An Income Corrected Social Accounting Matrix

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Abstract

We propose a new method to correct the multipliers of a social accounting matrix for underreporting and nonresponse in the income distribution. To do so, we combine a recent imputation technique developed by Blanchet, Flores, and Morgan (2022) with traditional social accounting multiplier analysis. We apply this method to the Chilean economy to study the effect of government transfers on the income distribution using Holst and Sancho's (1992) framework. We utilize national accounting data along with survey data from the CASEN survey for 2017. Failure to correct for nonresponse and underreporting in the income distribution suggests that government transfers improve deciles 1 to 7 of the income distribution. However, after applying the correction methodology, government transfers improves deciles 1 to 5 and also decile 10. This implies that our method can provide a more accurate depiction of the effect of government transfers on the income distribution.

Keywords: Social Accounting Matrix, Income Distribution, Survey Corrected, Fiscal Policy.

1. Introduction

Over the past years, there has been significant interest in analyzing income inequality in economies, as it can be detrimental to future growth and poverty reduction (Alvaredo et al., 2020; Nissanke & Thorbecke, 2006). Moreover, it is one of the Sustainable Development Goals, which encompasses the social, economic, and political inclusion of all individuals. In this regard, government expending has been used to redistribute resources across individuals. Indeed, determining the redistributive impact of fiscal policy is not trivial, as there are direct and indirect effects in the economy that could influence the final effect of a shock. Thus, we can ask how can we measure the total effect of government in reducing inequality.

In this context, Social Accounting Matrices (SAMs) are frequently used to assess the impacts of various exogenous factors on a predefined economy. Developed by Stone (1962), a SAM is a suitable tool to analyze distributive effects of a shocks, because has the capacity to reflect that economic growth or fiscal policy could be an inadequate objective if distributional changes are detrimental to poorest people. We have opted to utilize this methodology as it provides a transparent framework for evaluating the indirect effects of the accounts, as it captures the flow of income and interdependences between institutions. (Pieters, 2010; Pyatt & Round, 1977; Roland-Holst, 1990).

All the referenced works share a commonality: despite employing household surveys to construct the SAM (specifically, the CASEN survey for Chile), none have addressed the limitation in capturing the upper echelons of the income distribution. This limitation significantly affects the measurement of inequality derived from household surveys.

For this, first we need to adequate measure inequality. However, there are still fundamental challenges that governments and researchers face to adequate measure the levels and trends of economic inequality. Part of the difficulty in measuring income inequality has been the discrepancy between the data sources that construct macroeconomic and microeconomic income accounts (De Rosa et al., 2022). This issue can be reflected in the failure to capture the incomes of the *more affluent individuals*. Which directly impact any measure of income inequality.[1]. Failing to capture the upper tail of the income distribution can be more aggravated by the dependence on the use of household surveys to collect microdata associated with individuals/household incomes. Household surveys are subject to nonresponse and underreporting at the top (Lustig et al., 2020).

The objective of this document is to provide guidelines for constructing a SAM with corrected households incomes, to evaluate the effect of fiscal expenditure on the income distribution. To correct the incomes, we will implement a novel methodology proposed by Blanchet et al. (2018) (hereafter, BFM method), and in order to measure the impact of the correction, we will use Chile as an example, comparing an uncorrected SAM with a corrected SAM. To make this comparison, the redistributive effects matrix proposed by Roland-Holst & Sancho (1992) is considered, because analysis of multipliers alone does not inform about modifications in the relative state of an institution.

Failure to correct for nonresponse and underreporting in the income distribution suggests that traditional and relative multipliers are biased, government transfers improves decil's 1 to 6. However, after applying the correction methodology, government transfers also improve the decil 10. The results confirm the importance of consider the top tail income correction when a SAM is constructed.

The rest of the article is organized as follows: Section 2 describes the background of the SAM, Section 3 presents the method for correction at the top tail on survey data, Section 4 contains data description, Section 5 describes the results, Section 6 presents the discussion of results, and Section 7 concludes.

[1]Two indexes have been widely used to measure inequality, the Gini coefficient and top income shares. Those two indices depend on the correct measure of the upper tail.

2. The methodology for constructing a SAM

The SAM is an information system that covers the entire income flow in an economy, divided into different categories. Rows in a SAM represent income accounts, while columns represent expenditure accounts. When using a SAM as a model, it is necessary to make distinctions between endogenous and exogenous accounts. The typical form includes industries, factors of production, households, and firms, with the latter encompassing the government, capital accounts, and the rest of the world.

SAMs have been made to evaluate redistributive impacts on income (Roland-Holst, 1990; Roland-Holst & Sancho, 1992), outcomes in the reduction of poverty rates (Ge & Lei, 2013) or inequality (Pieters, 2010). The construction of a Social Accounting Matrix (SAM) traces back to the work of Stone (1962), complemented by the macroeconomic reform questions raised by Pyatt & Round (1977). These works have allowed the establishment of at least two principles derived from the construction of a SAM: first, a SAM brings together different sources of information to describe the structural forms of an economy. Second, a SAM provides information that allows establishing a relationship between income distribution and different sectors of an economy (Pal & Bandarlage, 2017).

The analyses that can be conducted using a SAM are diverse and can provide relevant information for the development and implementation of public policies. Croes & Rivera (2017) evaluate the distributive effect of income resulting from tourism growth in Ecuador. Pieters (2010) studies how inequality is affected by sectoral growth in India. Ge & Lei (2013) assess the development in the mining sector and its impact on income redistribution and poverty rates. de Miguel Velez & Perez-Mayo (2006) discusses how, using the multiplier model, it is possible to assess fiscal policies for redistribution with a SAM and its application in Extremadura, while De Miguel-Velez & Perez-Mayo (2010) evaluates policies aimed at poverty reduction for the same region.

