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Tax-benefit microsimulation and income redistribution in Ecuador

H. Xavier Jara[1] and Marcelo Varela[2]

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Abstract: The aim of this paper is to explore the redistributive effects of taxes and benefits in Ecuador using two different approaches: direct use of reported taxes and benefits in household survey data, and use of simulated taxes and benefits obtained from ECUAMOD, the tax-benefit microsimulation model for Ecuador. Our results show that simulated taxes and social insurance contributions capture better the number of taxpayers and aggregate revenue amounts from official statistics than information taken directly from the data. Moreover, using reported data on taxes and social insurance contributions underestimates their redistributive effect in comparison with simulated policies. We discuss factors behind the differences between the two approaches and conclude with a discussion of the advantages offered by microsimulation for policy analysis.

Keywords: taxes, benefits, microsimulation, Ecuador
JEL classification: I32, I38, H24, D13

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[1] ISER, University of Essex, corresponding author: hxjara@essex.ac.uk; [2] Instituto de Altos Estudios Nacionales

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Since the beginning of the century, and along with the process of dollarization, the tax-benefit system in Ecuador has experienced numerous changes. As part of the reforms introduced in 2008, personal income tax was made more progressive and tax collection became more efficient. The main social assistance benefit in Ecuador, the Human Development Transfer (HDT), has also been made more generous, the monthly payment increasing from US$30 to US$35 in 2009 and then to US$50 since 2013. Over the last decade, a significant decrease in income inequality was also observed, the Gini coefficient falling from 55.1 in 2007 to 46.6 in 2016 (INEC 2016).[1] From a policy perspective, it is important to assess the redistributive role of tax-benefit instruments with the aim of improving their design in order to strengthen social protection in the country.

The present study compares the redistributive effect of taxes and benefits in Ecuador under two different approaches. The first approach involves using reported information on taxes and benefits from survey data. The second relies on microsimulation techniques to calculate tax-benefit instruments. As stressed by Figari et al. (2012), who carry out a similar analysis for selected EU countries, the two approaches are subject to different degrees of error. On the one hand, research using data from developed economies has shown that welfare benefits may be under-reported in household surveys (Lynn et al. 2012; Meyer et al. 2009). On the other hand, microsimulation models might overestimate means-tested benefits if full take-up is assumed (Figari et al. 2012; Figari et al. 2015). Moreover, microsimulations are constrained by the quality of the underlying microdata they use. For instance, household survey data often fail to capture the top of the market income distribution, particularly in developing countries, so that simulated income taxes might underestimate aggregate tax revenue in a country. Figari et al. (2015) provide a formal discussion about reconciling reported and simulated incomes with official macro statistics.

In the case of Ecuador, as in most developing countries, rich household data containing detailed information about taxes and cash transfers are scarce. For this reason, research on the redistributive effect of taxes and benefits in Ecuador remains limited. CEPAL-IEF (2014) use household survey data to study the effect of tax-benefit systems on income inequality in Latin America. Information about cash transfers is taken directly from the data, whereas direct taxes are imputed. According to their results, direct taxes and cash transfers in Ecuador reduce income inequality by 2.8 points, when Gini for disposable income is compared with Gini for market income. Public pensions and cash transfers account for a 2-point reduction in inequality, whereas taxes and social insurance contributions account for 0.8 points. More recently, the Commitment to Equity (CEQ) Institute has studied the incidence of taxes and benefits in Latin American countries under a common methodology.[2] Lustig (2017) presents a comparative assessment of the impact of fiscal policy on inequality and poverty in Latin America. The results for Ecuador are based on the National Survey of Income and Expenditures of Urban and Rural Households (*Encuesta Nacional de Ingresos y Gastos de Hogares Urbanos y Rurales*, ENIGHUR) 2011–12, which provides information about cash transfers, taxes, and social security contributions that is used directly from the data in the analysis (Llerena et al. 2015). According to Lustig (2017), the tax-

[1] Differences between INEC (2016) figures and the results presented in this study are due to the use of different surveys in the analysis. INEC (2016) figures are based on the National Survey of Employment, Underemployment and Unemployment (*Encuesta Nacional de Empleo, Desempleo y Subempleo*).

[2] For more information about CEQ, see www.commitmentoequity.org/.

benefit system in Ecuador reduces income inequality by 3.02 points, when Gini for disposable income is compared with Gini for market income.[3]

Microsimulation models in Ecuador have been developed but limited to the analysis of specific tax components, such as personal income tax, corporate profit tax, and indirect taxes (Ramírez 2010; Ramírez and Carrillo 2012; Ramírez and Oliva 2008; Ramírez et al. 2010). However, an integrated microsimulation model encompassing both tax and benefit policies is needed if the objective is to perform distributional analysis. This paper makes use of ECUAMOD, the newly developed tax-benefit microsimulation model for Ecuador. ECUAMOD combines detailed country policy rules with representative household micro-data from ENIGHUR 2011–12 to simulate cash benefit entitlements, personal income tax and social insurance contribution liabilities, and VAT and excise duties for a number of products, for the policy years 2011–16. Our study takes advantage of the availability of reported data on social benefits, taxes, and social insurance contributions in ENIGHUR to compare their effect on income inequality and poverty with that of simulated tax-benefit components calculated from ECUAMOD.

Our results show that reported social assistance benefits (i.e. the HDT) from ENIGHUR data match very well the number of recipients and aggregate amounts from official sources. However, reported personal income tax provides a very poor representation of the number of taxpayers and aggregate tax revenue relative to tax records. ECUAMOD simulations match better the external statistics on personal income tax, capturing around 80 per cent of income tax revenue, and highlighting the advantages of microsimulation in calculating income components that are difficult to collect in survey data. Our comparison of inequality and poverty indicators calculated from reported ENIGHUR data and simulated ECUAMOD data shows only minor differences between the two approaches, with slightly lower estimates obtained with ECUAMOD simulations. Our results depict, however, a very different picture of the redistributive effect of direct taxes and social insurance contributions depending on the approach used in the analysis. Direct taxes (social insurance contributions) reduce inequality, as measured by the Gini coefficient, by only 0.1 (0.9) points based on ENIGHUR data, whereas the effect is 0.9 (1.5) points based on ECUAMOD simulations. We discuss possible reasons for the observed discrepancies and highlight the advantages offered by ECUAMOD for distributional analysis and ex-ante policy evaluation.

