

Heterogeneity in Macroeconomics

The Compositional Inequality Perspective

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Motivation

- Consider two types of heterogeneity
 - ▶ *Behavioral heterogeneity*: distribution of savings and consumption across the income distribution
 - ▶ *Endowment heterogeneity*: distribution of capital and labor incomes across the income distribution
- Macroeconomic models with heterogeneous agents adopt specific *behavioural* and *endowment heterogeneity* assumptions
 - ▶ [Kaldor \(1955\)](#): capitalists save capital and workers consume labor income
 - ▶ [Kaplan et al. \(2018\)](#): capitalists and workers earn from multiple sources but unclear association with their total income
- Which set of heterogeneity assumptions best describe modern economic systems?

Contribution

- This paper presents a framework to jointly study behavioral and endowment heterogeneity from an empirical perspective
- We adopt the concept of *compositional inequality* to measure behavioural and endowment heterogeneity across more than 20 economies over the past 2 decades
- Three main empirical results stand out:
 - ① Heterogeneity matters and is country-specific
 - ② Negative relationship between heterogeneity (any type) and aggregate savings rate
 - ③ Inverted U-shaped relationship between heterogeneity (in both dimensions) and growth

Literature

- Heterogeneity in macroeconomics: *empirical* studies
 - ▶ Behavioral heterogeneity:
 - ★ Dynan et al. (2004), Saez and Zucman (2016), Jappelli and Pistaferri (2014), Bunn et al. (2018)), among others
 - ▶ Endowment heterogeneity:
 - ★ Berman and Milanovic (2020), Iacono and Ranaldi (2022), Ranaldi (2022), Ranaldi and Milanovic (2022), Iacono and Palagi (2022), among others
- Heterogeneity in macroeconomics: *theoretical* studies
 - ▶ Kaldorian models: Kaldor (1955), Pasinetti (1962)
 - ▶ TANK & HANK models: Aiyagari (1994), Kaplan et al. (2018), Bilbiie (2020)
 - ▶ OLG models: Stiglitz (2015), Mattauch et al. (2022)
 - ▶ ABM: Dosi et al. (2010), Botta et al. (2021), Palagi et al. (2021)

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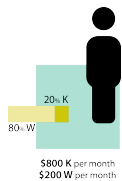
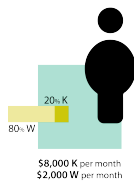
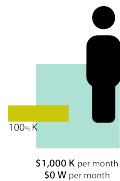
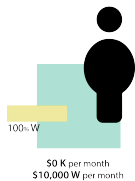
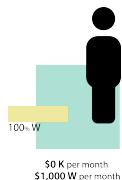
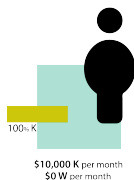
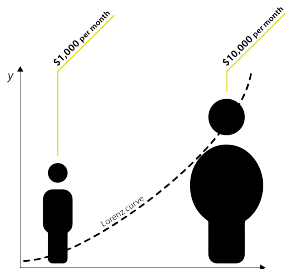
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Compositional Inequality

Illustration



Compositional Inequality

Definition

- Compositional inequality is the extent to which two income components are distributed unevenly across the income distribution (Ranaldi, 2022)
- Compositional inequality is
 - ▶ **Maximal** when the two components are separately distributed at the top and at the bottom of the income ladder (**Societies I and II**)
 - ▶ **Minimal** when each individual has the same relative shares of the two income components in her total income (**Society III**)

Compositional Inequality

Interpretations

① Macroeconomic

- ▶ Compositional inequality *links* the functional and personal distributions of income
 - ★ If the rich earn all capital income in the economy an increase in the capital share increases the income of the rich

② Varieties of Capitalism

- ▶ *Classical capitalism*: high compositional inequality of capital and labor → (Milanovic 2017)
- ▶ *New capitalism*: low compositional inequality of capital and labor → (Milanovic 2017, 2019)

③ Heterogeneity

- ▶ High (low) compositional inequality is associated to high (low) behavioral/endowment heterogeneity (across the income distribution)

