TAXES, TRANSFERS AND INCOME DISTRIBUTION IN CHILE

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July 4, 2018[1]

Abstract

This paper seeks to measure the distributive impact of fiscal interventions in Chile, applying the "Commitment to Equity" (CEQ) methodology, a standardized fiscal incidence analysis. As a methodological innovation, we incorporated income accrued and not received by Chilean taxpayers through their companies and corporations into the distribution of pre-fiscal income. We find that the difference between the distribution of accrued and received income turns out to be important, around 6 Gini percentage points for each main concept of income. In addition, when moving from the distribution of market income to the distribution of final income (after taxes and transfers) the distribution of income improves by 7 Gini percentage points. To assign the improvement in the distribution of income between the different fiscal interventions, we apply the Shapley value and it is observed that half of the improvement in the distribution of income is due to transfers in education, while direct taxes only explain 20% of the reduction of the Gini coefficient. Finally, based on the simulation of the impact of the 2014 tax reform carried out by the World Bank, we estimate that the reform would produce an additional reduction of 2.4 Gini percentage points when going from market income to final income.

Contents

1 Introduction

Distributive topics have been the central topics of public debate over recent years, amongst various factors, due to increasing inequality in various developed countries. Chile was no exception to this trend. During the presidential campaign in 2013, an ambitious tax reform was the central element of the program of the winning candidate Michelle Bachelet, which was approved by Congress in 2014. This reform changed the tax regime for companies in order to establish a more progressive tax and increase tax revenue from 19 to 22% of GDP. Additional resources were allocated, mostly to finance educational reform.

Measuring the distributive impact of a tax structure and transfers financed by tax revenues proves to be a methodological challenge. Moreover, it is desirable to have a standard methodology that allows for comparison across countries. An important initiative along this line was the CEQ project which has been constructing a standardized methodology that includes more and more sources of income, taxes and transfers and which has been applied in a growing number of countries.

This work contributes to the CEQ project by proposing a methodology for incorporation of capital income into the calculations of distributive impact of fiscal interventions.[2] With that aim, we have applied the methodology used by Engel et al. (1999) to combine the information from the National Survey of Socioeconomic Characterization (CASEN for its acronym in Spanish, Encuesta de Caracterización Socioeconómica Nacional) with the administrative data of the Internal Revenue Service (SII for its acronym in Spanish, Servicio de Impuestos Internos) to pare individuals from both sources of information.

Unlike Engel et al. (1999), this work had access to information about the accrued income of high-income Chilean taxpayers through their firms and companies. The income accrued, but not received, by high income individuals is particularly important in the case of Chile, at least before the reform of the 2014 tax regime because the integrated character of the tax regime facilitated indefinite deferment of income tax payments of people through the creation of investment companies. Therefore, taking into account the income of firms and companies as the income of their owners, even though they are not withdrawn or paid out in dividends, it leads to a more comparable distribution measurement than those of other countries.[3]

The difference between the distribution of accrued and received income turns out to be significant. Taking data for the year 2013, the Gini coefficient is calculated for five income distributions, from that of the market, passing through the one immediately after tax collection and also considering the one after the transfers (monetary and non-monetary) financed by the State with their income (we call it final income). In all the cases, the Gini coefficient is higher when working with accrued income, with a rather stable difference, about 6 Gini percentage points.

We have also concluded that going from the market income distribution to the final income distribution (after taxes and transfers), the distribution of the income improves by almost 7 Gini percentage points. This motivates another topic that we will approach in this work: how to assign this improvement in the distribution between different fiscal interventions.

This work considers 16 different possible fiscal interventions -among them, direct taxes, indirect

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[2]The taxes and transfers, both monetary and non-monetary, are specific cases of fiscal interventions.

[3]Fairfield and Jorrat (2014) emphasize this point.

taxes, spending on different types of education and health- and we propose evaluating the distributive impact of each of them. One logical step is to compare the Gini coefficient for the income distribution before and after the application of a particular intervention that we are evaluating. The problem is that there are a great number of possible distributions to consider when calculating the previous difference. In effect, the referenced income distribution could be after any subset of the other 15 that are not being considered. This is to say that there are $2^{15} = 32,768$ possible income distributions to which we can apply the interest intervention so we can later calculate and observe how the Gini coefficient varies. Which of these distributions do we work with?

A secondary contribution of this work, following Sastre and Trannoy (2002), is to apply the Shapley value to assign the change in the income distribution to the fiscal interventions that originated it. This focus gives a simple and reasonable criterion to average the large number of changes in the Gini coefficient just described. We first applied this methodology to the 2013 income distribution, concluding that half of the improvement is due to transfers in education. On the other hand, direct taxes only explain a 20% decline of Gini coefficient. In continuation, we consider an impact simulation of the 2014 tax reform conducted by the World Bank (World Bank, 2016). According to this estimation, the reform would result in an additional reduction of 2 points of the Gini if switched from market income to final income. Upon using the Shapley value to distribute this additional improvement between the 16 fiscal interventions considered, it is concluded that two thirds are explained by an increase in education spending that is financed by the reform.

The rest of this paper is organized as follows: Section 2 gives a brief description of the Chilean tax regime. It is followed by section 3 where we describe our proposal to incorporate capital income into the CEQ methodology. This proposal is applied using Chilean data from 2013 in section 4, comparing the distribution of market income with final income (and several stages in between), taking capital income into consideration in two possible scenarios: accrued and received. Section 5 explains how to use the Shapley value to measure the distributive impact of a particular fiscal intervention. The methodology has an additive property: the sum of the values assigned to individual interventions is equal to the impact of all the interventions combined. Section 6 applies the developments from previous sections to estimate expected distributive impact of the 2014 tax reform. Section 7 concludes.

2 Tax regime and social spending in Chile

2.1 Tax regime

In the Chilean tax system, two types of taxes are observed: direct taxes and indirect taxes. Direct taxes are applied to income and equity, while the indirect taxes affect wealth, encumbering acts and/or contracts.

2.1.1 Direct taxes

The most important direct tax in Chile is Income Tax, which, in 2013, was composed of 3 different taxes: a flat rate of 20% on company profits (First Category Tax), a tax on dependent work incomes (Second

Category Tax) and a general tax encumbering all income generated by a natural person (Complementary Global Tax). The work tax and general tax share the same structure of progressive rates where 8 sections can be differentiated, starting with the exempt section, until the last section, which is subject to a marginal rate of 40%. The only difference between these taxes is that the Second Category Tax is retained and deposited into state coffers by the employer on a monthly basis, while the Global Tax is paid once a year.

The main characteristic of Income Tax in 2013 is that it represents an integrated regime where the subject of taxation must be a natural person. In order to assure the integration of the regime, the tax paid for concept of First Category Tax acts as an Income Tax credit that must be paid by a natural person, which is recognized at the moment of withdrawing profit or receiving company dividends. The essential difference between the maximum marginal rate of the Complementary Tax and the rate of First Category Tax is 20 percentage points, which generates incentives to defer the payment of the capital income.

Table 1 shows the participation of tax revenues and the percentage of GDP that each direct tax represents for 2013. It is observed that direct taxes correspond to 39.6% of total tax collection (6.6% of GDP). This study considers personal taxes as well as corporate taxes.

2.1.2 Indirect taxes

The most important indirect tax in Chile is Value Added Tax (VAT), which generates the largest quantity of tax income (47.5% of total tax collection). In 2013 the majority of transactions were encumbered with a fixed rate of 19%, which is applied to the sales price in the case of internal sales and to the CIF value, plus tariff, in the case of imports. VAT has relatively few exemptions, the most important being those that benefit exportations, and services related to health, education and transportation. As observed in table 1, indirect taxes represent 58.7% of total tax collection (9.8% of GDP). Indirect taxes considered in this paper are VAT, Luxury Tax on Products, Tax on Alcoholic and Non-alcoholic beverages and Similar Products, Tobacco Tax, Fuel Tax and Tariffs.

Table 1: Chilean tax system, 2013

	% of total revenue	% of GDP
Direct taxes		
Business tax	22.1	3.7
Personal taxes	7.9	1.3
Adicional	6.8	1.1
Others	2.8	0.5
Total	39.6	6.6
Indirect taxes		
VAT	47.5	7.9
Alcoholic/non-alcoholic beverages	1.1	0.2
Additional others	0.1	0.0
Excise taxes	8.7	1.4
Import tariffs	1.4	0.2
Total	58.7	9.8
Others	1.9	0.3
Total	100	16.7

*Source: Own elaboration based on 2009-2014 annual tax revenue, SII.

2.2 Social spending

As observed in table 2, the social spending for Chile in 2013 was 14.2% of GDP and it was mainly disaggregated as an expense for social protection, education and health. In this section, the most important components of this spending is briefly described.

Table 2: Social spending in Chile, 2013

	% of social spending	% of GDP
Social spending		
Social protection	43.0	6.1
Education	30.0	4.3
Health	27.0	3.8
Total	100	14.2

*Source: Own elaboration based on the 2013 executed budget, DIPRES.

2.2.1 Social protection system

The social protection system in Chile is based on two subsystems: Ethical Family Income and the Family Benefit System.

Ethical Family Income is the sum of benefits given by the State to the most vulnerable persons and families, which aims to eradicate extreme poverty. In 2013, 170,000 families received these benefits, which consist in access to participation in personalized social support programs and delivery of bonuses. Among the main beneficiaries are elderly people who are living in dire conditions, homeless people and

minors whose legal guardian is being incarcerated. The main objective of the programs is the development of individuals in the social environment, providing them with tools necessary to facilitate entering into the labor market, allowing a better family development and improving the autonomy and independence of households. The bonuses are given after certain achievements and upon fulfilment of duties in the area of health, education and employment.

The Family Benefit System is a set of subsidies that aims to complement family income for the most vulnerable part of the population. This study contemplates all bonuses and subsidies related to these programs.[4]

2.2.2 Pension system

The Chilean pension system establishes that all persons should save in one individual capitalization account that will later finance their pensions and whose amount depends on the number, amount and temporary ordering of the contributions, of their salary profile, retirement age and the profitability of the funds. The pension system is based on 3 basic pillars: a contributive pillar of a mandatory nature, a poverty prevention pillar (solidarity pillar) and a voluntary savings pillar.

The solidarity pillar is orientated to provide a minimum pension to those people who are not part of the pension system, such as informal workers, and to those whose level of savings is very low, either because they had their working life interrupted or because they had joined the pension system late in life. The resources to finance these types of pensions are obtained from fiscal income, thus the name "Solidarity". This study considers the Basic Solidarity Pension of Old Age and Disability, and also the Solidarity Pension Support for Old Age and Disability.

2.2.3 Education system

In a brief summary, there are 3 key features of the Chilean education system: the market model (competition and free election), state subsidiarity and territorial decentralization. This system is made up of four levels of teaching: preschool, primary, secondary and superior. The administrative dependency may be municipal, subsidized (on behalf of people or institutions called holders) or private. The subsidy per student that the State provides to educational establishments, whether municipal or subsidized, is the same, and 93% of students attend these kinds of educational institutions,[5] which makes education a large public spending item. As shown in table 2, 30% of social spending in 2013 corresponds to Education, which represents 4.3% of GDP.

2.2.4 Health system

The Chilean health system is of mixed character because it is made of two subsystems: one public and one private. The public system includes all organizations that actually form The National System of

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[4]Household allowance, single family subsidy, mental disability subsidy, family protection bonus, family base bonus, bonus for medical control for children, school attendance bonus, school achievement bonus, and working woman bonus.

[5]This figure was calculated based on information of inscriptions provided by the Ministry of Education for preschool, primary, secondary, adult and special education.

Health Services (SNSS for its acronym in Spanish, Sistema Nacional de Servicios de Salud): Ministry of Health and its dependent bodies (Undersecretary of Public Health and Undersecretary of Welfare Networks), the Institute of Public Health, the Central Supply and Superintendence of Health. The National Health Fund (FONASA for its acronym in Spanish, El Fondo Nacional de Salud) is a public organization in charge of providing health coverage to its beneficiaries, which in 2013 reached approximately 76.3% of the country's population. FONASA is being financed mostly with the fiscal contributions established by the Law on Budgets (58.4%) and with the health contributions from affiliates (36.4%).[6] As table 2 shows, the spending on health corresponds to 27% of social spending, which represents 3.8% of GDP. On the other hand, the private system is in the hands of so called Private Health Institutions (ISAPRE for its acronym in Spanish, Instituciones de Salud Previsional) which is in charge of financing the healthcare and benefits in accordance with the plans agreed upon with its affiliates. The beneficiary population of these types of institutions reached 17.8% of the population in 2013.