The remainder of this paper is structured as follows. Section 2 presents the household survey data used in the analysis and provides detailed information about our tax-benefit microsimulation model. Section 3 presents and discusses the results of the analysis. Section 4 concludes.

[3] Our results differ from those of Lustig (2017) for several reasons. First, ECUAMOD systematically applies legislation rules to simulate taxes and benefits, as long as the information required for the simulations is available in the data. Lustig (2017) uses taxes and benefits reported directly in the data unless the information is not available, in which case these incomes are inferred, predicted, or imputed from other sources. Second, contrary to Lustig (2017), our definition of market income does not include imputed rent, as this component is not considered in the calculations of poverty and inequality by the National Institute for Statistics and Census (*Instituto Nacional de Estadística y Censos*, INEC). Finally, for Ecuador, Lustig (2017) includes in-kind transfers such as free school breakfasts, textbooks, and uniforms as part of direct transfers (see Llerena et al. 2015). This information is imputed from other sources and not included in our simulations.

2 Data and methodology

2.1 National Survey of Income and Expenditures of Urban and Rural Households (ENIGHUR) 2011–12

ENIGHUR is a nationally representative cross-sectional survey on the income and expenditures of households in Ecuador. The aim of the survey is to provide information on the distribution and structure of the income and expenditures of Ecuadorean households based on the demographic and socioeconomic characteristics of the household members (INEC 2012). The survey is conducted approximately every eight years. The latest ENIGHUR is for the years 2011–12 and contains information for 39,617 households and 153,444 individuals. The survey follows a probabilistic two-stage sample design in nine self-represented cities, and a three-stage design in the rest of the country.[4] The sampling unit is the dwelling, defined as the person or group of people living in the same housing structure (dwelling), sharing meals, and depending on a common budget.

ENIGHUR contains very detailed income information. Employment and self-employment income from principal and secondary occupations are reported, including extra pay, bonuses, in-kind income, and self-consumption from self-employment activities. Information about contributions to social security and tax payments is also collected for both employees and self-employed workers. Moreover, detailed information about social security affiliation is reported, allowing individuals to be categorized in relation to specific social security regimes. Cash transfers from social benefits, such as public pensions, the HDT, the transfer Joaquín Gallegos Lara (see below), and housing grant are also included. Other sources of income such as income from capital and property, private transfers, remittances, and other rents are also reported in the data. Finally, detailed data on household expenditures are also available in the survey, as well as information on the demographic and socioeconomic characteristics of each member of the household.

The present study takes advantage of the availability of reported data on social benefits, taxes, and social insurance contributions to compare their effect on income inequality and poverty with that of simulated tax-benefit components calculated from ECUAMOD, which is presented in the next section.

2.2 ECUAMOD

Our study makes use of ECUAMOD, the tax-benefit microsimulation model for Ecuador. ECUAMOD has been developed as part of UNU-WIDER's project 'SOUTHMOD—simulating tax and benefit policies for development', in which tax-benefit microsimulation models have been built for selected developing countries.[5] ECUAMOD combines detailed country-specific coded policy rules with representative household microdata to simulate direct and indirect taxes, social insurance contributions, and cash transfers for the household population of Ecuador. ECUAMOD is a static model in the sense that tax-benefit simulations abstract from the behavioural reactions of individuals and no adjustments are made for changes in the population

[4] The nine self-represented cities are Cuenca, Machala, Esmeraldas, Guayaquil, Loja, Manta, Quito, Ambato, and Santo Domingo.

[5] ECUAMOD and other country models from the SOUTHMOD project run on the EUROMOD software, which enables users to analyse the effect of tax-benefit policies on the income distribution in a comparable manner. For more information about SOUTHMOD see: https://www.wider.unu.edu/project/southmod-simulating-tax-and-benefit-policies-development. For more information about EUROMOD see Sutherland and Figari (2013).

composition over time. Simulation results for ECUAMOD have been validated against external statistics (see Jara et al. 2017).

The underlying microdata used in ECUAMOD comes from ENIGHUR 2011–12. Adjustments to the data and variables, for the construction of ECUAMOD's input data, were kept to a minimum. First, individuals recorded as domestic employees in a household were dropped, as information about their own household (e.g. number of children, expenditures) is not available. In total, 103 individuals (0.07 per cent of the sample) were dropped from the original sample, leaving us with a sample of 153,341 individuals. No households were dropped and no adjustments to the weights were made as a result of dropping individual observations. Second, ENIGHUR data include a single variable covering all pension payments, including contributory pensions, as well as severance pay and maintenance for divorce and children, whereas this single variable is split into five variables in the ECUAMOD database: (i) old-age pension, (ii) disability pension, (iii) survivors' pension, (iv) severance pay, and (v) maintenance payments. In our analysis, the first three variables are considered as part of public pensions, severance pay is included in social benefits, and maintenance payments are included in market income.

ECUAMOD version 1.0 covers the policy years 2011–16 for the purpose of tax-benefit simulations based on ENIGHUR 2011–12. To account for time inconsistencies between the input data year and the policy year in the simulations, market incomes and non-simulated tax-benefit variables in the data are adjusted using source-specific updating factors (see Jara et al. 2017). In this study, 2011 policies (as of 30 June) in Ecuador are used for the analysis.

