3 A microsimulation model of distribution for Chile[1]

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1. Introduction

Microsimulation models have become increasingly important tools for the preliminary assessment of public policies. Although they are still relatively uncommon in Latin America, a good number of those models have been developed over the years for the industrialized countries, such as EUROMOD for the European Union, CBOLT for the US, and NATSEM for Australia (see, e. g., Absalón and Urzúa, 2011). According to Bourguignon and Spadaro (2006), the main strengths of these models are the use of the heterogeneousness of the databases in contrast to the models of representative agents, as well as the possibility of obtaining results on the economic level by aggregating individual results.

In this chapter we present a microsimulation model that has been developed for Chile with the explicit purpose of determining the distributive impacts of changes in tax policy and social spending. It is a free-access model, meaning that it can be used by all those interested in public policy issues. Along these lines, the model has a user-friendly interface that facilitates its use on the part of interested parties.

Our model is an instrument for analyzing public policy, inasmuch as it can assess in advance the effects that reforms and public policies will have on the population's welfare, the income distribution and poverty indicators. It is an arithmetic type of instrument; that is, it does not contemplate variations in the agents' behavior in response to policy changes. This, which could be considered a limitation, has the advantage of allowing a broad range of policies to be evaluated, from taxes to

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subsidies or social security, or combinations of the same. Furthermore, as we later show in Chapter 4, it is also possible to use this basic model to create more advanced modalities that contain functions on the reactions of economic agents.[2]

Specifically, the simulation possibilities in our arithmetic model include indirect taxes (the value added tax, as well as specific taxes on tobacco, alcoholic and non-alcoholic beverages, and fuels), the income tax for individuals, and the main monetary transfers that are used to fight poverty; namely, the single family subsidy, the family allowance, the basic solidarity pension, and the *Chile solidario* bonus. It can also simulate the distributive effects of changes in the contributions to the public health and pension system, and of changes in the poverty line.

This article has two central objectives: first, to present the model in terms of its characteristics and the modality of its construction; and second, to undertake an application by evaluating the impact on distribution and poverty of a tax reform that would cut the value added tax (VAT) by one per cent, from 19% to 18%, while keeping a balanced budget with a progressive increase in the personal income tax. The objective of the balanced budget is to focus the analysis on the impact of the tax reform without having to make any changes in the levels of social spending. The purpose of the exercise is to illustrate the model's operation and to demonstrate its potential contribution to the public policy debate by quantifying the expected effects that policies will have on the population's economic welfare. It is shown that the joint effect of the policies analyzed is a tax cut for the population in deciles one through nine, along with a tax increase for households in the top decile.

The chapter is organized in the following way: the model, its scope and characteristics follow this introduction. In particular the database construction process is described, along with the elements to be simulated and the premises used. The third section explains the tax policies to be simulated. The results are subsequently presented in the fourth section, after which the chapter ends with the conclusions.

2. Model

Our microsimulation model is an instrument for estimating the distributive effects prior to public policy changes, especially those related to taxes, pension contributions and monetary transfers.[3] Thus, it is possible to determine which socioeconomic, demographic or geographic groups will be benefited or affected by changes to the aforementioned policy instruments.

In the Chilean model, the distributive impact of changes in direct taxes can be analyzed, specifically the income tax for private individuals, as well as changes in indirect taxes. With regard to the latter, the results refer to households, while when it comes to direct taxes the unit of analysis is the individual. The first result is derived from the traditional assumption that the household is the relevant economic unit in consumption and that household resources are part of a common budget. In contrast, direct taxes affect income at the point where it is generated, and it is therefore natural to refer to them in terms of the individuals who pay them. In Chile there is no different tax treatment in the event that more than one member of a household generates an income. Aside from those tax applications, the model can also be used to analyze the distributive impact of changes in pension contributions, in addition to the monetary transfers provided by the state, among which family benefits and welfare pensions stand out.

2.1. Characteristics of the model

The microsimulation model is arithmetic in nature and partially balanced. That is, it does not contemplate behavioral changes in individuals in the face of public policy changes, nor does it consider dynamic effects as a consequence of the changes analyzed. However, the base model can be expanded to consider the aforementioned aspects of behavior and dynamics. It was developed based on the Stata statistics software, which is widely used in the country and provides sufficient calculation power to be able to work with large samples. The model uses the total sample of the 2009 national survey Casen (known as *Encuesta de Caracterización Socioeconómica Nacional*), which is made of close to 247,000 people or 71,000 households. Its access to a wide public is facilitated by an interface that consists in dialogue boxes that specify the policies to be simulated and can provide results in a swift and simple way.

