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Changing the tax structure to reduce income inequality in Colombia: A microsimulation model.

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Changing the tax structure to reduce income inequality in Colombia: A microsimulation model [*]

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Abstract

This Document simulates a change in the structure of the Colombian tax system (changes in income pension tax thresholds and marginal earner income tax rates, as well as in social contribution rates), and measures the impact of these possible reforms on disposable income inequality. Using a microsimulation model of taxes and transfers built for Colombia, called COLMOD and based on the methodology used in EUROMOD for the European Union, the study shows that large-scale changes are needed to achieve a significant reduction in inequality in Colombia. This is because the country has a large heterogeneity in income distribution and an underground (untaxed) economy that represents 49.2% of GDP (DANE). The article concludes with a discussion of the feasibility of such major tax reforms, highlighting the link between popular support for the tax system and structure of the proposed tax.

JEL: H20; H22; I38; D63

Keywords: Microsimulation; inequality; distribution; Taxes and Benefits.

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Changement de la structure fiscale pour réduire les inégalités de revenus en Colombie : Un modèle de microsimulation *

Nicolás Alejandro Ortega Rodríguez **

May 19, 2021

Résumé.

Ce document simule un changement de la structure du système fiscal colombien (modification des seuils d'imposition des pensions de retraite et des taux marginaux d'imposition des revenus des salariés, ainsi que des taux de cotisation sociale), et mesure l'impact de ces éventuelles réformes sur l'inégalité des revenus disponibles. En utilisant un modèle de microsimulation des impôts et des transferts construit pour la Colombie, appelé COLMOD et basé sur la méthodologie utilisée dans EUROMOD pour l'Union européenne, l'étude montre que des changements à grande échelle sont nécessaires pour parvenir à une réduction significative des inégalités en Colombie. En effet, le pays présente une grande hétérogénéité dans la distribution des revenus et une économie souterraine (non taxée) qui représente 49,2% du PIB (DANE). L'article se termine par une discussion sur la faisabilité de ces grandes réformes fiscales, en soulignant le lien entre le soutien populaire au système fiscal et la structure de l'impôt proposé.

JEL : H20; H22; I38; D63
Mots-clés : Microsimulation; inégalité; distribution ; Distribution ; Taxes et bénéfices.

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1.Introduction.

Colombia is considered one of the most unequal countries in terms of income concentration in the world and the second in Latin America after Brazil, inequality is an increasingly worrisome factor that grows over time, in this health crisis (COVID 19) this indicator worsened and accompanied by increases in poverty and unemployment causes the Colombian economy to collapse gradually accompanied by a growing social dissatisfaction.

In most countries, once the tax system is applied, inequality as measured by the Gini index tends to decrease, as is the case in OECD countries, whereby charging taxes and providing transfers, inequality as measured by the Gini index is reduced on average 25% or 11 Gini points , the Colombian case shows that once the tax system is applied, the variation in the Gini indicator remains almost unchanged, this is an extremely worrying scenario for an economy where 39% of the wealth is concentrated in decile 10, where the labor informality of the economy is 49.2% and where 42% of the population is in a state of poverty.

It is due to this difficult scenario that it is necessary to understand and evaluate the Colombian tax system, a complex system with a great number of rules, laws, deductions, exemptions, and privileges. A structure that avoids the redistribution process along the income distribution, affecting to a great extent the lowest deciles of the distribution. Well, the tax system presents structural failures, and a heterogeneity in the different components that make it up, it is clearly a system that does not redistribute income and that strongly punishes households with greater needs, at the same time benefiting only some individuals.

Thus, the objective of this thesis will be to demonstrate the effect that the establishment of new structures (Netherland's tax system as counterfactual) would have, in order to obtain betters results decreasing inequality and obtaining redistribution along the income distribution. For this purpose, a microsimulation model of taxes and transfers built for Colombia called COLMOD [1] was used as a methodology, which follows the methodology and software of EUROMOD, the microsimulation model of the European Union.

[1] For more detail see Rodriguez (2017)

Throughout this thesis it is recognized that there is little literature and studies that make use of microsimulation tools for Colombia, partly because of the few models available so far since this was born in 2017 and the difficulty in the homogenization of administrative data, this is how this project is established as one of the few that use this methodology and that establishes new structures for policy evaluation, especially by linking the Netherlands system to the Colombian tax . Prior to this methodology, normative analytical developments were recurrent.

As policies, two main components of the tax system were affected, on the one hand, exemptions in pensions, thresholds for personal earner income tax and pension income, marginal tax rates for personal earner income tax and pension income were modified, and on the other hand, social security contribution rates were modified. It is recognized that these elements have great weight in the disposable income of households in Colombia, being relevant factors at the time of making redistributive policies at the country level.

There is a long way to go in terms of social policy in Colombia, it is clear that there is a need to increase social programs and enhance tax tools, it is found that the redistributive power is achieved to a greater extent through the establishment of policies that are oriented towards social security contributions than the different measures in terms of personal income tax and personal pension, in part because of the purpose for which they are built, the social character.

This document is composed of seven sections, including this first one which is the introduction. Subsequently, the second section will review the literature on the different results in terms of tax reforms and evaluation of the results of policies in the reduction of inequality in the Colombian case. In the third section I will review the methodology and data used for the evaluation of the new policies implemented, in the fourth section I will give a framework of the results in terms of distribution and inequality in Colombia, as well as an analysis of the components that constitute it, then in section five I will make the policy modifications and find the results of inequality through different indexes, in section six there is a discussion and finally in section seven the conclude discussion remarks .

2.Literature Review

Since the late twentieth century, Colombia has been considered one of the most unequal countries in Latin America, when we enter to see the different categories of inequality and focus on income inequality, its results despite policies to promote entrepreneurship and subsidy coverage to families with greater social needs are not good, the real effects we observe show no improvement in quality of life and welfare, maintaining indexes during the last five years averaging 0.526 Gini 2019 (DANE).

Now, Colombia's scenario in terms of social redistribution once the tax system is applied is very low, behavior that can be evidenced in the OECD 2019 report, where once taxes and transfers are applied, the Gini index seems to remain unchanged, Trends that are also evidenced in the works of Gonzalez (1996), Lustig (2016), Rodriguez (2019). In which very low collection capacity of the tax system is observed, and there are large regressive pensions with very small distribution.

According to Latin American and Caribbean statistics, tax collection as a percentage of Colombia's GDP in 2018 was (19.4%), this below the LAC average (23.1%) by 3.6 percentage points and below the OECD average (34.3%) (OECD). The Colombian tax system only attends to short-term conjunctural problems, we can evidence this behavior between the years 1990 and 2016, a period during which 22 tax reforms were carried out, which were approved in Colombia by Congress, or directly by the government, through the declaration of "emergencies" Delgado (2017). According to Lustig (2017), tax benefit systems in Latin America reduce the Gini coefficient by 2.7 points, on average, while for European countries it does so by an average of 20.9 points.

A systematic literature review was developed with the purpose of evidencing the different studies carried out for Colombia in terms of social redistribution policies through the tax system. **The objective of this thesis is to see the effect that the establishment of new structural tax models (counterfactual) would have in Colombia**, in order to improve in income distribution as a reduction of income inequality, all this through a microsimulation model (COLMOD) that takes the Colombian tax and transfer system.

The issue of social redistribution policies through the tax system may turn out to be a recent issue for Colombia, if we take into account that most of the tax reforms implemented have tried to follow the guidelines consistent with the social rule of law and rules stipulated in the 1991 constitution, In addition, it is recognized the little trajectory that has been had in terms of social policy because the

subsidies and programs for the poorest have less than two decades in Colombia with the birth of the program "familias en acción" that was born due to the real estate crisis of 1999, a program of conditional subsidies to people in a state of extreme poverty, which gave the first step to social policy in Colombia (DNP).

In the search for studies that implement structural tax models in Colombia, it is recognized the little development that has been made on the subject, especially the little empirical rigor that supports the results found. Efforts of theoretical - Normative analysis by scholars on the subject are identified, as is the case of Espitia et al. (2017) where they make an exhaustive exercise of reflection and proposals on the duty to be of a structural tax reform for Colombia, all this in the framework of the 2016 peace process, it highlights the complex tax system and the inability to make the reforms really structural since it only responds to concrete facts, this point is evaluated by Herrera et al. (2012) who after the use of an econometric model (ARIMA) evaluates the efficiency and success of tax reforms in the period 1990-2009 finding significant increases in revenue only for the 1990 and 2000 reform, the others tax reforms did not have permanent effects over time, thus supporting the idea that reforms respond to concrete facts. Some exploratory and descriptive work by Jaimes & Fuentes (2017) of 6 tax reforms for Colombia and evaluating their effects on tax increases, macro variables such as GDP, inflation and unemployment.

Focusing on the effect that the tax system has on income redistribution, the literature provides few studies, among this one characteristic stands out and that is the little importance that the government has in reducing income inequality, the narrow tax bases especially for income tax, and the recognition of the importance of conditional cash transfers to reduce poverty. Some authors such as Gonzáles (1996) and Jaumard & Londoño (2013) highlight the weak progressivity of the income tax system, and especially the high proportion paid by low-income households, the latter being an important factor of regressivity of the tax system. Goñi et al. (2011) find an insignificant effect on inequality, taking as a measure the Gini coefficient for market and disposable income in 2003, maintaining results of 0.54 and 0.53 respectively.

The use of microsimulation models is increasingly recurrent in the analysis of public policies, despite their recent application less than 30 years ago, they link the structure of taxes and benefits that countries have on micro-level units, especially households or individuals, and are increasingly used by policy makers. Through these models, the effects of the introduction of new norms and rules to the system can be evidenced, being a great tool that through simulations allows one to see the

repercussions on different variables such as income distribution, inequality and poverty levels that affect social welfare Bourguignon & Spadaro (2006).