ECUAMOD aims to simulate the main tax and benefit components of household disposable income in Ecuador, where household disposable income is defined as the sum of market income and social cash transfers of all household members net of income tax and social insurance contributions.[6] However, simulation of tax-benefit instruments depends on the relevant information being available in the underlying dataset used in the simulations—in this case ENIGHUR 2011–12. Instruments that are not simulated are taken directly from the data and included as part of disposable income. The remainder of this section describes briefly the policy instruments simulated in ECUAMOD for the year 2011, as well as the underlying assumptions used in the simulations of each income component. Table A1 in the Appendix summarizes the tax and benefit components included in the model, differentiating between simulated and non-simulated components, and provides information about why simulation was not feasible where this was the case.

Employee social insurance contributions

Social insurance contributions (SICs) in Ecuador are defined according to the sector of work of the person affiliated with the Ecuadorian Institute of Social Security (*Instituto Ecuatoriano de Seguridad Social*, IESS). ECUAMOD simulates employees' SICs for three sectors of work: (a) private sector employees and secular clergy members; (b) bank employees, employees of municipal and decentralized public institutions, notaries, and property and commercial registrars; and (c) civil servants, including public education teachers and employees in the judiciary system, and other employees. All employees are liable to SICs, which are based on their gross employment income. Contributions are not paid if employment income is below the minimum wage (US$264 per month in 2011). In 2011, employees were liable to four types of social contributions: pension insurance,

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[6] Market income is the sum of employment and self-employment income, bonuses, in-kind income, self-consumption from self-employment activities, capital and property income, inter-household payments, and private transfers, minus maintenance payments. Imputed rent is not included in market income.

rural worker insurance, severance pay insurance, and administrative costs. The total contribution rate was 9.35 per cent or 11.35 per cent depending on the sector of work. Since 2009, pensioners also need to contribute to social insurance at a rate of 2.76 per cent of their pension income. Social insurance contributions from pensioners are categorized under employee SICs in ECUAMOD.

Self-employed social insurance contributions

Self-employed SICs include contributions by two categories of workers: self-employed workers and voluntary affiliates. These two categories can make SICs on a voluntary basis. These are based on their declared gross self-employment income. Contributions are not paid if self-employment income is below the minimum wage. In 2011, self-employed workers and voluntary affiliates were liable to five types of SICs: pension insurance, health insurance, occupational risk insurance, rural worker insurance, and administrative costs. The total contribution rate for these categories was 17.5 per cent. An additional category of workers considered in the simulation of self-employed SICs in ECUAMOD is rural workers, who are affiliated to the special rural worker social security regime (*Seguro Campesino*). In order to be a member of the rural worker social security regime, a person must: (i) have a residency in the rural area or be an artisanal fisherman, (ii) not be affiliated to the general social security regime, (iii) not receive remuneration from an employer, and (iv) not be a permanent employer. The amount of SICs paid by members of the rural worker social security regime is equal to 2.5 per cent of 22.5 per cent of the minimum wage.

Employer social insurance contributions

All employers are liable to pay SICs based on gross employment income. Contributions are not paid if employment income is lower than the minimum wage. Employers are liable to six types of SICs: pension insurance, health insurance, occupational risk insurance, rural worker insurance, severance pay insurance, and administrative costs. The total contribution rate for employers is 9.15 per cent or 11.15 per cent depending on the sector of employment of their workers. Employer SICs do not enter into the definition of disposable income in ECUAMOD.

Armed forces and police social contributions

Members of the armed forces or the national police contribute to special regimes of social insurance. Members of the armed forces are affiliated to the Institute of Social Security of the Armed Forces (ISSFA), whereas members of the national police are affiliated to the Institute of Social Security of the National Police (ISSPOL). For this reason, in addition to SICs to the IESS, ECUAMOD simulates contributions made by members of the armed forces or the national police. However, although the information available in the input data for ECUAMOD allows us to distinguish individuals who are affiliated to these specific regimes, it does not show whether an individual is affiliated to the ISSFA or the ISSPOL. The rate of SICs for members of the ISSFA is 23 per cent, whereas the rate for members of the ISSPOL is 23.10 per cent. ECUAMOD therefore simulates jointly SICs to ISSFA and ISSPOL, assuming a common rate of 23.05 per cent of earnings. Additionally, ECUAMOD simulates the government contribution to these special regimes at 26 per cent. However, this contribution is not included in disposable income in ECUAMOD.

Personal income tax

Personal income tax in Ecuador is assessed at the individual level. The tax base is defined as taxable income minus exemptions, minus deductions. Since 2008, taxable income has been composed of gross earnings from labour (employment and self-employment income), plus extra pay (for extra hours, bonuses, etc.), plus utilities participation.[7] The main types of income exempted are income from pensions from the IESS, 13th and 14th months' pay, reserve funds, and income from old-age and disabled persons. Deductions from gross earnings include social insurance contributions and personal expenditures, which include expenditure on food, clothing, education, health, and housing.[8] The tax schedule applied to the tax base is formed from nine tax bands with rates between 0 and 35 per cent.

In ECUAMOD, personal income tax is simulated under the assumption of full compliance (zero evasion). Simulation of some sort of tax evasion could be included in future versions of the model, based on certain assumptions about people who might be evading tax payments.

Indirect taxes

Since 2000, the VAT rate has been set at 12 per cent.[9] Goods and services considered 'basic needs' are taxed at 0 per cent, such as food products and basic services like water and electricity. A 'special consumption tax' (*Impuesto a los consumos especiales*, ICE), which represents a form of excise duty, is applied to specific products and services, such as alcohol, tobacco products, and automobiles. The rates vary widely with respect to the type of good. ECUAMOD simulates ICE for four types of goods based on the number of observations in the data for which consumption of these goods is observed: alcoholic drinks including beer; cigarettes; soda drinks; and perfumes.[10]

*Human Development Transfer (*Bono de Desarrollo Humano*)*

The Human Development Transfer (HDT) is a proxy means-tested conditional cash transfer (CCT). The proxy means test is based on the composite index of socioeconomic classification calculated by the Social Registry, which is based on a series of variables for household characteristics, characteristics of the head of the household, type of housing, living conditions, assets, and territory. Three population subgroups are eligible for HDT: (i) families with children aged 18 years or younger; (ii) elderly adults who do not receive any pension; and (iii) disabled persons. In order to be eligible for HDT, families of children aged 18 years and under need to belong to the poorest population according to the composite index. Elderly adults and disabled persons (with a 40 per cent or higher degree of disability) need to be in vulnerability conditions (as defined by the Ministry of Social Development Coordination) and cannot be affiliated to any type of social security institution.