Regarding our microsimulation model, Figure 1 shows the dialogue box that allows one to generate the scenarios that are to be simulated. It contains all of the simulation possibilities and the reference values of the base scenario in view, in addition to allowing one to obtain help from a description of each variable and its simulation possibilities by clicking on the question mark in the lower left corner.

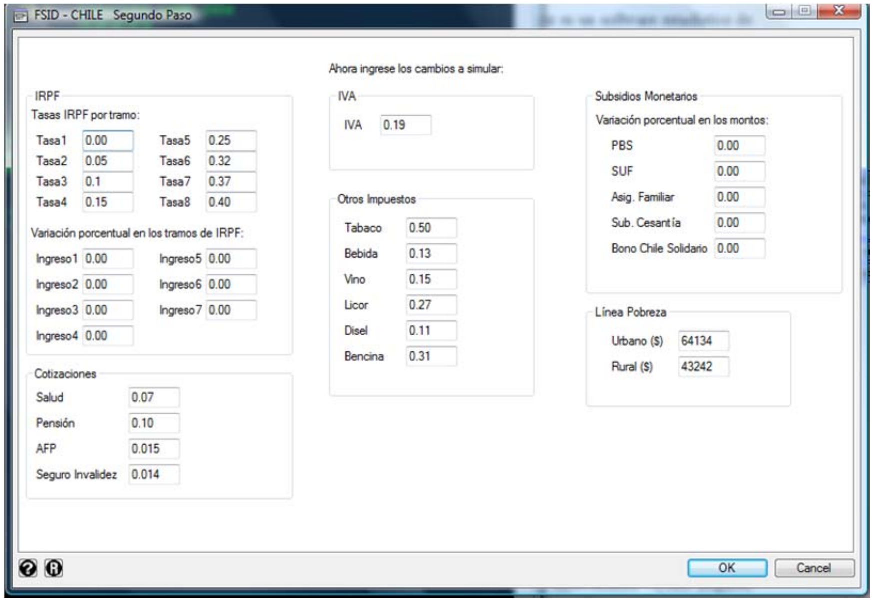

Figure 1. *Dialogue box of the microsimulation model*

2.2. Databases

As said before, the microsimulation model is built on the database of households contained in the 2009 Casen survey, the main socioeconomic characterization survey in the country. The survey is held every three years and is used for the effects of assessing, analyzing and evaluating social policy, poverty indicators and income distribution, among others. It provides information through seven modules: socio-demographic information, education, health, housing, income, occupation and others.

The Casen's coverage is national and is representative at a regional level, and also at the urban and rural levels. The sample is stratified by conglomerates and the reference period of the incomes declared is monthly; specifically, incomes from the month prior to the one when the survey was taken (November). In 2009, 71,460 households were interviewed, equivalent to 246,924 individuals and representative of the 4,685,490 households and 16,607,007 people nationwide, respectively.

The Casen survey contains the base information required to simulate the impact of changes in indirect taxes, pension contributions and monetary transfers. However, it does not contain the information on consumer spending needed to analyze the effect of changes in indirect taxes. For that end the information provided by the Family Budget Survey (EPF) 2006-2007 is used. The purpose of this survey is to measure consumer spending in private households, and its traditional use has been the derivation of the weighting factors for the consumer price index. It is undertaken every ten years and covers a sample of 10,092 households that are nationally representative. The EPF asks about acquired consumption expenditures. That is, the goods and services acquired in the reference period are accounted for, regardless of whether the money is disbursed at a later time or in installments (all prices are referenced to April 2007). The microsimulation model requires transferring information on consumer spending from the EPF to the Casen survey to engage in an integrated and consistent analysis of public policies. This is done via an imputation process using the hot-deck method, which is described in the following section.

2.3. Imputation process

The hot-deck imputation process consists in transferring information on a level of subgroups or "cells" of households defined in variables that both databases have in common, after correcting for inflation so that the amounts are expressed in the same nominal terms. Specifically, households are considered grouped into percentiles of income per capita in each household. Other specifications were tried (combinations of variables) to obtain subgroups, but the best imputation is achieved when the subgroups consist in the aforementioned percentiles.

The procedure consists in assigning each subgroup in the Casen to the amounts spent on consumption by the same subgroup in the family budgets survey. This procedure is based on the assumption that within each group or cell the distribution of the variable is similar in both surveys. In this way, if the unavailable data is random, the process will result in unbiased estimators of the measure. Thus, the process begins by randomly assigning values from the EFP database to the Casen. A given piece of data in each percentile of the Casen is duplicated in the same percentile in the EPF. This number is randomly selected from within the group and assigned to its counterpart with the missing observation. This can be done several times to increase consistency and in general between two and ten repetitions are used. In our case, five repetitions were done since the process makes intensive use of computer resources.