In Colombia studies through microsimulation models that seek to evaluate policy scenarios are very recent, only until 2017 is given the first microsimulation model of taxes and transfers built for Colombia called COLMOD, this follows the methodology and software EUROMOD, the microsimulation model of the European Union Rodriguez (2017). Therefore, there are very few results of policy evaluations through microsimulation for Colombia.

For Colombia, articles such as the one by Rodriguez (2019) that uses the microsimulation model where seeks to see the effects on poverty and tax collection with the linkage of two structural changes, the first a universal income to directly address the problem of poverty, and the second scenario the linkage of two tax systems affecting income tax, linking the Estonian system (tax flat) and then the Ecuadorian tax system. Low effects on poverty and a loss of progressivity are found with the first measure due to the lack of focusing of resources. As for the effects of the Estonian and Ecuadorian income tax systems, it is found that the collection increases by 5% with the Ecuadorian system, and there is a large increase of more than 50% with the Estonian system.

An interesting approach is given by Romero et al. (2019) for 5 Latin American countries taking Colombia as a reference, evaluates the effects of revenue, poverty and inequality for these countries, uses microsimulation models that link tax systems and evaluates the effect of including Uruguay's income tax, since this presents the least inequitable system among the countries studied by previous estimates. It is found that after the imposition of this new rule, collection is considerably improved for Colombia and Ecuador, since there is a lower exemption rate. In terms of inequality, there is a small reduction in inequality of 0.14 percentage points for Colombia, maintaining the highest inequality figure of the countries studied.

Comparative studies of tax systems among Latin American countries are now possible due to the standardization of microsimulation models, especially for Bolivia, Colombia, Ecuador, Uruguay, Peru and Venezuela. Delgado et al. (2020) evaluates the effects on the formalization and collection of economies implementing a total formalization of the economy, Colombia does not stand out for its good results since it has very high costs to be a formal worker, it is estimated that 65% of the income of informal workers would be taxed when they become formal.

One of the studies with a close approximation to the objectives of this thesis in effects on inequality is conducted by Bargain et al. (2017), the authors focus on the effects on poverty and inequality for two economies, the Colombian and Ecuadorian, the exercise they perform is the exchange of tax systems between the two countries and evaluate through microsimulation models the potential results, for Colombia there is a considerable reduction of inequality by 1.7 pp (Gini), a favorable result taking into account that at present inequality in Colombia remains almost unchanged once the tax system is applied (OECD), in terms of poverty results a reduction of 10% and an intensity of 14.7% is achieved.

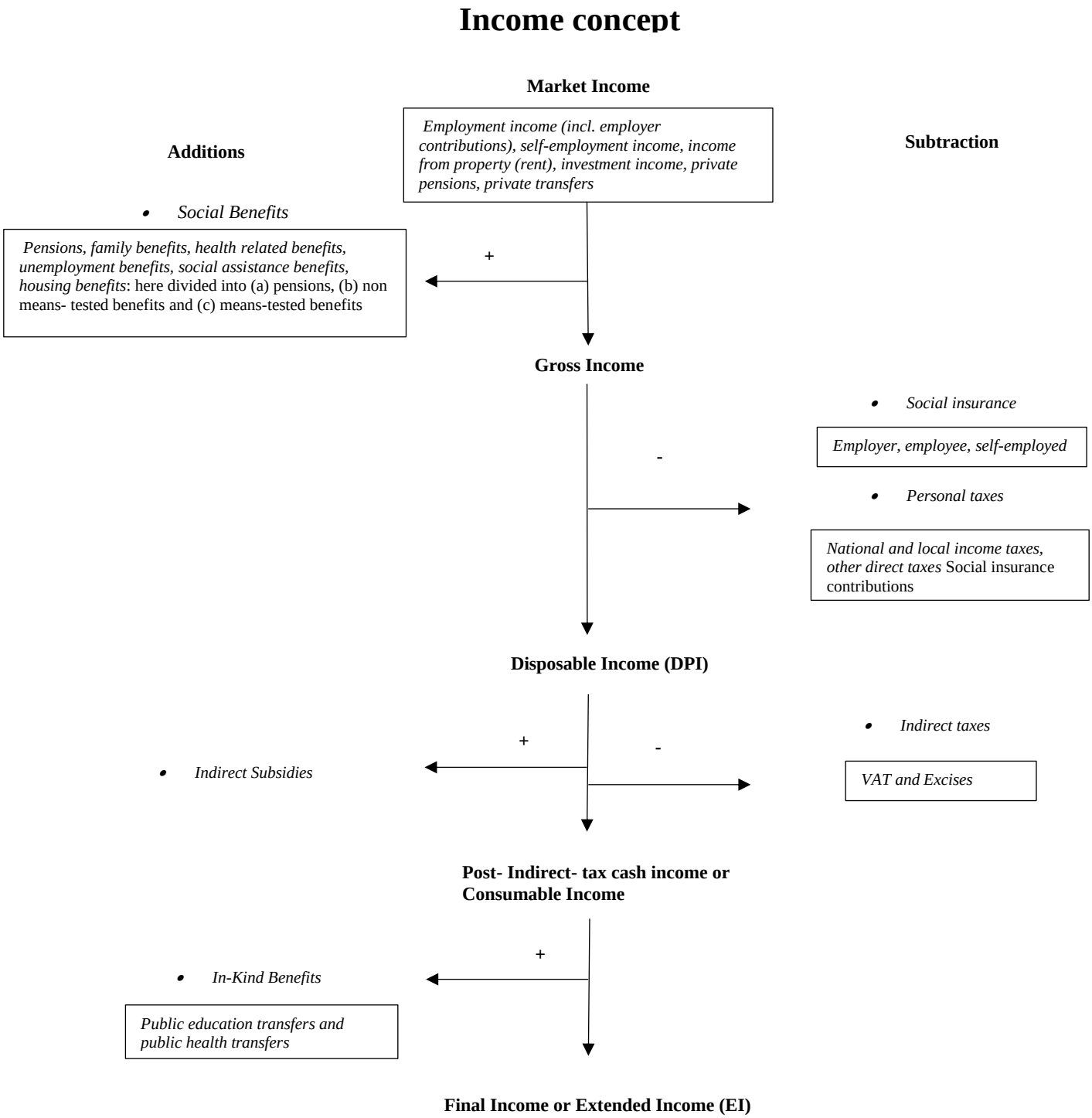
Therefore, a lack of development of structural model evaluations for the Colombian case is identified, and even more, a great gap in the use of microsimulation tools that allow to see counterfactual cases of the tax system. Especially the possibility of implementing new rules that can be compared with other countries due to the homogenization of the method. It is recognized the great importance of contemplating new study scenarios that deal with the three main topics: Collection, inequality and poverty, in order to give a greater extension and rigor to the tax issue. A new tax reform is approaching, which could come out by the end of 2021. That is why it is important to contemplate the hypotheses of new structures in the tax system to reduce income inequality since these rules have not been made in the Colombian literature, providing a deepening to the understanding and improvement of the complex tax system.

2.1 Income Concept

During the rest of the document the concept of income will be important, in this analysis I will use the standard disposable income (DPI) concept (see Graph 1), Disposable income is equal to the market income plus social benefits, less social insurance contributions and personal taxes. Note that employer social insurance contributions are also considered, i.e., included in original income and deducted together with employee and self-employed contributions when deriving disposable income.[2]

[2] As in Fuest et al. (2010) and Dolls et al. (2012) I assume full incidence of employer social insurance contributions on employees and this needs to be borne in mind in the interpretation of the results.

Graph 1.Definition of Income



Source: adapted from Alari (2013), Lusting (2016), and Jones et al. (2009)

3.Methodology

The next section seeks to explain the methodology used to simulate the policies. In the first part, I explain the microsimulation models as tool to evaluate public policy, then in the second part I introduce COLMOD the tax benefit Microsimulation model used for the proposed exercise, some justifications and consideration, and in the third part I present a critic point of microsimulation and Data used.

3.1 microsimulation as a tool of public policy.

The academic literature generally acknowledges the pioneering work of Guy Orcutt in his 1957 paper, "A new type of socio-economic system", as providing the foundation for the field of microsimulation. However, the potential of this new approach was slow to materialize because of limitations in computing power and the lack of suitable data.

The use of microsimulation increased in the 1970s, the microsimulation models were being used in the USA to assist the development of social policy Citro & Hanusek, (1991), and by 1990 "microsimulation had become widespread enough in the domain of tax and transfer analysis" (Anderson & Hicks, 2011, p. 1).

The core of microsimulation has been defined as "a means of modelling real life events by simulating the actions of the individual units that make up the system where the events occur" Brown & Harding, (2002), "microsimulation models are computer programs that simulate aggregate and distributional effects of a policy, by implementing the provisions of the policy on a representative sample of individuals and families, and then summing up the results across individual units using population weights" (Martini & Trivellato, 1997, p. 84).

There exists a range of types of microsimulation for policy purposes, which can be categorized on various dimensions. Zucchelli, et al. (2010) propose a taxonomy that comprises "arithmetical versus behavioral models and static versus dynamic models" (Zucchelli, Jones & Rice, 2010, p. 6). In this master thesis the static simulation model is used.

