidential, and respect the principle of self-determination, which implies that the information of all the taxpayer's returns is available. Still, their identity cannot be reasonably established, in addition to the fact that the data submitted by the taxpayer are respected, even though they may be inconsistent.

To anonymize the data, the SAT added random shocks to the variables in order to eliminate the relation between the taxpayer and the data, generating a noise process that presents a normal distribution with zero mean and standard deviation so that the data corresponding to each declaration do not offer the possibility of establishing a relation between them. Still, the functional and statistical relations at the aggregate level are not altered. Additionally, taking anonymization into account, the SAT performed a cleansing of atypical data based on the variable "total accrued income."

The information presented by the SAT corresponds to three groups of taxpayers: Legal Entities under the general regime, Individuals obligated and not obligated to file annual returns, and the multiple informative returns of wages and salaries.

The population under study in this document is taxpayers classified as obligated and non-obligated individuals for the fiscal years 2010 to 2015, the period with available information. The individuals required to file annual returns are described in Article 117, section III of the Income Tax Law (LISR) in force for 2010 to 2013 and Article 98, section III of the new LISR, in force for 2014 and 2015. In general, taxpayers are required to file a tax return when they have obtained income from the following items: rendering professional services (fees); renting out real estate; engaging in business activities (commercial, industrial, agricultural, livestock, forestry, fishing, and motor transportation), except for

those taxpayers under the Tax Incorporation Regime; disposing of goods; acquiring goods; receiving salaries; and receiving interest. Other types of income to be declared are debts forgiven by the creditor or paid by another person, for investments abroad, for moratory interest, for conventional penalties, etcetera. (SAT, 2018).

According to the tax and management report for the fourth quarter of 2015 presented by the SAT (2015a), in 2010 the active taxpayer registry consisted of 33.5 million active taxpayers, a figure that in 2015 reached 51.6 million, of which 3.5% corresponded to Legal Entities, 38.6% to Individuals and 57.9% to Employees.

Descriptive analysis

According to the Annual Report 2015 and Challenges 2016 presented by the SAT (2015b), in 2015 the number of returns filed was 5.4 million. However, in the anonymized database, only 4.7 million records are presented, corresponding to the same number of returns, which can be explained by the purging discussed above. The figures have this characteristic in each of the six years analyzed, as seen in Table 1.

From the database composed of 45 variables, two are particularly relevant for the present study and correspond to "Total Accrued Income" (TIA) and "Income Taxes Caused" (ISRC), based on which it was intended to establish the distribution of income and the distributive effect of the tax. For this purpose, a new purging of the series was performed, eliminating those records in which the TIA was zero or contained no information or in those cases in which no tax incurred was recorded. Once this cleansing was performed, only 62% of the total returns were analyzed for 2010, a percentage that increased throughout the period, reaching 84% in 2015, as shown in Table 1. It is important to mention that due to the elimination of the records, there were marginal changes in the results, even though the trends were generally maintained.

Table 1
Number of annual declarations, total and analyzed records

Year	Annual returns	Total records	Analyzed Records
2010	3 121 383	3 084 581	1 907 495
2011	3 217 616	3 397 961	2 043 568
2012	3 584 788	3 678 138	2 360 490
2013	4 086 990	4 156 047	3 014 340
2014	4 703 885	4 497 340	3 462 081
2015	5 433 502	4 651 488	3 907 787

Source: created by the author with SAT data

The cumulative income of this segment of taxpayers represented around 6.6% of GDP in 2010 and increased throughout the period to reach just over 9% in 2015 (Figure 3). What explains the behavior of the TIA? For some years, it can be explained by the economy's dynamism. Still, for the whole period, the explanation has to do with the increase in the taxpayer register, which is made evident by the increase in the number of returns filed and of course of the records analyzed in this paper: from 2010 to 2015 the records analyzed increased by 105%, while the TIA in the period increased by about 60% and GDP by about 16%. In 2013 there was a significant increase in the number of analyzed records, which can be associated with a tax debt regularization program called "Ponte al corriente" ("Catch up").

In the period under study, the rates on which the tax is levied underwent both quantitative and qualitative changes. From 2010 to 2012, the LISR established a maximum marginal rate of 30% on income exceeding MXN 392 842.97, while it provided for 8 income levels. For 2013, the rate was modified, establishing a maximum marginal rate of 29% and adjusting the two previous excess rates and their corresponding fixed installments. This modification was published on December 11, 2013, in the Official Gazette of the Federation through the new LISR, abrogating the previous one published on January 1, 2002.