3   Methodology, data and assumptions

We used the methodology developed by the global project "Commitment to Equity Assessment" (CEQ) and applied it to the case of Chile in order to estimate the incidence of social spending, subsidies and taxes.[7] The objective is to measure the degree of redistribution resulting from social spending, subsidies and taxes, quantify the progressivity of the tax regime and government spending and determine what changes in social spending and taxes can achieve a better distribution of wealth and a greater reduction in poverty within the context of fiscal responsibility.

This methodology defines main concepts of income in order to measure the redistributive effect and the impact on poverty of fiscal interventions. A pre-fiscal income is defined which corresponds to market income, and then an entire series of post-fiscal incomes, which reflect income obtained after a set of fiscal interventions is applied. These correspond to net market income, disposable income, consumable income and final income. The analysis unit is household.

The analysis developed in this paper contemplates two innovations aimed to improve CEQ methodology: using tax administrative information in order to develop a methodology that will allow incorporation of capital income and include corporative taxes into the analysis.

Figure 1 contains a diagram that explains the construction of main concepts of income analysed in this study. Two initial scenarios of definition of market income are established. The first scenario corresponds to the received market income which considers dependent and independent work income, pensions, rent, interest, private money transfer, self-consumption, imputed rent, capital gains, dividends and withdrawals.[8] The second scenario corresponds to accrued market income that, as a part of per-

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[6]The pension and healthcare system of armed forces (CAPRADENA) and police force (DIPRECA) also are part of public system and are mostly financed from fiscal income.

[7]Lustig y Higgins (2017).

[8]This corresponds to the definition of market income usually used in CEQ methodology. It is important to clarify that the original CEQ methodology proposes reference analysis where pensions that are part of the social security system are considered part of the market income, and sensibility analysis where the pensions that are part of the social security system are treated as one transfer. In this study, the pension is considered to be market income regardless of which pension system it comes from.

sonal income, includes income not distributed by companies.[9] This definition of income is very close to the Haig-Simmons definition, which defines income as consumption expenditure plus the change in equity.[10] This definition is more adequate for doing distributive analysis because retained profits correspond to a fundamental component of high-income households given the particularities of the Chilean tax system described in section 2.[11] On the other hand, it is possible to incorporate corporate taxes into the analysis as part of the direct taxes.[12]

3.1 Data

The main source of information related to income is the 2013 National Survey of Socioeconomic Characterization (CASEN). The Ministry of Social Development conducts this survey every two years in order to collect data related to social and economic characteristics of a representative sample of the population. The survey includes 218,401 individuals from 66,725 households. The data used corresponds to the 2013 survey and the methodology used is the traditional one, a methodology that adjusts for non-declaration and under-declaration of income in such a way that the income in different categories is the same as the one observed in the national account.[13]

The database of the Internal Revenue Service was used as a complementary source of income information and as a main data source to determine the direct tax payment of households. The database of the Internal Revenue Service contains the information on income and tax payments of 9,064,803 taxpayers for the year 2013, and corresponds to the database used in World Bank (2016).

The consumption pattern of households was estimated based on the 2011-2012 Family Budget Survey (EPF for its acronym in Spanish, Encuesta de Presupuesto Familiar). This survey was conducted by the National Statistics Institute and provides information on the spending structure and consumption patterns in every regional capital of the country. It is conducted every five years and its main objective is to elaborate a basket of goods and services based on which the Institute can calculate the inflation rate.

The 2012 Input-Output Matrix constructed by the Central Bank of Chile allows determining the fraction of household spending that corresponds to imported and tradable goods, both in final goods and supplies used in national production, which allows the estimation of the tariff payments for households.

To avoid double calculation, pension contributions are not counted.

[9]The received income scenario considers dividends and withdrawals, while the accrued income scenario considers financial profit attributed according to the participation in the property.

[10]The main difference in the definition of accrued income in this study, and the one used in Heig-Simmons, is that the latter does not include pensions as part of income considering them a dissaving, and not income.

[11]Agostini, Martínez and Flores (2012); Fairfield and Jorrat (2014) are examples of recent studies about income distribution where accrued profits have been incorporated.

[12]Even though the definition of accrued income is better for doing distribution analysis, presenting the results under both definitions of income with the aim of providing a better comparison was opted for.

[13]The Economic Commission for Latin America and the Caribbean (CEPAL) carried out this procedure. The proportional difference between CASEN and the data from national accounts is imputed uniformly for each category of income (wages and salaries, independent work income, social security provisions and imputed rent). The adjustment coefficients are estimated for national accounts on the basis of the year 2008. For the property incomes, the difference between CASEN and national accounts is attributed to 20% of the highest income individual receivers in a manner proportional to independent income. This corresponds to the database used by the SII to measure evasion. In the year 2013, CASEN published the results with and without adjustment for National Accounts.

Figure 1: Definition of the main concepts of income
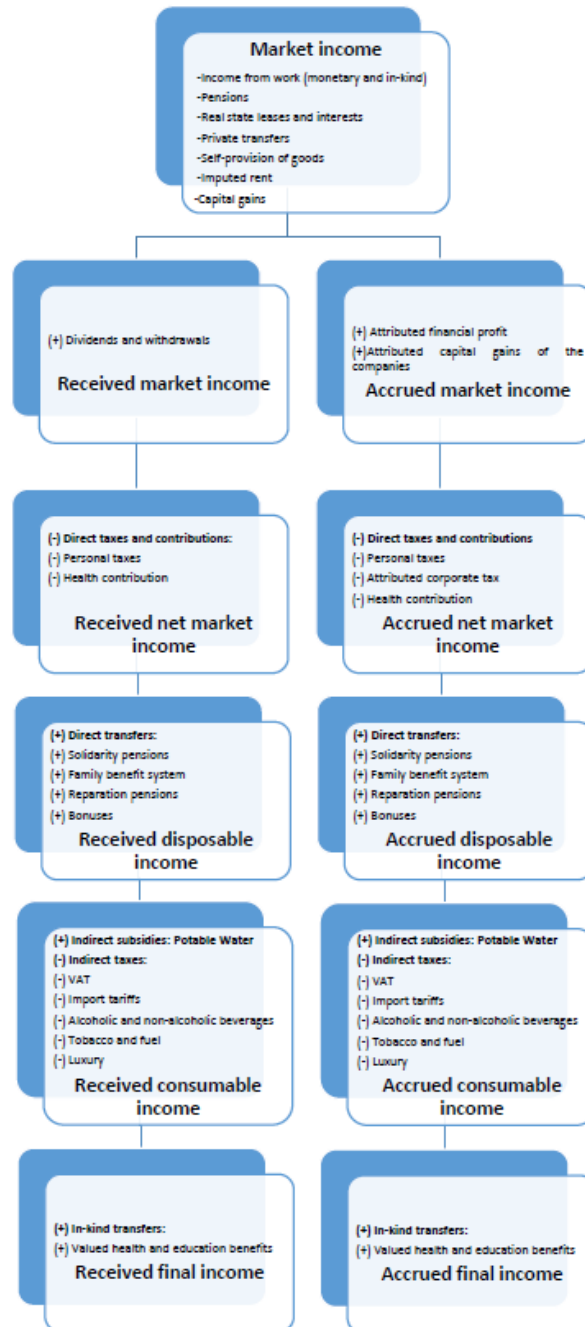
Source: Own elaboration based on Higgins y Lustig (2017).

It also allows determining how the specific fuel tax impacts the price of supplies.[14] Later on, these two sources of information allow estimating the payment of indirect taxes on the consumption of households.

Finally, valuable information was obtained from the official data provided by the Ministry of Finance, Ministry of Education, Ministry of Social Development, National Institute of Statistics, FONASA and the Budget Office.

3.2 Construction of the main concepts of income

The following explains how the main concepts of income were constructed.[15]

3.2.1 Market income

The main idea is to assign to Casen individuals variables not reported in the CASEN survey such as financial profit, capital gains and taxes through a cross-reference with the database provided by the SII (in English, IRS). The strategy consists in carrying out the matching between both sources of information through a variable that is contained in both databases.[16]

The database provided by the SII contains a variable of income received from the individual that is defined as the sum of income from dependent and independent work, capital gains, interest income, income from real estate leases, withdrawals, dividends and pensions.[17] The same variable of received income is constructed for Casen individuals.[18]

Then CASEN individuals are identified with a received income higher than the minimum amount of taxable liquid income from which individuals must pay taxes, accounting for a total of 3,282,402 individuals.[19] The same procedure is carried out for the individuals of the SII database, where there are a total of 2,286,190 individuals that exceed the income tax payment threshold.[20] Thus, there is a difference of 996,212 individuals between both sources of information.

These individuals are considered as non-declarants, either because they receive income in the informal sector of the economy, because they evade, or because they receive exempt income that should not be declared such as the income received from the rental of housing associated with the DFL2. The rest of CASEN individuals are considered as potential contributors. CASEN individuals classified as non-declarants are chosen from those individuals who have an annual income exceeding the tax payment

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[14]Only the payment of the specific tax is considered as an input of transportation services since the fuel used in the production process is exempt from the tax payment.

[15]The technical detail of the construction of the concepts of income is contained in the Methodological Appendix, available upon request from the authors.

[16]The CASEN survey is anonymous so it is not possible to make a direct cross.

[17]This corresponds to the variable y_1 in World Bank (2016).

[18]The non-declaration and under-declaration of dividend income and interest income in CASEN were corrected using the methodology of Engel, Galetovic and Raddatz (1999).

[19]In 2013, the tax payment threshold corresponded to $ 6,605,304 per year.

[20]For this procedure, the capital gains of the individuals in the SII database were not considered, since CASEN does not report capital gains.

threshold and less than \$ 21,000,000.[21] It is assumed that it is not possible for an individual with an annual income exceeding \$21,000,000 to not pay any kind of tax and that the probability of not paying taxes decreases linearly with income. The probability distribution used to select the non-declarants was parameterized in such a way that the probability of an individual not declaring an annual income higher than \$ 21,000,000 is 0 and the expected value of the number of non-declarants is equal to the actual number of non-declarants.

Once the number of potential taxpayers in Casen is equal to the number of individuals that exceeds the tax payment threshold according to the received income from the SII database, the individuals in both databases are ordered by centiles of received income. It is assumed that the individuals that make up the nth centile in Casen are the same as those who make up the nth centile in the SII database. Then the Casen individuals are imputed with the variables that are only contained in the SII database. These variables correspond to the attributed financial profit,[22] capital gains, attributed capital gains of the companies,[23] tax base and total direct taxes paid by the individual.[24] The imputation is made proportionally to the received income of the Casen individual.

Once the procedure described above is carried out, it is possible to construct the received market income and the accrued market income (see figure 1). It should be remembered that the received market income only considers the income obtained by the taxpayers as natural persons, while the accrued market income also considers the income generated at the company level and attributed to the people according to their participation in the ownership. As CASEN reports the liquid income of the individuals, that is, net of taxes and contributions, the market income is constructed by adding the health contributions and the tax payment. For the received income, the payment of taxes is obtained by applying the tax regulations on the tax base variable, which allows calculating the personal taxes.

3.2.2 Net market income

Net market income is obtained by subtracting the payment of direct taxes and health contributions from market income.[25] The payment of direct taxes considered under the definition of received income and accrued income is different. For the received income scenario, only personal taxes are considered, that is, the payment of Second Category Tax and Global Complementary Tax. On the other hand, for the accrued income scenario, personal taxes and business taxes attributed to individuals are considered.

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[21]A person with an annual income exceeding \$21,000,000 is among the richest 7.2% of individuals over 20 years old with positive income.

[22]For a detailed description of the process of attribution of financial profits in the income of individuals, see methodological annex 2 of World Bank (2016). Only the positive financial profits generated by the companies (corporations and partnerships) were attributed.

[23]It only considers the capital gains (of individuals and companies) taxed. These correspond to the operations described in N° 8 of art. 17 of the Income Tax Law. The amount recorded generally corresponds to the difference between the acquisition value and the sale value of the share.

[24]The tax base corresponds to the income base on which the payment of Second Category Tax and Complementary Global Tax is calculated. The total payment of direct taxes corresponds to the amount of First Category Tax attributed, First Category Single Tax of persons and company attributed (this tax applies to certain capital gains), Second Category Tax and Complementary Global Tax less reductions for First and Second Category credits.

[25]Pension contributions are not considered, since pensions are part of the market income, that is, the pension is understood as deferred income independent of the pension system from which it comes.