In Table 1, the SAM scheme is presented. The exogenous account corresponds to fiscal expenditure, and all endogenous accounts have been grouped together: commodities, activities, factors (capital and labor), households, firms and others (which represent investment, rest of the world, taxes and stock). Money that flows from government to the economy is represented by X_i accounts. X_1 represent government expenditure on activities, X_2 are direct transfers to households and X_3 is savings. Money which flows from endogenous to exogenous account (principally taxes) is represented by L *leakages* vector.

The account T_{13} represents activities, while T_{11} represents produced goods. T_{12} includes different types of taxes (VAT, production tax, tariffs) and imports. T_{14} encompasses the value added produced by various activities, which is redistributed among households, firms, and the rest of the world. T_{18} is household consumption and T_{19} is their savings. T_{20} is the transfer from firms to households and T_{21} is their capital account. T_{22} contains

Table 1: A schematic SAM

	Endogenous accounts						Exogenous	Total
	Commodities	Activities	Factors	Household	Firms	Others	Government	
Commodities		T_{13}		T_{18}		T_{22}	X_1	Y_1
Activities	T_{11}							Y_2
Factors		T_{14}						Y_3
Household			T_{15}		T_{20}	T_{23}	X_2	Y_4
Firms			T_{16}					Y_5
Others	T_{12}		T_{17}	T_{19}	T_{21}	T_{24}	X_3	Y_6
Government				L_1	L_2	L_3		Y_x
Total	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_x	

exports, investment, and stock flow, T_{23} is household income from external sources, and T_{24} is income to capital accounts from external sources.

2.1 The multiplier model

Once SAM is constructed, the first objective is focused on calculating the multipliers that affect the income deciles of households in the SAM. To formulate these models, following Stone (1985) and Pyatt & Round (1977), exogenous accounts are first defined. Next, a variation in the exogenous accounts is defined, and the impact on the remaining accounts that constitute the total economy is observed. Multiplier analysis is derived from the proportional spending matrix, which is obtained by dividing each income entry of the endogenous accounts by the column total.

This exercise begins with the construction of the SAM and the calculation of multipliers, where n represents the number of accounts in the SAM, which can be divided into n and k endogenous and exogenous accounts, respectively. Denoting Y_{ij} as the income flow between institution i and j, the relationship is defined as follows:

$$Y_i = \sum_{j=1}^{n} Y_{ij} = \sum_{j=1}^{n} Y_{ji} \tag{1}$$

Let $a_{ij} = \frac{Y_{ij}}{Y_j}$ it is the proportion of average expenditure. Substituting into equation (1), we have that:

$$Y_i = \sum_{j=1}^{n} a_{ij} Y_j \tag{2}$$

Where this equation can be disaggregated between endogenous and exogenous accounts:

$$Y_i = \sum_{j=1}^{n} a_{ij} Y_j + \sum_{j=n+1}^{n+k} a_{ij} Y_j \tag{3}$$

And it can be expressed in matrix notation, decomposing Y en AY:

$$Y = \begin{pmatrix} Y_n \\ Y_k \end{pmatrix} = \begin{pmatrix} A_{nn} & A_{nk} \\ A_{kn} & A_{kk} \end{pmatrix} \begin{pmatrix} Y_n \\ Y_k \end{pmatrix} \tag{4}$$

The effect of exogenous institutions on endogenous ones can be measured as follows:

$$Y_n = A_{nn}Y_n + A_{nk}Y_k \tag{5}$$

or

$$Y_n = M * x \tag{6}$$

Where $M = (I - A_{nn})^{-1}$ and $x = A_{nk}Y_k$. M is the matrix of multipliers with n endogenous accounts, where each $m_{ij} \in M$ represents how much income in account i is generated by a change in account j. x is a vector representing the changes produced in exogenous institutions expressed in terms of endogenous institutions.

2.2 Relative Income Determination

The matrix M indicates the total incomes of endogenous institutions due to an injection into an exogenous institution, but it does not report changes of the relative state of an institution. Roland-Holst & Sancho (1992) define the relative income vector y_n to analyze the redistributive effects of an exogenous income shock:

$$z_n = \frac{y_n}{e'y_n} \tag{7}$$

Where e' is a unit row vector. Using the differentiation matrix in equation (6), the redistribution model can be expressed as follows:

$$\begin{aligned} dz_n = (e'Mx)^{-1}[I - (e'Mx)^{-1}(Mx)e']Mdx, \\ dz_n = \frac{1}{e'y_n}[I - \frac{y_n}{e'y_n}e']Mdx, \\ dz_n = Rdx \end{aligned} \tag{8}$$

Where dz_n represents the distributional effect on endogenous accounts generated by a change in the exogenous account dx, and the generated income is distributed within endogenous accounts using the matrix $R = (e'Mx)^{-1}[I - (e'Mx)^{-1}(Mx)e']M$. Redistribution can be evaluated considering different dynamics. In this case, dx represents a matrix of exogenous accounts that can simulate government spending, exports, or investment. The term Mdx can be expressed as:

$$Mdx_i = \sum_{j=1}^{n} m_{i,j}dx_j \tag{9}$$

And the redistribution that the exogenous account generates in account i would be:

$$dy_i = \frac{(Mdx)_i - y_i \sum_{j=1}^{n} Mdx_j}{e' y_n} \tag{10}$$

The sign and intensity of dy_i determine how the exogenous account is beneficial in the endogenous accounts i. The effect depends on the interaction between the income generated within institution i by the exogenous injection $(Mdx)i$ and the share yi in the total income generated by the exogenous injection in the economy $\sum_{j=1}^{n} Mdx_j$. Thus, the exogenous injection will be progressive (regressive) on an institution i if what i directly receives from the shock is greater (less) than what it would have obtained from the entire economy. To do our analysis, following Roland-Holst (1990) and de Miguel Velez & Perez-Mayo (2006), we non-normalized R matrix premultiplying by $(e'Mx)$ in order to have an economic interpretation. So, $(e'Mx)R(x)$ indicate the implicit value of redistribution, holding total income constant at its inicial value, induced by a one *chilean peso* inflow.