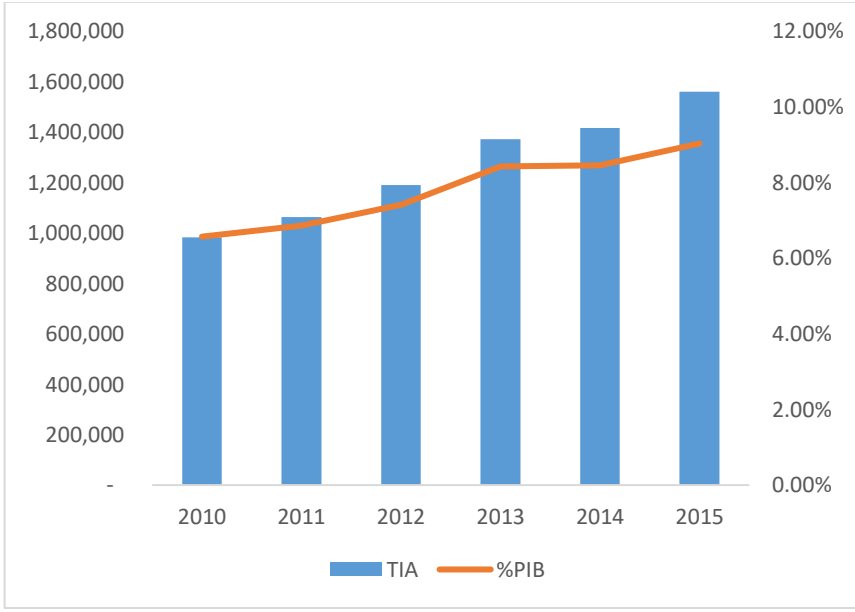

Figure. 3. Total accruable income and tax revenues (at 2013 prices, in millions of pesos and %GDP)
Source: created by the author with SAT data

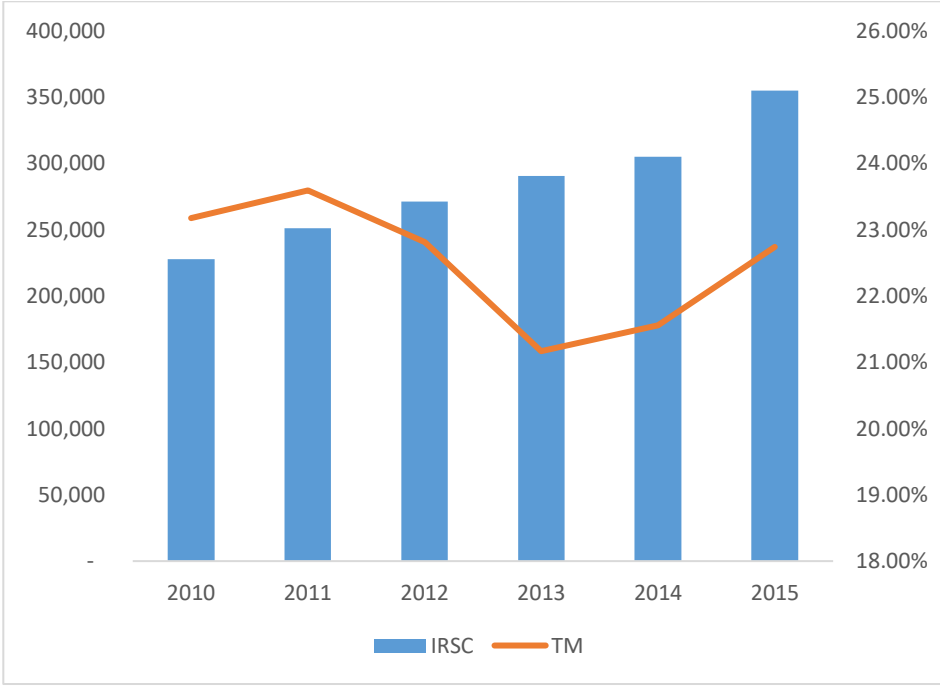

Figure. 4. Income tax payable and average rate (at 2013 prices, in millions of pesos)
Source: created by the author with SAT data

The rate established with the new LISR takes the 2010-2012 rate and adds three additional income levels with the respective marginal rates. For the ninth income level, a lower limit of MXN 750 000.01 and an upper limit of MXN 1 000 000 are established, with a marginal rate of 32% for the income above the lower limit and a fixed fee of MXN 180 850.82. The next income level ranges from MXN 1 000 000.01 to MXN 3 000 000.01 with a marginal excess rate of 34% and a flat rate of MXN 260 850.81. The last income level ranges from MXN 3 000 000.01 and above with a marginal excess rate of 35% and a flat rate of MXN 940 850.81. The changes in the rates affected the average rates in such a way that they went from 23.59% in 2012 to 22.81% in 2013. With the new LISR, the average rate was improved (Figure 4).