In 2011, the benefit amount for HDT was US$35 per month. Since 2013, the amount has been fixed at US$50 per month (Presidencia de la República 2009, 2013). Two types of conditionality apply to mothers with children receiving HDT. First, it is required that children aged 6–18 years in the household enrol in school and attend at least 90 per cent of the school days in a month.

[7] Utilities participation is a benefit for employees, where 15 per cent of a firm's utilities are distributed among all employees in the firm.

[8] Deductions from personal expenditures cannot be higher than 50 per cent of taxable income or 1.3 times the threshold of the basic exempted band (US$9,210 in 2011). Additionally, there are individual limits for each type of expenditure. Expenditures on food, housing, education, and clothing cannot exceed 0.325 times the basic exempted band threshold, individually. Expenditure on health cannot exceed 1.3 times the basic exempted band threshold.

[9] In 2016, the VAT rate was increased to 14 per cent in all provinces except those hit by the earthquake in April 2016.

[10] For more details about the simulation of ICE in ECUAMOD see Jara et al. (2017).

Second, it is required that children below 6 years in the household attend health centres at least twice per year for medical check-ups.[11]

In order to simulate eligibility for HDT in ECUAMOD, a pseudo composite index was generated in the input data. Our pseudo index and the official index are likely to have different distributions as they are based on different samples. Therefore, we determine the threshold for eligibility as the value of the pseudo index below which we identify the same number of individuals as the official index.

Transfer Joaquín Gallegos Lara

The transfer Joaquín Gallegos Lara was introduced with the aim of improving the living conditions of people with severe disabilities or illness who are unable to live independently and who live under 'critical economic conditions' (Presidencia de la República 2010). The following categories are eligible for the benefit: (i) individuals with at least a 75 per cent level of physical disability or 65 per cent mental disability; (ii) individuals with catastrophic or rare illnesses who are not affiliated to or receiving pensions from the social security system; (iii) children below the age of 14 years living with HIV/AIDS; and (iv) orphans. The amount of the benefit is US$240 per month and it is paid to the person responsible for the care of the individual with a disability or illness. The benefit is not subject to the means test.

In ECUAMOD, the transfer Joaquín Gallegos Lara is only partially simulated, meaning that eligibility for the benefit is based on whether individuals are observed as receiving the benefit in the data. Full simulation (simulation of eligibility) is not possible because information about the degree of disability is not available in the data.

Non-simulated taxes and benefits

Contributory pensions are included in the concept of disposable income used by ECUAMOD but cannot be simulated due to lack of information on contributory records. The same applies to injury benefit and severance pay. Scholarships cannot be simulated because information on students' grades is not available in the data.[12] No information on the price of properties to be purchased or remodelling costs is available to simulate the housing grant. Property and property transfer taxes, motor vehicle tax, and wealth tax are included as deductions in disposable income but cannot be simulated due to lack of data on property values, vehicle values, and wealth, respectively.

3 Empirical results

This section presents the main findings of our comparison of income distributions based on reported survey income data and tax-benefit microsimulation. First, we provide a detailed comparison of the number of benefit recipients and taxpayers, as well as aggregate yearly amounts of taxes and benefits obtained under both approaches, with external official statistics. Then, we analyse the relative importance of different tax-benefit components across the income distribution in Ecuador. Third, we compare poverty and inequality indicators obtained with ENIGHUR and

[11] Additionally, the conditionality of the programme extends to prenatal health controls, sexual and reproductive health consultations, eradication of child labour and mendicancy, and maintenance of the dwelling, and eligibility is subject to an annual update of changes in the socioeconomic situation of the household.

[12] Only students with very good grades in various school tests are eligible for scholarships.

ECUAMOD data. Finally, we provide a picture of the effect of different tax-benefit components on income poverty and inequality with the two approaches and discuss factors driving discrepancies.

3.1 Validation of reported and simulated tax-benefit instruments

Validation of simulated taxes and benefits is a crucial part of microsimulation modelling. In this section, we compare information about the number of benefit recipients and taxpayers as well as aggregate annual expenditure on social benefits and revenue from taxes and SICs obtained with ECUAMOD and reported in ENIGHUR with external official data. The results presented in this section are based on the validation of ECUAMOD simulations by Jara et al. (2017).

The numbers of recipients of benefits and payers of taxes and SICs obtained with ECUAMOD and reported in ENIGHUR are compared with external benchmarks in Table 1. In terms of benefits, the results show that ECUAMOD underestimates the number of recipients of the HDT by around 18 per cent compared with external statistics. Information on HDT recipients directly from ENIGHUR data matches better the external benchmark, with an underestimation of around 10 per cent. It is worth noting that in order to assess eligibility for the HDT in our simulations, we replicated the index of the Social Register with the input data and fixed the threshold of eligibility by identifying the same number of people below the official threshold. The underestimation of recipients of the HDT in ECUAMOD could be related to discretion as to who is eligible for the transfer, which cannot be captured in our simulations.

Table 1: Tax-benefit instruments in 2011: Number of recipients/payers (in thousands)

	ECUAMOD	ENIGHUR	External	Ratios		
	(A)	(B)	(C)	(A)/(B)	(A)/(C)	(B)/(C)
Social benefits						
Human Development Transfer	1,523	1,681	1,854	0.91	0.82	0.91
Joaquín Gallegos Lara	9	9	14	1.00	0.64	0.64
Taxes and social insurance contributions (SICs)						
Personal income tax	331	35	472	9.46	0.70	0.07
Employee SICs	2,047	1,836	2,510	1.11	0.82	0.73
Self-employed SICs	307	74	1,093	4.15	0.28	0.07

Source: Jara et al. (2017).