3.2.3 Disposable income

Disposable income is constructed by adding money transfers from the government to the net market income. CASEN contains information about beneficiaries of social programs and the amount of money received, so it is possible to make the allocation directly. The analysis includes the benefits related to the Family Benefit System (Single Family Subsidy, Family Allowance and Subsidy for Mental Disability), Solidarity Pensions (Basic Solidarity Pension for Old Age and Disability, Solidarity Pension Contribution for Old Age and Disability), bonuses related to the Ethical Family Income program (School attendance bonus, Healthy child control bonus, Family base bonus, School achievement bonus, Women's work bonus and Family protection and discharge bonus), Pensions of Special Reparation Laws and other government bonuses (Golden Anniversary bonus, Winter bonus, March bonus). The coverage and the average amount of the benefits were adjusted in such a way that they coincide with the coverage and average amount contained in the administrative records of the different social programs according to information from the Ministry of Social Development (MDS, for its acronym in Spanish Ministerio de Desarrollo Social).[26]

3.2.4 Consumable income

Consumable income is obtained by adding the subsidies to disposable income and subtracting the payment of indirect taxes. The only subsidy considered in the analysis is the potable water subsidy, which is reported in CASEN.[27] To calculate the payment of indirect taxes it is necessary to know what fraction of the disposable income received from the household corresponds to the payment of indirect taxes. For this, the methodology of Engel et al. (1999) was employed to measure the burden of these types of taxes, for which it was necessary to combine information provided by the EPF 2011-2012 and IOM 2012 constructed by the Central Bank.[28]

Indirect taxes produce an increase in the price of the good (price effect) and an increase in the cost of inputs (input effect). The EPF allows us to know the consumption pattern of households, which allows us to determine the price effect, while the IOM describes the production relationships between different sectors or economic activities, which allows us to determine the input effect. Among the indirect taxes considered are VAT, tariffs, alcoholic beverages, non-alcoholic and similar products, luxury products, tobacco and fuels (diesel oil and gasoline).

The households contained in the EPF are ordered in deciles of disposable income and the fraction of disposable income that corresponds to the payment of indirect taxes is calculated. Then households contained in the CASEN are ordered in deciles of disposable income and it is assumed that all CASEN households belonging to the same decile are then ordered have the same consumption pattern as the household representative of each decile in the EPF survey. For the analysis of incidence, it is assumed

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[26]To correct for under-reporting of beneficiaries of the Family Allowance, Single Family Subsidy, Family Base Bonus, March Bonus, Winter Bonus and School Achievement Bonus programs, the Souza, Osório and Soares (2011) method was applied. The method of correction for under-reporting for the rest of the social programs (if possible) is explained in detail in the Methodological Appendix.

[27]Corrected for under-reporting using the Souza et al. (2011) method.

[28]The methodology is explained in detail in the Methodological Appendix.

that the burden of indirect taxes falls entirely on consumers and that the fraction of household income allocated to the consumption of each good and service is independent of the tax structure.

3.2.5 Final income

The final income is constructed by adding the valued health and education benefits to the consumable income. In the case of benefits valued in education, information was requested from the Ministry of Education about the cost of education and the number of enrollments, differentiated by educational level and administrative unit of the educational institution, with which it was possible to calculate the average expenditure per type of student. The method of allocating the average expenditure on education is imputation, since CASEN contains information to identify who in the household attends an educational institution, the administrative unit (public, subsidized or private) and the educational level (pre-school, primary, secondary, tertiary, adult and special).[29]

To determine the average expenditure on health, the study "Methodology of Spending Characterization" was used as the main source of information, conducted by the Subdepartment of Studies of FONASA, which estimates the per capita public expenditure depending on the sex, age and income level of the beneficiary for the year 2011. To this end, health expenditure is determined by type of care modality and by the characteristics of the beneficiary. FONASA's health expenditure is divided into two broad categories: medical benefits and other services. Within the medical benefits is the Institutional Care Modality (MAI for its acronym in Spanish, Modalidad de Atención Institucional) to which all insured persons are entitled and the Free Choice Modality (MLE for its acronym in Spanish, Modalidad de Libre Elección) to which only people who contribute 7% to healthcare are entitled (groups "B","C" and "D"). On the other hand, other services include medical loans, subsidies for work disability expenses and other types of expenses. Since CASEN contains information about the age, sex, and FONASA group to which the individual belongs, it was possible to impute the average expenditure.[30]

4   Results

Figure 2 shows the Gini coefficient for the main concepts of income. The Gini coefficient of accrued market income (0.593) is considerably higher than the Gini coefficient of the received market income (0.537), because the definition of accrued income captures the income of high-income individuals better. It is observed that the set of fiscal interventions (all taxes and transfers) has an equalizing effect on the distribution of income measured by the Gini coefficient. When going from market income to net market income, the Gini coefficient is slightly reduced under both definitions of income, so the joint effect of direct taxes and health contributions is equalizing.[31] On the other hand, when going from disposable

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[29]We thank Sandra Martínez who provided relevant information to allocate the average expenditure in tertiary education. These data were used in Martínez-Aguilar, Fuchs, Ortiz-Juarez and Del Carmen (2017).

[30]The average expenditure per capita was adjusted in proportion to the real growth in the FONASA budget between 2011 and 2013. For the individuals belonging to CAPREDENA and DIPRECA, the average expenditure charged was calculated from the official budget execution data published by the Budgets Office. For more details see Methodological Appendix.

[31]It should be remembered that in the received income scenario, only personal taxes are considered, while in the accrued income scenario, personal taxes and corporate taxes attributed to individuals are considered.

income to consumable income, inequality increases in both scenarios, reflecting the inequalizing effect of indirect taxes in Chile.

Figure 2: Effect of fiscal interventions on income inequality
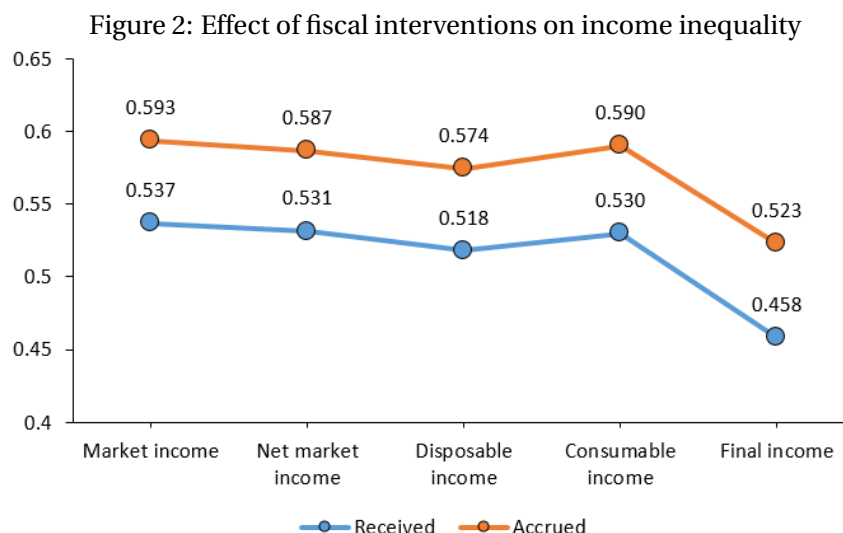
Source: Own elaboration based on CASEN, SII and official government data.

Table 3 shows the income shares of the top 10%, 5% and 1% for the main concepts of income. The share in the accrued market income from the top 1% is 18.7%, while the share in the received market income from the top 1% is 13.2%. For the accrued income scenario, the share of the top 1% is reduced by 2.2 percentage points (from 18.7% to 16.5%) when going from market income to final income, while the share of the top 10% reduces by 4.5 percentage points (from 50.8% to 46.3%). A similar reduction is observed for the scenario of received income.

Table 3: Income Shares (%)

Income	Top 1 %	Top 5 %	Top 10%
Received			
Market	13.2	31.5	44.1
Net market	12.4	30.6	43.3
Disposable	12.2	30.1	42.6
Consumable	12.4	30.7	43.5
Final	11.0	27.5	39.2
Accrued			
Market	18.7	38.7	50.8
Net market	17.7	37.6	49.9
Disposable	17.4	37.0	49.2
Consumable	18.2	38.3	50.6
Final	16.5	34.8	46.3

Own preparation based on CASEN, SII and official government data.

The Kakwani index of the tax system in the received income scenario and in the accrued income scenario is -0.006 and -0.022 respectively.[32] That is to say, under both definitions of income (and direct

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[32]The Kakwani index (1977) is a measure of the progressivity of fiscal interventions. Values can be taken in the interval [-1,1]

taxes) the tax system is slightly regressive, which is consistent with previous studies on tax incidence analysis in Chile.[33] When analyzing the received income scenario, separating by type of tax, the Kakwani index is 0.40 for direct taxes and -0.12 for indirect taxes. On the other hand, for the accrued income scenario, the Kakwani index is 0.34 for direct taxes and -0.18 for indirect taxes, that is, direct taxes are less progressive and indirect taxes more regressive compared to the scenario of received income. The Kakwani index for direct transfers in both definitions of income is higher than 0.85, which reflects the good targeting of social spending in Chile.

In a system with multiple taxes and transfers, Kakwani's progressivity index of a given fiscal intervention does not provide direct information as to whether the intervention has an equalizing or inequalizing effect.[34] Then, to determine the effect on the income distribution of a given fiscal intervention, it is more appropriate to observe its marginal contribution, which is defined as the difference between the Gini coefficient of some end concept of income without the intervention and the Gini coefficient of the end concept of income but including the intervention. In this way, if the marginal contribution is positive, the intervention helps to reduce inequality.

Figure 3 shows the marginal contribution of a series of fiscal interventions for both definitions of income. Panel A considers disposable income as the end concept of income, while panel B considers consumable income as the end concept of income. There are no qualitative differences in the marginal contribution of the different fiscal interventions under both definitions of income. It is observed that direct transfers and direct taxes contribute to improving the distribution of income while health, VAT and other indirect taxes contribute to increasing inequality.[35] In particular, when moving from disposable income to consumable income, the Gini coefficient increases from 0.518 to 0.530 under the received income scenario and from 0.574 to 0.590 under the accrued income scenario.[36] Moreover, as shown in the next section, the marginal contribution of indirect taxes will always be negative, independent of the end concept of income used.

with positive values indicating an equalizing effect and negative values an inequalizing effect. The higher the index, the greater the progressivity of the fiscal intervention. The Kakwani index for a tax is defined as the difference between the coefficient of concentration of the tax and the Gini coefficient of the pre-fiscal income (market income) while for a transfer it is defined as the difference between the Gini coefficient of the pre-fiscal income and the concentration coefficient of the transfer.
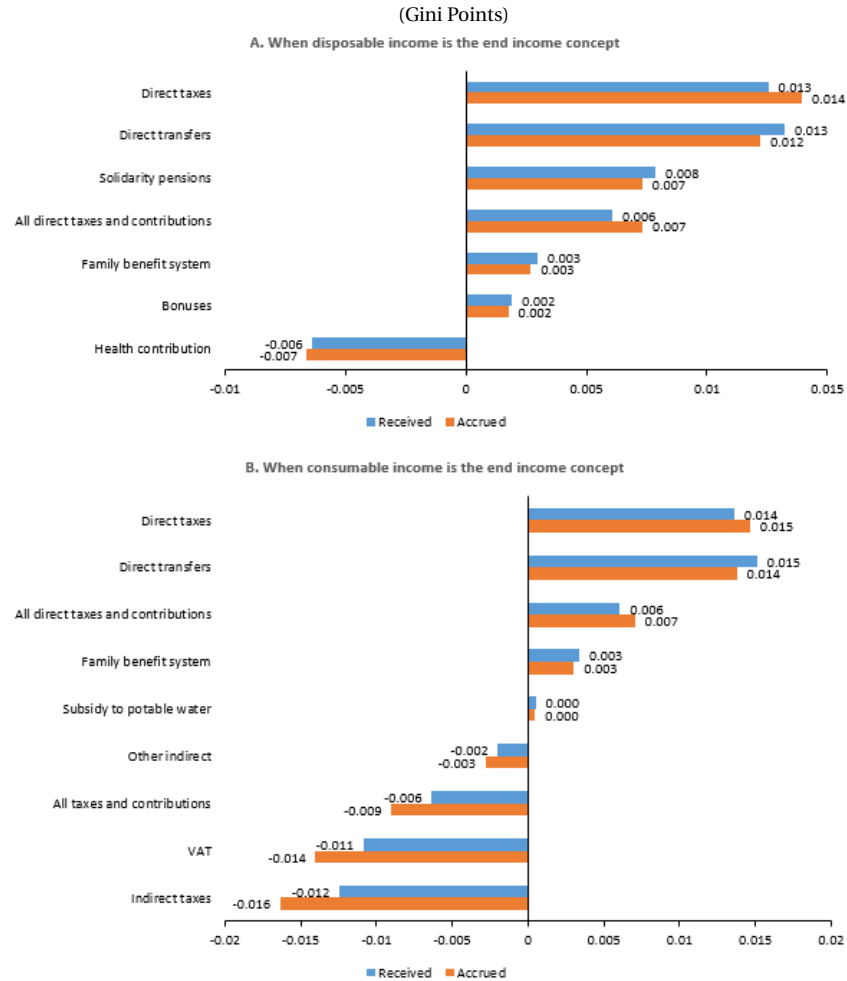
[33]See Engel et al. (1999) and Cantallopts, Jorrat and Sherman (2007).