According to the quarterly reports of the Ministry of Finance and Public Credit (SHCP), the change in the ISRC from 2010 to 2012 was mainly due to the dynamism of economic activity. In real terms, the growth rate in those years was around 3.65%, the highest in the study period. As previously mentioned, the improvement in collection in 2013 was in part due to the "Ponte al corriente" program in addition to lower offsets recorded for the tax. This helped to improve collection even despite the economic slowdown in 2013. In its annual report, the SAT mentions that the direct comparison of income tax

collection observed between 2013 and previous years is inadequate due to the new compensation regime starting that year. On the other hand, as the electronic linkage in the tax system has been implemented, the collection level has also improved, as seen in Figure 4.

In terms of income concentration, what was happening in this population stratum? Before the effect of taxes, according to the TIA, the top 10% of the population earned 50%, while the bottom 50% only took 9%, with the rest remaining in the middle-income population.

Income concentration throughout the period was moderating, but in 2015 the trend was reversed. Nevertheless, progress was made in reducing concentration since in that year, the 10% of the population with the highest income earned 43%, 7 percentage points less than in 2010, 50% of the population took 5% more of the income compared to 2010, while the 40% of middle income did so by 2% (Figure 5).

Based on Figure 5, it is possible to observe that economic activity without the apparent effect of taxes has reduced income concentration, but it is important not to lose sight of the fact that there have been changes in the tax structure and therefore, this conditions the analysis of two behaviors: on the one hand 2010-2012 and on the other 2013-2015. In the first three years, the process is slower than in the following years, which suggests an indirect effect of taxes on taxpayers trying to reduce their tax burdens, which could also explain the increase of individuals by about 5.6 million from 2013 to 2015.

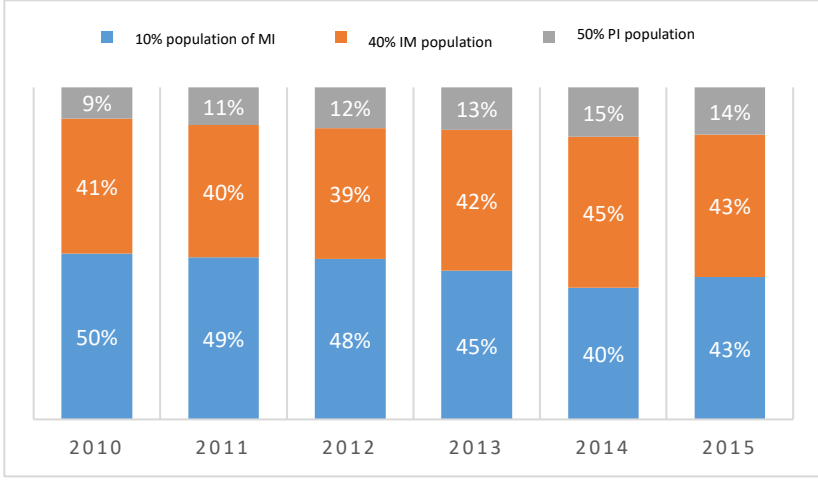

Figure. 5. Concentration of pre-tax income 2010-2015
Source: created by the author with SAT data[5]

Figure 6 shows the concentration of income after tax. In 2010, the difference between the situation with tax and without tax for the 10% of the population with the highest income meant a reduction

[5]MI indicates the top 10% of the population with the highest income, IM corresponds to 40% of the middle-income population and PI refers to 50% of the population with the lowest income (worst income).

in the concentration of about 2.7 percentage points, which were distributed 0.9 in the 50% with the lowest income and the rest in the percentage of the remaining population. Considering the tax, in 2012, the situation reduced the concentration of the 10% of the population with the highest income by 2.9 percentage points, improving the share of 50% of the population by 1.3 percentage points and 1.6 percentage points for the 40% of the middle-income population.

From 2013 to 2015, after tax, a greater impact was achieved in the participation of the top 10% of the population with the highest income and better participation of the bottom 50% of the population with the lowest income. Given the above, it could be inferred that taxes have had a certain redistribution capacity, at least in the population and years of study, even though they are still marginal changes.