The number of recipients of the transfer Joaquín Gallegos Lara obtained from ECUAMOD matches that of ENIGHUR because, as previously mentioned, simulations of the transfer are based on actual benefit receipt in the data. The transfer Joaquín Gallegos Lara cannot be fully simulated because eligibility depends on the severity of disability and this information is unavailable in the data. ENIGHUR and ECUAMOD results underestimate the number of recipients of the transfer, reflecting the fact that this population subgroup is not properly captured by the survey.

In terms of taxes and SICs, ECUAMOD underestimates the number of payers compared with data from the IESS and the Internal Revenues Service (SRI), which might be related to income under-reporting in the underlying input data. The underestimation is particularly important for payers of self-employed contributions. Note, however, that the underestimation of personal income tax and SIC payers is even more severe when reported payers from ENIGHUR are compared with external statistics. In particular, ENIGHUR data capture less than 10 per cent of personal income taxpayers compared with 70 per cent obtained with ECUAMOD, reflecting the difficulties of collecting tax data in household surveys and highlighting the usefulness of microsimulation to calculate this type of income.

Table 2 presents a validation of reported and simulated aggregate annual expenditure on social benefits and revenue from taxes and SICs. The results show an underestimation of ECUAMOD simulated amounts of HDT of around 7 per cent in comparison with ENIGHUR data and external statistics. The good match between ENIGHUR and the external benchmark reflects the fact that survey data in Ecuador capture well the bottom of the income distribution. Reported and simulated amounts of the transfer Joaquín Gallegos Lara underestimate the aggregate amounts compared with external sources by around 40 per cent, reflecting the underestimation of benefit recipients in the data (see Table 1).

Table 2: Tax-benefit instruments in 2011: Annual amounts (in millions US$)

	ECUAMOD	ENIGHUR	External	Ratios		
	(A)	(B)	(C)	(A)/(B)	(A)/(C)	(B)/(C)
Social benefits						
Human Development Transfer	656	706	706	0.93	0.93	1.00
Joaquín Gallegos Lara	26	24	41	1.08	0.63	0.59
Taxes and social insurance contributions (SICs)						
Personal income tax	615	19	784	32.37	0.78	0.02
Employee SICs	1,503	1,322	1,842	1.14	0.82	0.72
Self-employed SICs	456	268	802	1.70	0.57	0.33
VAT	1,710	592	3,073	2.89	0.56	0.19

Source: Jara et al. (2017)

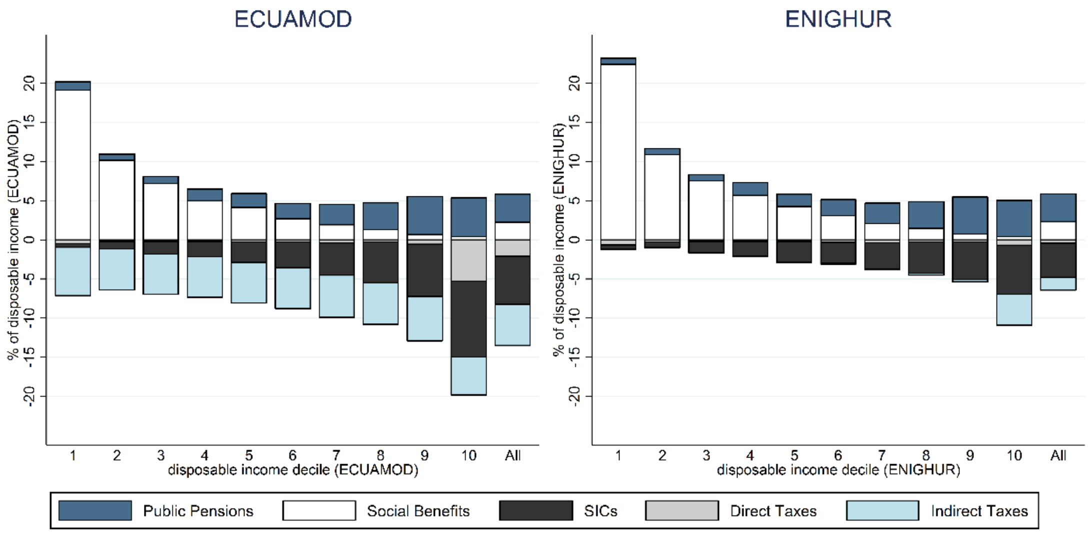
In terms of taxes and SICs, our simulations underestimate the aggregate amount of personal income tax and SICs compared with external statistics. ECUAMOD simulations capture around 80 per cent of revenue from personal income tax and employee SICs, whereas the underestimation of self-employed SICs is greater, and is in line with the underestimation of the number of payers. On the other hand, results obtained directly from ENIGHUR data provide an extremely poor match against the external benchmark. Reported personal income tax amounts from ENIGHUR capture only 2 per cent of personal income tax revenue. Reported self-employed SIC amounts represent only 33 per cent of the official aggregate amounts. Only reported employee SIC amounts provide a better fit, capturing 72 per cent of employee SIC revenue, compared with 82 per cent captured by ECUAMOD results.

The poor representation of aggregate annual revenue from personal income tax and SICs provided by ENIGHUR data is most likely related to the above-mentioned difficulties of recording this type of deduction in surveys and points to the importance of using simulated taxes and SICs to assess the effect of these components on the income distribution, as their effect would otherwise be underestimated. The underestimation of income tax and SICs might also be related to the fact that, in general, surveys fail to properly capture the top of the income distribution; this is particularly the case for developing countries like Ecuador. Additionally, Table 2 provides a comparison of aggregate revenue from VAT. Compared with external statistics, ECUAMOD underestimates VAT by around 44 per cent. VAT reported by ENIGHUR represents only 19 per cent of the official aggregate amounts. However, it is worth noting that ENIGHUR reports VAT payments by the self-employed only, as part of their expenditures; VAT payment by households is not directly reported by ENIGHUR. On the other hand, ECUAMOD simulates VAT payments by households only, whereas the official statistics on VAT include payments by both households and firms.