Static simulation models restrict their analysis to a single point in time or a set of points in time, without modelling the processes which drive the changes over time (Spielauer, 2011, p. 2). Thus, static models evaluate the putative state of each individual under a changed set of policy rules Brown & Harding, (2002). Static models are typically used to model changes in taxes and social security benefits. A data-based static microsimulation model consists of two parts: (1) a baseline database – containing information on individual or family/household units, particularly sociodemographic characteristics and economic information that bears a relationship with a set of policies, and (2) a set of accounting rules – computer language instructions that produce for each unit the results of, for example, alternative tax or transfer policies and procedures (Martini & Trivellato, 1997).

Microsimulation techniques bring a range of benefits to social policy modelling, including the ability to change a greater variety of parameters independently and the capacity to provide considerably more accurate estimates and detailed projections of the distributional effects of changes. Two key advantages of microsimulation models are that: 1) they can replicate the complexity of the policy structures, transfers, and settings; and 2) they can be used to forecast the outcomes of policy changes and "what if" scenarios (i.e. the counterfactual where the results describe what, under specified conditions, may happen to particular individuals and groups) Brown & Harding, (2002).

3.2 COLMOD: the tax-benefit microsimulation model for Colombia.

COLMOD is a tax-benefit microsimulation model for Colombia based on EUROMOD[3] (Microsimulation model for Eu-28 countries) and follows their conventions. The model is open access and is administered by the Faculty of Economics at Universidad Externado de Colombia[4] . This model uses data from an administrative survey country called (Encuesta Nacional de Calidad de Vida, ENCV) to simulate indirect taxes (VAT and consumption tax). The tax and benefit system that COLMOD simulates is presented in Table 1. In this table shows the inputs and their simulated outputs: household characteristics ($\mathbb{X}$) and market incomes ($\mathbb{Y}$). The model uses these two sources of information to recreate taxes ($\mathbb{T}$), social insurance contributions ($\mathbb{S}$) and benefits ($\mathbb{B}$). Some exercises show the scope of the simulation in COLMOD and can be consulted [5].

[3] EUROMOD is the tax-benefit microsimulation model for the European Union. They are present on top of the 28 European countries, six African countries and six Latin American countries (including Colombia). This software allows simulate effects of tax and benefits changes in the tax system. It is possibly make a comparative studies between countries, and evaluation of policies
[4] Available at: https://www.uexternado.edu.co/economia/colmod
[5] Bargain, et al. (2017), Arancibia, et al. (2019), Rodríguez (2017), Rodríguez (2019)

Table 1 . Inputs and outputs for the tax-benefit system in Colombia[6]

			Inputs			
			$\mathbb{Y}_i$	$\mathbb{X}_i$	$\mathbb{S}_i$	$\mathbb{B}_i$
Simulated output	$\mathbb{T}_i$	Income tax	Market income	expenditures	Social insurances contributions	Pension income
		Occasional earnings tax	Sale of properties			
		Property tax	Not simulated but taken from the survey			
		vehicles				
		Sales tax		Sales in goods and services		
		Consumption tax				
	$\mathbb{S}_i$	Employee or pensioner health insurance contributions	Labor Income	Employment type		Pension income
		Pension contributions				
		Pension solidarity fund contributions				
		Employers' health contribution				
		Employers' pension contribution				
		Employers'severance contribution				
		Employers' risk insurance contribution				
		Employers' Family Compensation Fund contribution				
		Employers' SENA contribution				
		Employers' ICBF contribution				
	$\mathbb{B}_i$	Old age pension	Not simulated but taken from the survey			
		Survivors pension				

[6] For a detailed description see Rodríguez (2017), Rodríguez (2019).

<table>
<tr><td rowspan="6"></td><td rowspan="6"></td><td></td><td colspan="4" rowspan="2"></td></tr>
<tr><td>Disability pension</td></tr>
<tr><td>Familias en Acción</td><td></td><td rowspan="4">Demographics</td><td></td><td></td></tr>
<tr><td>Colombia Mayor</td><td></td><td></td><td>Pension Income</td></tr>
<tr><td>Jóvenes en Acción</td><td></td><td></td><td></td></tr>
<tr><td>Other transfers</td><td colspan="3">Not simulated but taken from survey</td></tr>
</table>

Source: Own elaboration

3.2.1 Model justification and consideration

To demonstrate the impact of the establishment of policies on inequality, scholars use the technique of counterfactual, the counterfactual measures what would have happened to beneficiaries in the absence of the intervention, and impact is estimated by comparing counterfactual outcomes to those observed under the intervention.

in this way the choice of the method depends on the policy variables at hand that could be (statutory or effective policy). In this case the model using COLMOD Microsimulation allows me to implement the effective variables of effective policy, since the source is an administrative survey. Normally in the modification of the variables, these will establish a consequence on the way of behavioral responses that could be (observable or simulated). In this case the method takes micro data, and the empirical strategy will be the microsimulation seeing the simulation of behavioral effects.

The microsimulation method allows me to obtain a counterfactual as a source of identification of the policy impact, leading to the answer which policy is the most efficient. this counterfactual takes the same year, same population and same country. Microsimulation models are static by nature, and therefore do not allow to see the response in the behavior of the agents to the different changes made (just capturing by a simulation), losing the dynamic approach to the imposition of a policy, therefore, this approach may overlook two important facts: i) the benefits and losses accumulated during the transition, and ii) the discount effect. Therefore, I could have results as if the economy jumps from one state to another, attributing the entire effect in the long run.

Microsimulation models show differences in the results compared to reality for specific cases, this is the case of tax evasion or the so-called "Welfare Stigma" where individuals do not claim monetary transfers. In addition, the heterogeneity of data means that the models cannot simulate certain elements due to lack of information, for example, in the case of some social systems where there are difficulties in the allocation rules.

3.3 Criticism: Data and microsimulation models.

The problematic elements presented by microsimulation models as an analysis tool are recognized, and the difficulties are present in the Colombian economy. As very well documented by Rodriguez (2019) in the relationship with data rules and behaviors of the Colombian economy.

3.3.1 Data

In terms of data, it is recognized the general difficulty of having all the information of a Population, usually acquiring this detailed information is costly and difficult to identify even for developed countries, despite advances in data collection techniques this information is complex to deal with.

The Colombian context is no stranger to this reality, the use of administrative data is a challenge since it does not present a great harmonization between the different existing surveys. For the COLMOD microsimulation model, the National Quality of Life Survey (Encuesta Nacional de Calidad de Vida ENCV) of 2014 conducted by DANE (National Administrative Department of Statistics) is used, this contains information from 20.141 households and 67.331 individuals, being the most recent survey on household expenditures (right now the is an update with a new source of administrative data GEIH “Gran Encuesta Integrada de Hogares”).

The COLMOD model is built on the same structure of EUROMOD, which allows making updates directly on monetary values such as income or expenditures, so based on different price indexes, simulations can be made for different periods. An advantage of using the model is the linkage and adaptation of other surveys that have information on household budgets such as the Large Integrated Household Survey (Gran Encuesta Integrada de Hogares GEIH). Rodriguez (2017) describes in detail the different inputs considered on the COLMOD microsimulation model for Colombia.

Theoretical aspects developed regarding the problems that are transferred when using administrative surveys have been discussed previously, the problem of over-registration in terms of income for the first deciles of the population, and under-registration for the last deciles is recognized, as mentioned by Atkinson, Piketty and Saez (2011) and for the Colombian case Alvaredo and Londoño (2013). This is relevant since there will be problems with the extremes of income distribution, which could show differences with reality.

An important point of the data to highlight is that only formal workers are simulated for, which are the people who declare to have made a pension contribution, in this way the evasion to social security is controlled, which can reach more than 60% of the workers.

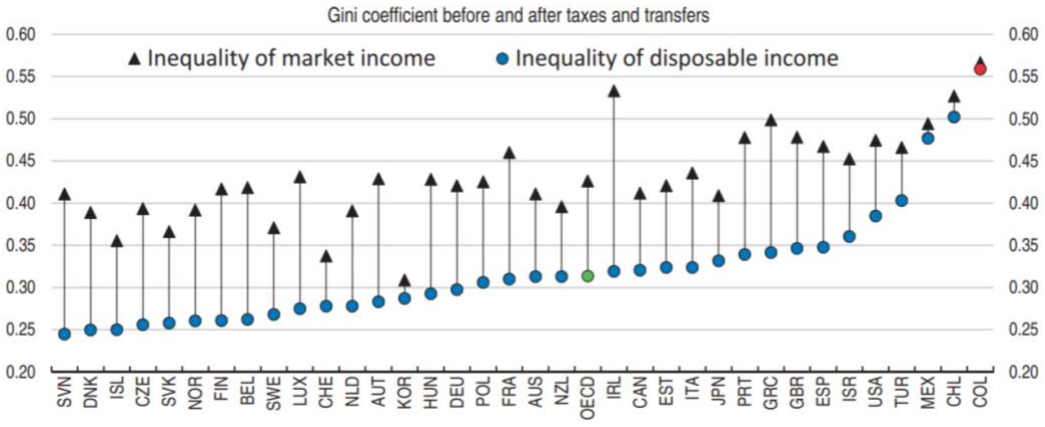
4. Framework Inequality and Redistribution

The reduction of inequality in Colombia once the tax system (taxes - transfers) is applied is really low, when we take the inequality of market income measured by the Gini see (Graph 1) income concept and compare it with the inequality of disposable income, the result obtained is a difficult reality, the system does not meet the objective of redistribution.

Comparing the level of redistribution that the Colombian system has compared to other countries in the world, we realize the lag of this see (Graph 2), despite the great heterogeneity between the inequality of the countries, the decrease is considerable, as in the case of Ireland, one of the countries that obtains the greatest reduction of almost 22-23 points of Gini, the OECD average for 2016 was 13 points well above the Colombian case, Causa et al (2019) show a reduction of 25% per cent or (11 Gini points) in average for OECD counties in 2019 see (Appendix 6 Graph 13). Countries in the same region, if we see Graph 2 such as Chile or Mexico, stand out for their low reduction in the Gini index (3-5), despite this they are above Colombia, these numbers reflect a call for reform and restructuring of the system.