[34]Enami, Lustig and Aranda (2017) carry out a detailed study of the conditions that taxes and transfers must meet to determine whether they are equalizing, neutral or inequalizing.

[35]Other indirect correspond to the sum of tariffs, jewelry, alcoholic beverages and similar, tobacco, gasoline, diesel oil and luxury goods.

[36]Martínez-Aguilar et al. (2017) find that the Gini coefficient decreases when going from disposable income to consumable income, where the main intervention between both incomes is VAT.

Figure 3: Marginal contribution of fiscal interventions to income inequality

(Gini Points)

A. When disposable income is the end income concept

	Received	Accrued
Direct taxes	0.013	0.014
Direct transfers	0.013	0.012
Solidarity pensions	0.008	0.007
All direct taxes and contributions	0.006	0.007
Family benefit system	0.003	0.003
Bonuses	0.002	0.002
Health contribution	-0.006	-0.007

■ Received ■ Accrued

B. When consumable income is the end income concept

|	Received	Accrued
Direct taxes	0.014	0.015
Direct transfers	0.015	0.014
All direct taxes and contributions	0.006	0.007
Family benefit system	0.003	0.003
Subsidy to potable water	0.000	0.000
Other indirect	-0.002	-0.003
All taxes and contributions	-0.006	-0.009
VAT	-0.011	-0.014
Indirect taxes	-0.012	-0.016

■ Received ■ Accrued

Source: Own elaboration based on CASEN, SII and official government data

In-kind transfers of education and health services have a significant equalizing effect. When passing from the consumable income to final income, the Gini coefficient goes from 0.530 to 0.458 in the received income scenario and from 0.590 to 0.523 in the accrued income scenario. Figure 4 shows the marginal contribution of transfers in kind to income inequality when the final concept of income is final income. The marginal contribution of benefits valued in education and health is 0.040 and 0.029 Gini points respectively for the received income scenario. When disaggregating transfers in education by educational level, it is observed that primary education is the one that reduces inequality in a more significant way. On the other hand, the marginal contribution of tertiary education is close to 0. The intuition behind this result is that the proportion of individuals who attend tertiary education in the lower socio-economic strata is lower.

Transfers in health and education generate a high redistributive effect because private education and health are oriented to high-income households. Indeed, in 2013, 93% of the students attended a public or

Figure 4: Marginal contribution of transfers in kind to income inequality

(Gini Points)
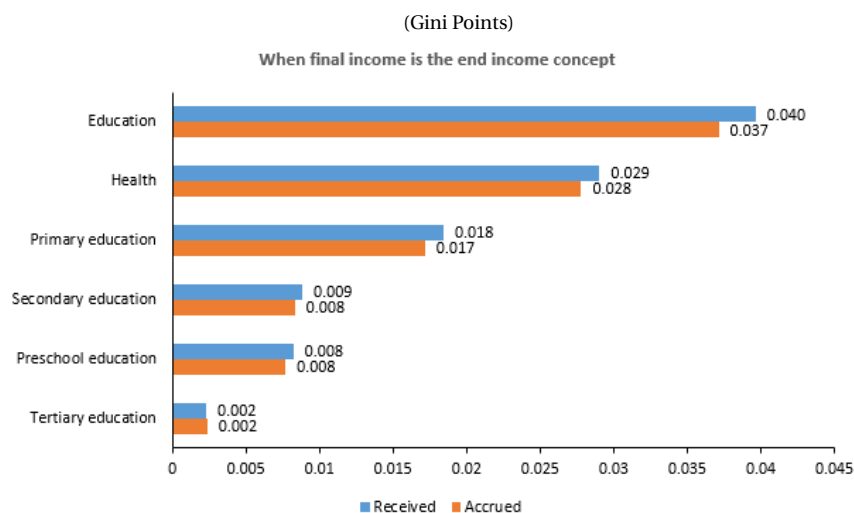
Source:Own preparation based on CASEN, SII and official government data

subsidized educational establishment[37] while about 85% of the population was found within the public health system.

It is important to note that the above results should be viewed with caution, especially the results related to education. When imputing average expenses, services delivered is not corrected for quality, but more importantly, the administration of the educational establishments is carried out by the municipalities, which often divert the resources allocated for education to other activities, so that the effective spending on education should be less than what is observed in budget line items.[38] The same can happen with the holders of subsidized educational establishments.

Fiscal interventions also have an impact on poverty.[39] Figure 5 shows the percentage of the population vulnerable by way of income under the received income scenario.[40] The proposal by Lopez-Calva and Ortiz-Juarez (2014) was used as a vulnerability threshold for middle-income countries, as in the case of Chile.[41] When going from market income to net market income, the percentage of the vulnerable population increases from 15.8 to 17.1%. This increase is explained by the health contributions that dependent workers have to pay more than for the direct taxes they pay, since the payment of this type of taxes is only made by 20% of the higher income individuals

When going from the net market income to the disposable income, the fraction of the vulnerable population falls from 17.1 to 14.3%. This fall is explained by direct transfers, whose main objective is to provide social protection. Finally, when going from disposable income to consumable income, the percentage of the vulnerable population increases by one third, from 14.3 to 20.4%. This increase reflects the

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[37]This percentage does not consider tertiary education.

[38]The Chilean Educational Reform aims to end municipalization with the goal of eliminating this distortion.

[39]For a discussion on the effect of fiscal interventions on poverty, see Higgins and Lustig (2016). This study shows that a significant fraction of the population impoverishes despite the fact that the tax-transfer system is progressive. The intuition is that some individuals receive fewer transfers than they have to pay in taxes.

[40]Results are not shown under accrued income because they are almost identical to the results of received income.

[41]The threshold corresponds to 10 $ USD / day, at constant international prices from 2005.

negative impact of indirect taxes on poverty. The poorest quintile consumes practically all their income, so that a significant fraction of their income corresponds to the payment of indirect taxes.[42]

Figure 5: Effect of fiscal interventions on poverty
(Percentage of vulnerable population, by concept of income)
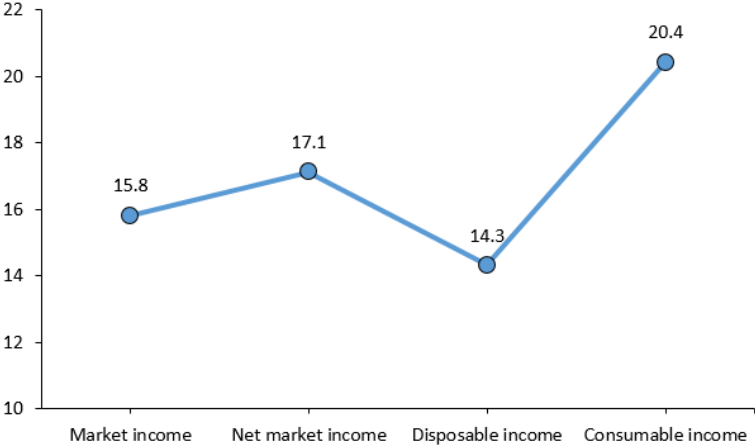
Own elaboration based on CASEN, SII and official government data.

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[42]For a more detailed analysis of the incidence of different fiscal interventions on poverty for Chile see Martínez-Aguilar et al. (2017).

5 Marginal contribution and Shapley value

In the previous section we measured the distributive impact of a series of fiscal interventions (various taxes and transfers) setting the measure of income to be considered in each case (see figures 3 and 4). For example, we saw that, whether we work with received or accrued income, the impact of spending on education on the distribution of final income is approximately 4 percentage points of the Gini.

There is a certain degree of arbitrariness regarding which income should be used for the previous comparisons. For example, for a tax, should pre-intervention income consider market income before or after the remaining taxes? And for a particular transfer, should the pre-intervention income be before or after the remaining transfers? Nor is it obvious that the evaluations of the transfers must take one as initial income after the collection of all taxes. After all, the budgetary logic of governments works simultaneously with expected incomes and expenditure items.

The previous arbitrariness means that the distributive impact of particular fiscal interventions will depend on which of the remaining interventions is included in the income that is used to make the comparison. This motivates consideration of impact measures that average over all possible income options to be considered. In this section we apply the *Shapley value* concept (Shapley, 1953) to calculate this average.[43]

The Shapley value is a concept of game theory that corresponds to the criterion of distribution of income among n players in a competitive game that complies with certain properties (axioms). In our application of the Shapley value, the income to be distributed is the reduction in the Gini coefficient when going from market income to final income and the players are all the interventions under consideration, which include various taxes and transfers.

We assume that the total number of interventions is n and that they are applied sequentially, so that there are $n!$ possible sequences for the order in which resources are collected and spent. Then, to measure the contribution of a particular intervention, we calculate its contribution to the Gini for each of the previous sequences, taking as a measure of income that which results from applying the interventions that appear before the one of interest, and then we calculate the average of these differences. As we shall see below, the difference between the Gini coefficient of final income and the Gini coefficient of market income will be equal to the sum of the individual Shapley values of the interventions considered. Next, we formalize the previous intuition.

5.1 Formalization

Consider a society composed of m individuals indexed by the set $M = \{1, \ldots, m\}$. Within this society, each individual $i \in M$ has a market income M_i and also receives n interventions, indexed by the set $N := \{1, \ldots, n\}$ and summarized in the field $I_i = (I_{1i}, \ldots, I_{ni})$, where the taxes have a negative sign, and transfers a positive sign. Thus, the income of any individual $i \in M$ after applying a set of interventions

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[43]Sastre and Trannoy (2002) are the first to apply the Shapley value to assess the distributive impact of particular interventions on income distribution.

$S \subseteq N$ will be given by

$$Y_i(S) = M_i + \sum_{k \in S} I_{ki}. \tag{1}$$

Given $S \subseteq N$, we assume without loss of generality that $Y_1(S) \leq \ldots \leq Y_m(S) \ \forall S \subseteq N$. Then, the Gini coefficient after the set of interventions S will be

$$G(S) = \frac{2}{m} \frac{\sum_{i \in M} i \, Y_i(S)}{\sum_{j \in M} Y_j(S)} - 1 - \frac{1}{m}. \tag{2}$$

For example, $G(\{1, 2, 3, \ldots, n\})$ is the Gini coefficient once all fiscal interventions have been applied to market income, that is, it is the Gini coefficient of final income and $G(\{1\})$ is the Gini coefficient when only fiscal intervention 1 has been applied to market income. There are many ways to measure the impact of incorporating a fiscal intervention k into the income distribution. For example $G(\{2\}) - G(\{1, 2\})$ or $G(\{2, 3, 4\}) - G(\{1, 2, 3, 4\})$ are two different ways of measuring the impact of the fiscal intervention 1.[44]

The market income is the starting point, then there are $n!$ ways to incorporate each fiscal intervention until reaching the final income. The Shapley value of fiscal intervention k corresponds to the weighted average of all possible ways to measure the impact on the Gini coefficient.

Suppose you want to calculate how many of the possible trajectories does the impact of the reduction in the Gini due to the application of fiscal intervention 1 correspond to $G(\{2, 3, 4\}) - (G\{1, 2, 3, 4\})$. In other words, we want to calculate the number of trajectories where fiscal intervention 1 is incorporated, when fiscal interventions 2, 3 and 4 have already been incorporated, and fiscal interventions 5 to n have not. There are 3! ways to order interventions 2, 3 and 4, then fiscal intervention 1 is added, and $[n - (3 + 1)]!$ ways to order the remaining interventions. Therefore the weighting of $G(\{2, 3, 4\}) - (G\{1, 2, 3, 4\})$ corresponds to $3! \times [n - (3 + 1)]!/n!$, since the number of N permutations that $2, 3, 4$ have before 1 and the remaining interventions after 1 is $3!(n - 4)!$.