3.2 Relative size of tax-benefit instruments

Before comparing poverty, inequality, and the redistributive effect of tax-benefit systems between our two approaches, it is worth considering the extent to which the size of different tax-benefit components varies across the income distribution depending on the use of simulated or reported incomes. Figure 1 shows the relative size of five tax-benefit components in Ecuador, where the average size of each income component is measured as a percentage of average household disposable income by household disposable income decile, and on average for the whole population. Direct and indirect taxes and social insurance contributions are shown as negative values as they represent deductions from disposable income.

Figure 1: Tax-benefit components as a share of household disposable income in 2011



Source: ECUAMOD version 1.0 calculations.

Under both approaches, our results show the extent to which social benefits succeed in targeting groups with low incomes. Social benefits represent on average 19 per cent of household disposable income for individuals in the bottom decile of the income distribution with ECUAMOD and 22 per cent with reported benefits from ENIGHUR. The slightly larger size of social benefits with ENIGHUR data reflects the fact that ECUAMOD simulations of the HDT slightly underestimate the number and aggregate amounts of this benefit compared with ENIGHUR, as shown in Tables 1 and 2.

ECUAMOD and ENIGHUR results differ more in terms of the relative size of taxes and SICs. Simulated direct taxes represent an important proportion (5.3 per cent) of household disposable income only for the top decile of the income distribution. This might be due to the presence of deductions from personal expenditures that are applied to taxable income. On the contrary, direct taxes reported in the data account for only 0.7 per cent of household disposable income for the top decile. The discrepancies between ECUAMOD and ENIGHUR results are driven by the fact that personal income tax in ENIGHUR seems to be poorly captured due to the difficulties of recording this type of income in surveys. Indirect taxes in ECUAMOD are mostly proportional with respect to disposable income, although the relative size of this income component is slightly larger for the first income decile, pointing to a minor regressivity. The mostly proportional nature of indirect taxes is in line with a recent paper by Rojas Baez (2017) and is driven by the presence of a 0 per cent VAT rate on goods and services considered basic needs. The relative size of indirect taxes in ENIGHUR is on average smaller than that of ECUAMOD and they appear to affect mostly the top income decile. As previously mentioned, ENIGHUR reports VAT payments from expenditures related to self-employment activities only, which explains the differences with respect to ECUAMOD simulations. Finally, reported and simulated SICs are progressive in nature but represent a smaller share of household disposable income with results based on ENIGHUR data.

Table 3 confirms the pattern of tax-benefit components with respect to disposable income in our two approaches, where the progressivity of different policy instruments is assessed using the Suits index. Public pensions are regressive with respect to disposable income, whereas social benefits are progressive. Direct taxes and SICs are progressive but to a larger extent with results obtained from ECUAMOD. Finally, ECUAMOD and ENIGHUR provide contrasting results in terms of the progressivity of indirect taxes. Reported VAT payments in ENIGHUR are progressive with respect to disposable income, whereas ECUAMOD results points to a minor regressivity of indirect taxes, which is in line with the fairly proportional nature of this income component, observed in Figure 1.

Table 3: Progressivity of tax-benefit components in 2011, Suits index

	Public pensions	Social benefits	Direct taxes	Social insurance contributions	Indirect taxes
ECUAMOD	-0.21	0.60	0.74	0.30	-0.02
ENIGHUR	-0.19	0.61	0.22	0.24	0.83

Source: ECUAMOD version 1.0 and ENIGHUR 2011–12.

3.3 Poverty and inequality

Table 4 presents the results of our comparison of inequality and poverty indicators calculated from the reported ENIGHUR data and the simulated ECUAMOD data. The results are computed for individuals according to their household disposable income (HDI) per capita (i.e. HDI divided by household size). HDI is calculated as the sum of all income of all household members net of income tax and SICs. Using HDI per capita is the approach proposed by the National Institute for Statistics and Census (*Instituto Nacional de Estadística y Censos*, INEC) to calculate income poverty and inequality.

In terms of income inequality, Table 4 shows that the Gini coefficients obtained with the two sets of results are similar. The Gini coefficient obtained from ENIGHUR data is only 3 per cent higher than that estimated from ECUAMOD data. The difference is also small for the p90/p10 ratio. Table 4 also provides the Atkinson index using three values for the parameter of 'inequality aversion': $\varepsilon = 0.5$, 1, and 2. Calculating the Atkinson index for different values of ε allows us to change the importance attached to variations at different points in the income distribution, larger values of ε being more sensitive to variations at the lower end of the income distribution. ENIGHUR data provide slightly larger estimates for the Atkinson index. The gap between ENIGHUR and ECUAMOD data estimates is the largest for the Atkinson index with $\varepsilon = 0.5$, with a difference of 9 per cent of the size of the ECUAMOD estimate.

The second and third sections of Table 4 compare statistics on absolute poverty and extreme poverty calculated under the two approaches. The national poverty lines of US$72.87 per month for absolute poverty and US$41.06 per month for extreme poverty are used in the calculations. As was the case for inequality, absolute poverty and extreme poverty calculated using reported ENIGHUR data are slightly higher than those based on simulated incomes. Our results further distinguish poverty estimates between households living in the urban or rural areas of the country. The discrepancies between poverty estimates calculated from ENIGHUR data and ECUAMOD data are more marked in urban areas. The gap between urban extreme poverty from ENIGHUR data and ECUAMOD simulations is around 15 per cent, although in absolute terms this represents only 0.4 percentage points given the low levels of extreme poverty in urban areas of the country.