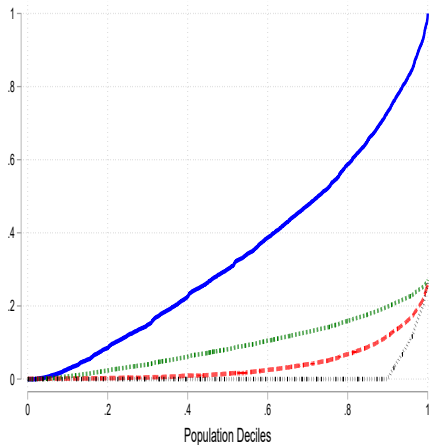
Measurement

IFC Index

- To measure compositional inequality we use the income-factor concentration (IFC) index (Ranaldi, 2022)
- The IFC index is constructed by means of three concentration curves (case of *capital* and *labor*):
 - ① *Zero-concentration curve* (\approx equality line for Gini)
 - ★ describes the distribution whereby all individuals have the same composition of capital and labor income
 - ② *Actual-concentration curve* (\approx Lorenz curve for Gini)
 - ★ describes the actual way capital income is distributed across the income distribution
 - ③ *Maximum-concentration curve* (\approx axis x and y for Gini)
 - ★ describes a distribution whereby the poorest earn labor income, and the richest earn capital income

Concentration Curves

Italy 1989



— Lorenz Curve - - - Conc. Curve Capital ····· Zero-Conc. Curve
····· Max-Conc. Curve

Measurement

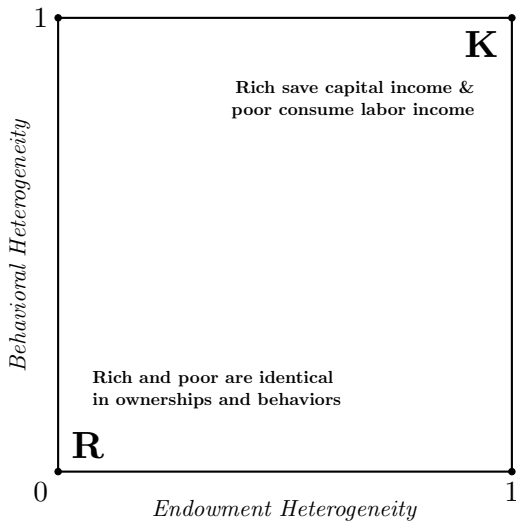
IFC Index

- If \mathcal{A} is the area between the zero- and the actual-concentration curve and \mathcal{B} the area between the zero- and the maximum-concentration curve the IFC index is defined as

$$\mathcal{I} = \frac{\mathcal{A}}{\mathcal{B}} \quad (1)$$

- The IFC ranges between 1 and -1
- Denote \mathcal{I}_{kl} and \mathcal{I}_{sc} as the IFC for **capital and labor** and for **savings and consumption**, respectively
- We define the *Heterogeneity Box* as the set of all possible combinations of the two indicators of compositional inequality

Heterogeneity Box



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Database

Structure

- **Structure:** average per capita labor income, capital income, savings, and consumption by percentile*, country and year (\$2011 PPP-adjusted)
- **Data:** Luxembourg Income Study (LIS) Database
- **Years:** \approx 1995 to 2018
- **Definitions**
 - ▶ *Capital income:* interest incomes + dividends + rental incomes
 - ▶ *Labor income:* wage income + self-employment income + pensions
 - ▶ *Consumption:* 12 categories of consumption
 - ▶ *Savings:* market income + transfer – consumption
- **Unit of Analysis:** Individual

Database

Coverage

Country	ISO3	N. Years	Country	ISO3	N. Years
Australia	AUS	2	Palestine	PSE	1
China	CHN	2	Peru	PER	4
Estonia	EST	1	Poland	POL	4
France	FRA	3	Romania	ROU	2
Georgia	GEO	2	Russia	RUS	3
Guatemala	GTM	3	Serbia	SRB	1
Hungary	HUN	6	Slovenia	SVN	6
India	IND	2	South Africa	ZAF	5
Israel	ISR	8	South Korea	KOR	4
Italy	ITA	8	Switzerland	CHE	3
Ivory Coast	CIV	1	Taiwan	TWN	8
Mexico	MEX	11	Vietnam	VNM	2