Given the above, the Shapley value of the fiscal intervention $k \in N$ is defined as

$$\Phi_k = \sum_{S \subseteq N \setminus \{k\}} \frac{\#S!(n - \#S - 1)!}{n!} \{G(S) - G(S \cup \{k\})\}, \tag{3}$$

where $\#S$ denotes the number of elements of S. We also note that the empty set ϕ is a subset of $N \setminus \{k\}$ where $G(\phi)$ corresponds to the Gini coefficient of the market income.

An important result for the Shapley values is that

$$\sum_{k=1}^{n} \Phi_k = G(N) - G(\phi). \tag{4}$$

That is, the sum of the Shapley value of all the interventions is equal to the difference between the Gini coefficient of final income and the Gini coefficient of market income, of which this difference mea-

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[44]We subtract the Gini with the interest intervention to the Gini without the intervention so that improvements in the Gini are associated with positive values.

sures the total redistributive effect. The percentage contribution of the intervention $i \in N$ will then be

$$\text{Contribution intervention } i = \frac{\Phi_i}{G(N) - G(\phi)} = \frac{\Phi_i}{\sum_{k=1}^{n} \Phi_k}. \tag{5}$$

The application of the Shapley value to measure the redistributive impact assigned to each tax and transfer assumes that there is no particular order in which the different fiscal interventions must be applied and that there is no hierarchy of aggregation of the fiscal interventions.[45] This assumption is reasonable because in practice the different tax interventions are applied simultaneously.

5.2   Application

Table 3 shows the percentage of the Gini reduction attributed to each fiscal intervention calculated from the Shapley value for both income scenarios. Health contributions, VAT and other indirect taxes, on average, increase inequality while direct taxes, subsidies, direct transfers and benefits valued in health and education, on average, reduce inequality.

The percentage of total redistributive effect attributed to direct taxes is 20.1% when considering accrued income and 16.2% when considering received income. Consequently, under the accrued income scenario, direct taxes contribute more to the Gini reduction.

The interventions that contribute the most to reducing the Gini coefficient are transfers (in-kind) in education. These interventions explain, as a whole, approximately half of the Gini reduction (48.9% with received income, 50.9% with accrued income). Primary education accounts for almost half of this contribution, followed by preschool and secondary education, each accounting for around 10%. Expenditure on tertiary education, on the other hand, contributes very little to improving the Gini, for the reasons already explained in section 2.

It is interesting to visualize the distribution of all the marginal contributions for each one of the interventions, that is, the distributions whose averages we report in table 3. This is what is done in figure 6 for received income and in figure 7 for accrued income. For each intervention, the smallest and largest marginal contribution is indicated as a percentage of the total redistributive effect and the histogram is plotted with the relative frequencies.[46] The red line corresponds to the Shapley value. The marginal contribution ranges are particularly large for VAT (12.3%), health (11.9%) and primary education (8.1%). By contrast, direct taxes always have a positive marginal contribution, that is, they always contribute to reducing inequality, and their variance is much smaller.

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[45]In the case of an existing aggregation scheme, the Shapley value must be applied hierarchically, since the "simple" Shapley value does not comply with the principle of independence at the level of aggregation. See Sastre and Trannoy (2002) and Shorrocks (2013).

[46]The distance between the highest marginal contribution and the lowest marginal contribution was divided into 20 equal tranches and the fraction was calculated for all possible orders where the marginal contribution is within each tranche.

Table 4: Percentage of decrease in Gini coefficient attributed to each fiscal intervention

Fiscal intervention	Received	Accrued
Bonuses	2.3	2.4
Direct taxes	16.2	20.1
Adult education	0.3	0.3
Preschool education	10.5	10.9
Primary education	22.8	23.5
Secondary education	11.2	11.7
Special education	0.9	0.9
Tertiary education	3.2	3.6
Family benefit system	3.5	3.5
Health	35.6	37.7
Health contribution	-6.9	-8.2
Other indirect	-1.4	-2.7
Potable water	0.5	0.6
Reparation pensions	0.6	0.6
Solidarity pensions	10.0	10.4
VAT	-9.3	-15.1

*Own preparation based on CASEN, SII and official government data.

Next, we will see what the magnitude and sign of the marginal contribution of a particular intervention depends on. From equation (7) in Lambert (1985) the change in the Gini coefficient of applying a tax to a "Pre" distribution corresponds to

$$G^{\text{Pre}} - G^{\text{Post}} = [t/(1-t)](C^{\text{Tax}} - G^{\text{Pre}}), \tag{6}$$

where G^{Pre} is the Gini coefficient before applying the intervention, G^{Post} is the Gini coefficient after applying the intervention, C^{Tax} is the concentration coefficient of the tax and t is the fraction of the total income (prior to the intervention) paid in the tax. On the other hand, the change in the Gini coefficient of applying a transfer to a "Pre" distribution corresponds to

$$G^{\text{Pre}} - G^{\text{Post}} = [e/(1+e)](G^{\text{Pre}} - C^{\text{Trans}}), \tag{7}$$

where C^{Trans} is the concentration coefficient of the transfer and e is the fraction of the total income (prior to the intervention) received in the transfer.[47][48] The expressions above show that the magnitude of the marginal contribution depends on the fraction of the total income represented by the intervention and its progressivity index. On the other hand, the marginal contribution being inequalizing, equalizing or neutral with respect to the "Pre" distribution, only depends on whether the intervention is regressive,

[47]Note that $C^{\text{Tax}} - G^{\text{Pre}}$ corresponds to the Kakwani progressivity index of the tax with respect to the income distribution before applying the tax and $G^{\text{Pre}} - C^{\text{Trans}}$ corresponds to the Kakwani progressivity index of the transfer with respect to the distribution of the tax income before applying the transfer.

[48]When using concentration curves, we ignore the possibility of changes in the ranking of individuals when applying a tax or a transfer.

progressive or neutral with respect to the reference distribution, not the intervention burden.[49][50]

The greater the progressivity of the intervention with respect to the "Pre" distribution, the greater its marginal contribution will tend to be.[51] If the intervention is progressive, a greater burden of the intervention will tend to increase its marginal contribution, while if the intervention is regressive, a greater burden of the intervention will tend to decrease its marginal contribution.[52]

If an intervention is progressive with respect to all the reference distributions, the marginal contribution will tend to be greater the more progressive the intervention is, and the greater the burden of the intervention on the reference distribution. On the other hand, if an intervention is regressive with respect to all reference distributions, the marginal contribution will tend to be greater, while the intervention is less regressive and the intervention's burden on the reference distribution is smaller.

It could be that an intervention is progressive for some reference distributions, while it is not for others. The marginal contribution will tend to be higher the greater the burden is and the more progressive the intervention with respect to the reference distribution, while the marginal contribution will tend to be lower the greater the burden is and the more regressive the intervention with respect to the reference distribution.[53]

To visualize the above, let's take health spending as an example of transfer, and VAT as an example of tax in the accrued income scenario. Health spending is always progressive, whereas VAT is always regressive. As table 5 shows, the largest marginal contribution of health expenditure is 44.1% and the lowest marginal contribution is 32.7% of the reduction in the Gini coefficient. The largest marginal contribution of health expenditure is obtained when all taxes on market income have been applied. In this case, the fraction that represents health expenditure over total income is the maximum possible. In addition, the application of VAT, health contributions and other indirect taxes contribute to increasing inequality, increasing the progressivity of health spending (higher G^{Pre}). On the other hand, the lowest marginal contribution of health expenditure is obtained once the rest of the transfers have been applied to market income. The fraction that represents health expenditure over total income is the minimum possible

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[49] C^{Tax} and C^{Trans} depend only on the distribution of the intervention, so they are independent of the order of application of the intervention.

[50] The mean of the correlation between the intervention burden (t or e) and the Gini coefficient of the reference distribution (G^{Pre}) for the 16 fiscal interventions is 0.539 (standard deviation of 0.071). The moderate positive correlation between the charge and the Gini coefficient of the reference distribution is explained because, in the case of Chile, the transfers are progressive, so that when applied, the Gini coefficient decreases, and as total income increases, the burden of the intervention decreases. On the other hand, taxes are regressive, so when applied, the Gini coefficient increases and, as total income decreases, the burden of the intervention also increases. The only exception is direct taxes, which are progressive. This also explains why the correlation between the burden and the Gini coefficient of the reference distribution for direct taxes is the highest among the 16 fiscal interventions (0.793).

[51] A tax will be more progressive with respect to the reference distribution while the lower is G^{Pre}. On the other hand, a transfer will be more progressive with respect to the reference distribution while the greater is G^{Pre}.

[52] In our convention, the largest marginal contribution of an intervention is obtained when the improvement in the distribution of income is the greatest, that is, when $G^{\text{Pre}} - G^{\text{Post}}$ is at the maximum. Note that for the case of an intervention that is regressive with respect to all reference distributions, the largest marginal contribution is obtained when the distribution of income worsens the least.

[53] The 16 interventions analyzed in this study comply with being progressive or regressive with respect to all reference distributions. This can be seen in the histograms of figures 6 and 7, where there is no intervention where the histogram passes through 0. For example, direct taxes are progressive for all reference distributions, whereas VAT is regressive for all distributions of reference.

once all transfers have been applied to market income. In addition, transfers help to reduce inequality, reducing the progressivity of health spending (lower G^{Pre}).

As table 5 shows, the largest marginal contribution of VAT is -9.6% and the lowest marginal contribution of VAT is -21.5% of the reduction in the Gini coefficient. The largest marginal contribution of VAT is obtained when all transfers and direct taxes on market income have been applied. When applying transfers and direct taxes on market income, the VAT regressivity is the minimum possible. On the other hand, the VAT burden is lower once the transfers have been added to the market income since the total income increases. On the other hand, the lowest marginal contribution of VAT is obtained once health contributions and other indirect taxes have been applied to market income. The intuition is that both health contributions and other indirect taxes are regressive, so G^{Pre} increases and consequently increases the regressivity of VAT when applied to market income. On the other hand, since health contributions and other indirect taxes generate a decrease in total income once they are applied to market income, the VAT burden is higher on this distribution.

Table 5: Maximum and Minimum Marginal Contribution

Marginal contribution	Charge	Progressivity	$G^{\text{Pre}} - G^{\text{Post}}$	$\frac{G^{\text{Pre}} - G^{\text{Post}}}{G(N) - G(\phi)}$ (%)
Health	$e/(1+e)$	$G^{\text{Pre}} - C^{\text{Trans}}$		
Maximum	0.0461(1)	0.7003(609)	0.0323(1)	44.1
Minimun	0.0374(32768)	0.6411(31453)	0.0239(32768)	32.7
First intervention	0.0397(25536)	0.6893(2956)	0.0273(17813)	37.3
Last intervention	0.0431(7233)	0.6437(30890)	0.0277(15282)	37.8
VAT	$t/(1-t)$	$C^{\text{Tax}} - G^{\text{Pre}}$		
Maximum	0.0733(30369)	-0.0964(1)	-0.0070(1)	-9.6
Minimun	0.0817(2400)	-0.1928(32768)	-0.0157(32768)	-21.5
First intervention	0.0786(10688)	-0.1834(32485)	-0.0144(32107)	-19.7
Last intervention	0.0760(22081)	-0.1023(218)	-0.0077(312)	-10.6

Own preparation based on CASEN, SII and official government data. Note: The figures in parentheses correspond to the ranking occupied by the charge, the progressivity, and the marginal contribution when ordered from highest to lowest, in $2^{15} = 32,768$ possible income distributions to which the intervention can be applied. The first intervention refers to the marginal contribution of the intervention when applied to market income, while the last intervention refers to the marginal contribution of the intervention once the rest of the fiscal interventions have been applied to market income.

A problem with all the previous analysis is that it does not take into account the fact that taxes are what finance social spending, so a good idea would be to calculate the net redistributive effect by type of tax. Table 6 breaks down the improvement in income distribution, measured through the Gini coefficient, in the contribution of direct taxes, health contributions, VAT and other indirect taxes.[54] For the received income scenario, 46.4% of the improvement in the distribution of income is due to VAT, while 35.6% to direct taxes. Although the VAT is a regressive tax, it is assigned a high participation in the reduction of the Gini coefficient, since it generates a high tax collection (54.9%).