The hot-deck procedure ensures that the variables being imputed have the same average level of sampling observations. However, there is a need to guarantee the equivalence of the variables on a population level, for which the imputation process needs to be undertaken with the variables multiplied by the expansion factors of the respective surveys. Furthermore, the imputation was undertaken on a household level, as that is the most disaggregated unit in the EPF survey.

Table 1 contains the descriptive statistics of spending in the survey of origin, the EPF, while the final result of the imputation is presented in Table 2 with descriptive statistics on the spending imputed in Casen. The imputation was undertaken on eight variables corresponding to expenditures associated with the seven indirect taxes to be simulated, plus the spending that is exempt of VAT, identified as "Exempt" in the tables below. Each category identifies the levels of spending.

A comparison of both tables shows that the two surveys are not the same in terms of expanded sample. The EPF represents close to 2.6 million households, while the Casen represents the existing 4.6 million. This difference is due to the fact that the EPF only covers regional capitals and their metropolitan areas. The hot-deck imputation shows positive results when one compares the spending averages in the EPF with what is imputed in the Casen. However, the variance of the imputations is less than what was observed in the EPF.

There should not be any effects from the reduced variance in spending, as the effect is produced in both directions. That is, for income in any given centile, a lower variance will have similar and inverse effects in both directions on the income distribution within the centile.

Table 1. *Descriptive statistics of variables in EPF (by household)*

Variable	Obs.	Obs. expand.	Avg.	Std. dev.
Exempt goods & services	10,088	2,649,429	78,207	179,265
Beverages	10,088	2,649,429	10,367	10,604
Wine	10,088	2,649,429	2,195	6,890
Liquor	10,088	2,649,429	4,715	11,001
Tobacco	10,088	2,649,429	6,151	12,076
VAT	10,088	2,649,429	452,913	562,654
Buses	10,088	2,649,429	15,841	23,503
Public transportation	10,088	2,649,429	7,443	15,747
Gasoline	10,088	2,649,429	6,957	26,912

Source: EPF 2006–2007.

Table 2. *Descriptive statistics of variables imputed in Casen (by household)*

Variable	Obs.	Obs. expand.	Media	Std. dev.
Exempt goods & services	71,460	4,685,490	80,998	62,622
Beverages	71,460	4,685,490	10,412	2,075
Wine	71,460	4,685,490	2,245	1,616
Liquor	71,460	4,685,490	4,853	2,627
Tobacco	71,460	4,685,490	6,169	1,628
VAT	71,460	4,685,490	472,038	387,039
Buses	71,460	4,685,490	15,985	4,587
Public transportation	71,460	4,685,490	7,692	2,771
Gasoline	71,460	4,685,490	7,331	9,805

Source: Casen 2009, EPF 2006–2007, and own estimations.

2.4. Calibration

Calibration consists in adjusting the spending levels and/or expansion factor reported in the surveys so that the total amounts collected, spending, and the number of taxpayers and beneficiaries can coincide with the administrative data that the respective agencies maintain: the internal tax service, social program administrators, etc. Discrepancies can originate in problems with the representativeness of the surveys, in mistakes made while collecting data (both on the part of the interviewer as well as the interviewees), or, in the case of tax payment, in evasion practices that make effective collection differ from the amounts forecast in the model. The calibration assumes that the totals reported in the administrative data are free of significant errors.

Calibration is done in two sequential steps: adjustment in the number of homes or individuals using expansion factors, and adjustments in the per-capita amounts. For indirect taxes only household level results are available in the poll, while administrative data does not provide information on "households-taxpayers", meaning that this calibration is only undertaken with the spending levels. In the case of subsidies and health coverage payments, the poll contains data on a personal level. The administrative data informs on the number of beneficiaries (or contributors) and the total amounts. Thus, the calibration consists in adjusting the expansion factors and the amounts of the benefits declared (or contributed) per person.

Regarding direct taxes, the administrative records give figures on the number of taxpayers based on total collection. The expansion factors are corrected based on this information. However, in order to correct for the tax amounts paid, a structure of evasion rates by tax bracket is used based on a study by Barra and Jorratt (1999), adjusted to level according to effective collection in 2009.