Various authors have used the matrix of relative incomes to analyze exogenous shocks in an economy. Starting from the definition of the redistributive matrix and subsequent analysis in the US economy described in Roland-Holst & Sancho (1992), de Miguel Velez & Perez-Mayo (2006) analyze changes in the income redistribution matrix for Extremadura as one of the measures of inequality. Barrera Lozano et al. (2020) construct a SAM for Sevilla and analyze the matrix $R(x)$ to measure the relative effect of the demand for the optics industry on other accounts, and Garrido & Morales (2023) evaluate the redistributive impact of fiscal policy. Following this line of work, our purpose is to determine the impact that income correction has on the relative position of deciles in response to a shock, in this case, fiscal expenditure.

2.3 The problem in SAM construction

Let (T_i) be a macro account of household income. This macro account can be represented as a weighted sum of income deciles, where α_i represents the share of the income decile in the macro account.

$$T_i = \sum_{i=1}^{10} \alpha_i Y_i \tag{11}$$

This latter point holds particular significance in this study, as it directly influences the re-estimation of α. According to given definitions of SAM disagregation, we are not taking into account the survey problem due to underreporting and missespecification (Lustig et al., 2020). As weights are adjusted, income deciles undergo modifications. Observations from the upper part of the distribution gain greater prominence, so α will be greater when decil is equal to 10, and deciles from the lower and middle sections are overrepresented. This consideration reestimates a new alpha $(\hat{\alpha})$, the income distribution is reestimated, and finally the effects of shocks of macro-accounts. With the correction, we are invoving three household income streams classified in the SAM: labor, capital and mixed income

(T_{15}), and income from abroad (T_{23}). A correction to income data from surveys that has gained traction over the past two years is the proposal put forth by Blanchet et al. (2018). They implemented a correction in five countries: three in Europe (France, Norway, and the United Kingdom) and two in Latin America (Brazil and Chile). While the corrected population in European countries does not exceed 0.5%, in Latin America it reaches 6%. The implications are twofold: firstly, average incomes are underreported, thereby affecting associated indicators (e.g., the median or measures of inequality). Secondly, the sample's representativeness is distorted.

3. Methodology for Income Correction: the BFM Method

In recent years, the discussion about the validity of household survey results in capturing incomes at the upper end of the distribution has been intensified. It is known that household surveys capture lower and middle part of the income distribution quite well but fail to capture incomes at the upper end, as it is subject to underreporting and non-response from higher-income individuals (Burdín et al., 2022; Jenkins, 2022; Lustig et al., 2020; Zwijnenburg, 2022).

Even though one possible solution is to have a larger sample for certain identified sectors, this approach can be costly. An alternative is to replace the high end of the distribution with a parametric model.

Blanchet et al. (2018) represent this issue as follows:

$$f_Z(y) = f_Y(y)\theta(y)(1 - p(y)) + f_M(y)\bar{p} \tag{12}$$

Where f_Y is the true income distribution, f_M is the income distribution considering non-response, $p(y)$ is the probability of not responding conditioned on the income level, and $\bar{p}$ is its average. This means that with probability $p(y)$ individuals with income y will not report their income, and in that case, they will declare a random number following the density function $f_M(y)$. Then f_Z is defined as the income distribution of a sample that is described by $f_Y(y)$, including non-response and bias due to underreporting.

To address this issue, the methodology developed by Blanchet et al. (2018) is proposed, which, based on information from Tax data, corrects survey incomes and weights, recovering their true expansion factors. Moreover, they manage to non-arbitrarily find the merging point, i.e., the point where the two sources of information begin to disagree. From this point, the relevance of the correction in the upper part of the distribution is evaluated. This correction can be divided into 2 steps: locating the merging point and reweighting observations.

3.1 The comparable income

To execute the correction, the income distribution from the Tax data must be standardized to a survey income distribution. This implies constructing a comparable income, composed of wage income, pensions, mixed income, and capital income accounts. Additionally, not all incomes are subject to taxes, so assumptions were made about the streams that pay taxes, both for salaried and self-employed incomes. While salaried incomes were considered exempt as long as individuals are not formally employed, self-employed incomes do not undergo grossing-up if they do not issue invoices (both appealing to an underlying concept of informality).

3.2 Merging point

The assumption behind is that tax data construct a true income distribution, denoted by f_y. On the other hand, the distribution of comparable income from the survey, we will call f_x. Then, it is possible to construct the ratio between the densities:

$$\theta(y) = \frac{f_x(y)}{f_y(y)} \tag{13}$$

Which represents the number of people from the survey within the distribution coming from taxes at the income level y. Therefore, if $\theta(y)$ can be interpreted as the relative probability of being within the survey.

Having both distributions makes it possible to identify the point where they become homologous. This non-arbitrary point suggests that the income distribution from the Tax data differs from the survey based distribution from that percentile onwards. Consequently, the relevance of correcting each evaluated income will be assessed.