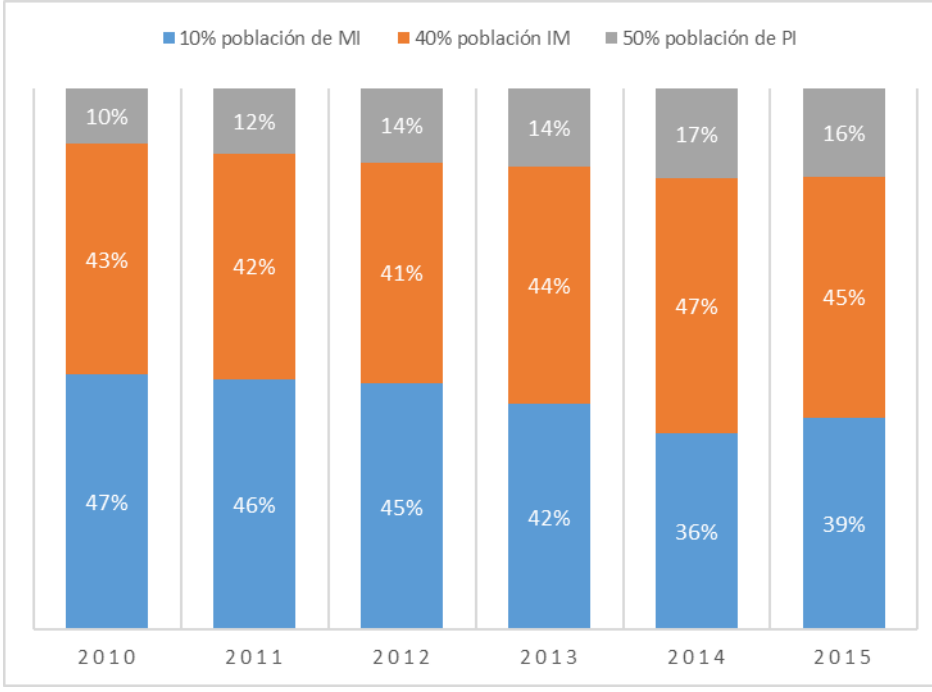

Figure. 6. Concentration of after-tax income 2010-2015
Source: created by the author with SAT data

Breakdown of income into deciles and its concentration

Table 2 presents the average TIA at 2013 prices for each income decile according to the years of study. It is interesting to note that in 2010 the average income of decile 10 represented 405 times the income of the first decile, and given the upward trends in the second case and downward trends in the first, by 2015, the number of times that the tenth decile was greater than the first was only 69 times, without this being directly due to the tax effect.

Table 2
Total average accrued income 2010-2015 (pesos at 2013 prices)

Decile	2010	2011	2012	2013	2014	2015
1	335.07	424.54	663.37	500.75	058.21	006.77
2	109.17	678.64	702.71	610.35	461.81	472.59
3	575.08	613.49	457.68	539.20	640.60	709.50
4	041.38	387.71	527.72	417.00	382.70	575.16
5	957.95	351.89	473.07	702.40	162.58	393.24
6	303.29	231.13	816.29	407.50	220.15	109.53
7	625.81	824.98	929.64	382.20	706.21	481.99
8	219.08	411.91	901.29	800.70	635.64	635.05
9	899.35	905.65	267.08	989.30	731.16	618.26
10	567 301.50	540 800.89	436 852.37	041 307.00	619 818.43	714 276.00

Source: created by the author with SAT data

Table 3 shows the average taxable income at 2013 prices, which refers to the taxes incurred by taxpayers. Comparing the extremes, i.e., decile 10 and 1, it is possible to perceive that the gap between

them is wide, being much larger than that observed in the average TIA, and in 2010 the average taxable income of decile 10 was 3 437 times higher than that of decile 1, while in 2015 the relation was 374 times.

Table 3
Average taxable income 2010-2015 (pesos at 2013 prices)

	2010	2011	2012	2013	2014	2015
	204	378	443	644	1	1
	.71	.88	.49	.41	337.99	349.05
	1	5	3	3	4	4
	399.82	286.27	103.66	547.97	564.39	507.46
	9	17	21	9	11	10
	670.49	763.47	878.54	749.65	528.94	877.15
	31	36	26	17	31	18
	144.39	026.82	019.85	777.63	308.25	561.37
	32	50	37	28	29	27
	948.77	891.86	671.65	469.32	711.60	568.42
	56	61	57	45	45	42
	427.43	010.38	538.71	839.61	652.77	330.03
	80	81	79	69	67	64
	811.06	209.74	057.09	517.76	607.98	581.86
	111	113	103	95	92	91
	615.07	214.33	375.06	301.14	016.63	545.37
	164	162	151	144	141	141
	303.18	057.79	218.16	974.00	019.60	837.72
	703	699	668	547	456	505
0	633.08	496.33	715.75	383.20	542.33	000.00

Source: created by the author with SAT data

Given the above, it is possible to assume, on the one hand, that income concentration has been reduced and, on the other hand, that the tax has been progressive. When calculating the average tax rate for the deciles (Table 4), the following clarifications can be made:

a) The abrupt changes in the average rates of deciles 4 and 5 correspond to changes in the composition of the tariffs that do not consider the composition of the income deciles.

b) The minimal changes in the average rates of deciles 9 and 10 exemplify the difficulty in generating a greater distribution in the deciles with higher incomes.

c) In 2015, the average rate for the different deciles denotes an orderly behavior in which the average rate increases as income increases, which suggests a pattern of progressivity.