Table 3 presents the results of the calibrations of indirect taxes, subsidies, health coverage contributions, and income taxes for 2009. The

Table 3. *Results of model calibration*

	Official amounts		Pre-calibration amounts	
	$Millions	N	$Millions	N
VAT	6,999,560	*	5,695,034	*
Tobacco	556,651	*	195,860	*
Special	194,627	*	190,540	*
Fuels	745,457	*	1,032,151	*
Family allocation	98,881	2,130,103	104,486	887,870
PBS	531,735	581,315	571,074	634,527
SUF	129,905	704,968	75,016	904,284
Unemp. subsidy	2,479	217,380	1,369	94,368
Chile solidario	19,380	222,044	4,811	273,732
Health contr.	1,023,350	4,798,769	1,444,887	4,716,564
Income taxes 2009	1,393,699	1,329,397	3,223,368	1,675,241
	Calibration		**Post-calibration amounts**	
	Exp. factor	Factor	$Millions	N
VAT	*	1.229064	6,999,559	*
Tobacco	*	2.842080	556,651	*
Special	*	1.021454	194,627	*
Fuels	*	0.722236	745,457	*
Family allocation	2.399116	0.394461	98,881	2,130,103
PBS	0.916139	1.016346	531,735	581,315
SUF	0.779587	2.221298	129,905	704,968
Unemp. subsidy	2.303535	0.786143	2,479	217,379
Chile solidario	0.811173	4.965693	19,380	222,044
Health contr.	1.017429	0.708187	1,023,250	4,798,768
Income taxes 2009	0.793496	Evasion rate	1,393,102	1,329,297

Source: EPF 2006-2007, Casen 2009, and own estimations.

administrative information, the results prior to calibration, the calibration procedure, and the final results are presented for each variable, in terms of the amount collected and the number of taxpayers or beneficiaries. The calibration allows one to undertake a precise adjustment of the official numbers and the database that was built, as can be observed upon comparing the table's first and last two columns.

2.5. Policies that can be evaluated

The model makes it possible to evaluate the distributive effect that the diverse public policies specified below have.

2.5.1. Direct taxes

The income tax charged to private individuals, also known as the global complementary tax, is an individual and progressive tax. For dependent workers it is withheld from their salaries every month and paid for by their respective employers. In the case of independent workers, they must pay 10% of their wages every month. Then, once a year, all taxpayers must calculate their total tax payment and if the amount to be paid is greater than what they have already paid they must pay for the difference. Should the opposite be the case, then the surplus is refunded to them.

Table 4 shows the structure of this tax and the base scenario on which simulations are carried out, which consists of changes in tax rates and/or the limits of each income bracket.

2.5.2. Indirect taxes

The indirect taxes that can be simulated in the framework of this model are the value added tax and the specific taxes on tobacco, alcohol (wine and liquor), non-alcoholic beverages, gasoline and diesel.

VAT is the main source of tax revenue in Chile. This tax is applied to all the goods and services, with the exception of exports, health services, public transportation, and interest from financial instruments and education. The tax is a flat 19% for all goods and services. The specific tax on tobacco is calculated as 50% of the sales price, after VAT. The tax on wine is 15%, while with other alcoholic beverages is 27%. The tax on non-alcoholic beverages is 13% (plain water is exempt).

The fuels tax is 1.5 UTM per cubic meter for diesel and 6 UTM for gasoline.[4] However, it is not applied directly in the construction of the model, but rather as the proportion of the tax that households spend on

Table 4. *Income brackets and tax rates (2009 pesos)*

Bracket	Lower limit	Upper limit	Deductible	Rate
1	0	497.651	0	0%
2	497.651	1.105.890	24.882	5%
3	1.105.890	1.843.150	80.177	10%
4	1.843.150	2.580.410	172.334	15%
5	2.580.410	3.317.670	430.375	25%
6	3.317.670	4.423.560	662.612	32%
7	4.423.560	5.529.450	883.790	37%
8	5.529.450	And more	1.049.673	40%

public transportation, buses, and while using their automobiles. Thus, the rate that constitutes the base scenario must be built. The proportional gasoline tax that households pay corresponds to the percentage of the final price that is due to the tax, which is calculated at close to 31%. In the case of diesel it is estimated that the specific tax is equivalent to 11% of the price of diesel, which in turn is 26% of bus fares. One can therefore deduce that about 3% of the fare corresponds to taxes. Lastly, to calculate how much of public transportation spending corresponds to the specific tax, the assumption is made that the proportion of fuels tax in the fare is 26% (the same as with the buses). Thus, the proportion of specific fuels tax paid when using public transportation services is 8%.

2.5.3. Transfers

Five monetary transfers are included in this microsimulation model: the basic solidarity pension (PBS), the family allowance, the single family subsidy (SUF), the unemployment subsidy, and the *Chile solidario* bonus.

The PBS is provided to men and women over the age of 65 who do not receive a contributory pension and who are part of the 60% of the population with the lowest socioeconomic levels. In addition to this, a PBS for disability is paid to those considered to have a physical and mental disability and who are between the ages of 18 and 65. The pension amounts to close to US$160 per month.