Inequality along the distribution is persistent in the history of Colombia, currently according to the World Bank report which studies the inequality of 160 countries, Colombia is positioned in the 147th position, it is the second country in Latin America after Brazil in terms of inequality and with a great heterogeneity within the country.

Graph 2. Gini coefficient before and after taxes and transfers



Source: OECD Income Distribution Database and OECD (2016a).

In order to understand the Colombian context, it is now necessary to see how income is distributed in the general society. For this purpose, the distribution of income in Colombia by deciles is examined and the behavior of the different mechanisms of the tax system in the distribution of income is also evaluated.

A characteristic of the income distribution in Colombia is the concentration in the last decile (10) as can be seen in the (Graph 3), the 39.4% of income is concentrated in the last decile, followed by 15.8% for decile 9 and 11.3% for decile 8. The percentage received by the first two deciles is worrisome, as they only concentrate 3.8% of the total national income, and as individuals who consider themselves middle class (Decile 5-6) the percentage of income does not even reach 15% of the total national income.

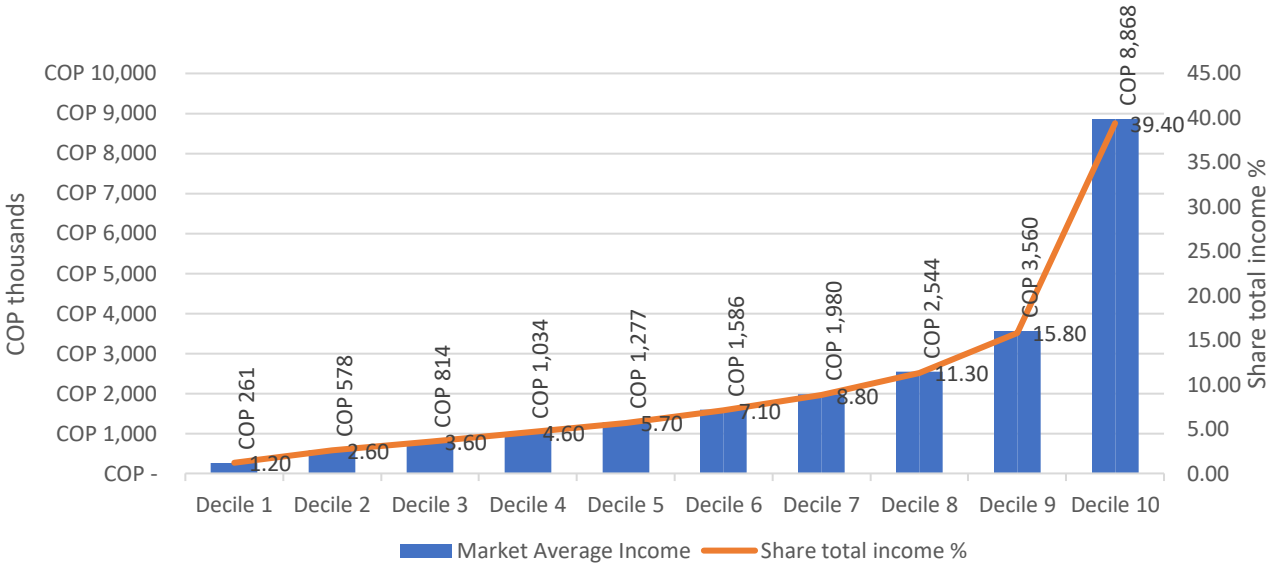
This graph helps to illustrate the distribution of income in Colombian society. It is important to know and understand this distribution, because in Colombia there is a current debate in which most individuals claim to belong to the middle class (decile 5-6), but they are in higher deciles.

Much of this belief is due to a bias of information within individuals, the above is a circumstantial debate because at this time the new tax reform "Ley de solidaridad Sostenible " is being built and approved, one of the key points is the expansion of the tax base that touches a large part of the population that is considered middle class but would be upper middle class or Upper.

Now, a relevant point in the discussion will be the great heterogeneity that is presented within the decile 10, since a formal worker, the president and Luis Carlos Sarmiento Angulo one of the richest men in Colombia are in the same group and the tax burden is totally different of each one.

The market average income of Colombia is really heterogeneity in general terms, the first 7 delices show a distance not so far in average, and maybe, if we make an analysis of preferences for redistribution just seeing these 7 deciles, we could find outputs in order of social rivalry theory Corneo Gruner (2000) just for the distances between deciles.

Graph 3. Market Average Income by deciles of income. Total National expend 2016 -2017



Source: Own elaboration adapted DANE, ENPH

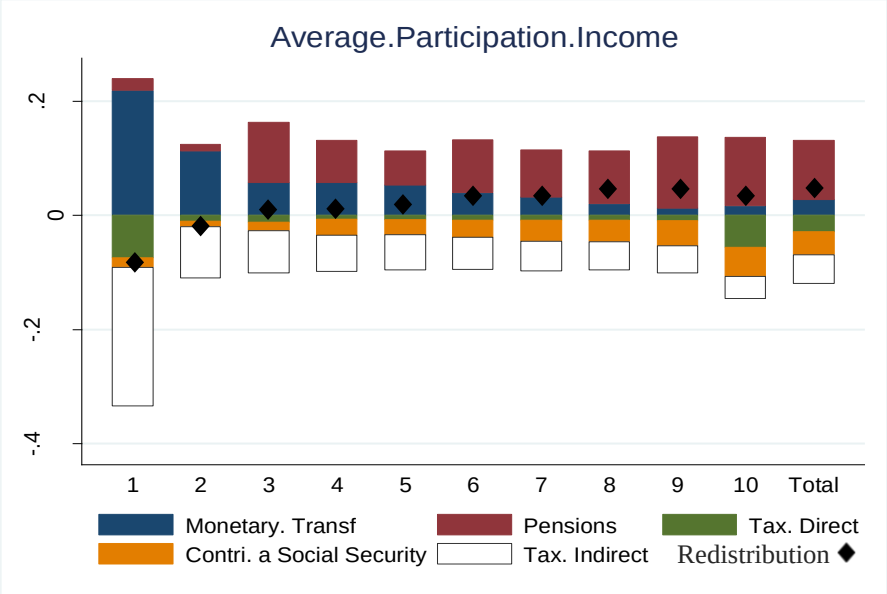
Now As framework we can see an overview of the burden of the different components of the tax system, the graph 4 shows the average participation in the disposable income for 5 categories of the tax system. We can see the average of each component for the distribution for each decile of disposable income. It is clear for decile 1 that the burden specially for monetary transfer represents a symbolic percentage of disposable income almost 21 % in average of the disposable income, this counteracts importantly the tax burden in general.

Also, it is disturbing the quantity of the tax burden both direct and indirect for decile 1, since in relative terms the average percentage of the total Disposable income is higher, and representative compared to almost all deciles. The pensions have a representative value since decile 3 with almost 10% of it to the last decile and is an important factor of total average income since decile 7.

The analysis will be relevant for decile 1 perhaps all the different problems of the data mentioned in section 3.1.2, because the tax burden is considerable and highly regressive if we compare with higher deciles in the distribution. An important point that is not perceived in the graph but affects, are the different mechanisms like exemptions and deductions for individuals though the distribution, since the system becomes more regressive benefiting the highest income earners.

The graph presents the percentage burden of direct taxes – predial, vehicles, income – indirect (VAT and consumption) to social security payments, pensions and other money transfers, for each decile of Disposable Income (DIP)

Graph 4. Share of tax-transfer on disposable income by decile and total redistributive effect by decile COLMOD 2019.



Source: Own elaboration COLMOD Model results.

Is interesting how between deciles 3-8 seems to have a similarity in the percentage of each components especially in direct and indirect tax,

An essential point provided by this graph is the anti-redistributive behavior of the Colombian system, at the decile level the situation is much clearer and worrisome, basically the tax system punishes individuals who are at the bottom of the distribution, it is clear that the redistributive level does not fulfill its function and that it has a bad focus, observing how the system increases income for the highest deciles of the distribution, this is totally the opposite of what should be presented.

An important point that weighs in this result of the Colombian redistribution is the pension component, as we can see in (Graph 4), which has a relevant weight, especially for deciles 6-10, this pension component does not touch the first two deciles.

Now, as established by Causa et al (2019), redistribution is strongly associated with public social spending, especially the different transfer programs to the lower part of the distribution. The social spending policy in Colombia is relatively recent, the insufficiency of social programs is constant, for example Colombia does not have unemployment insurance, the COVID 19 pandemic has been a catalyst for the establishment of social transfers, currently there are 5 social programs covering 4.9 million households.

The first cash transfer program promoted in Colombia was Familias en Acción, a social program that started in 2000 and today benefits 2.6 million families living in poverty and extreme poverty with an average monthly transfer of $145,000 Cop. The second program is Jóvenes en Acción, which currently covers 288,000 low-income young people between 14 and 28 years of age with an average subsidy of $356,000 Cop. The third program is Colombia Mayor, which benefits 1.7 million older adults with an average monthly transfer of $80,000 Cop.

Two new programs emerged during the pandemic, the first called Ingreso Solidario, which benefits 2.6 million households in a situation of poverty and vulnerability that had not benefited from any of the social programs mentioned above, with an unconditional transfer of $160,000 Cop per month. The second is a VAT refund. This scheme reaches one million households with bimonthly cash transfers of $75,000 Cop.