Table 4
Average Tax Rate 2010-2015 (in %)

	2010	2011	2012	2013	2014	2015
1	3.2	4.5	4.5	4.7	5.5	5.3
2	5.3	14.03	7.4	5.7	6.0	6.1
3	13.14	16.82	17.58	8.2	9.6	9.4
4	20.76	20.78	13.59	10.75	18.48	12.01
5	14.71	19.32	14.92	12.90	13.43	13.90
6	15.79	17.08	17.03	15.01	15.36	15.91
7	17.97	18.26	18.83	16.86	17.09	17.97
8	20.14	20.68	20.51	18.40	18.57	20.00
9	22.33	22.39	21.05	20.86	21.02	22.49
10	27.41	27.53	27.44	26.82	28.18	29.46

Source: created by the author with SAT data

The Gini coefficient coincides with the previous data, denoting a high income concentration that was reduced in the period, but it is far from even the national situation that, according to World Bank data, was 0.453, 0.454 and 0.458 for the years of 2010, 2012, and 2014 respectively, while for those years the

data for the study population stratum were 0.638, 0.607 and 0.534[6]. In the years from 2013 to 2015, even if in a limited way improved, the condition of the Gini coefficient in favor of lower-income concentration remains minimal, especially for the type of tax in question (Figure 7).

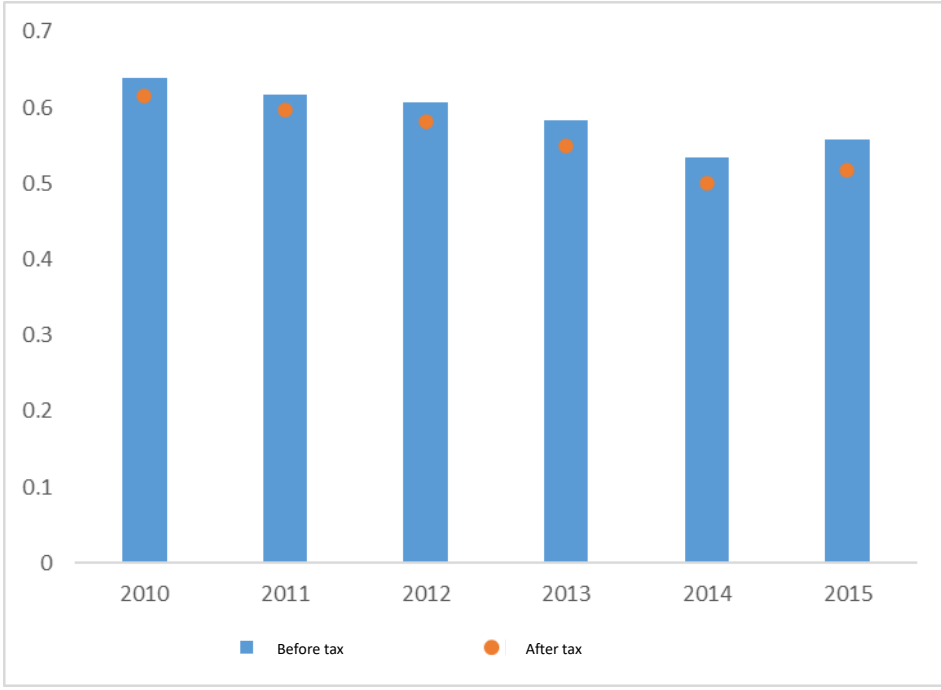

Figure. 7. GINI coefficient before and after tax 2010-2015
Source: created by the author with SAT data

When breaking down the Gini coefficient for each decile, the highest concentration of income is found in the extreme deciles and is particularly higher in the tenth decile corresponding to the 10% of the population with the highest income, while the seventh decile is the one with the lowest concentration. From 2010 to 2012, the tax had a minimal impact in changing this situation. Nevertheless, it is important to note that from 2013 to 2015, the tax had a favorable impact on reducing the concentration in the tenth decile, but its impact on the last percentile is negligible.

[6]The reduction in income inequality was not exclusive to Mexico; according to Amarante and Colacce (2018) the Latin American region had a favorable trend in the reduction of inequality in the period from 2002 to 2014, a process that occurred thanks to factors at a general level such as the increase in the price of commodities, which improved the dynamics of the labor market and consequently the employment of unskilled workers and wages. At the individual level, institutional factors in labor matters have been improved and redistributive policies have been implemented.