The family allowance is a benefit paid to salaried workers with low wages. The benefit is equal to US$13 per months and per family dependent for salaried workers who earn less than US$340 per month; it is US$10 for salaries between US$340 and US$580, and US$3 per month per dependent for salaried workers who earn between US$538 and US$912 per month. Higher salaries do not receive the benefit.

The SUF is paid for every minor under the age of 18 in the poorest 40% of households. Those who do not receive the Family Allocation receive this benefit. The benefit is US$8 per month for every minor under the age of 18.

The unemployment subsidy is a cash benefit that dependent workers who have lost their jobs receive. The benefit is provided for a year and the amounts gradually drop.

Finally, the *Chile solidario* bonus is a benefit that is provided to the families who complete the Puente Programme. The benefit is paid monthly for three years and is close to US$12 per month.

2.5.4. Social security contributions

The elements to be simulated with regard to social security are: health coverage contributions, withholding for pension savings, withholding for the disability insurance coverage, and the commission charged by the AFPs (pension fund administrators). These are paid by all taxpayers and discounted every month from their gross income, after which the tax base for income tax payment is calculated. Thus, variations in the withholding rates affect workers' disposable income.

The withholding for coverage by the public health fund (Fonasa) is 7% of income. All salaried workers must make an obligatory health payment and can choose between the aforementioned public health system and private health insurance institutions (Isapre).

Every month workers must deposit 10% of their income in a savings fund for pensions in an individual capitalization system. In addition, together with this savings, 1.4% of earnings are withheld for a disability and premature death policy and 1.5% in commissions for the fund administrators.

2.5.5. Poverty lines

It is possible to undertake simulations with different poverty lines. Urban and rural poverty lines are calculated at $64,134 (US$136) and $43,242 (US$92), respectively. Thus it is possible to alter the basic food basket (CBA) and the factors that are used to calculate the lines by zone. The cost of the CBA in urban areas is $32,067 (US$68.2) and in rural areas it is $24,710 (US$52.6). The basket is multiplied by a factor of 2 in urban areas and 1.75 in rural ones.

2.6. Model assumptions

The model was built while making a series of assumptions for its operation. They are as follows:

- Consumers absorb the totality of the effect that tax changes have on prices.
- Being an arithmetic model, no behavioral changes in the agents are foreseen in response to changes in their budget limitations (due to income or price effects).
- Changes in contributions or in the income tax affect agents' net income. This is a short term assumption, as in the long term workers are expected to ask for salary adjustments to compensate for changes in contributions. This is particularly so in the public health system, where the payment might not be associated with a compensating benefit.

3. Simulation

The VAT is the most important tax in Chile, as it provides close to half of the taxes collected and has low evasion rates, between 8% and 15%, for the period spanning 2002-2008. It is therefore natural to resort to VAT increases when there is a need to increase tax collection. Thus, in 2003 the rate was increased by one percentage point (from 18% to 19%) to compensate the drop in customs income from the signing of free trade agreements with other countries. It was supposed to be a transitory increase, as the new businesses that would be started under the treaties would compensate the reduced customs. More recently, in the aftermath of the February 2010 earthquake, there were proposals to increase the VAT again to raise funds for reconstruction activities.

Notwithstanding its desirable qualities in terms of collection and evasion, the VAT is a regressive tax. The lowest-income households pay a larger proportion of their income in this tax, considering that their average propensity to consumption is higher than that of other groups.

The influential work by Engel, Galetovic and Raddatz (1999) contains one of the first microsimulation models for evaluating the effects of the tax burden on income distribution. The article's main conclusion is that the tax system is in the best of cases neutral from a distributive perspective, but somewhat regressive when considering that social spending (financed with taxes) results in fiscal action that ultimately favors lower income households. They also show that the regressive pattern of the VAT tends to be compensated with income tax, which has a progressive structure.

The simulation exercise done below consists in returning to a VAT of 18%, its pre-2003 level, and to finance the reduced collection with an increase in income tax paid by the taxpayers in the highest income bracket. The exercise keeps the level of social spending constant, as fiscal revenues will not be altered.

The expected effects of the policy being simulated are a lower tax burden for lower income households, together with a greater effect on the part of taxes on the income of more accommodated households, thus reducing after-tax income inequality and lowering the poverty rate. The resulting amounts are less predictable and are provided by the microsimulation model.

4. Results

This section presents the distributive results of a one-point VAT reduction and a compensatory increase in income taxes. The effects of these policies on income distribution and poverty are described separately and then jointly.

4.1. VAT from 19% to 18%

The results show that a one-point VAT reduction causes tax collection to drop by some 6%, equivalent to $424.121 trillion (US$902 million). Total VAT collection in 2009 was $6.999 trillion (US$14,892 billion), but the amount collected for this concept after the tax cut would be close to $6.575 trillion (US$13.99 billion).

