An income corrected Social Accounting Matrix

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Summary

- The objective is to analyse redistributional household income measures when a shock, interpreted as targeted fiscal policy, is implemented.
- We use SAM given that we can estimate direct, indirect and inducted effects of fiscal policies and its effects on the household income distribution.
- We use household data to construct and dissagregate our SAM.
- However, there are undercoverage issues in household surveys at the top tail of the income distribution.

Summary

- Our main contribution is that we show how our redistributive SAM analysis changes due to a income distribution correction.
- Our new redistribution matrix depends on four terms:
  - i The previous redistributive matrix.
  - ii The change in shares due to the correction method.
  - iii The change in the SAM multipliers implied by the correction.
  - iv The combination of the share and the SAM multiplier effect.
- We exemplify our results by using a commonly used income distribution adjustment: the Blanchet et al. (2022) method (hereafter BFM)) using Chilean data.

Summary

- We assume two policy scenario: (i) a targeted subsidy GDP shock of 0.4% to the bottom 40% of the household distribution, and (ii) a targeted subsidy GDP shock of 5% to the bottom 90% of the household distribution. We decompose the effects of both policies into our four terms.
- Our results confirm that not correcting household surveys to perform SAM distributional analysis can lead to severe bias the redistributional effects of fiscal policies in the economy.

Introduction

1. 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 and Thorbecke, 2006).
2. In this regard, the role of government has been constantly assessed to determine its involvement in reducing inequality, as fiscal policy decisions vary across the globe (Benabou, 2000).

Introduction

- SAMs are frequently used to assess the impacts of exogenous shocks (such as increase in government expenditures) on incomes, including all the interrelations in an economy. For example:
  1. Croes and Rivera (2017); Ge and Lei (2013); Pieters (2010) analyze SAM to evaluate inequality and poverty trends, taking agriculture, mining and tourism role.
  2. Roland-Holst (1990); Roland-Holst and Sancho (1992) $\longrightarrow$ propose to use a zero-sum redistributional matrix R
     - ★ de Miguel Velez and Perez-Mayo (2006)
     - ★ De Miguel-Velez and Perez-Mayo (2010)
     - ★ Garrido and Morales (2023)
- In this paper, we start by constructing a Commodity by Industry SAM and we analyze how Fiscal Expenditure affects the household income distribution. With this, we build, following Vásquez et al. (2024) a redistributional matrix, that redistributes a shock only at the household level.

Main contribution

- Part of the problem in studying inequality has been the discrepancy between the data sources that construct income macro and micro-accounts, $\longrightarrow$ failure to capture the incomes of the wealthiest individuals, ie. undercoverage at the top of the income distribution (Burdín et al., 2022; De Rosa et al., 2022; Jenkins, 2022; Lustig et al., 2020; Zwijnenburg, 2022)
- Our main contribution is to propose and implement a methodology to measure the effects of Top-Correcting the household income distribution in the SAM distributional analysis. In particular, we decompose the zero sum R redistribution matrix Roland-Holst (1990); Roland-Holst and Sancho (1992), including undercoverage at the top, into four terms. That is, we connect the inequality measurement literature and tools with the SAM redistributional methods.
- As an additional contribution we quantitatively measure all of this terms for Chile and employing a commonly used adjustment methodology, the BFM.

SAM definitions

	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	

We are interested on multipliers of households when government is exogenous. T_{15} encompasses labor and capital/mixed income, T_{23} are income from abroad[a].

[a] T_{20} are marginal in our SAM

Multiplier model

This problem can be expressed in matrix notation, decomposing endogenous and exogenous accounts or Y en AY:

$$Y = \begin{pmatrix} Y_s \\ Y_k \end{pmatrix} = \begin{pmatrix} A_{ss} & A_{sk} \\ A_{ks} & A_{kk} \end{pmatrix} \begin{pmatrix} Y_s \\ Y_k \end{pmatrix} \tag{1}$$

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

$$Y_s = A_{ss} Y_s + A_{sk} Y_k \tag{2}$$

or

$$Y_s = M * x \tag{3}$$

And obtain traditional equations $M = (I - A_{ss})^{-1}$ and $x = A_{sk} Y_k$. The elements M_{ij} of such matrix represent the quantitative effect that an injection in the endogenous account j has over account i including all the interactions in the economy.