According to the data in 2010, more than 21% of income was concentrated in the top 1% of taxpayers, similarly to the following two years. As a result of the changes made in 2013, the income concentrated in the last percentile was less than 18%, and by 2015, with the new LISR, it was less than 15%. Figure 8 presents the average Gini coefficient for 2010-2012 and 2013-2015, grouping deciles 1-9, tenth decile and last percentile. The figure provides an interesting perspective on two aspects:

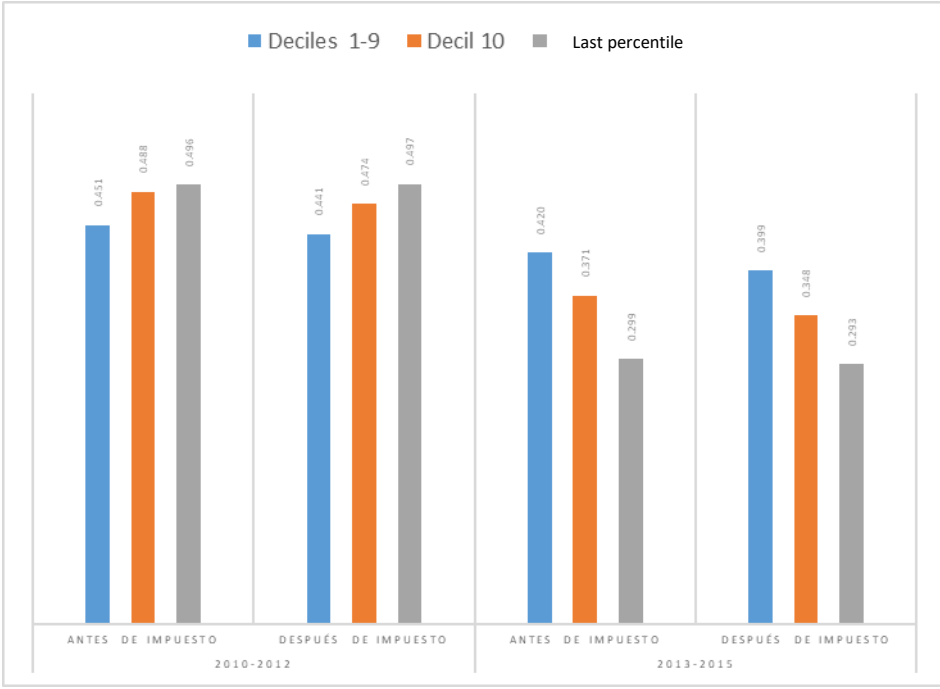

Figure. 8. GINI Coefficient averages before and after tax for different income strata (2010-2012, 2013-2015)
Source: created by the author with SAT data

a) A change in the concentration of income in the first group of years to the second indicates that the modifications made to the tax have followed the right direction in attenuating this concentration, even though a greater incidence is lacking.

b) The effect on concentration attenuation for the 2013-2015 period occurs for 90% of contributors and for 10%, but its capacity is lower for 1%. This makes it necessary to think about direct taxes on inheritances, bequests, and donations to try to have more impact on the last percentile.

Progressivity analysis

Progressivity seems simple to understand and relatively easy to explain, but ambiguous to obtain. According to Musgrave and Thin (1948), this ambiguity resides in the fact that the result depends on how the degree of progressivity is measured. For these authors, a rate structure is progressive when the average rate of a tax increases as the income scale rises, while it is proportional when the rate remains constant and regressive when the average rate decreases as income increases.

Musgrave and Thin (1948) set out four different ways to derive the degree of progressivity shown in Table 5, the first two derived from Pigou's theories, the third about the elasticity of tax revenue to income, and the last a derivation of the third.

Table 5
Progressivity measures

Progressivity measure	Formula	Criteria
Average rate of progression	$\frac{T_1 - T_0}{\frac{Y_1}{Y_1 - Y_0}}$	+ Progressive 0 Proportional
Marginal rate of progression	$\frac{\frac{T_2 - T_0}{Y_2 - Y_1} - \frac{T_1 - T_0}{Y_1 - Y_0}}{Y_1}$	- Regressive + Progressive 0 Proportional
Progressivity of the obligation	$\frac{T_1 - T_0}{T_0} * \frac{Y_0}{Y_1 - Y_0}$	- Regressive >1 Progressive 1 Proportional
Progressivity of residual income	$\frac{(Y_1 - T_1) - (Y_0 - T_0)}{Y_0 - T_0} * \frac{Y_0}{Y_1 - Y_0}$	<1 Regressive <1 Progressive 1 Proportional >1 Regressive

Where: T_0 is the taxable income corresponding to income Y_0 and T_1 is the taxable income corresponding to income Y_1, where $Y_1 > Y_0$
Source: created by the author based on Musgrave and Thin (1948)

The four measures establish different relations between income and taxable income, the main distinction being that as income grows, the gap between marginal income and average income narrows,

generating indicators that lead to proportional tax structures, taking as a reference the progressivity of the obligation (PO) and the progressivity of the residual income (PIR). Table 6 shows that, in general, the tax remains progressive, with the particularity of being more progressive in the first income deciles. According to the PO, from 2010 to 2012, moving from decile 1 to 2 was more progressive than from decile 9 to 10. For the following years, this situation is reversed, at least for the jump from the first to the second decile.