Table 5 shows the VAT burden on income, spending, and total taxes paid per household, by per capita income decile. The results in the first column illustrate the VAT's regressive nature. The higher income deciles pay a smaller fraction of their incomes in VAT: the 10th decile pays 14.3% of its income, while the first decile pays close to 19.8%. The second column shows the tax's impact in the simulated scenario. With a VAT of 18%, the impact (tax paid as a percentage of income) drops for all deciles, but to a greater degree in the first ones, as can be seen in the final column. The impact of the VAT drops 1.2 points in the first decile and the effect is diminished for the higher income deciles.

Table 5. *Impact of the VAT on income (% household income paid in taxes)*

Decile	Base scenario	Simulated scenario	Difference
1	19.75	18.56	-1.20
2	19.40	18.23	-1.18
3	19.11	17.95	-1.16
4	18.49	17.37	-1.12
5	18.63	17.50	-1.13
6	18.66	17.53	-1.13
7	17.82	16.74	-1.08
8	17.56	16.50	-1.06
9	17.99	16.90	-1.09
10	14.25	13.39	-0.86

4.2. Income tax increase

The increase in the income tax rates is applied to the highest income taxpayers and the amount collected compensates the cut in the value added tax. The model allows for different tax rate structures to be tested until one that maintains balanced fiscal accounts is found. The structure that is finally chosen maintains the first income tax bracket exempt; the second bracket sees an increase from 5% to 6%; the third from 10% to 12%; the fourth from 15% to 18%; the fifth from 25% to 29%, the sixth from 32 to 37%; the seventh from 37% to 43%; and the final from 40% to 48% (see again Table 4). Under that new tax structure, the income tax that can be collected increases by 31.7%, from $1.393 trillion in 2009 to $1.834 trillion in the simulated scenario. The difference is close to $441.543 billion.

The first column in Table 6 shows the tax impact as a percentage of household income (before taxes). The burden is positive after the fourth decile, fluctuating between 1% in that decile and 7.6% in the 10th decile in the base scenario. The effects of the variation in tax rates, in the third column, show an increase of between one hundredth of a percentage point to 2.4 points.

The following columns in that table show the average per capita income per decile. The fourth and fifth columns correspond to the averages in the base scenario and the simulated one, respectively. The final column shows the percentage variation of income between the two scenarios, which is significant after the seventh decile and has the greatest impact on the 10th decile, where per capita household income falls by 5.1%.

Table 6. *Impact and per capita income by decile (individuals)*

	Impact			Average per capita income		
Dec.	Base scenario	Simulated scenario	Difference (%)	Base scenario	Simulated scenario	Difference (%)
1	0.00	0.00	0.00	27,895	27,895	0.0
2	0.00	0.00	0.00	55,119	55,119	0.0
3	0.00	0.00	0.00	72,862	72,861	0.0
4	0.01	0.01	0.00	90,166	90,162	0.0
5	0.04	0.05	0.01	109,842	109,831	0.0
6	0.08	0.09	0.02	134,594	134,553	0.0
7	0.18	0.22	0.04	168,520	168,397	-0.1
8	0.39	0.48	0.08	220,156	219,785	-0.2
9	0.80	0.98	0.18	320,665	319,513	-0.4
10	7.64	10.00	2.37	920,369	873,669	-5.1

4.3. Joint effects

The model allows combinations of policies to be evaluated and provides results on a household level. The results of the proposed tax policy are presented below.

Total tax collection in the base scenario, considering all of the model's taxes, is close to $9.889 trillion and the amount collected in the simulated scenario is close to $9.899 trillion or a positive difference of $10.069 billion, equivalent to 0.1% of total tax collection. The importance of analyzing the two policies together is reflected in the variation in total collection. The variation in the VAT collection was less than $424.121 billion, while the variation in income tax collection was over 441.563 billion. The difference between the two concepts is over $17.422 billion, greater than the difference obtained. This is due to the fact that a change in the VAT also affects collection of other taxes like tobacco and gasoline.

Table 7 shows the effects in terms of impact on income before tax on a household level. The first column shows the base scenario, the second the simulated one and the third the difference in terms of percentage points. The impact of the total tax burden, both on the base scenario as well as the simulated one, is shown to be greater on the lower income deciles, ranging from 30% in the first one to 21.3% in the 10th. The variation in the impact caused by the simulated policies indicates that it drops until the ninth decile and that the impact is concentrated on the highest-income decile.