Redistribution Matrix

Matrix M does not report changes of the relative position (income share) of an institution. Roland-Holst (1990) define the relative income vector y_s to analyze the redistributive effects of an exogenous income shock on the income share of an institution (for example the first decile):

$$dy_s = d(\frac{y_s}{e'y_s}) \tag{4}$$

Where e' is a unit row vector. Using the differentiation matrix in equation (4), the redistribution model can be expressed as follows:

$$R = \frac{1}{e'y_s}[I - \frac{y_s}{e'y_s}e']M \tag{5}$$

$$dy_s = R(x)dx \tag{6}$$

Note that this is a zero col sum matrix ($\sum_{i=1}^{h} R_{,ij} = 0, \forall j$). The element R_{ij} means the redistributional effect of an unitary injection in the account j on the account i

Redistribution Matrix in the households accounts

- Typically, we are insterested in a subset of accounts, for example, the ten deciles of the household income.
- Following Vasquez et al. (2024) we assume that we are interested in the redistribution that happens only in h accounts with $h < m$.
- Assume z_h is a vector that contains our account of interest (the household deciles), and $y_h = \frac{z_h}{e' z_h}$ the income share related to the account of interest.

$$z_h = M_{hm} \cdot x$$

$$dy_h = \frac{1}{e' z_h} \left[I - \frac{z_h e'}{e' z_h} \right] M_{hm} \cdot dx = R_h \cdot dx, \tag{7}$$

Which R_h is a *hxm* redistributional matrix, that redistributes the effect on the households accounts a generic shock from any of the endogenous accounts. The colsum of R_h ($\sum_{i=1}^{h} R_{h,ij} = 0, \forall j$) continues to be 0.

SAM redistributional analysis and undercoverage at the upper tail

- When SAMs are constructed we use household survey distributional information. Nevertheless, household surveys do not adequately measure the the top tail of the income distribution.
- Folowing (De Rosa et al., 2022; Lustig et al., 2020) the undercoverage at the upper tail can be due to:
  - i Sparseness: Survey design affect coverage
  - ii Item non-response: Individual does not answer part of a survey
  - iii Unit non-response: Individual does not answer any part of a survey
  - iv Underreporting: Individual report less income than true

- There are several methods to adjust for undercoverage at the upper tail (Brunori et al., 2022; Carranza et al., 2023).
- In this context, the magnitude of the undercoverage correction at the upper tail of the household distribution can affect the SAM redistributional analysis.
- Why? Undercoverage adjustments change the income shares from y_h to $\hat{y}_h$
- This implies that the multiplier matrix changes from M_{hm} to $\hat{M}_{hm}$ implying that the value of the accounts contained in z_h changes to $\hat{z}_h$.
- There are several implications for our SAM redistributional analysis

We have that:

$$\hat{z}_h = \hat{M}_{hm} \cdot x$$

Thus, we have that:

$$d\hat{y}_h = \frac{1}{e'\hat{z}_h}\left[I - \frac{\hat{z}_h e'}{e'\hat{z}_h}\right]\hat{M}_{hm} \cdot dx = \hat{R}_h, \tag{8}$$

Which is a corrected redistribution matrix

- We are interested in the redistribution impacts of an exogenous injection, in particular government expending. We can set the following condition:
  Condition 1: $z_h e' = \hat{z}_h e$
- Condition 1 means that the sum of the studied accounts is equal before and after the top income correction. That is, the top income correction does not add additional value added to the economy.