For the accrued income scenario, 48.1% of the reduction in the Gini coefficient is due to direct taxes, while 37.9% to the value added tax. The surprising thing about this result is that, although the participation in the tax collection of direct taxes (26.4%) is approximately half of the participation in the tax

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[54]To obtain the decomposition in the reduction of the Gini coefficient between the 4 taxes, the Shapley value was applied, where it was assumed that the share of each tax in social expenditure is proportional to its participation in the collection.
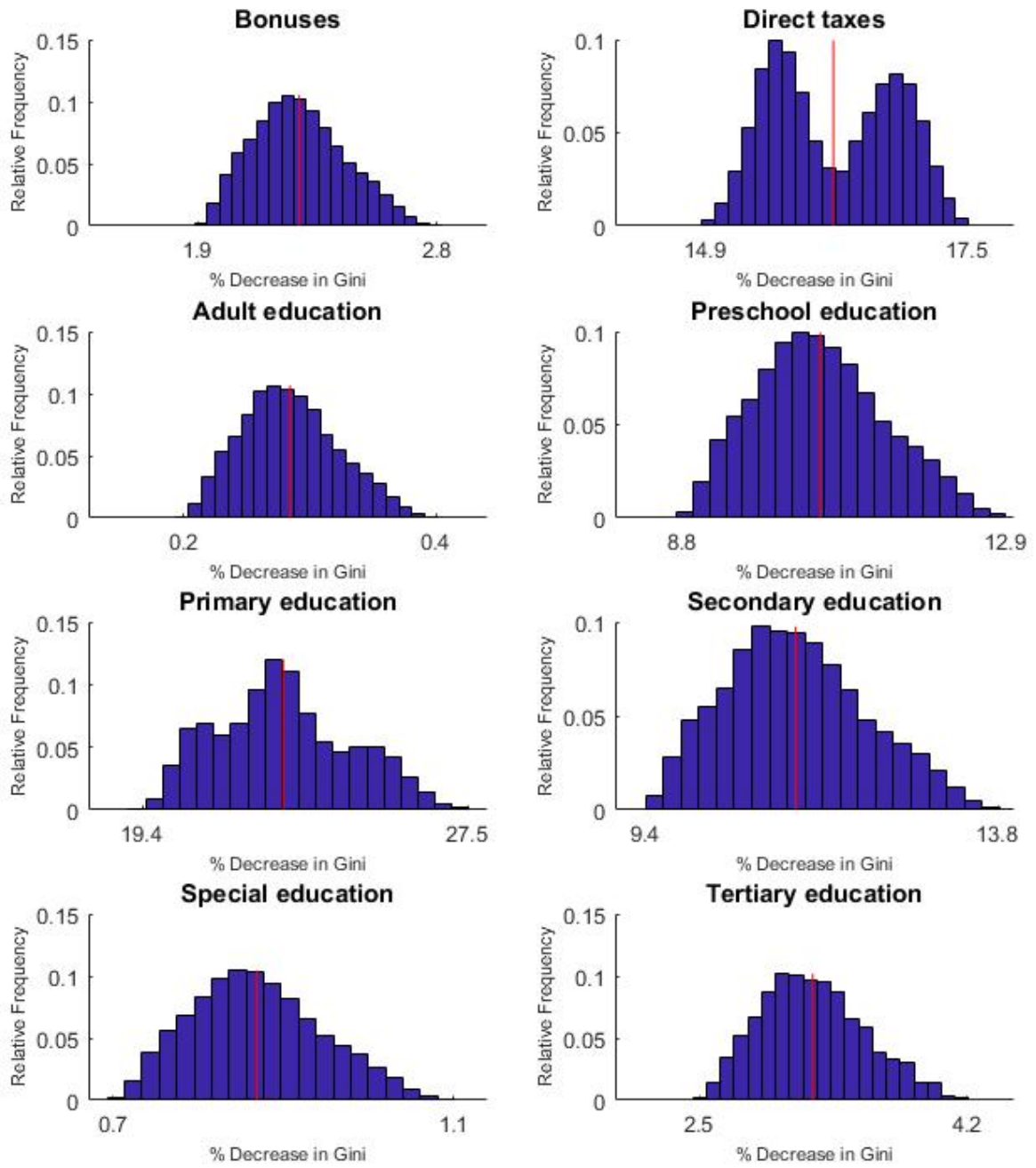
collection of VAT (50%), the net redistributive effect of direct taxes is greater, which reflects the high progressivity of this type of tax.
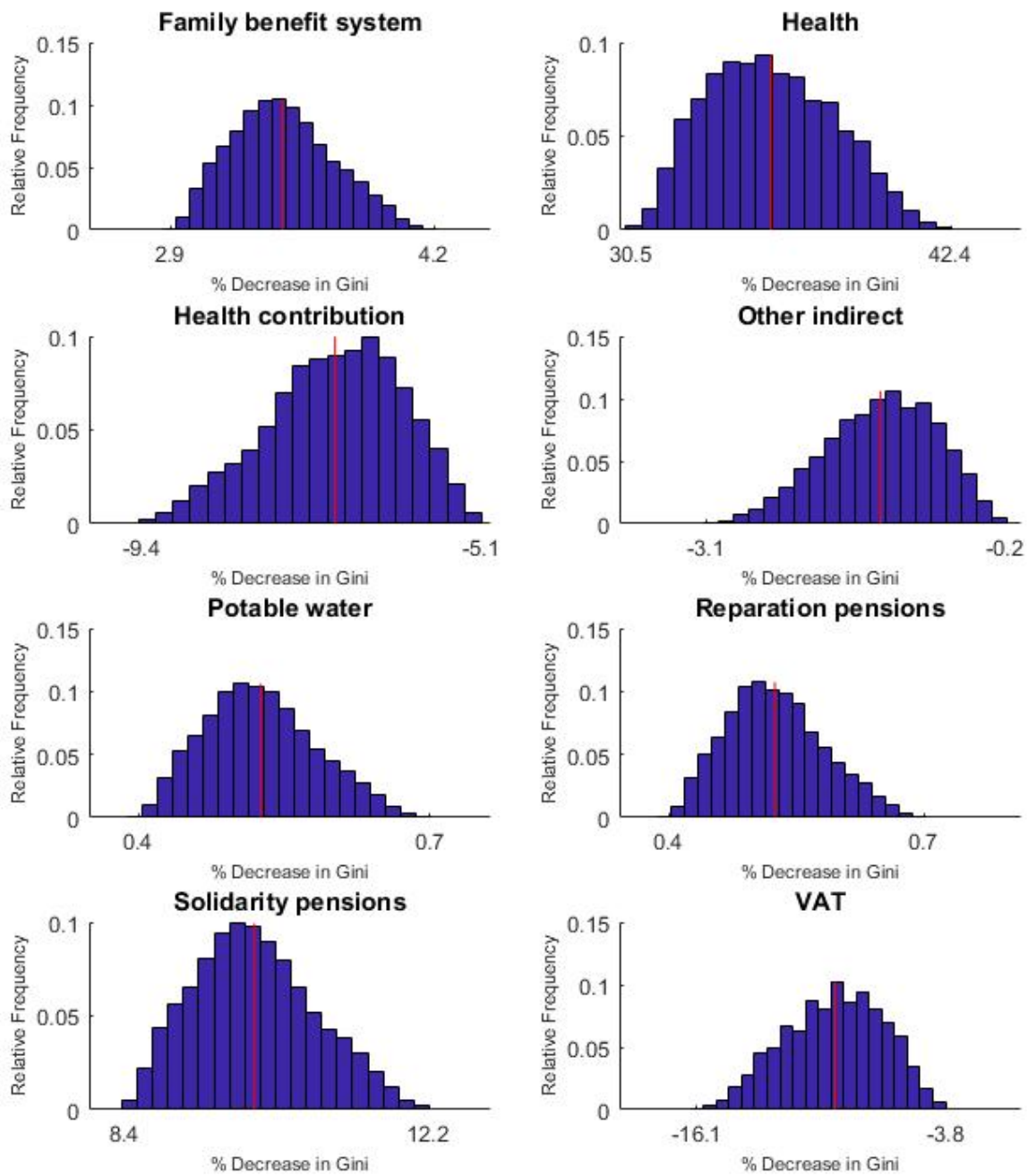
Table 6: Decomposition of decrease in Gini coefficient

	Received		Accrued	
Tax	% of collection	% of change in Gini	% of collection	% of change in Gini
Direct taxes	19.2	35.6	26.4	48.1
Health contribution	13.6	6.9	12.4	4.9
Other indirect	12.4	11.2	11.3	9.2
VAT	54.9	46.4	50.0	37.9
Total	100	100	100	100

*Own preparation based on CASEN, SII and official government data.

Figure 6: Received income

Family benefit system

Health

Health contribution

Other indirect

Potable water

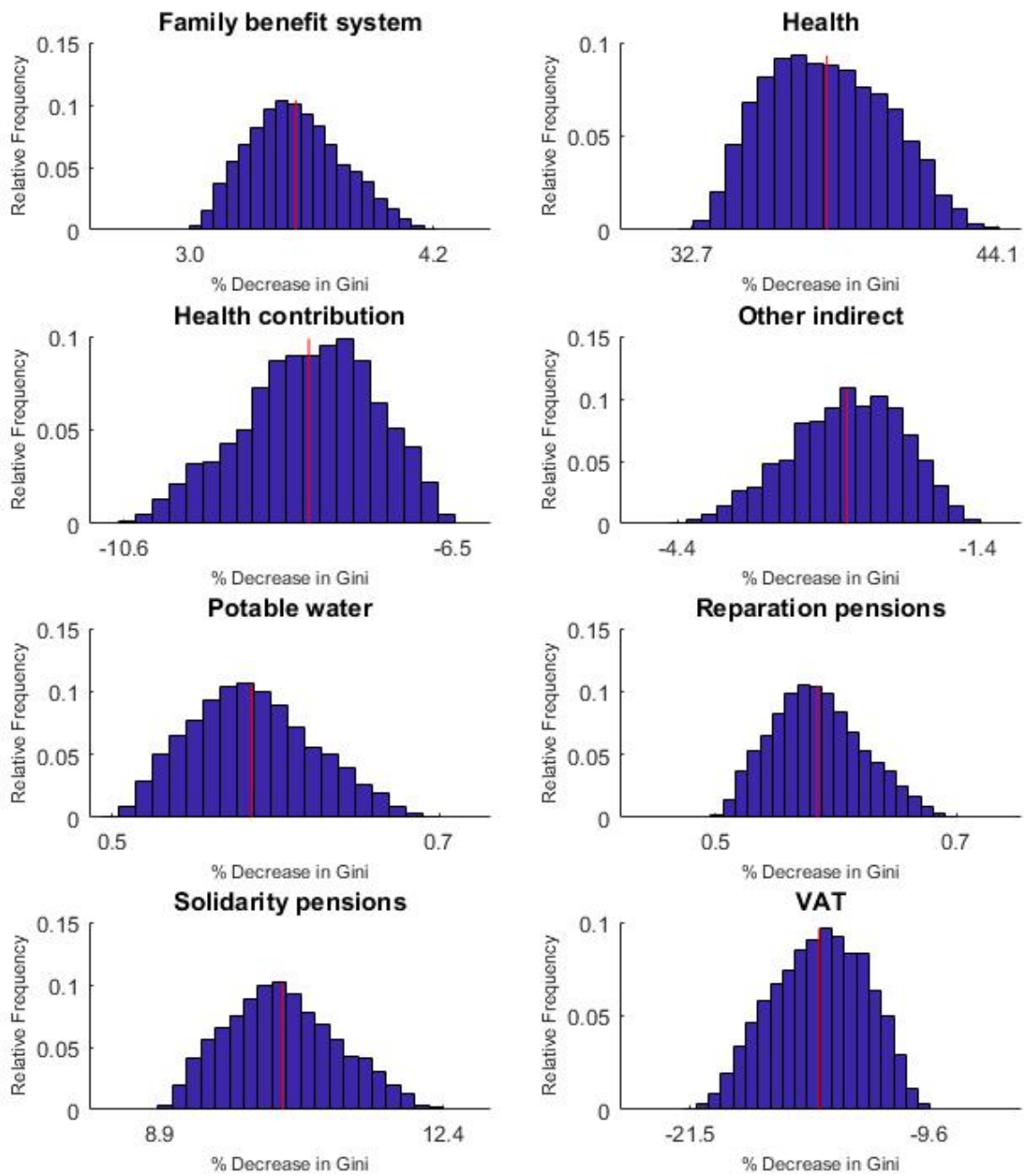Reparation pensions

Solidarity pensions

VAT

Own preparation based on CASEN, SII and official government data.