However, this is not enough, and an effort is needed to increase the number of programs and the amount, as we can see in the (Graph 4), monetary transfers reach an average of 21% of income for decile 1.

4.2 Inequality and Redistribution by components tax system.

The current tax system has a structure that influences the reduction of inequality in Colombia, this inequality will be measured through the Gini index, an indicator that allows us to have a measure of economic inequality at the income level that occurs between citizens, it is an indicator that ranges between (0-1) being zero the maximum equality (all citizens have the same income) and 1 the maximum inequality (all income is held by a single citizen).

Table 2 shows the variation presented in the inequality of the tax system through the Gini index, I will display the variation of the Market Income Gini Vs Disposable Income Gini, all of this follow the definition of income presented in Alari (2013) and jones et al. (2009) see (Graph 1). Also showing these results in those terms allow make some comparison with previous results like Lusting (2016) and Rodriguez (2019)[7]

Column 1 presents the value of inequality income for Colombia without having applied the tax system (transfers and taxes) measured by the market income, column 2 is of great importance since it shows how much the income inequality decreases once the tax system is applied by calculating the disposable income of the society see (Graph 1) definition of income.

It is also important to see how the different components of the Colombian tax system (transfers and tax) influence the reduction of inequality, these results will be shown in column 3-8.

[7] Lustig (2016) show for Latin America that market income Gini vs disposable income Gini decrease in 2.7 Gini Points in average, Rodriguez (2019) follow similar values with the same incomes obtaining 2.6 Gini Points of redistribution.

Table 2. effect of the components of the tax system in the microsimulation model.

	Market Income	**Disposable Income (DPI)**	DPI minus pensions	DPI minus monetary transfer	DPI plus direct tax	DPI plus social insurance contribution	DPI plus Social Insurance Contributions And direct tax	DPI minus indirect tax
Gini 1 Baseline 2019	0.583	0.550	0.564	0.566	0.558	0.555	0.563	0.556

Source: Own elaboration COLMOD Model results.

According to calculations the Colombian tax system for 2019, once the different components such as taxes and transfers are applied, there is a reduction of 3.3 Gini points in redistribution considering the Gini values, when I compare these results are close to the line of Rodriguez (2019) with 2.6 Gini points for Colombia period 2014 and Lusting (2016) 2.7 Gini points on average for Latin America. These results are important, unfortunately when compared with countries such as the United States, the European Union EU 28 or the European area, the results are poor, since their numbers are in the order of 12 Gini points for the US, 19 Gini points for the EU 28 and 20 Gini points for EA[8].

(Table 2) shows how each component of the tax system contributes to the redistribution of the population. The first impression from the decomposition is that monetary transfers have the greatest impact on the reduction of income inequality, followed by pensions, social insurance contributions and direct taxes, direct taxes, indirect taxes and finally social insurance contributions. This analysis provides an important tool for thinking about the targeting of resources to support the components that have the greatest impact on income inequality in Colombia.

Despite these positive results that show us the behavior of each component it is necessary to compare with other indicators that bring the best interpretation once we want better results in progressiveness, which is why the Suits indexes help to have a better interpretation of this aspect. I draw for Colombia the Suits indexes, this is a type of indicator like Gini which is based on the Lorenz curve Suits (1977), it allows to relate the percentages of transfer or tax, given the ordered income of the population. (Table 3) shows these results.

[8] For a detailed description see Stefano (2017), European incomes, national advantages: EU wide inequality and its decomposition by country and region.

Table 3. Progressivity of components SUITS Index.

	DPI pensions	DPI monetary transfer	DPI direct tax	DPI social insurance contribution	DPI Social Insurance Contributions And direct tax	DPI indirect tax
SUITS	-0186	0.411	0.582	0.131	0.314	-0.112

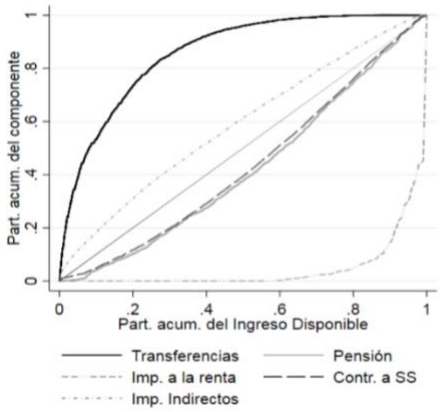
Source: Own elaboration COLMOD Model results.

A value of zero 0 in a Suits tax index indicates that the burden falls equally for each income group (proportional tax), while negative values of minus one -1 in the limit imply (regressive taxes) higher burden for lower incomes, a positive value of one 1 indicates a progressivity for society, that is, a higher burden for those with higher incomes.

As we can see in (table 3) the best performance is for direct taxes, this component shows the highest value of progressiveness in the tax system, followed by Monetary transfers, social insurance contributions and direct taxes. An important aspect for the analysis is the pension component, when we see the effect of pensions in income distribution taking to account just Gini (table 2), reflect the second-best value in terms of Gini, but the Suits index give another perspective, since this component has a regressive part in the distributions, that means a higher burden for lower incomes, so we could have a trade of between distribution (Gini) and progressiveness (suits) for each part of tax system.

This is a relevant point in Colombia right now, due to the pandemic crisis (Covid 19) the social problems like poverty and inequality have increased, the economy crisis impact in different ways to each sector of society specially to poorest, adding a constant corruption problem that remain since many years ago, all of this make necessary improve and changes the political aspects with a vision of inclusions.

Graph 5 . Progressiveness of the different components of the microsimulation model [9]



Source: Graph 3 Rodriguez (2019)

When we see the Colombia tax system, differences considerations are perceived, the first one is the complexity, since a considerable number of deductions, exceptions, divisions and preferences are established, with the argument of seeking Better results in economic performance of the differences economics actors, the most remarkable thing is once the tax system is applied the results in terms of inequality still the same, in section 5 I will make some changes looking for a better results in this aspect .

5. Policy implantation

On April 28th, 2020 Colombia formally became the 37th member of the OECD, since then it starts to be compared with the different members of the organization not only in terms of indicators but in general policies, for its entry different reforms had to be implemented, policies implemented such as the regulation and monitoring of financial conglomerates, a new regime for liquor taxes and a new regulation and monitoring of state-owned enterprises. Although these modifications allowed Colombia to enter the select group, there is still a long way to go to reach the same indicators.

[9] For a detailed description see Rodríguez (2019

Given this context, I would like to reduce inequality by 25% per cent or (11 Gini points) equivalent to the average of OECD32 countries found in Causa et al (2019), a scenario that is far from the current situation in Colombia, but it is important to achieve to be in the range of the organization's measures.

Therefore, to reach these levels in the reduction of inequality, I link values of the tax system of Netherlands, I can see that Netherlands presents the same values as the average of the OECD countries, its values start from the same Gini Market of almost 0.40 and reaches 0.31 once taxes and transfers are applied See(Appendix 6 graph 13) this reduction is in the same line of the average of the OECD countries.

Looking at the characteristics of the Netherlands throughout its history, it is evident that it has had good redistribution indicators, previously with a better result (above the OECD average of 13 Gini points), but always very close to the rest of the countries. In addition, once its tax system is analyzed, it is found that its tax rates like earners income or Social insurance contribution are high compared to countries such as the United States, the United Kingdom, Germany, Italy, or Spain.

This is an important point since Colombia currently has tax rates not very far from the previous countries (United States, United Kingdom or Germany). Despite these rates, the results in terms of redistribution are totally different and low for Colombia. Thus, the route to follow is the modification of different aspects of the tax system. Modifications (increases) will be made in its components, analyzing whether these changes achieve better results in terms of redistribution and inequality.

The changes to be carried out will allow to know if implementing these structures in Colombia will lead to obtain results in terms of inequality reduction like OECD countries (11 Gini points), also to analyze their feasibility in the Colombian context, and to be a point of reference as one of the first articles that links structures of the Netherlands system in a microcirculation model for Colombia.

Therefore, two relevant factors are modified, the first one is the implementation of an increase in the marginal taxation rates of earner income and pensions income, so the first one value established by Netherland, 49% in earner income tax rate. As a second major change the values for the social security contribution (SIC) are established, rising to 53%, this compared to the Colombian social security rates (12% Health + 16 % Pension = 28% SIC) establishes an increase of almost 85%.

In addition to these modifications, the objective is to have a much just and progressive system, for this reason exemptions to large pension incomes are reduced, a very problematic issue in Colombia that requires a lot of attention since these large incomes never become taxable. Therefore, 4 modifications are made to the Colombian tax system, which are explained in detail below and the new values are shown.

The first modification implemented is the modification of the pension exemption established by the system, as evidenced in section 4 is one of the main points and has great weight in the disposable income of Colombian households, this does not benefit the first two deciles and has a significant importance for the highest part of the distribution.

Currently pensions in Colombia or pension payments are exempt from income tax, this exemption establishes that nothing will be paid in income to individuals who do not exceed the limit established by law which is 1.000 TVU per month equivalent to 34.720.000 Cop or 10.850 USD all at 2019 values, that mean that annually the amount of 12.000 TVU equivalent to 41.6640.000 Cop or 130.200 USD will be declared as exempt income. The TVU is the measure equivalent to pesos used to determine different tax obligations, 1 TVU for the year 2019 was equivalent to 34,270 Cop or 10.7 USD.

Therefore, simulations were performed by progressively lowering this exemption in the tax and transfer system from 1.000 TVU to 180 TVU obtaining positive values in terms of Gini See (Appendix 3 table 10). This policy will be the first scenario which I call scenario A.