3.3 Reweighting

Once the point where both distributions become homologous is defined, it is necessary to recalculate the weights of the distribution. This procedure is based on terms of a non-response model, given that survey weights are the inverse of the probability of inclusion in the sample. The probability of inclusion has 2 components: the probability that the household is selected ($D_i = 1$) and then that the household responds to the survey ($R_i = 1$). However, the second factor is subject to household income, and this assumes that the weights must be corrected.

$$
\begin{aligned}
w_i &= \frac{1}{P(D_i=1)}\frac{1}{P(R_i=1)}, \\
w_i &= \frac{1}{P(D_i=1)}\psi(U_i,Y_i), \\
w_i &= \delta\phi U_i \frac{\psi(U_i,Y_i)}{\phi U_i}, \\
w_i &= \delta\phi(U_i)\frac{\psi(U_i,Y_i)}{\phi(U_i)}, \\
w_i &= d_i\frac{\psi(U_i,Y_i)}{\phi(U_i)}
\end{aligned} \tag{14}
$$

Equation (14) implies that the survey expansion factors depend on income. Having comparable income and income from tax data, the correction will recover new expansion factors, which consider the underrepresentation of individuals located in the upper part of the distribution, and consequently, consider the overrepresentation of individuals located in the lower and middle part of the distribution. These new weights must satisfy the representation of the total population. If the entire sample of size n is described by a feature vector of size $(x_1, ..., x_n)$, which is multiplied by the original expansion factors $(d_1, ..., d_n)$, then the new factors must also satisfy $\sum_{i=1}^{n} w_i x_i = t$, where t is the population vector. The method for determining the new expansion factors is based on a minimization problem of the χ^2 distance between the original and new factors.

$$
min \sum_{i=1}^{n}\frac{(w_i-d_i)^2}{d_i} s.t \sum_{i=1}^{n} w_i x_i = t \tag{15}
$$

The authors also impose a constraint ensuring that the new factors $\left(\frac{w_1}{d_1}, ..., \frac{w_n}{d_n}\right)$ remain within the bounds $(\frac{1}{\alpha}, \alpha)$, to prevent excessively high adjustments. These adjustments are made to the factors that are above the merging point, and ensure that the new factors sum up to the population size.

4. Data

4.1 SAM Sources of information

Following Fuentes Risco (2017) and Marentis et al. (2021), a MacroSAM is constructed from the Tables of Economic Integration and the Input-Output Matrix for the year 2017. This will generate a $14x14$ matrix of accounts that closes the circular flow of the economy. This macro accounts can be disagregated into types of goods, types of activities or income deciles, obtaining the final SAM. The sources used for the construction of the SAM are as follows: (i) Tables of Economic Integration, (ii) Supply and Use Tables, (iii) the Input-Output Matrix for the year 2017, (iv) the 2016 Family Budget Survey (FBS), and (v) the National Socioeconomic Characterization Survey (CASEN 2017) from the Ministry of Social Development.

The purpose of using household surveys is to estimate the participation of income (CASEN) and expenditure (FBS) deciles, recovering the proportion of each decile, in different flows and weighting them by the macro account defined in the MacroSAM. This way, a $14x14$ MacroSAM becomes a $46x46$ SAM, where account 46 captures errors and omissions that occur during disaggregation in table 4.

4.1.1 Family Budget Survey and Expenditure Deciles

To carry out the disaggregation by income deciles, the FBS and CASEN surveys were considered. To disaggregate the households expenditure we clasified 1186 product of FBS in each activity defined by Central Bank. This raise a $12x10$ activity by decil matrix. Also, following definitions of FBS to construct deciles, we construct them adapting published codes. To disagregate savings we use fundamental definitions given by FBS, and also in concordance with Garrido & Morales (2023): FBS incomes less expenditures, raising a $1x10$ saving vector.

4.1.2 CASEN and Income Deciles

To disaggregate the macro-income accounts, we used the 2017 CASEN Survey, aligning the construction of each macro-income account following the definitions of the Central Bank. Variables for main job income, capital and mixed income, government transfers, and income from abroad were constructed. Description are available in 7.

The weighting of firm transfers in the deciles was extracted from Garrido & Morales (2023), while the disaggregation of government transfers and transfers from the rest of the world was estimated based on the 2017 CASEN Survey.

As result, we have five $10x1$ disagregated incomes vector: main job income, capital and mixed income, direct transfers of companies, direct government transfers and income from abroad. An additional problem to solve is how to disagregate the transfer from households to government. To do this, we use a grossed-up income that we construct to make the adjustment as input to determine the complementary global tax, which was divided into deciles. A summary of each account could be founded in table 6.

4.2 BFM data correction

We implemented the method proposed by Blanchet et al. (2018) using BFMCORR to what we define as comparable income. In this correction, individuals (rather than households) will be adjusted, additionally defining the credibility point of tax data, and we will use recalibration without creating new observations. Once the comparable income is corrected, we reestimate weights. With the new weights, there will be new income deciles, and therefore, three corrected income streams: labor income, capital and mixed income, and income from the rest of the world, giving rise to the corrected SAM.

CASEN data collect monthly and after-tax incomes, so they must be recalculated to annual incomes and grossed up according to the income bracket to which they belong. Chile has a policy of progressive taxes, which is considered in the grossing-up calculation.

To perform the correction, we use variables from table 8. We constructed the comparable income following the guidelines of Blanchet et al. (2018), according to their definitions of homologable income survey-tax for Chile. Results of the correction are in line with previously corrections made for Blanchet et al. (2018) for years 2009, 2011, 2013 and 2015. Merging results can be found in figure 5.

Finally, the application of the correction aims to find the new survey weights, extrapolatable to all variables in it. These weights have the advantage of maintaining the total estimated population, allowing the recalculation of various income streams and the participation of each decile in the total income of the affected streams.

5. Results

5.1 Income Corrected SAM

Results show an increased participation of decile 10 in all income streams, notably in main job income with an increase of 9 percentage points and in capital and mixed income with a 5 percentage point increase. At the same time, there is a decline in the participation of the first eight deciles in all treated income streams. This suggests that the impact assessment from the SAM should consider that incomes from household surveys might be biased due to underreporting and non-response from participants in the upper part of the distribution.