Table 4: Absolute poverty rates and income inequality in 2011

	ECUAMOD	ENIGHUR	Ratio
	(A)	(B)	(A)/(B)
Inequality			
Gini	46.0	47.3	0.97
p90/p10	7.4	7.7	0.97
Atkinson index (0.5)	17.7	19.5	0.91
Atkinson index (1)	30.6	32.8	0.93
Atkinson index (2)	50.3	52.6	0.96
Absolute poverty			
Total	20.8	21.6	0.96
Urban	12.4	13.2	0.94
Rural	37.9	38.5	0.98
Extreme poverty			
Total	5.8	6.1	0.95
Urban	2.2	2.6	0.85
Rural	13.0	13.3	0.98

Notes: Computed for individuals according to their household disposable income per capita. Household disposable income is calculated as the sum of all income sources of all household members net of income tax and SICs.

Source: ECUAMOD version 1.0 calculations and ENIGHUR.

All in all, the comparison of poverty and inequality calculated under our two approaches points to only minor differences. However, as observed in the previous section, the relative size and progressivity of particular tax-benefit components can vary considerably depending on the use of reported or simulated incomes. From a policy perspective, it is important to have a clear idea of the effect of tax-benefit instruments on poverty and inequality. The following section compares the extent to which the effect of tax-benefit components differs depending on whether reported or simulated incomes are used in the analysis.

3.4 The effect of taxes and benefits on income inequality and poverty

Accurately assessing the role of taxes and benefits in reducing poverty and inequality is essential to improving the design of existing and new policy instruments. Tables 5 and 6 compare the effects of different tax-benefit components on income inequality and poverty calculated under our two approaches. For this part of the analysis, we concentrate on income inequality as measured by the Gini coefficient and absolute poverty and extreme poverty based on the national poverty lines defined above. In order to assess the effect of public pensions and social benefits, we deduct each component separately from disposable income and recalculate income inequality and poverty. In order to assess the effect of direct taxes and SICs, we add back each component separately to disposable income and recalculate poverty and inequality. Finally, we also present poverty and inequality estimates for market income and for disposable income minus indirect taxes.

The redistributive effect of direct taxes, SICs, and cash transfers is defined as the difference between the Gini coefficient for disposable income and the Gini for market income (column B minus column A). Table 5 shows that direct taxes and cash transfers reduce income inequality by 4.2 points (46.0 minus 50.2) based on ECUAMOD data. The redistributive effect is reduced by almost half based on ENIGHUR data, accounting for 2.3 points reduction in inequality (47.9 minus 50.2). Under both approaches, the income component that reduces inequality the most is social benefits, accounting for a reduction of around 1.6 points with ECUAMOD data, and 1.7 points with ENIGHUR data, when Gini for disposable income is compared with Gini for disposable income minus social benefits (column B minus column D). The role of public pensions is minor in both cases. Table 5 points to a very different effect of direct taxes and SICs depending on the approach used in the analysis. SICs reduce income inequality by 1.5 points based on ECUAMOD data, which is similar in size to the effect of social benefits, whereas the effect of SICs is 0.9 points when reported incomes are used (column B minus column F). The differences are even more striking for direct taxes, which contribute to inequality reduction by 0.9 points with ECUAMOD data and only 0.1 points with ENIGHUR data (column B minus column E). Finally, indirect taxes tend to slightly increase inequality according to ECUAMOD simulations, whereas inequality decreases by 0.8 points when the Gini for disposable income is compared with the Gini for disposable income minus indirect taxes reported in ENIGHUR (column B minus column G).

Table 5: Effect of tax-benefit components on income inequality in 2011, Gini coefficient

	Market income	Disposable income (DPI)	DPI minus public pensions	DPI minus social benefits	DPI plus direct taxes	DPI plus SICs	DPI minus indirect taxes
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
ECUAMOD	50.2	46.0	46.1	47.6	46.9	47.5	46.1
ENIGHUR	50.2	47.9	48.1	49.6	48.0	48.8	47.1

Source: ECUAMOD version 1.0 and ENIGHUR 2011-2012.

Table 6 presents the effect of tax-benefit instruments on absolute poverty and extreme poverty under our two approaches. Using simulated incomes, there is a difference of 4 points when we compare absolute poverty for disposable income and absolute poverty for market income. Based on reported incomes from ENIGHUR data, the difference between absolute poverty for disposable income and absolute poverty for market income is 3.2 points (column B minus column A). The effect of the tax-benefit system on extreme poverty is more similar between the two approaches: extreme poverty is reduced by 3.6 (3.2) points when ECUAMOD (ENIGHUR) data are used. The income component that reduces poverty and extreme poverty the most is social benefits and the effect is very similar under the two approaches. Social benefits reduce poverty (extreme poverty) by 3.2 (2.8) points with ECUAMOD data and 3.4 (2.9) points with ENIGHUR data (column B minus column D). The effect of public pensions is also similar under the two approaches, reducing poverty by 1.4 points and extreme poverty by around 1 point (column B minus column C). The role played by direct taxes and SICs is, on the other hand, very modest under the two approaches and adding them back to disposable income actually results in slightly lower poverty levels.

Finally, our two approaches provide a very different picture of the effect of indirect taxes. Deducting indirect taxes from disposable income increases poverty by 2.2 points and extreme poverty by 0.8 points based on simulated data from ECUAMOD, whereas neither poverty nor extreme poverty are affected when reported VAT is deducted from disposable income calculated from ENIGHUR data (column B minus column G). As observed in Figure 1, this is related to the fact that indirect taxes affect only the top of the income distribution calculated from ENIGHUR data, whereas they are proportional with respect to disposable income calculated from ECUAMOD.