Under condition 1, we can decompose $\hat{y}_h$ as follows:
Recall the definitions of R_h, $y_h =$ and $\hat{y}_h$, we have that:

$$\hat{R}_h = R_h + \frac{1}{e' z_h}\left[(y_h - \hat{y}_h)\, e'\right] \cdot M_{hm} + \frac{1}{e' z_h}\left[I - y_h e'\right]\left(\hat{M}_{hm} - M_{hm}\right) + \frac{1}{e' z_h}\left[(y_h - \hat{y}_h)\, e'\right]\left(\hat{M}_{hm} - M_{hm}\right),$$

Notice that $A = \frac{1}{e' z_h}\left[(y_h - \hat{y}_h)\, e'\right] \cdot M_{hm}$ is the effect on the redistribution matrix due to the change in the households accounts shares implied by income distribution correction, $B = \frac{1}{e' z_h}\left[I - y_h e'\right]\left(\hat{M}_{hm} - M_{hm}\right)$ is the effect on the redistribution matrix due to the change in the SAM multipliers induced by the correction in the income distribution, and $C = \frac{1}{e' z_h}\left[(y_h - \hat{y}_h)\, e'\right]\left(\hat{M}_{hm} - M_{hm}\right)$ is the effect on the redistribution matrix due to the combination of the change in the SAM multipliers and the households accounts shares implied by income distribution correction.

Empirical Application to the Chilean economy:

SAM Datasources: MacroSAM (SNA and TIO), CASEN, EPF:

- System of National Accounts for complete a 14 x 14 MacroSAM (2017)
- Dissagregation of Commodities, Activities, Final demand and Value Added from Input-Output Matrix published by Central Bank (2017)
- Dissagregation in deciles of household expenditure using Family Budget Survey (2016)
- Dissagregation in deciles of household income using National Socioeconomic Characterization Survey (2017)

Plus margins, we construct a 46 x 46 SAM, and we are interested on accounts 28 to 37, which contains D1 to D10.

BFM (Blanchet et al., 2022)

- Armonization of two information sources: tax data and survey data.
- Assumption: we believe on survey data until the merging point, i.e, the point of discrepancy between two sources.
- Based on the tax brackets, a Pareto distribution is constructed and assumed to be true for high-income segments of the distribution. This is armonized with an income distribution from survey data.
  - Comparable income
  - Merging point: is endogenous (contribution)
  - **Reweighting**
  - Changes in deciles participation