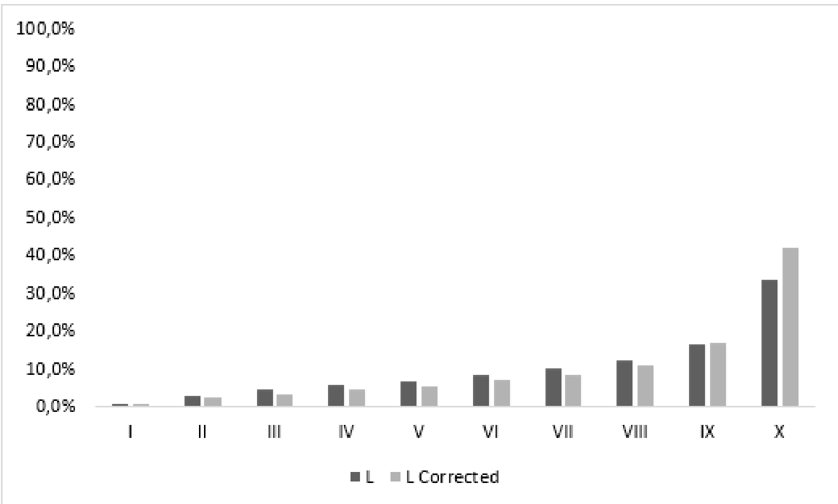

Figure 1: Income for main job, CASEN 2017

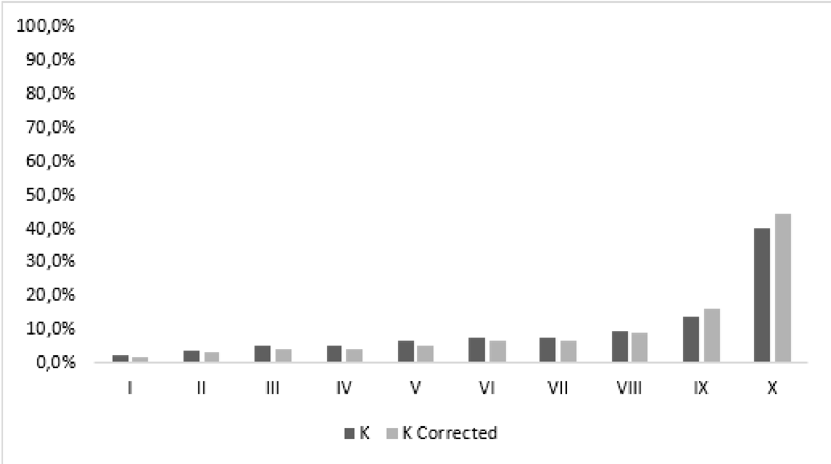

Figure 2: Capital and mixed incomes, CASEN 2017

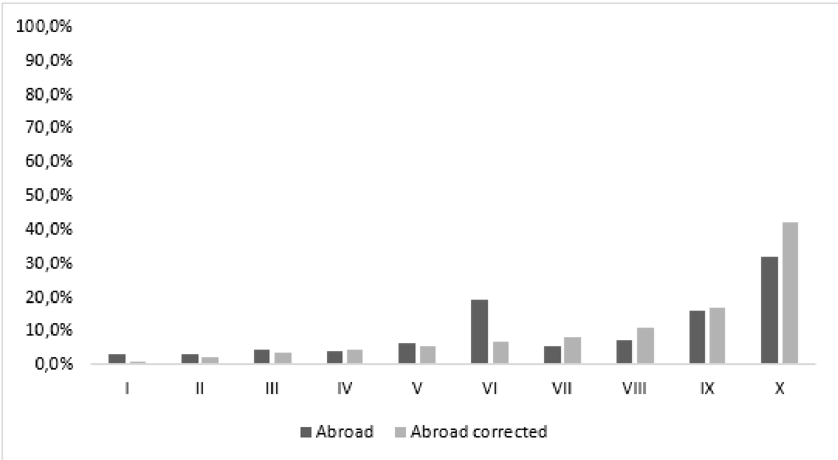

Figure 3: Incomes from abroad, CASEN 2017

Finally, changes in income from abroad distribution is observed. When we perform the correction, we observe a declination in 6 decile in twelve points. This is redistributed to 7, 8, 9 and 10 decile.

5.2 Relative Income Determination: the effect of fiscal expenditure on the income distribution

When the correction is implemented, deciles fiscal multipliers are affected. The tenth decile increases its multiplier by 18.5%, and the ninth decile by 2.7%. All other deciles experience decreases in their multipliers, indicating potential regressivity. Additionally, the overall impact of the fiscal multiplier has a slight decrease; however, the tenth decile's share within the total multiplier increases by 0.8 percentage points.

The second result of interest concerns the outcomes obtained from the redistribution matrix and the subsequent assessment of the fiscal effect. The non-normalized redistribution matrix $(e'Mx)R(x)$ shows that the fiscal expenditure implemented will not be entirely directed towards redistributing the shock among the other household groups be-

Table 2: Fiscal Multipliers

Mdx	Mdx corrected	$\sum_{j=1}^{n} Mdx_j$	$\sum_{j=1}^{n} Mdx_j$ corrected
0.087	0.077	31.112	30.980
0.137	0.112	31.112	30.980
0.187	0.15	31.112	30.980
0.201	0.16	31.112	30.980
0.236	0.19	31.112	30.980
0.291	0.24	31.112	30.980
0.316	0.267	31.112	30.980
0.384	0.348	31.112	30.980
0.533	0.575	31.112	30.980
1.259	1.492	31.112	30.980