Table 6: Effect of tax-benefit components on income poverty in 2011

	Market income	Disposable income (DPI)	DPI minus public pensions	DPI minus social benefits	DPI plus direct taxes	DPI plus SICs	DPI minus indirect taxes
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Absolute poverty headcount							
ECUAMOD	24.9	20.9	22.3	24.1	20.7	20.4	23.1
ENIGHUR	24.9	21.7	23.1	25.1	21.6	21.4	21.7
Extreme poverty headcount							
ECUAMOD	9.4	5.8	6.8	8.6	5.7	5.8	6.6
ENIGHUR	9.4	6.2	7.1	9.1	6.1	6.2	6.2

Source: ECUAMOD version 1.0 and ENIGHUR 2011-2012.

4 Conclusions

The analysis of the redistributive effect of tax-benefit systems in developing countries is paramount for the improvement of existing policies and the development of new instruments with the aim of strengthening social protection. In this paper, we compared the redistributive effect of taxes and benefits in Ecuador under two different approaches. The first approach involved using reported information on taxes and benefits from ENIGHUR data, whereas the second approach made use of the newly developed microsimulation model for Ecuador, ECUAMOD, to calculate tax-benefit instruments.

Our results include a number of interesting findings. First, compared with official statistics, ENIGHUR data capture very well the number of recipients and aggregate amounts of the Human Development Transfer, the main social assistance benefit in Ecuador. However, reported information about personal income tax provides a very poor representation of the number of taxpayers and aggregate tax revenue relative to tax records. ECUAMOD simulations match better external statistics, capturing around 80 per cent of income tax revenue, and emphasizing the importance of using microsimulation to calculate income components that are difficult to collect in survey data.

Second, inequality and poverty indicators obtained from ECUAMOD simulations slightly underestimate those based on ENIGHUR data. The Gini coefficient for disposable income is 1.3 points lower with ECUAMOD data than with ENIGHUR data (46.0 compared with 47.3), whereas the absolute poverty headcount is 0.8 points lower (28.0 compared with 21.6).

Finally, under both approaches, social assistance benefits are the instrument that has the largest effect in inequality reduction, and the size of its effect is similar with ENIGHUR and ECUAMOD data. However, important differences between the two approaches are observed in terms of the redistributive effect of direct taxes. Based on ENIGHUR data, direct taxes reduce inequality, as measured by the Gini coefficient, only by 0.1 points, whereas the effect is 0.9 points based on ECUAMOD simulations. The discrepancies between the two approaches reflect the fact that personal income tax is poorly captured in the household survey data. Our results point to a much larger effect of direct taxes in reducing inequality than indicated by previous studies, which have either used reported incomes or imputed taxes from other sources into survey data.

From a policy perspective, understanding the role played by the tax-benefit system in reducing income inequality and poverty is a first step to considering potential policy reforms in developing countries. In this respect, tax-benefit microsimulation models represent a powerful tool for assessing the redistributive effect of current tax-benefit instruments, as well as proposed or hypothetical policy changes. In addition to the analysis presented here, ECUAMOD offers numerous opportunities for policy analysis and research. ECUAMOD allows us to analyse the effect on the income distribution of actual changes in policy over time. It also offers the possibility of simulating the effects of revenue-neutral policy reforms—for instance, to assess the effect of increasing the amount of social assistance benefits financed through direct taxes of social insurance contributions. Additionally, indicators of work incentives at the intensive and extensive margin can be calculated for both actual and hypothetical tax-benefit policies. Finally, the implementation of ECUAMOD simulations in the EUROMOD software enables us to carry out comparative distributional analyses, such as assessing the effect of swapping tax-benefit policies between Ecuador and another country that uses the EUROMOD platform.

The results presented here suggest a number of extensions and directions for future research. First, despite better matching external information from tax records, ECUAMOD simulations still underestimate the number of personal income taxpayers and aggregate tax revenue. This is most likely related to problems capturing the top of the market income distribution in household surveys, which is particularly relevant in developing countries. Therefore, enriching survey data to better represent the top of the market income distribution would represent a step forward for the simulations of personal income tax. Imputations based on administrative tax records could be considered in future versions of the model to assess their impact on the simulations and the redistributive effect of the tax-benefit system.

Second, the possibility of relaxing the assumption of full compliance with tax rules should be considered through the simulation of some sort of tax evasion based on information collected by the public administration or on different definitions of informality.

Third, we should consider extending the scope of our simulations to provide a broader picture of the role of the welfare state, for instance, by simulating indirect fuel subsidies.

Finally, the development of a regional tax-benefit microsimulation model for Latin America, using a common harmonized language, represents an important opportunity for policy developments and collaborations within the region. Progress in this area is already being made with the development of a microsimulation model for Colombia, which will allow comparative analyses to be performed (Rodriguez 2017; Bargain et al. 2017).

All these topics represent promising areas for future research.

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Appendix

Table A1: Simulation of taxes and benefits in ECUAMOD

Policy instrument	Treatment in ECUAMOD	Why not fully simulated?
Simulated tax-benefit instruments		
Employee social insurance contributions	Simulated	-
Armed forces and police social insurance contributions	Simulated	-
Self-employed social insurance contributions	Simulated	-
Employer social insurance contributions	Simulated	-
Government social insurance contributions for armed forces and police	Simulated	-
Personal income tax	Simulated	-
Human development transfer (HDT)	Simulated	-
Joaquín Gallegos Lara	Partially simulated	Eligibility for the benefit cannot be simulated due to lack of information about severity of disability in the data
Value added tax (VAT)	Simulated	-
Special consumption tax (excise duties)	Simulated	-
Non-simulated tax-benefit instruments		
Old-age pension	Included	No data on contribution records
Invalidity pension	Included	No data on contribution records
Survivors' pension	Included	No data on contribution records
Injury benefit	Included	No data on contribution records
Severance payments	Included	No data on contribution records
Scholarships	Included	No information about students' grades to determine eligibility for scholarships
Housing grant	Included	No information about the price of the property individuals intend to buy nor about the cost of planned remodelling for their current house
Property tax and property transfer tax	Included	No information on property values in the data
Wealth tax	Included	No information on wealth in the data
Motor vehicle tax	Included	No information on vehicle values in the data

Source: Authors' compilation.