In 2010, moving from decile 1 to 2 meant that for every peso that income increased, tax revenue increased by 1.87 pesos, while moving from decile 9 to 10 meant that for every peso that income increased, tax revenue increased by 1.32 pesos, unlike in 2015, when the tax burden of moving from decile 1 to 2 is lower than in the case of decile 9 to 10.

Table 6
Progressivity of obligation (PO) and Progressivity of residual income (PIR)

	2010		2011		2012		2013		2014		2015	
Decile	PO	PIR	PO	PIR	PO	PIR	PO	PIR	PO	PIR	PO	PIR
1												
2	1.87	0.97	3.73	0.87	1.81	0.96	1.26	0.99	1.13	0.99	1.21	0.99
3	3.25	0.87	1.31	0.95	3.05	0.84	1.93	0.94	2.61	0.90	2.52	0.90
4	2.14	0.83	1.60	0.88	0.35	1.14	2.02	0.91	4.13	0.67	2.03	0.89
5	0.12	1.23	0.80	1.05	1.41	0.94	1.80	0.90	- 0.17	1.26	1.71	0.90
6	1.20	0.97	0.56	1.11	1.56	0.90	1.59	0.91	1.56	0.91	1.57	0.91
7	1.67	0.87	1.35	0.93	1.54	0.89	1.47	0.92	1.45	0.92	1.50	0.91
8	1.64	0.86	1.71	0.84	1.54	0.88	1.45	0.91	1.43	0.91	1.53	0.88
9	1.44	0.89	1.34	0.91	1.09	0.98	1.52	0.88	1.51	0.88	1.45	0.89
10	1.32	0.91	1.32	0.91	1.43	0.89	1.43	0.89	1.58	0.85	1.49	0.86

Source: created by the author

Regarding the PIR, as shown in Table 6, its interpretation changes, and it will be progressive in cases where it is less than 1 and regressive when it is greater, being proportional in 1. The PO and the PIR have no differences in detecting changes from progressive to regressive or vice versa, but their interpretation changes about how progressive the tax collection is. For example, in 2015, while moving from decile 2 to decile 3 implies a PO of 2.52 and a PIR of 0.90, moving from decile 4 to decile 5 would imply a PO of 1.71 and a PIR of 0.90, which may generate a misconception regarding progressivity.

In 2010 and 2012, to consider the extremes, moving from decile 1 to 2 and from decile 9 to 10 according to the progressivity measure used generates a different perception. As commented above, the PO indicates a more progressive structure at the lower end than at the upper end, while the PIR would indicate the opposite. In terms of vertical equity, it would be desirable to keep the measure of progressivity constant through income change.

Table 7 shows some aggregate progressivity measures in which it can be observed that regardless of the index used, the ISRPF has had a distributive effect, even though its impact is minor due to the low collection obtained through this tax and its level of progressivity, which is also slight, as has been noted by several studies on the subject[7].

Table 7
Redistribution, progressivity, and equity indices

	2010	2011	2012	2013	2014	2015
Gini before tax	0.64	0.62	0.61	0.58	0.53	0.56
Gini after tax	0.62	0.60	0.58	0.55	0.50	0.52
Musgrave-Thin Index	1.06	1.05	1.07	1.08	1.07	1.09
Suits Progressivity Index	0.12	0.10	0.13	0.17	0.17	0.18
Kakwani Progressivity Index	0.08	0.07	0.09	0.12	0.12	0.14
Reynolds-Smolensky Index	0.02	0.02	0.03	0.03	0.03	0.04
Atkinson-Plotnick Index	0.0006	0.0014	0.0011	0.0006	0.0012	0.0004

Source: created by the author using the PROGRES module developed for Stata by Van Kerm and Peichl (2007)

Musgrave and Thin (1948) propose an index called the Progression Effect (effective progression), which results from the quotient between the after-tax equality coefficient and the pre-tax equality coefficient. The result of the Index will be influenced by the income distribution in which it is applied: in the case where the pre-tax income distribution is perfectly equal, either the proportional or highly progressive rate structure will have an index value equal to 1; when the pre-tax income distribution is unequal, the progressive rate structure will result in an index value greater than 1; and the less equal the pre-tax income distribution, the more the progressive rate structure will be able to equalize income. Nevertheless, if the rate structure maintains constant progression or even increases, the effect will be smaller in the lower income levels. According to the data in Table 7, a slight distributive effect was improved in 2015, which may be the result of the improvement in the distribution and progressivity achieved by the rate structure (see Table 4).