Table 3: Redistribution Matrix

	I	II	III	IV	V	VI	VII	VIII	IX	X
I	0,9921	-0,0083	-0,0085	-0,0087	-0,0088	-0,0088	-0,0089	-0,0089	-0,0090	-0,0088
II	0,0212	1,0207	0,0204	0,0199	0,0199	0,0198	0,0196	0,0201	0,0202	0,0192
III	0,0364	0,0357	1,0353	0,0346	0,0346	0,0344	0,0342	0,0349	0,0351	0,0335
IV	0,0174	0,0164	0,0160	1,0155	0,0154	0,0151	0,0150	0,0156	0,0157	0,0148
V	0,0118	0,0106	0,0101	0,0094	1,0093	0,0090	0,0088	0,0094	0,0095	0,0087
VI	0,0116	0,0101	0,0095	0,0087	0,0086	1,0081	0,0079	0,0086	0,0087	0,0079
VII	-0,0216	-0,0235	-0,0242	-0,0248	-0,0251	-0,0256	0,9742	-0,0254	-0,0254	-0,0249
VIII	-0,0590	-0,0615	-0,0624	-0,0631	-0,0635	-0,0641	-0,0645	0,9357	-0,0645	-0,0627
IX	-0,1133	-0,1172	-0,1187	-0,1195	-0,1203	-0,1211	-0,1217	-0,1218	0,8777	-0,1186
X	-0,2221	-0,2319	-0,2357	-0,2383	-0,2404	-0,2422	-0,2439	-0,2439	-0,2449	0,7616

fore correction. Decile 10 shows that redistribution is no longer between the other deciles, given that sign turns negative in other deciles. Roland-Holst (1990) analyze this matrix to conclude that for each dollar in a demand shock all activities perform diferent. He pays attention to the agriculture sector, observing that the diagonal element in that sector is 1.28, which is in line with the forward linkage definition. In this empirical exercise, fiscal expenditure is less redistributed if the location is directly in each decile, a different conclusion that if we do not perform BFM correction.

In order to analyse the fiscal expenditure on final redistribution, is necessary to evaluate results of $R(x)dx$. For this purpose, we have endogenized all the accounts that make

Table 4: Corrected Redistribution Matrix

	I	II	III	IV	V	VI	VII	VIII	IX	X
I	0,9828	-0,0176	-0,0178	-0,0178	-0,0179	-0,0180	-0,0181	-0,0182	-0,0183	-0,0177
II	0,0000	0,9994	-0,0009	-0,0012	-0,0013	-0,0014	-0,0015	-0,0013	-0,0013	-0,0015
III	0,0052	0,0044	1,0041	0,0036	0,0035	0,0034	0,0032	0,0035	0,0035	0,0031
IV	-0,0166	-0,0176	-0,0179	0,9818	-0,0184	-0,0186	-0,0188	-0,0187	-0,0187	-0,0183
V	-0,0229	-0,0241	-0,0246	-0,0250	0,9747	-0,0255	-0,0257	-0,0256	-0,0257	-0,0251
VI	-0,0307	-0,0323	-0,0329	-0,0334	-0,0337	0,9660	-0,0343	-0,0341	-0,0342	-0,0334
VII	-0,0615	-0,0634	-0,0641	-0,0645	-0,0649	-0,0653	0,9344	-0,0657	-0,0659	-0,0638
VIII	-0,0860	-0,0886	-0,0896	-0,0900	-0,0906	-0,0911	-0,0915	0,9083	-0,0921	-0,0892
IX	-0,0731	-0,0771	-0,0786	-0,0798	-0,0805	-0,0814	-0,0820	-0,0816	0,9181	-0,0799
X	-0,0233	-0,0327	-0,0366	-0,0407	-0,0420	-0,0442	-0,0458	-0,0431	-0,0429	0,9557

Table 5: Redistribution matrix multipliers results

$R(x)dx$	$e'(Mx)R(x)dx$	$R(x)dx$ corrected	$e'(Mx)R(x)dx$ corrected
$3.2e^{-8}$	0.036	$2.29e^{-8}$	0.026
$4.91e^{-8}$	0.055	$2.72e^{-8}$	0.031
$6.47e^{-8}$	0.073	$3.24e^{-8}$	0.036
$4.56e^{-8}$	0.051	$9.78e^{-9}$	0.011
$3.88e^{-8}$	0.043	$2.28e^{-9}$	0.0026
$4.14e^{-8}$	0.047	$-3.9e^{-8}$	-0.003
$1.11e^{-8}$	0.012	$-3.1e^{-8}$	-0.035
$-2.1e^{-8}$	-0.023	$-5e^{-8}$	0.057
$-6.6e^{-8}$	-0.074	$-2.7e^{-8}$	-0.03
$-1.4e^{-7}$	-0.154	$7.56e^{-8}$	0.085

up the SAM, except for the government and margins account. This allows evaluating the performance of the government account in the economy, where the analysis focuses mainly on income deciles. To do this, the assessment contrasts the SAM without corrected incomes and another SAM with the BFM implemented.

The results suggest that fiscal expenditure benefits deciles 1 to 7, as the direction of the effect is positive for all of them (column 1 and 2). In addition, one *chilean peso* invested in the government account, is positively redistributed between the first and the seventh decile before applying the correction (0.036 pesos for the first, 0.055 for the second, and so on up to 0.012 for the seventh decile). However, redistribution is affected upon correction, where the tenth decile receives the highest redistributive benefits (0.085).

When performing the correction, the impact is received by decile 10. The change of sign, following the definition of the redistributive matrix, suggests that fiscal expenditure improves the economic situation of this decile. Even though the direction of the effect is negative for deciles 6 to 9, we are suggesting that fiscal expenditure is regressive when we perform corrections.

The findings align with the work conducted by Garrido & Morales (2023). After a fiscal shock, the tenth decile will receive 14 times more income than the first decile (and 19 times more when the correction is applied). Moreover, even though tax payments are predominantly contributed by the tenth decile (91%), its role in redistribution is minor (Contreras, 1999; Repetto, 2016).