BFM estimates in the Chilean economy

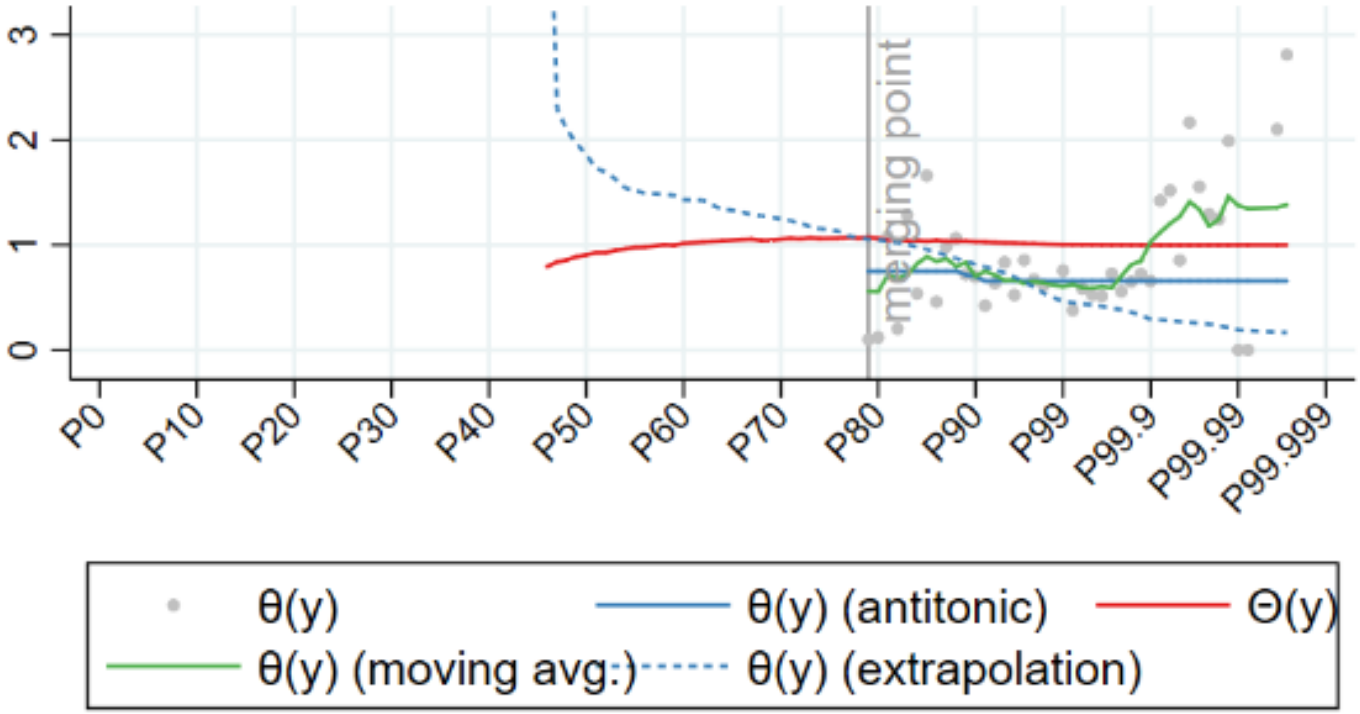


Figure 1. Merging point, CASEN 2017

Merging point is founded on $P80$, in line with previous results for Chile. Also, corrected population is 5.86%.

BFM effect

Deciles	y_h	$\hat{y}_h$
1	0.0230	0.0201
2	0.0371	0.0304
3	0.0511	0.0410
4	0.0551	0.0439
5	0.0650	0.0537
6	0.0801	0.0662
7	0.0871	0.0739
8	0.1060	0.0967
9	0.1474	0.1595
10	0.3481	0.4145

Table: Uncorrected and BFM corrected deciles

Policy evaluations

- To evaluate the performance of our method, We perform two re-distributive fiscal policy simulations incoroporating all the interactions in the economy.
- Simulation 1: Lump sum fiscal subsidy of 0,4% GPD (Wealth tax expected revenues) 40% of the population. Same amout for each decile.
- Simulation 2: Lump sum fiscal subsidy of 5% GPD to the 90% of the population (Universal Basic Income). Same amount for each decile.

Policy shock 1: Lump sum fiscal subsidy of 0,4% GPD (Atria et al., 2023)

Decile	$\hat{R}_h(dx)$	$R_h(dx)$	$A(dx)$	$B(dx)$	$C(dx)$
1	0,0070	0,0069	0,0004	-0,0003	-1,3E-06
2	0,0072	0,0070	0,0009	-0,0007	-3,1E-06
3	0,0069	0,0066	0,0014	-0,0011	-4,6E-06
4	0,0069	0,0065	0,0016	-0,0012	-5,1E-06
5	-0,0020	-0,0024	0,0016	-0,0012	-5,2E-06
6	-0,0024	-0,0028	0,0019	-0,0015	-6,4E-06
7	-0,0026	-0,0030	0,0018	-0,0014	-6,1E-06
8	-0,0033	-0,0036	0,0013	-0,0009	-4,2E-06
9	-0,0051	-0,0048	-0,0017	0,0014	5,57E-06
10	-0,0127	-0,0104	-0,0092	0,0069	3,04E-05