Suits (1977) proposes an index in which, based on the idea of the Lorenz curve, a situation is established where the tax burden is proportional to the level of income, with the parameter K being the area under the curve and the parameter L the area representing the tax rate structure on the tax burden relation in correspondence with income. When the tax rate structure is proportional, the index value will be 0, progressive greater than zero and regressive less than zero. As in the proposal of Musgrave and Thin (1948), it is important to consider income distribution without tax since, as Suits mentions, no tax is

[7]Countries that have strong redistributive effects such as the Scandinavian countries collected more than 15% of their GDP from personal taxes in 2017, while Mexico in that year had a collection of no more than 3.5%.

regressive by its nature. Such is the case of VAT, whose regressivity is generated by income distribution; the more unequal the distribution, the greater the regressivity. The Suits progressivity index for the data studied indicates the existence of progressivity.

One of the most common indices is the well-known Kakwani (1977) Progressivity index, which considers the tax concentration index and the pre-tax Gini coefficient; a positive index value indicates a progressive tax system, and a negative value indicates a regressive system. As seen in Table 7, the Kakwani Index is positive in all years and has increased over time, even though its progressivity is slight[8].

The Reynolds-Smolensky Index (1977) is usually considered an index of vertical equity and can be derived from the Kakwani index and the level of the tax[9]. Table 7 shows that, although low, vertical equity has been maintained over time with a slight marginal improvement.

Finally, the Atkinson (1970) and Plotnick (1981) index measure horizontal inequality. According to Plotnick (1981), horizontal equity consists of all equals being treated equally; the same level of welfare is subject to the same tax liability. In cases where a redistribution process alters the previous order, it would violate horizontal equity. The index indicates the effect of vertical equity in the presence of redistributive measures; when the value of the index is equal to zero, there is no effect on inequity because the i-th poorest unit at the base of the previous distribution is also the i-th poorest unit after redistribution. The Atkinson-Plotnick index, shown in Table 7, is very small and has a downward trend, which can be interpreted as a situation where the distribution effect has not appreciably affected horizontal equity.

The results obtained in the present research are similar to those presented by Vargas (2010), who reports slight progressivity in the tax system that tends to proportionality for 1984-2002, in which direct revenues are progressive, while indirect revenues are regressive. There are also coincidences with the results of Huesca and Araar (2016) that present evidence of an increase in progressivity with polarization levels from 2002 to 2012. Table 7 shows an improvement in the indices for 2012, but with greater progressivity in the lower income deciles than in the higher ones, as seen in Table 6.

Conclusions

[8]How low is the progressivity of the Kakwani index (K) obtained for the case of Mexico? In 2010, the pre-tax and post-tax Gini coefficients for Mexico were 0.64 and 0.62%, respectively. K was 0.08 and RS was 0.02. Data for a similar study carried out for Ecuador (Cano, 2017) reported for the year 2010 the following data respectively: 0.64, 0.63, 0.30, and 0.0071. The value of K for Ecuador is about 3.75 times that of Mexico, however, it has an extremely low distributional effect. This makes it clear that the progressivity of the tax is significant but the level is substantial

[9]RS=(t/(1-t)K, where t is the average effective rate and K is the Kakwani index.

Over time, several studies have measured the progressivity of taxes at the national and Latin American levels, concluding that when personal taxes are studied, there is a certain level of progressivity that is low and that sometimes is not sufficient to maintain a progressive rate structure as a whole. Normally, studies take place as a consequence of any reform in the tax structure to try to know the result of the reform in terms of equity.

The present document offers an opportunity to address this issue by providing new information. Research that attempts to measure income redistribution and the progressiveness of the tax rate structure for Mexico usually does so through the National Survey of Household Income and Expenditures (ENIGH), but the novelty of this document lies in the use of information derived from taxpayers' tax returns.

To conclude, it can be highlighted that the ISRPF has been progressive and presents redistributive effects, the progressivity of the tax has improved throughout the study period, and the changes made in 2013 and the adjustments to the rates have played a favorable role in improving the distribution of progressivity among deciles, in addition to having increased the number of people who filed their tax returns by a significant percentage. Nonetheless, the distributional effect is low, and since it is only a part of the tax structure, it may be diluted by the regressive effect of consumption taxes.

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