Table 7. *Effects in terms of impact on taxable income and its distribution*

	Impact on taxable income			Indirect taxes / Total taxes			Income distribution (percentages)		
De.	Base scen.	Sim. scen.	Dif. (pp)	Base scen.	Sim. scen.	Dif. (pp)	Before taxes	Base scen.	Sim. scen.
1	30.23	28.98	-1.25	100	100	0.00	0.93	0.76	0.78
2	27.50	26.29	-1.21	100	100	0.00	2.12	1.87	1.92
3	26.98	25.79	-1.19	99.99	99.99	0.00	2.92	2.64	2.70
4	24.78	23.64	-1.14	99.94	99.92	-0.02	3.84	3.54	3.62
5	24.71	23.57	-1.14	99.79	99.73	-0.06	4.84	4.54	4.64
6	24.04	22.90	-1.13	99.61	99.50	-0.11	6.07	5.81	5.93
7	22.63	21.58	-1.05	99.05	98.79	-0.26	7.75	7.57	7.71
8	21.83	20.85	-0.98	97.95	97.39	-0.56	10.23	10.23	10.42
9	21.80	20.91	-0.90	95.99	94.90	-1.10	14.89	15.11	15.32
10	21.29	23.03	1.74	63.66	55.59	-8.07	46.40	47.92	46.97

The next three columns in Table 7 illustrate the proportion of taxes that correspond to indirect taxes in the base scenario, the simulation and the difference between them. One can observe that the proportion of indirect taxes is close to 100% until the seventh decile. Only in the 10th is the proportion of direct taxes that are paid significant, which explains why the impact of the income tax increase is greater than the drop in the VAT for this decile. This could be explained by the falling marginal performances in consumption. That is, there is a maximum level of consumption that satisfies people’s needs regardless of the income level. Therefore, if the difference between income and consumption is very great then the income tax will manage to attain greater representativeness in the total amount of taxes that are paid.

The last three columns of Table 7 present the results on income. The seventh column contains the income distribution before the payment of any taxes. The next column shows the current scenario and the final one considers the payment to be made under the simulated tax structure. Upon comparing income distribution between the fourth and fifth columns, one can see the distortion in income distribution that the tax burden generates, where the imposition of a tax system generates greater concentration in the higher-income deciles.

The simulation exercise shows that the tax system is not efficient as a redistributive policy, since even with the significant income tax increases and the reduction of a regressive tax like the VAT, the initial income distribution structure remains without major changes. However, the new taxation structure does generate funds to finance social spending, which can be very effective in redistributive terms.

Upon comparing both tax systems, the base scenario and the simulated one, it can be seen that the latter manages to improve slightly the income distribution profile, although, as it might be expected, the improvement is very slight. One way to analyze this is with certain indicators of inequality, such as the percentage ratios D10/D1 and Q5/Q1, as well as indicators related to the Lorenz curve: the Gini and the Kakwani indexes. The former is more sensitive to income transfers that are close to the average, while Kakwani is more sensitive to transfers on the distribution extremes.

As shown in Table 8, the ratio of deciles D10/D1 in the distribution of before-tax income is 47 times, which increases to 55 in the base scenario tax structure. The income distribution produced by the simulation results in a ratio of D10/D1 is close to 53 times. The change is less pronounced in the ratio of quintiles Q5/Q1, going from 21.9 times in the base scenario to 21.6 times under the simulated scenario. The Gini index is between the ones corresponding to before-taxes and the base scenario, with a value of 0.58. The Gini income distribution index before taxes is 0.57 and the one corresponding to the base scenario is 0.59. Likewise, the Kakwani index shows similar variations.

The findings in Table 8 are complemented by Figure 2, which shows the distance between the Lorenz curve for the base scenario and the simulation in the case of after-tax income. It reveals that the positive effect on distribution is very small and concentrated in approximately the 50th centile. As can be seen from the figure, the only significant negative effects are found in the last percentiles.

Figure 3 shows, on the other hand, the difference between the tax payment concentration curves that arise in both scenarios. It reveals that the concentration of the tax payments drops in the higher percentiles. That is, with the new tax structure the upper deciles end up paying a larger proportion of the taxes.

Table 8. *Inequality indicators*

	D10/D1	Q5/Q1	Gini	Kakwani
Before-tax income	47.1	19.5	0.57	0.27
Base scenario	55.2	21.9	0.59	0.29
Simulated scenario	52.8	21.6	0.58	0.28