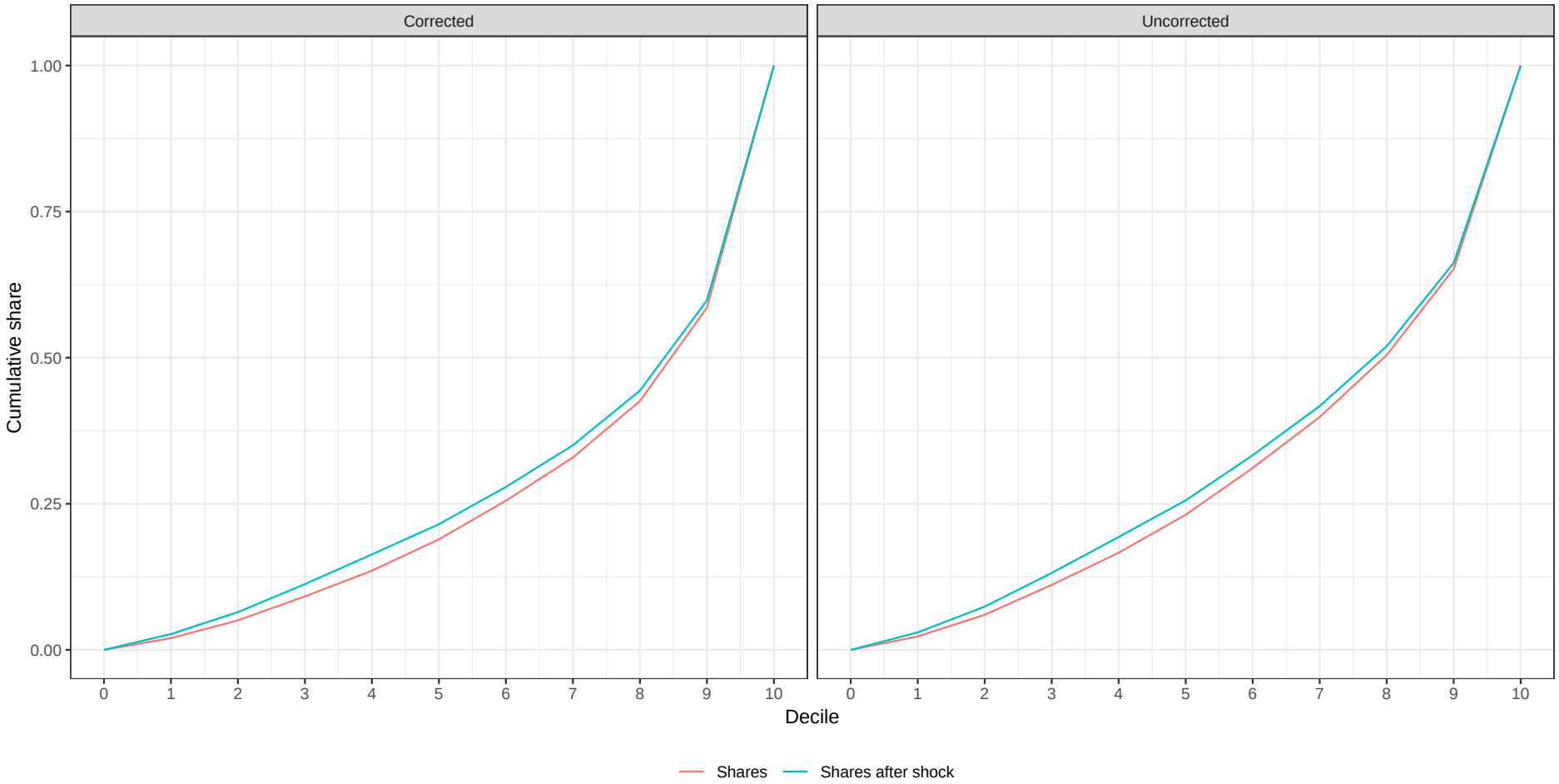
Table: Redistributive matrix decomposition

Policy shock 2: Universal Basic Income (Hochman et al., 2024)