As a second modification I focus on establishing different values of Threshold (Tax Burden Interval) for two schedular systems, Pensions income, and earner income, in Colombia there are 5 schedular systems with which the income tax of natural persons is made, see (Appendix 2 table 9) Colombia has almost 20 million workers, of these 20 million only 3 million declare earner income and 1.5 million contribute to earner income, this shows a total ignorance of the workers. I do not broaden the taxable base (Threshold 1) but I start to make modifications from the second Threshold onwards.

In Colombia 4 thresholds are established to make the earner income tax collection in the year, the first (1) tranche are individuals who receive less than 1.090 TVU (36.140.040 Cop) which would be in dollars about $ 10,096 or in euros about 8.535 Euros per year, this is a high amount once you

consider the minimum wage of Colombian that for the year 2019 was at 828. 116 Cop, 252 $ or 220 €, this would establish that an individual in Colombia earning up to 3.6 minimum wages would not have to make any payment, by way of comparison at present for a single person in France earning 1.2 minimum wages this would already pay tax on his income. Clearly the purchasing power parity must be considered, however the key fact is that only after 3.6 minimum wages in Colombia is taxed.

The second threshold is for individuals who are between 1090 TVU and 1700 TVU (56 million Cop) for this part of the population is taxed 19% of their income. The third threshold is established between 1700 TVU and 4100 TVU with a tax rate of 28%. Finally, the last threshold is from 4100 TVU onwards with a tax rate of 39%. This calculation is based on the result obtained from the net taxable income according to the table in Article 241 of the Tax Statute.

At the end I modify the first two systems by progressively lowering the values concentrating on individuals who would be in the decile 9 -10 See (Appendix 4 table 11), I am left with values that show positive effects in terms of Gini, this policy will be the second scenario B.

The third modification is focused on the marginal tax earner incomes rates of the two schedular systems mentioned above, Colombia in comparison with the different countries is located below in terms of marginal earner incomes rates, for example the maximum rate charged in Colombia is 39% on income, countries like the United States 46%, United Kingdom 47%, France 55%, Germany 45%, Netherlands 49%. show the existing gap in these values, so I start to raise the rates gradually, until arrive to the maximum tax earners income in Netherlands rate (49%) (Appendix 5 Table 12), this policy will be the third scenario C.

The fourth modification focuses on the increase of social insurance security (SIC) to 53 % as establishes Netherlands SIC, this increase is made in order to compare the results in terms of reducing inequality compared to previous scenarios that seek to increase the personal income tax, it is commonly found in different countries that the amount of personal income tax that is collected is very small, as in the case of France where the largest amount of resources is obtained through social contributions.

Therefore, the contribution rates of both employers and employees and also of independent workers (self-employers) are changed. the changes that are made are increases in the health and

pension contribution rates to arrive of maximum Netherlands values (53% SIC), this will be scenario E.

I integrate the ABC policy to see the overall result in terms of inequality, this scenario is called scenario (D) And finally I integrate all 4 policies to see the joint effect of both taxes and social security increases, this scenario is called (F).

5.1 Policy Modification by scenario.

A) Initial pension exempt income 1000 TVU modification 180 TVU

B) Threshold pension income and earned income.

Table 4. Modification of tax Burden Interval Pension income and Earned Income.

Actual System Baseline 2019

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1090 TVU	0%	
2	1090 TVU< Y < 1700 TVU	19%	(Taxable amount in TVU minus 1090 TVU) x 19 %
3	1700 TVU < Y < 4100 TVU	28%	(Taxable amount in TVU minus 1700 TVU) x 28 % + 166 TVU
4	4100 TVU < Y	33%	(Taxable amount in TVU minus 4100 TVU) x 33 % + 788 TVU

Proposed Reform Modification Tax Burden interval

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1000 TVU	0%	
2	1000 TVU< Y < 1500 TVU	19%	(Taxable amount in TVU minus 1000 TVU) x 19 %
3	1500 TVU < Y < 2500 TVU	28%	(Taxable amount in TVU minus 1500 TVU) x 28 % + 166 TVU
4	2500 TVU < Y	33%	(Taxable amount in TVU minus 2500 TVU) x 33 % + 788 TVU

C) Increase in the marginal tax rate in pension Income and earned income.

Table 5. Modification Marginal Tax Rate Pension income and Earned Income.

Actual System Baseline 2019

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1090 TVU	0%	
2	1090 TVU< Y < 1700 TVU	19%	(Taxable amount in TVU minus 1090 TVU) x 19 %
3	1700 TVU < Y < 4100 TVU	28%	(Taxable amount in TVU minus 1700 TVU) x 28 % + 166 TVU
4	4100 TVU < Y	33%	(Taxable amount in TVU minus 4100 TVU) x 33 % + 788 TVU

Proposed Reform Marginal tax rate pension and Earned Income rate as in Netherlands.

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1090 TVU	0%	
2	1090 TVU< Y < 1700 TVU	28%	(Taxable amount in TVU minus 1090 TVU) x 28 %
3	1700 TVU < Y < 4100 TVU	35%	(Taxable amount in TVU minus 1700 TVU) x 35 % + 166 TVU
4	4100 TVU < Y	49%	(Taxable amount in TVU minus 4100 TVU) x 49 % + 788 TVU

* Note. The proposed reform is based on the actual Netherlands tax system see Appendix 5.

E) Increase in the social insurance rates.

Table 6. Modification SIC (Social Insurance Contribution) rates.

Actual System Baseline 2019

E.1

Type	Employer	Employee	Total
Health	8.5%	4%	12%
Pension	12%	4%	16%

E.2

Type	Independent Worker	Total
Health	12%	12%
Pension	16%	16%

Proposed Reform increase of social insurance rate as in Netherlands

E.1

Type	Employer	Employee	Total
Health	17%	8%	25%
Pension	20%	8%	28%

E.2

Type	Independent Worker	Total
Health	25%	25%
Pension	28%	28%

* Note. The proposed reform is based on the actual Netherlands tax system. 53% (SIC)

5.2 policy outcomes inequality index

For the evaluation of the reduction in inequality after the implementation of policies, disposable income is evaluated in comparison with the baseline through the different indices.

Table 7. Inequality simulates Scenarios Results.

Inequality							
Indicator	Baseline Disposable Income	(A) decrease in pension exemption (DP)	(B) Modification of tax Burden Interval Pension income and Earned Income (DP)	(C) increase Marginal Tax Rate Pension income and Earned Income**.** (DP)	**(D) sum of the preceding policies (A+B+C)** (DP)	(E) increase of social insurance contribution (DP)	**(F) sum of the preceding policies (A+B+C+E)** (DP)
Gini	55.02	54.96	54.89	54.67	**54.57**	54.75	**54.33**
Atkinson 0.5	25.51	25.45	25.38	25.10	**25.00**	25.32	**24.83**
Atkinson 1	43.01	42.95	42.87	42.60	**42.48**	42.60	**42.10**
Atkinson 2	72.68	72.65	72.60	72.46	**72.39**	72.22	**71.95**
P90/P10	12.43	12.43	12.43	12.43	**12.43**	11.97	**11.96**
P90/P50	3.49	3.49	3.49	3.49	**3.49**	3.43	**3.42**
P50/P10	3.56	3.56	3.56	3.56	**3.56**	3.49	**3.49**
P75/P25	3.47	3.47	3.47	3.47	**3.47**	3.44	**3.44**

Measures of Generalized Entropy are calculated for the policies in place, the most used being the Theil index and the mean log deviation. Both belong to the generalized entropy (GE) family of inequality measures. The values of GE measures vary between zero and infinity, where zero represents an equal distribution and higher values represent higher levels of inequality, GE is more sensitive to changes in the lower tail of the distribution, and for higher values GE is more sensitive to changes affecting the upper tail. The most common values of α used are 0, 1, and 2. GE (1) is Theil's index, GE (0), also known as the log deviation.

Table 8. Inequality Generalized Entropy Simulate Scenarios.

Inequality Generalized Entropy indices							
Indicator	Base line	A decrease in pension exemption	(B) Modification of tax Burden Interval Pension income and Earned Income	(C) increase Marginal Tax Rate Pension income and Earned Income	(D) sum of the preceding policies (A+B+C)	(E) increase of social insurance contribution	(F) sum of the preceding policies (A+B+C+E)
GE (-1)	1.33006	1.32783	1.32462	1.31569	**1.31111**	1.30001	**1.28247**
GE (0)	0.56231	0.56120	0.55976	0.55511	**0.55302**	0.55521	**0.54641**
GE (1)	0.65187	0.64959	0.64736	0.63302	**0.62970**	0.65082	**0.62907**
GE (2)	2.39738	2.38764	2.38132	2.14700	**2.13636**	2.47074	**2.20152**

We see that after the implementation of the first three policy scenarios we obtain results in inequality reduction observing the indexes of (Gini-Atkinson) dispersion indicators, when we evaluate the disposable income of the base scenario and compare it with the disposable income of the different policies, we see a progressive reduction of inequality in each of the scenarios until reaching scenario D, the latter is the linkage of all the previous policies (A, B, C).

We have a reduction of 0.45 extra Gini points or 0.8% per cent in inequality after the implementation of the three initial policies, if we compare results of similar studies such as Romero et al. (2019) that urges the Uruguayan tax system for the Colombian economy obtaining 0.14 extra Gini points of inequality reduction for 2014, we could say that the results obtained from this thesis are significant and higher results are obtained when the Netherlands system is implemented.

After implementing the policy of increasing social insurance contribution (SIC) scenario (E), we see a significant reduction in inequality compared to the Baseline of 0.27 Extra Gini points, and when comparing this same scenario with the scenario of modifying the earner income tax (C), we see that there is considerable progress. The PIT scenario (C) reduces inequality by 0.35 vs. 0.27 of scenario (E), however, we see how at the interdecile level there are improvements in the different palm indices, which is a fundamental factor since it shows that the gap between the different deciles is closing.