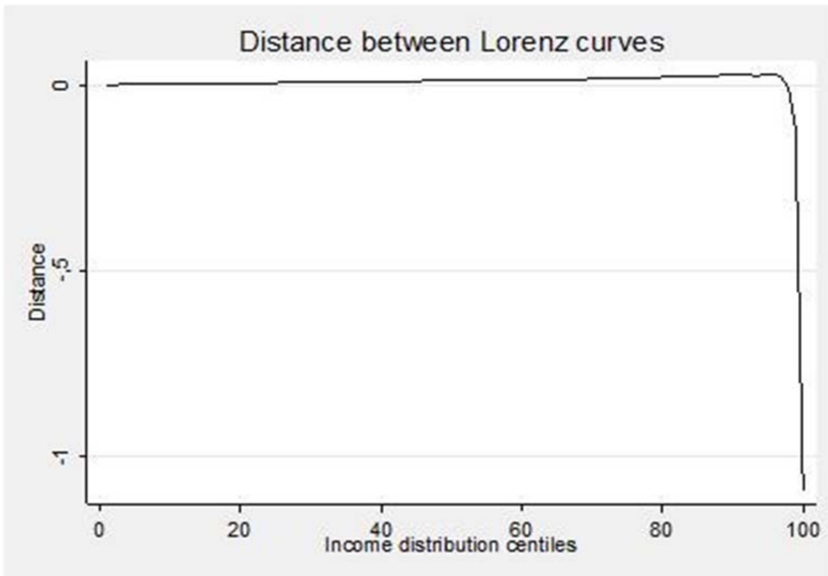

Figure 2. *Distance between Lorenz curves for base and simulated scenarios*

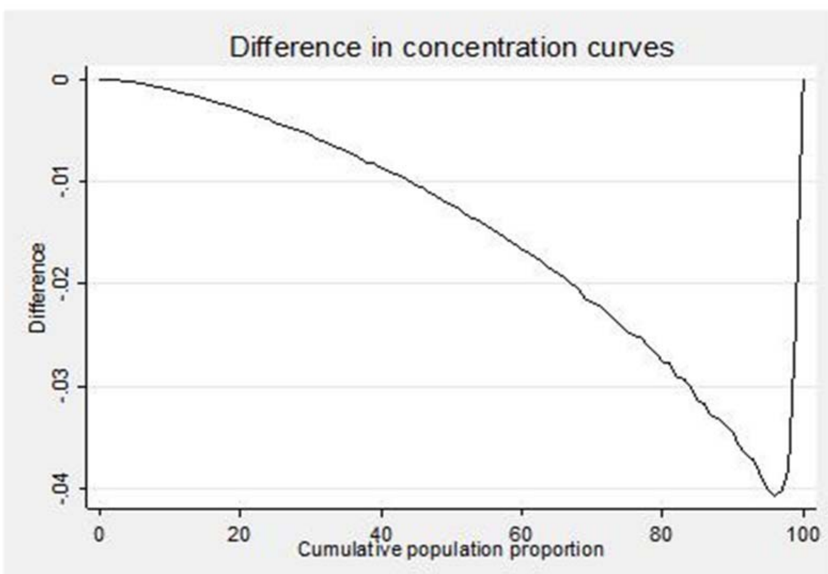

Figure 3. *Difference in tax payment concentration curves*

4.4. Effect on poverty

The one-point reduction in the VAT rate not only has an effect on the impact of taxes, but also on poverty according to the measurement method used in Chile. Since 100% of the goods and services included in the basic food basket are subject to the VAT, a reduction in this tax therefore means that the cost of the basket falls. The urban poverty line is $64,134 (US$136) and that of rural areas is $43,242 (US$92). Cutting the VAT rate from 19% to 18% causes the poverty line to drop by $641 (US$1.4) and $432 (US$0.9), respectively, and poverty levels to fall from 15.1% to 14.8%.

5. Final comment

The objective of this work has been to present a microsimulation model for Chile. The model allows us to study the impacts on income distribution and poverty of a series of public policies that are to be evaluated *ex-ante*, such as changes in income taxes, health and pension contributions, monetary transfers and specific taxes. The ultimate purpose of the model is to serve as a support tool for the design and evaluation of public policies, as can be observed in the practice of developed countries. The model's operation was exemplified simulating the effect of a one-point cut in the VAT rate and a progressive increase in income tax rates while maintaining a balanced budget.

Notes

[1] Document prepared for the project "An Integrated Framework for the Assessment of Equitable, Pro-Growth Fiscal Reform in Latin America and the Caribbean: Fiscal Schemes for Inclusive Development (FSID)", co-funded by UNDP and IDRC. Any errors or opinions are the authors' and do not necessarily represent the views of the United Nations Development Programme or those of the International Development Research Centre.
[2] See also Cabezas and Acero (2011).
[3] A detailed account of the tax-benefit system in Chile is provided in Larrañaga, Cabezas and Encina (2011).
[4] UTM stands for *unidad tributaria mensual* (monthly tax unit), which is an inflation-pegged accounting unit. It was equivalent to US$80.5 as of April 2011, at an exchange rate of $470 per dollar.

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