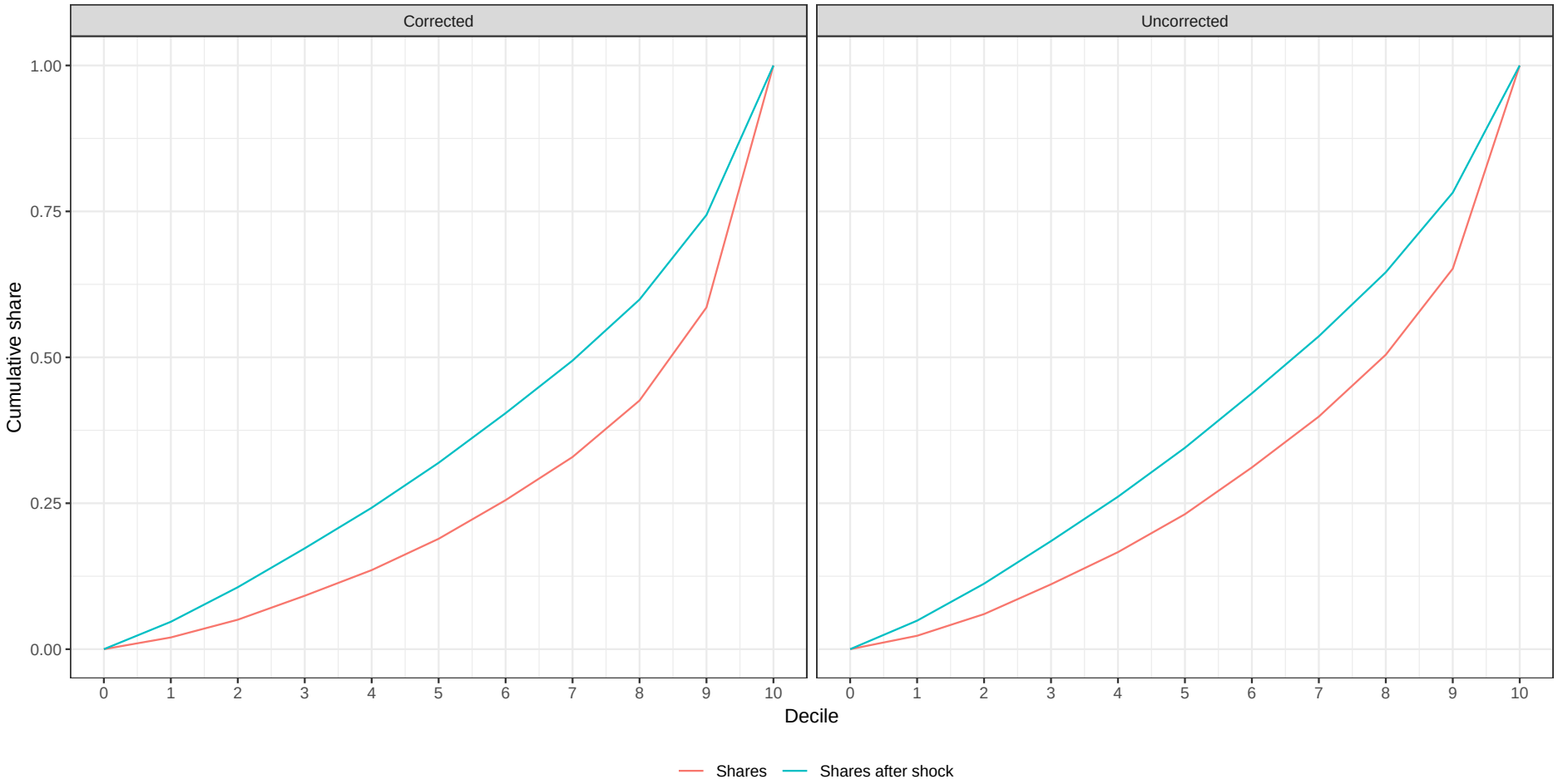
Decile	$\hat{R}_h(dx)$	$R_h(dx)$	$A(dx)$	$B(dx)$	$C(dx)$
1	0,0269	0,0260	0,0049	-0,0040	-1,6E-05
2	0,0289	0,0263	0,0118	-0,0092	-3,9E-05
3	0,0257	0,0219	0,0174	-0,0135	-5,8E-05
4	0,0256	0,0211	0,0194	-0,0148	-6,4E-05
5	0,0234	0,0188	0,0197	-0,0151	-6,5E-05
6	0,0189	0,0133	0,0241	-0,0185	-8E-05
7	0,0162	0,0107	0,0231	-0,0175	-7,6E-05
8	0,0079	0,0037	0,0161	-0,0119	-5,3E-05
9	-0,0147	-0,0110	-0,0212	0,0174	6,98E-05
10	-0,1589	-0,1307	-0,1155	0,0870	0,000381

Table: Redistributive matrix decomposition

Simulation 1



Simulation 2



Conclusion

- Importance of correctly measure the top tail of the income distribution on the SAM analysis.
- Effect of a redistributive shock can be even larger after adjusting for undercoverage at the top of the distribution.
- Future research compare the magnitudes of such effects to different undercoverage methods following Brunori et al. (2022); Carranza et al. (2023).
- Compare the effect on different countries and evaluate which production/consumption networks are more sensitive to top correction adjustments.

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