Figure 7: Accrued income
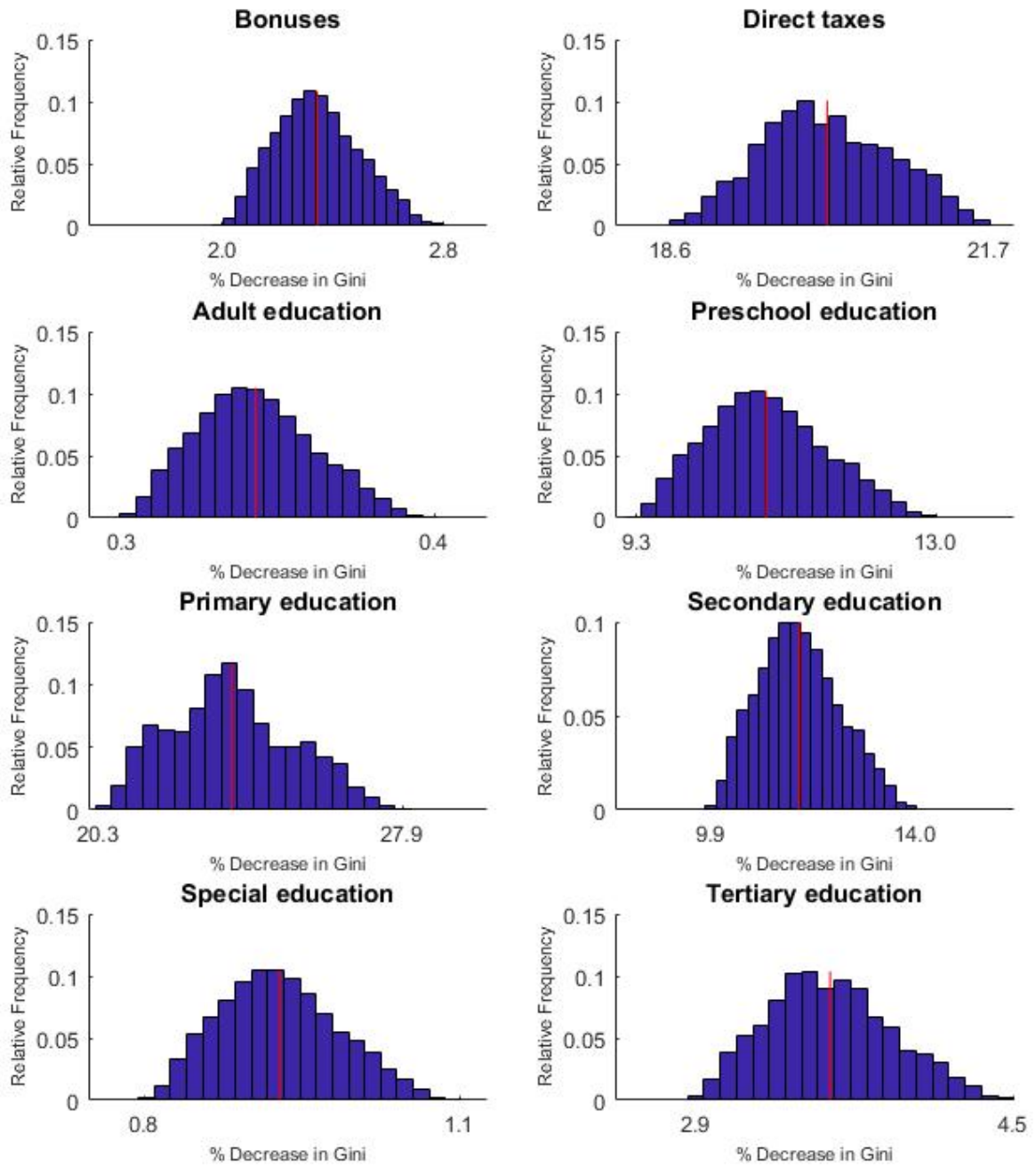
Own preparation based on CASEN, SII and official government data.

6 Distributive Effects of 2014 Tax Reform

In 2014, the Government of President Michelle Bachelet approved Tax Reform that made a series of important changes to income taxation of companies. The Tax Reform had 4 main objectives: 1) Increasing tax collection by 3 GDP points to finance Educational Reform, increase health spending, and reduce the structural balance deficit; 2) advancing tax equity by improving the distribution of income; 3) introducing new and more efficient savings incentives for investment and finally 4) incorporating new measures to combat tax evasion and avoidance.

Within the main modifications implemented by the reform, the most relevant are the profound changes in the Income Tax. Taxation on the profits of companies on an attributed basis, the increase in the First Category Tax rate from 20% to 25% in the integrated system and 27% in the semi-integrated system, the partial integration (and not total) of taxes on individuals and businesses, and the reduction of the higher marginal rate of the Second Category Tax, seeking to build a tax system that deals more neutrally with income from capital and labour. In addition, changes in the tax structure of companies reduce the incentive for the unlimited deferral of the income tax applicable at the time of the distribution of profits. In this way, these changes were intended to improve the neutrality of the system insofar as the previous mechanism disproportionately benefited the income from capital.[55] The implementation of the Tax Reform has been gradual and aims to be completed in 2018.

The objective of this section is to measure the impact of the Tax Reform on distribution of income using the main income concepts of the CEQ methodology. As the reform is still in the process of being implemented, the information from the World Bank micro-simulation model (World Bank, 2016) is used, which estimated what the total direct tax payment should be in 2013 of the taxpayers under the Taxation rules on the Income established by the Tax Reform.[56] To correctly measure the impact of the Tax Reform on the distribution of income, it is necessary to make a comparison based on accrued income, since an important part of the reform was aimed at reducing the gap between accrued and received income from capital. In particular, it is not possible to measure the direct effect of the changes introduced in the First Category Tax under the definition of received income.

The changes introduced in the payment of indirect taxes are of a smaller size, however, they are still included in the analysis. Changes in tax rates for tobacco and alcoholic beverages, non-alcoholic and similar products are considered. Given that one of the main objectives of the Tax Reform is to increase public spending on education and health, it was assumed that the average State expenditure on these services increases in proportion to the expected increase in the budget allocated to education and health.[57] Figure 8 shows the effect of fiscal interventions on income inequality in the Pre-Reform and Post-Reform scenario.

The Gini coefficient of net market income passes from 0.587 to 0.580, which represents a reduction

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[55]The Methodological Appendix contains a detailed comparison of the Pre-Reform and Post-Reform tax system.

[56]This variable was attributed to CASEN individuals using the same method of construction of market income. The detail of the methodology used by the SII can be found in World Bank (2016).

[57]Based on information provided by the Ministry of Finance, 1.5 GDP points would be allocated to education and 0.5 GDP points to health. It is assumed that spending on education of the different educational levels rises in the same proportion. The adjustment factor for transfers in education is 1.43 and the adjustment factor for transfers in health is 1.11.

Figure 8: Effect of fiscal interventions on income inequality
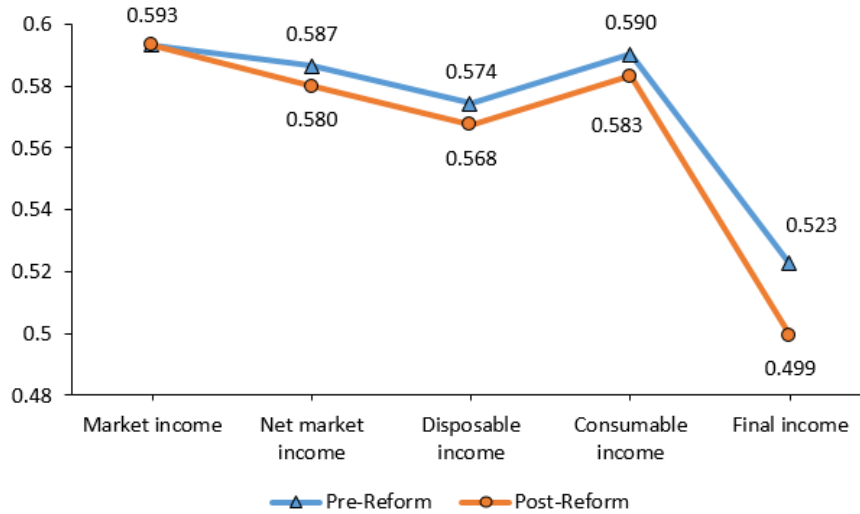
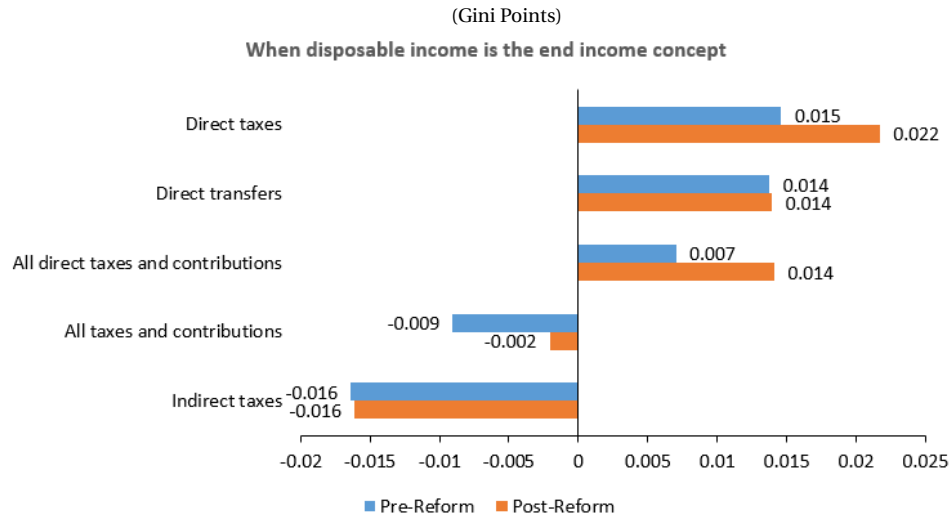Own preparation based on CASEN, SII and official government data.

of 0.007 Gini points.[58] The reduction in the Gini coefficient is modest, but it is explained because the Tax Reform affects mainly high-income individuals, so there is no considerable change in the area between the line of perfect equality and the Lorenz curve. The Kakwani index of the tax system in the Pre-Reform scenario is -0.022 while the Kakwani index of the Post-Reform scenario is 0.033, that is, the tax system stops being slightly regressive to become slightly progressive. By looking independently by type of tax, direct taxes increase their progressivity and indirect taxes remain the same. The main redistributive effect of the Tax Reform can be observed in the final income. The Gini coefficient goes from 0.523 to 0.499, which represents a reduction of 4.6%.

Figure 9 shows the marginal contribution of fiscal interventions in income inequality in the Pre-Reform and Post-Reform scenario when disposable income is the end concept of income. Direct taxes become more equalizing, increasing their marginal contribution from 0.015 to 0.022 Gini points, which represent a percentage increase of 46.6%. When considering the joint effect of all taxes and contributions, the marginal contribution remains negative, but is less unequal than in the Pre-Reform scenario. The marginal contribution of indirect taxes does not change significantly.

Figure 10 shows the marginal contribution of benefits valued in education and health when the end concept of income is final income. The Tax Reform increases the marginal contribution of transfers in education from 0.037 to 0.051 Gini points, which represents an increase of 37.8% and explains approximately two thirds of the Gini improvement going from the distribution of market incomes to the distribution of final incomes. When disaggregated by different educational levels, the marginal contribution of primary education increases by 35.2%, secondary education by 37.5%, and pre-school education by 25%. The marginal contribution of tertiary education remains slightly equalizing. Health transfers in-

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[58]This is exactly the same redistributive effect found in the World Bank study, however, it is not entirely comparable, since in this study the unit of analysis is the per capita income of the household while in the study of the World Bank are the individuals. On the other hand, the method of data crossing between CASEN and SII is different.

Figure 9: Marginal contribution of fiscal interventions to income inequality

(Gini Points)

When disposable income is the end income concept

Own elaboration based on CASEN, SII and official governmental data.

crease their contribution by only 3.5%.

Table 4, which considers accrued income, applies the Shapley values to give a more robust support to the previous conclusions. Column (2) shows the increase of the Gini, from market income to final income, which corresponds to each intervention, as a result of the 2014 Tax Reform.[59] This column can be compared to (1), which includes the contributions of each intervention with the tax structure of 2013. Column (3) reports the difference between (2) and (1) as a fraction of the improvement of the Gini thanks to the tax reform. We see that direct taxes account for almost 30% of the Gini reduction. This reflects that the reform had some success in making the tax structure more progressive. On the other hand, the various interventions in education, which is where spending increased significantly with the resources of the reform, explain 58.3% of the fall of the Gini. Finally, figure 11 shows the marginal contribution of fiscal interventions in the Post-Reform scenario for all possible orders that are considered when calculating the Shapley decomposition.