6. Discussion

To comprehend this regressiveness, from the SAM, it's necessary to observe how fiscal expenditure is defined in this context. Fiscal expenditure encompasses the entire government column, which includes:

1. Government expenditure on economic activities (25.363)
2. Subsidies and transfers to households (5.072)

	Public Administration		Personal Services	
	Capital Variation	Labor Variation	Capital Variation	Labor Variation
I	0,2%	-0,4%	2,0%	-0,4%
II	-0,3%	-0,1%	-0,2%	-0,2%
III	-0,6%	-0,7%	1,6%	0,1%
IV	-0,2%	-0,3%	-4,2%	0,7%
V	-2,2%	0,6%	5,0%	-0,7%
VI	0,3%	1,7%	1,3%	2,3%
VII	22,0%	9,3%	-3,1%	3,0%
VIII	-8,2%	3,6%	-1,1%	5,0%
IX	24,2%	3,7%	10,8%	3,8%
X	4,7%	5,3%	-5,1%	7,6%

3. Fiscal savings (1.561)

Therefore, the increase in fiscal expenditure is not only determined by a subsidy but by the entire column. Thus, the analysis deserves attention regarding how the government spends on activities and what happens with the correction. Government spending on economic activities is concentrated in personal services (52%) and public administration (43.6%). In both activities, 79% of the value added corresponds to wages, and the remaining 21% is gross operating surplus.

This implies that the increase in fiscal spending would primarily impact the wages of individuals working in personal services and public administration. What happens to the incomes of individuals working in these sectors when the correction is made? Those who receive the most significant relative increases in correction in these two activities are individuals from the 9th and 7th deciles, where individuals working in public administration see relative increases of 24% and 22%, respectively, with the 7th decile also experiencing the highest relative increase in primary labor income (9.3%). On the other hand, in the services sector, the 10th decile experiences a reduction in capital income (5%) contrasting with the increase in capital income of the 9th decile (10.7%). This increase is the highest within the entire distribution, resulting from the correction.

It's worth noting that among economic activities, commerce employs the most people (26.8%), followed by personal services (23.8%). Public administration represents 2.55% of the total workforce.

Therefore, the hypothesis is that the increase in fiscal spending would improve the situation of households in the lowest deciles and worsen the situation of deciles 6, 7, 8, 9, due to the aggregate variations experienced in their labor and capital incomes.

All observed variations are the result of the applied correction. This underscores the importance of considering that household surveys fail to capture the incomes of the upper part of the distribution and how efforts to reconcile macro and micro income estimates can distort the instruments used for analyzing impact and redistribution analyses.

7. Conclusion

The main purpose of this paper is to provide evidence of the importance of reconciling macro and micro income accounts for policy impact evaluation. One tool that draws from both sources is the social accounting matrix, as it considers the complete flow of the economy, incorporating households as a macro account. This incorporation prompts a rethinking of decile calculations while acknowledging that one of the problems with self-reported income capture occurs in the upper part of the distribution. By considering the development of innovative corrections, using tax data as true information for the upper part of the distribution in this case, conclusions of the results obtained in an applied exercise is enforced.

One aspect that we are not considering is to separate fiscal expenditure between households and capital and activity expenditures. In order to evaluate a subsidy, it could be interesting to perform a SAM considering only households direct transfers as exogenous account. We suppose in this paper that when fiscal expenditure is performed, all government accounts involved are affected.

On the other hand, the procedures incorporated in the correction solely involve data derived from tax records. We not considered another types of correction, as retained business profits. For example, business profits retained in a particular year can be transformed into capital gains for the same year (Gutiérrez et al., 2015). However, this item is not considered within the CASEN questionnaire, potentially leading to even greater distortions in the results found in relative income construction.

In this document, we reflect the impact of the correction based on the proposal of Roland-Holst & Sancho (1992) and Roland-Holst (1990), which highlights the importance of considering relative income to observe the influence of an institution on the economy. In this case, the results indicate that decile 10 improves their initial condition when the government institution is considered exogenous. Despite the limitations of the SAM, this result could suggest that fiscal policy is regressive for income redistribution in the other deciles.

Finally, the amount of information provided by the SAM can be utilized to analyze other demand shocks that shed light on the institutions that could generate an impact on income redistribution in favor of individuals located in the lower deciles.

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A. MacroSAM and institutions included

To conduct the results and disagregation, we use a Macro SAM, following Fuentes Risco, 2017 guidelines.

	Commodities	Activities	L	K	Companies	Households	Government	VAT	Production taxes	Tariffs	Capital account	Stock flow	Margins	Rest of the world
Commodities		145.971				113.984	25.363				37.781	429	-	51.115
Activities	310.199													
L		69.547												43
K		90.314												5.486
Companies				28.226										
Households			69.271	53.569	- 156		5.072							1.037
Government				1.360	7.827	2.920		14.705	4.367	817				
VAT	14.705													
Production taxes		4.367												
Tariffs	817													
Capital account					20.556	11.889	1.561							4.205
Stock flow											429			
Margins	-													
Rest of the world	48.923		319	12.645										

Figure 4: MacroSAM, 2017

This is the list of the accounts/institutions included in the Social Accounting Matrix used in the paper

Table 6: Accounts used to build the social accounting matrix

Agricultural forestry and fishing	Activity—Commerce, hotels, and restaurants	Household Decile 7
Mining		Household Decile 8
Manufacturing industry	Activity—Transport, communications, and information services	Household Decile 9
Electricity, gas, water, and waste management	Activity—Financial intermediation	Household Decile 10
Building	Activity—Real estate and housing services	Government
Commerce, hotels, and restaurants	Activity—Business services	VAT
Transport, communications, and information services	Activity—Personal services	Production tax
Financial intermediation	Activity—Public administration	Duties
Real estate and housing services	Wage payments	Capital Account
Business services	Capital payments	Stock Flow
Personal services	Firms	Markup
Public administration	Household Decile 1	Rest of the World
Activity—Agricultural forestry and fishing	Household Decile 2	Errors and omissions
Activity—Mining	Household Decile 3	
Activity—Manufacturing Industry	Household Decile 4	
Activity—Electricity, gas, water, and waste management	Household Decile 5	
Activity—Building	Household Decile 6	