This result is partly since the SIC social contributions are focused on social issues, helping individuals that will have a more redistributive character as evidenced in these indexes, while taxes when collected may have a different destination than social spending.

Regarding the different Palma indexes calculated (Gab-index) in the three first scenarios we observe that the values throughout the different policies remain the same or with an infinitesimal change that is not perceived, although the objective of this thesis is the establishment of policies that reduce inequality, the results obtained for the (Gab-index) are limited.

The results shown in (Table 8) for the generalized entropy indices follow the direction found in the dispersion indices, a gradual decrease, if we look at the Theil GE (1) index we see how through the different scenarios it decreases, going from a value of 0.65187 in the base scenario to 0.62970 scenario D and 0.62907 scenario F.

Policy (F) considers all the above scenarios, this potentiates the effect on the reduction of inequality of the entire Colombian economy compared with the disposable income in baseline, a total reduction of 0.69 extra Gini points or 1.2% per cent, if we compare policy (F) with respect to (D) which takes into account only the first three scenarios we see how adding all of them increases by 0.24 extra Gini points or 0.49% per cent in the reduction of inequality as measured by the Gini, which is a considerable result.

Romero et al. (2019) obtained a reduction in 0.14 Extra Gini points of inequality reduction after implement the Uruguayan system, this thesis obtains a reduction of 0.69 extra Gini points of inequality reduction once the Netherlands system is implemented, the above figures are measuring with the differences of disposable income Gini. Lustig (2016) show for Latin America reduction in 2.7 Gini points in average once each country applies its own tax system. Rodriguez (2019) evaluate the tax system in 2014 for Colombia, once this is applied 2.6 Gini points is obtained, this thesis shows a reduction in 3.97 Gini points for Colombia, the above figures are measuring with the differences of market income Gini vs disposable income Gini.

6. Discussion

For the discussion it is necessary to consider some clear concepts, for example, that the Gini index is considered a descriptive indicator which is based on the Lorenz curve. There are also other indicators that seek to provide information not only on general inequality but also to quantify the consequences on welfare, as evidenced in the works of Dalton (1920), Atkinson (1970) and Sen (1973), which assume the existence of a function that links collective welfare with the income distribution of individuals, in the case of Atkinson's indicator, the function is additive.

This aspect is relevant since the indicators can show more than just a number, in the end, the objective is to increase the welfare of individuals with the policy actions implemented, and by considering the positive relationship between welfare and income, there will be incentives to increase the income of individuals to generate greater generalized welfare.

Another important insight is found in Yitzhaki (1979) who highlights Runciman's (1966) interpretation of the Gini coefficient in terms of monetary deprivation. According to this logic, income gaps lead to a sense of deprivation that will be equal to the mean of the gaps in higher incomes, therefore, collective welfare will be mean income minus mean deprivation, Yitzhaki (1979) shows that the Gini coefficient is equal to mean deprivation divided by mean income.

It is important to say that the Gini coefficient does not fit into Atkinson's analytical framework, since utility does not depend only on one's own income, but also on the income of others. It fits into the more general framework proposed by Sen (1973).

All the above is to make mention of the strong political economy debates that we have at the moment of establishing new policies to reduce inequality. If we maintain the idea that the welfare of individuals is closely related to income, to what extent do we as policy makers play with the welfare of the highest income individuals in the distribution by reducing their disposable income? or what are our personal convictions to privilege a redistribution towards individuals at the bottom of the distribution? Undoubtedly, welfare is a factor that must be considered when interpreting results and implementing policies.

At first glance, there is an overall reduction of 0.69 extra Gini points or 1.2% per cent in inequality in Colombia after the implementation of the new policies scenario (F), which is a positive result in

terms of reducing overall inequality. The exercise of implementing policies that modify only the tax earner part (D) shows a gap in the Colombian tax system since this imposition of new tax structures is focused on higher earners income individuals without guaranteeing a redistribution to the first deciles.

Although increasing the amount of taxes will generate a redistribution, this does not touch all individuals in the system, as we can see in the different palm indices that do not show a significant change throughout the different policies, this is due to several reasons especially because the transfers to the first deciles are not increasing, a relevant factor is the transfers and as we have seen the proportion they have in disposable income.

A second point to explain the reduced effect on inequality at the interdecile level is due to the complexity of the tax system. Although the policies were aimed at increasing taxation, reducing exemptions, and presenting a more progressive character, these are not enough to significantly reduce the income inequality gaps, much more aggressive policies are needed (significant increases or reductions in the different values) that complement each other between the mechanisms.

Undoubtedly, the greatest flaw seen in the system is the scarcity of new social programs, despite the new programs that have been created, they fall short of the total population that needs them. A discussion of sources of financing for social policy and targeting of resources is increasingly necessary. An essential point in this discussion will be the way in which all individuals are identified, the databases and registry must be generalized.

An important point addressed in this thesis is the modification of the pension structure, since the weight it has on the disposable income of the highest income individuals, and the regressive character of the pension structure was identified. See Suits index (table 3).

With the implementation of the Social insurance contribution of Netherlands scenario (E), we have a much broader vision of the problem of inequality in Colombia and its redistribution. This component shows how the resources that are designed for the social part will have a more redistributive effect see (Table 7).

Although the different components of the system and the weight of each of them in the disposable income were identified see (graph 4), it is necessary to effectively implement the mechanisms that are at hand and that affect to a greater extent our objective: the reduction of inequality.

This is why we have a more generalized impact when dealing with SIC (Social Insurance contribution) than with PIT (Personal Income tax), this is due to the percentage that each of these components has, if we look at (graph 4), the SIC component is present in almost all deciles of the distribution and also has a greater weight since it is declared in a greater amount by individuals except for the first two deciles, so the SIC will contribute more money than the PIT and will have a greater effect, since by construction it is intended to be spent on the social aspect.

I can see through the different scenarios that when PIT modifications are made, there are no major effects, but after a modification of the SIC, the result is robust. If we look at decile 10, the SIC contribution does not have a great importance, since a large part of the income of this decile arrives via pensions and income from capital.

Regardless of the small amount of SIC that individuals in the 10th decile could contribute, social contributions play an important role, these are designed to feed the budget of social transfers and it is logical that they will be used in social contributions and social transfers, on the PIT side a part will be destined to monetary transfers or social programs, but another part may go to security, education, public goods, military forces, etc.

In Colombia according to the last figure of informal employment 49.2% of the economy is in this category, this result is relevant since the proportion that can be received from PIC or SIC is very low for the system in general, the national administrative department of statistics of Colombia found that in spite of this great informality 90.2% of the informal workers contributed to social security contributions and 49.9% pension contributions, while of the 20 million formal workers in Colombia only 1.5 million declare PIT income, a clear lack of knowledge of the Colombian labor force, therefore an important tool to reduce inequality will be the SIC.

In this Colombian scenario with a high percentage of labor informality, high levels of inequality, and a complex tax system that makes it difficult to obtain better results, it is necessary to have clear analytical frameworks to achieve better redistribution results.

Redistribution is largely achieved by social protection systems, there is a great debate as to the effectiveness of policies to achieve better redistribution results, certain sectors support that the transfer of money from rich to poor individuals (targeted policies) provides better results since there is evidence of a generalized increase in disposable income of poor individuals, this result is efficient and gets an important approval since Robin Hood policies will always be desirable.

Although these results are wanted, they may not be sustainable over time and may be disapproved by different individuals throughout the distribution, especially the richest, since they are the only ones who provide money and receive nothing in return. Social protection programs that are universal and not targeted may have interesting results in terms of redistribution and are much more accepted by the population.

What has been seen in some contexts is that these universally oriented redistribution programs receive greater support from the people, since all sectors and individuals feel supported by the policy, thus having greater revenue and public spending dedicated to the correction of inequality without increasing the public deficit.

This is known as the redistribution paradox, Korpi and Palme, (1998) "the more we target benefits at the poor and the more concerned we are with creating equal public transfers to all, the less likely". This paradox shows us that the more the policy is focused the less redistributive it will be, and this is partly due to political support.

As evidenced above, Colombia has 49.2% of its economy that is not on the radar and therefore this cannot be taxable, this generates a debate in which increasing taxes becomes unfair because it does not touch the entire population. So, linking these rates of the Netherlands system become very unfair under the Colombian structure and economy.

But if policies and systems of a universal nature were generated that could have considerable political support, increased collection and sustainability over time, and better results in redistribution could be achieved.

Economists make analyses based on assumptions, variables and models that help to understand reality in a simplified way, we are experts in these matters, and we say that in order to obtain better

results in redistribution and reduction of inequality it is enough just to focus resources thinking that budgets have an exogenous character, and that distribution will always be efficient.

But when an analysis is made through political economy these scenarios come to have a relevant contrast with the reality that is lived, we realize that for the establishment of policies, taxes, transfers, social benefit programs, the political support of different individuals will be essential, since this point will determine the policy results, therefore it is necessary to see the structure of the policy to be implemented considering heterogeneities and social contexts.

Achieving a reduction in Colombian inequality of 25% or 11 Gini points as the average established by OECD countries is challenging, clearly an increase in taxes and SIC rates to achieve these numbers will be politically unsustainable, especially in an economy like the Colombian one with major structural failures,

Having rates equal to those of OECD member countries does not guarantee similar results, let alone significant rate increases in the important components of individuals' disposable income. the debate remains open and focused on the acceptability of increases in taxes and SIC rates to have a redistribution in a country where 39% of income is in the last decile of the distribution.