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[59]It must be remembered that we work with data that simulates the impact of the reform, based on World Bank (2016).

Table 7: Shapley Value (Accrued Income)

| Fiscal intervention	Pre-Reform (1)	Post-Reform (2)	Tax Reform (%) (3)
Bonuses	0.00165	0.00160	-0.2
Direct taxes	0.01410	0.02093	28.5
Adult education	0.00022	0.00030	0.4
Preschool education	0.00761	0.01061	12.5
Primary education	0.01648	0.02298	27.1
Secondary education	0.00817	0.01137	13.4
Special education	0.00062	0.00087	1.0
Tertiary education	0.0025	0.00343	3.9
Family benefit system	0.00247	0.00240	-0.3
Health	0.02637	0.02838	8.4
Health contribution	-0.00577	-0.00547	1.3
Other indirect	-0.00191	-0.00181	0.4
Potable water	0.00039	0.00037	0.0
Reparation pensions	0.00042	0.00040	-0.1
Solidarity pensions	0.00727	0.00707	-0.9
VAT	-0.01057	-0.00945	4.7

*Own preparation based on CASEN, SII and official government data.
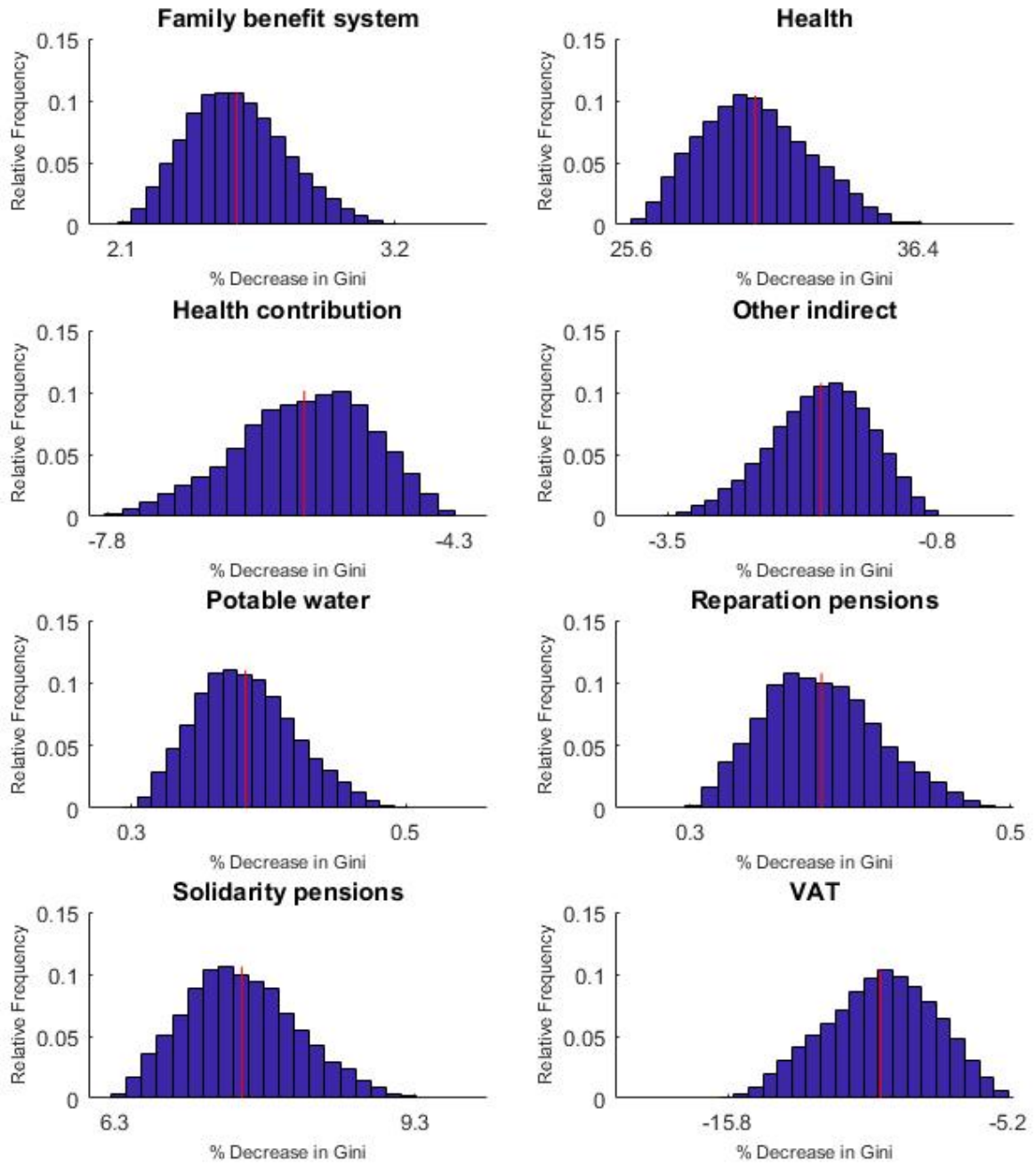
Figure 10: Marginal contribution of transfers in kind to income inequality

((Gini Points))

When final income is the end income concept
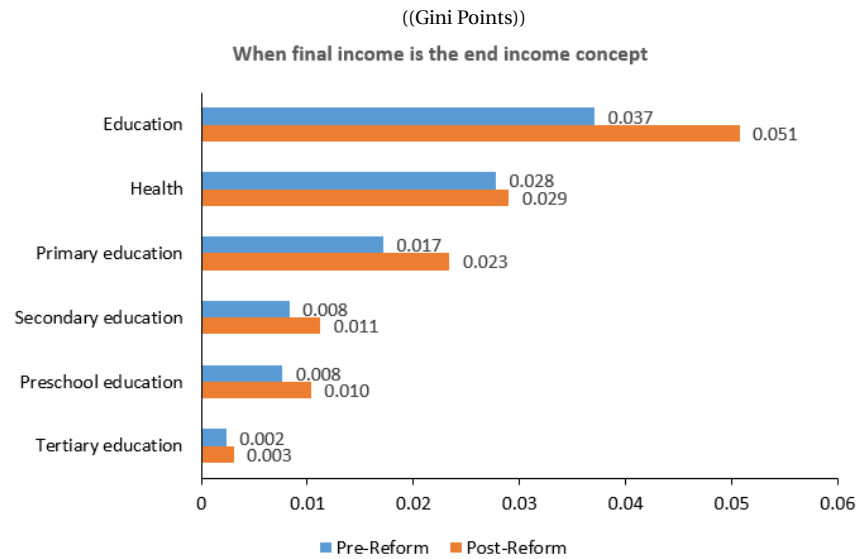
Own elaboration based on CASEN, SII and official government data.

Figure 11: Accrued Income Post-Reform
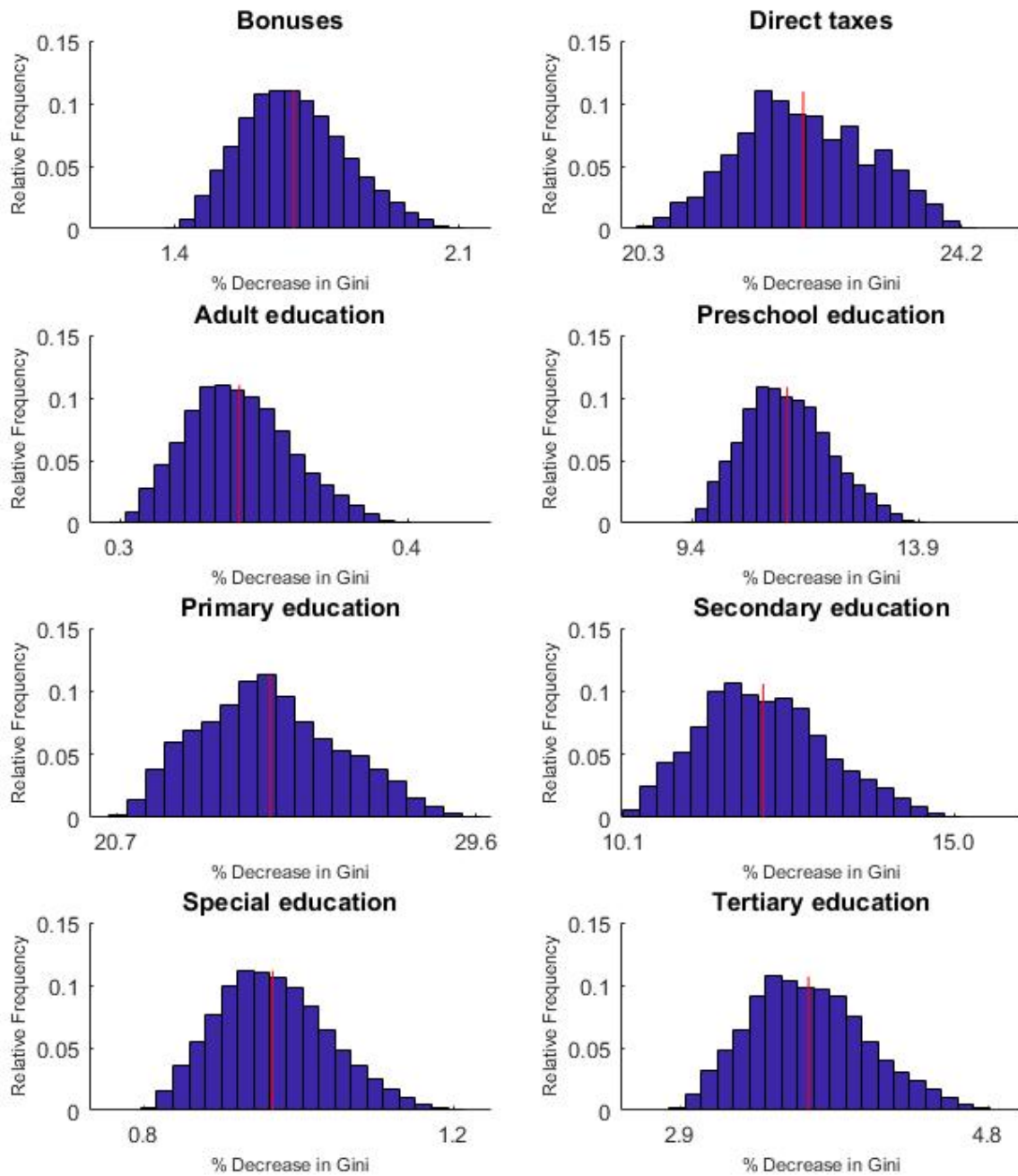
Own elaboration on the basis of CASEN, SII and official government data.

7 Conclusions

To conclude, let's summarize our main findings.

(1) The difference between the distribution of accrued income and received income turns out to be important in Chile. For each of the main concepts of income of the CEQ methodology, the Gini coefficient is higher when working with accrued income, with a fairly stable difference, around 6 Gini percentage points.

(2) Moving from the distribution of market income to the distribution of final income (after taxes and transfers), the income distribution improves by almost 7 Gini percentage points, which reflects the good targeting of social spending in Chile. Under the accrued income scenario, the Gini coefficient falls from 0.593 to 0.523, while for the received income scenario, the Gini coefficient falls from 0.537 to 0.458.

(3) The Shapley value was applied to assign the improvement in the distribution of income among a set of 16 fiscal interventions. For both definitions of income, approximately half of the improvement is due to transfers in education, followed by transfers in health (around 35%). Direct taxes, on the other hand, only explain 20% of the decrease in the Gini coefficient. The ability to improve the distribution of income through a progressive tax, as is the case of direct taxes in Chile, is limited and will be lower the more unequal the market distribution.

(4) The Chilean tax system is slightly regressive. Direct taxes are highly progressive and represent a smaller fraction of collection while indirect taxes are regressive and represent a larger fraction of collection. Considering the net redistributive impact by type of tax, 46.4% of the improvement in the distribution of income is due to VAT and 35.6% to direct taxes in the scenario of received income. However, under the accrued income scenario, which considers the tax paid by the companies, 48.1% of the reduction in the Gini coefficient is due to direct taxes, while 37.9% to the value added tax.

(5) Based on the simulation of the impact of the 2014 World Bank tax reform (World Bank, 2016), it was estimated that the reform would lead to an additional reduction of 2.4 Gini percentage points when going from market income to final income. When using the Shapley value to distribute this additional improvement among the 16 fiscal interventions considered, it is concluded that two thirds is explained by the higher spending on education that is financed by the reform. Direct taxes account for almost 30% of the Gini reduction, which suggests that the reform would have some success in making the tax structure more progressive.

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