Table 7: Variables used from CASEN in the macro accounts of SAM

Main job income	**Capital and mixed income**	**Income from abroad**
Salaries	Self-Employed Income	Income from abroad
Overtime	Work done before the previous month	
Commissions	Renting of machinery, animals, or equipment	
Tips	Interest on deposits	
Housing, Transportation, Education	Dividends from stocks	
Non-accountable Per Diems	Withdrawal of profits from companies	
Other Monetary Incomes	Retirement and pensions	
Bonuses or Year-End Bonuses		
Thirteenth Month or Additional Months		
In-kind compensation		

Source: Ministry of Social Development and Central Bank

B. Merging point results

Table 8: Variables used in standardization

y1	Net Salary from Main Job
y6	Total Net Income from Other Jobs or Occupations
y10	Total Net Income from Other Jobs or Occupations
y14b	Work done before the previous month
y3a	Income from Overtime Hours
y3b	Income from Commissions
y3d	Income from Housing, Transportation Allowances
y3f	Other Incomes
y4b	Bonuses
y4c	Additional Salary
y4d	Other Similar
y7	Withdrawal of money from the business for personal expenses
y14b	Work done before the previous month
y12b	Renting of machinery, animals, or equipment
y15a	Interest on Deposits
y15b	Dividends on ownership shares
y15c	Withdrawal of company profits
y16a	Rental of agricultural properties
y26.2c	Retirement or Old Age Pension
y26.2em1	Retirement or Disability Pension
y26.2f	Retirement or Disability Pension (second amount)
y26.2g	Widow's Pension or Survivor's Pension
y26.2h	Orphan's Pension

Source: CASEN 2017 and Blanchet, Flores & Morgan definitions

Computed merging point shows that results is aligned with Blanchet et al., 2018 findings. Merging point is founded on $P80$ and we corrected 5.83% population data.

Table 9: The structure of the corrected population

Population above Merging Point in Tax data:	20.00%
Population above Merging Point in Survey data:	14.17%
Share of total population that is corrected	5.83%

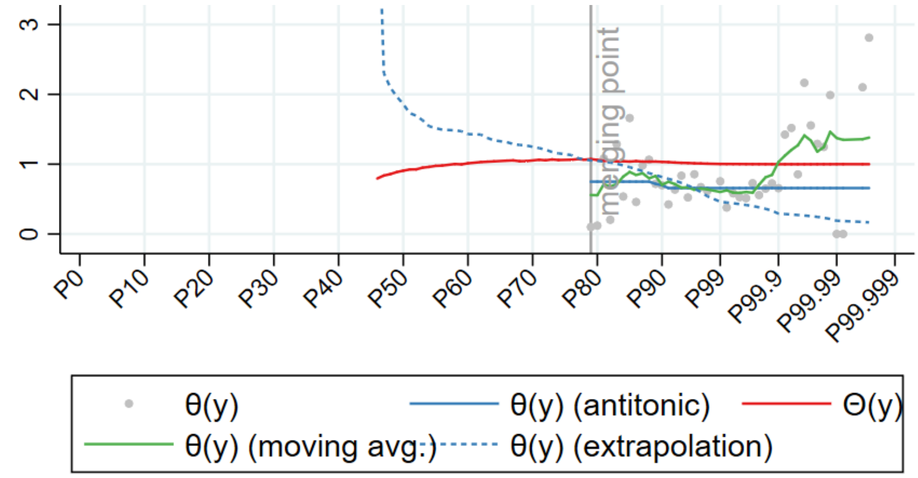

Figure 5: Merging point, CASEN 2017

C. Robustness check

To conduct a robustness check, an additional MacroSAM 2017 was implemented. Drawing from the methodology outlined in Marentis et al. (2021), we utilized their Social Accounting Matrix (SAM) framework to disaggregate the macroeconomic accounts.

	Commodities	Activities	L	K	Companies	Households	Government	VAT	Production taxes	Tariffs	Capital account	Stock flow	Rest of the world
Commodities		310.310											
Activities	146.076					113.984	25.363				37.781	429	51.122
L	69.595												43
K	90.440												5.486
Companies				59.836									
Households			69.319	22.102	31.941		4.902						1.037
Government				1.344	8.032	2.920		14.705	4.200	817			
VAT		14.705											
Production taxes	4.200												
Tariffs		817											
Capital account					19.863	12.397	1.752						4.198
Stock flow											429		
Rest of the world		48.923	319	12.645									

Figure 6: MacroSAM (Marentis et al., 2021)

They explored alternative definitions for constructing macroeconomic accounts, primarily focusing on transfers from companies to households, variations in the structure of household incomes, and additional total income transfers from the government to households.

Our additional consideration involves the distribution of household incomes derived from companies. The main exercise consider the same amount for all decils given the lower mount and following previous works. Nevertheless, following Marentis et al. (2021) we need to distribute 31.941 billion Chilean pesos. They consider the same mixed and capital income structure on this transference, and according with them we applied this structure. Also, we employed quintiles disaggregation to calculate SAM multipliers, resulting in a SAM structure of $41x41$.

The results indicate that additional fiscal expenditure exhibits regressive effects on quintile IV but becomes progressive towards quintile V after corrections are made. This underscores the notion that fiscal expenditure enhances redistribution, as it is not solely the wealthiest population group that bears the brunt of the impact, when principal ob-

Table 10: Redistribution matrix, Marentis et al. (2021)

Quintile	Redistribution	Non-normalized redistribution	Income corrected Redistribution	Non-normalized Income corrected redistribution
I	3,1E-07	0,3777	7,3E-08	0,0894
II	2,5E-07	0,3065	8,7E-08	0,1062
III	1,8E-07	0,2174	7,0E-08	0,0861
IV	4,7E-08	0,0570	-4,5E-09	-0,0055
V	-1,5E-07	-0,1879	3,8E-07	0,4682

jective is to mitigate inequality trends.