7. Conclusions discussion remarks

This thesis used the microsimulation technique to analyze the effects of the tax system on inequality in Colombia, after the implementation of new systems that seek to reduce exemptions, lower deductions, increase social rates and focus taxes on individuals with higher incomes and pensions, a reduction of 0.69 extra Gini points is obtained, going from 55.02 in inequality to 54.33, this is considering only the disposable income.

Romero et al. (2019) obtained a reduction in 0.14 Extra Gini points of inequality reduction after implement the Uruguayan system, this thesis obtains a reduction of 0.69 extra Gini points of inequality reduction once the Netherlands system is implemented, the above figures are measuring with the differences of disposable income Gini. Lustig (2016) show for Latin America reduction in 2.7 Gini points in average once each country applies its own tax system. Rodriguez (2019) evaluate the tax system in 2014 for Colombia, once this is applied 2.6 Gini points is obtained, this thesis shows

a reduction in 3.97 Gini points for Colombia, the above figures are measuring with the differences of market income Gini vs disposable income Gini.

The microsimulation model represents an excellent tool for evaluating the redistributive effects of the tax and transfer system. In this sense, modeling the tax-benefit system and understanding its potential for reducing income inequality is a first step to be considered when implementing public policies in developing countries such as Colombia.

The results of the different inequality indicators show positive effects (reduction of inequality) once the policies are implemented, even though the results are weak, partly due to the small number of people who pay income taxes and obtain large pensions in Colombia.

Colombia's tax system is a highly regressive system that establishes very little redistribution. Its design is worrisome, and a restructuring is necessary to obtain better results in reducing inequality at the country level, above all, it is necessary to present a distributive structure along the different deciles of the population.

The few social programs in Colombia have an important value in the disposable income of the lowest deciles, it is an essential tool to reduce inequality, it is necessary more social programs focused on the lower part of the distribution, Colombia cannot continue to have only 5 programs currently transfer as social policy.

It is important to contemplate scenarios where better redistribution results can be achieved, a relevant factor will be the political support of individuals in the different policies established, to have better redistribution results, it is necessary to reduce Colombian inequality, this problem is increasingly eroding society, dividing and generating negative externalities.

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Appendix

Appendix 1 calculation of the different components of the tax system on disposable income.

the literature of work incentive or Labor incentive, allow through the rate Marginal Effective Tax Rate (METR) a popular indicator of the incentives faced by a worker on the intensive margin of labor supply, see the different effects of the incidence of the tax and benefit system on a marginal increase of earnings. I follow (Jara and Tumino 2013) equations, where they calculate the Marginal Effective Tax Rates (METRs) for 27 members of the EU.

$$METR_i = 1 - \frac{y_{h,i}^1 - y_{h,i}^0}{w_i^1 - w_i^0} \quad (1)$$

Where subindex i represent the individual and h the household, $y_{h,i}$ represent income and w_i represent wages, the numerator measures the change in household disposable income before ($y_{h,i}^0$) and after ($y_{h,i}^1$), the denominator measures the change in wages before w_i^1 and after w_i^0. The second part of the equation allows us to see how much disposable income remains after change in labor income and when subtracted from the unit, represents the percentage change in labor income not received by the household, due to the tax and transfer system.

If algebra is performed, it is possible to decompose the effect of each of the components of the tax and transfer system in the equation (METR), since household disposable income is equal to household market income ($ym_{h,i}$), adjusted for taxes ($t_{h,i}$), contribution to social security ($s_{h,1}$) and transfers ($b_{h,i}$), solving for each of the components.

$$METR_i = \left(1 - \frac{y_{h,i}^1 + b_{h,i}^1 - t_{h,i}^1 - s_{h,i}^1 - (y_{h,i}^0 + b_{h,i}^0 - t_{h,i}^0 - s_{h,i}^0)}{w_i^1 - w_i^0}\right) \quad (2)$$

$$METR_i = \left(-\frac{\Delta b_{h,i}}{\Delta w_i}\right) + \left(\frac{\Delta t_{h,i}}{\Delta w_i}\right) + \left(\frac{\Delta s_{h,i}}{\Delta w_i}\right) = METR_i^b + METR_i^t + METR_i^s \quad (2)$$

This could be the for taxes $METR_i^t = \left(\frac{\Delta t_{h,i}}{\Delta w_i}\right)$

Appendix 2 Table 9. Income of individuals schedular system [10]

Income of natural Persons	
1	earned income
2	pension income
3	capital income
4	non-labor income
5	income from dividends and participations

Appendix 3 Table 10. Simulation performed by progressively lowering exemption in pensions of the tax and transfer system.

	Baseline	Progressively		
Indicator	1000 TVU	355 TVU	230 TVU	**180 TVU**
Gini	55.02	54.99	54.97	**54.96**
Atkinson 0.5	25.51	25.48	25.46	**25.45**
Atkinson 1	43.01	42.96	42.96	**42.95**
Atkinson 2	72.68	72.66	72.65	**72.65**

[10] For more information see web page (Dirección de Impuestos y Aduanas Nacionales (**DIAN**), https://www.dian.gov.co/impuestos/personas/Renta_Personas_Naturales_2017/Clasificacion_y_definicion_Rentas_Cedulares/Introduccion/Paginas/default.aspx

Appendix 4 table 11 Simulation performed Policy B

B.1

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1000 TVU	0%	
2	1000 TVU< Y < 1500 TVU	19%	(Taxable amount in TVU minus 1000 TVU) x 19 %
3	1500 TVU < Y < 3500 TVU	28%	(Taxable amount in TVU minus 1500 TVU) x 28 % + 166 TVU
4	3500 TVU < Y	33%	(Taxable amount in TVU minus 3500 TVU) x 33 % + 788 TVU

B.2

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1000 TVU	0%	
2	1000 TVU< Y < 1500 TVU	19%	(Taxable amount in TVU minus 1000 TVU) x 19 %
3	1500 TVU < Y < 2500 TVU	28%	(Taxable amount in TVU minus 1500 TVU) x 28 % + 166 TVU
4	2500 TVU < Y	33%	(Taxable amount in TVU minus 2500 TVU) x 33 % + 788 TVU

Indicator	Base line	B1	B2
Gini	55.02	54.90	54.89
Atkinson 0.5	25.51	25.40	25.38
Atkinson 1	43.01	42.88	42.87
Atkinson 2	72.68	72.61	72.60

Appendix 5 table 12 Simulation performed Policy C.

C.1

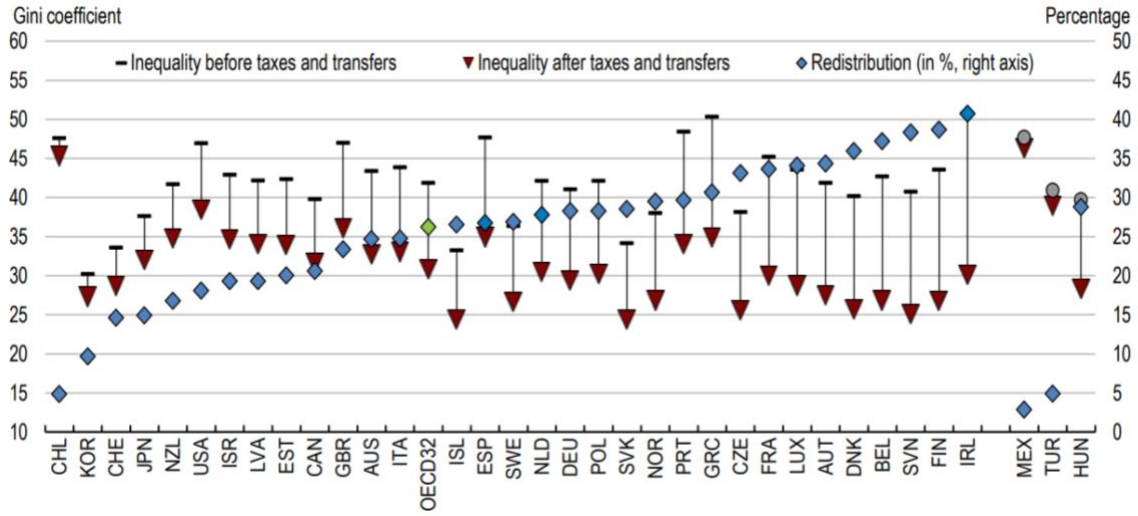
Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1090 TVU	0%	
2	1090 TVU< Y < 1700 TVU	28%	(Taxable amount in TVU minus 1090 TVU) x 28 %
3	1700 TVU < Y < 4100 TVU	33%	(Taxable amount in TVU minus 1700 TVU) x 33 % + 166 TVU
4	4100 TVU < Y	40%	(Taxable amount in TVU minus 4100 TVU) x 40 % + 788 TVU

C.2

Threshold	Tax Burden interval (measured TVU)	Tax Marginal Rate	Tax
1	0 < Y< 1090 TVU	0%	
2	1090 TVU< Y < 1700 TVU	28%	(Taxable amount in TVU minus 1090 TVU) x 28 %
3	1700 TVU < Y < 4100 TVU	35%	(Taxable amount in TVU minus 1700 TVU) x 35 % + 166 TVU
4	4100 TVU < Y	49%	(Taxable amount in TVU minus 4100 TVU) x 49 % + 788 TVU

Indicator	Baseline	C1	C2
Gini	55.02	54.67	54.57
Atkinson 0.5	25.51	25.13	25.00
Atkinson 1	43.01	42.60	42.48
Atkinson 2	72.68	72.45	72.39

Appendix 6 table 13. Gini coefficient before and after taxes and transfers 2019.



Source: Causa et all. (2019) OECD.