Table: List of countries and years covered

1 Motivation

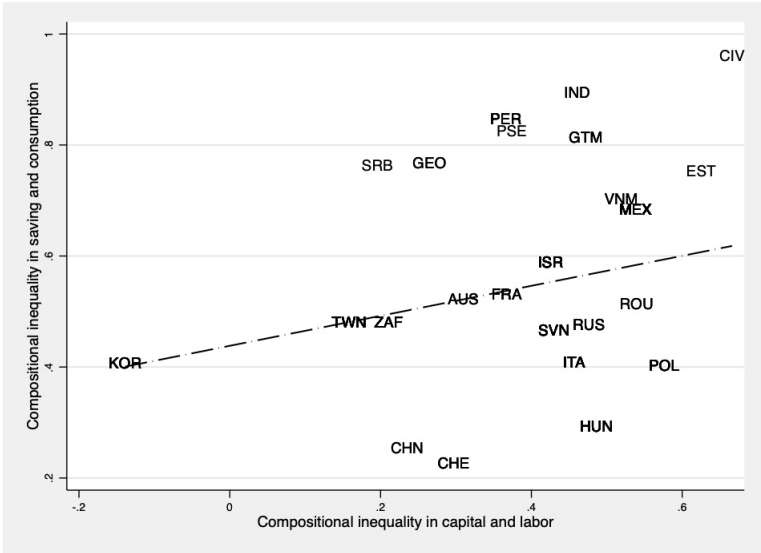
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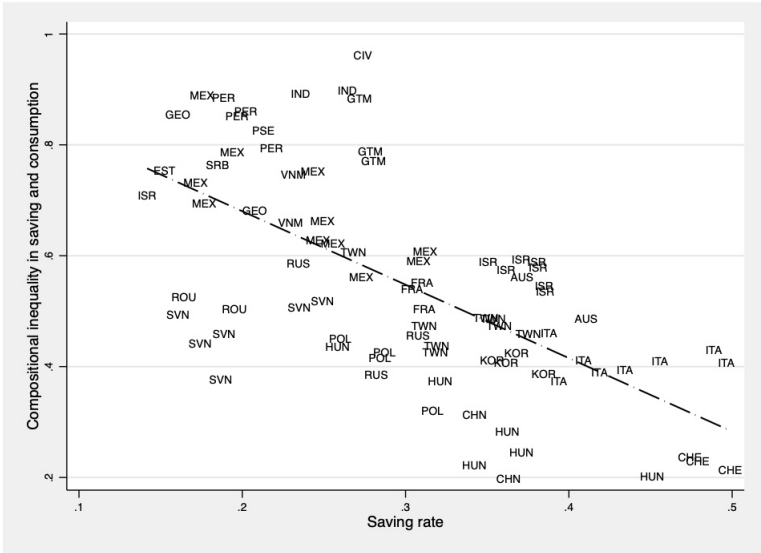
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Empirical Overview

- Positive values of both indicators of heterogeneity
- South Korea and China display, on average, low levels of behavioral and endowment heterogeneity
- Western countries like Italy, France, and Australia display moderate levels of heterogeneity in both dimensions
- Mexico and India display high levels of heterogeneity in both dimensions



Aggregate Savings Dynamics

- Following [Ranaldi and Milanovic \(2022\)](#) one can stylized the relationship between the aggregate saving rate (s) and behavioral heterogeneity (\mathcal{I}_{sc}) as follows

$$s = \alpha - \underbrace{\frac{2\mathcal{B}_{sc}}{\mathcal{G}}}_{\beta} \mathcal{I}_{sc} \quad (2)$$

where $\alpha = \frac{\mathcal{G}_s \mathcal{R}_{ss}}{\mathcal{G}}$ is the share of saving inequality to inequality overall and \mathcal{G} the Gini

- The savings rate and behavioral heterogeneity are negatively correlated
 - ▶ $\uparrow \alpha \implies \uparrow s$: constant composition and higher saving inequality
 - ▶ $\uparrow \beta \implies \downarrow s$: constant composition and lower size of top savers class

	(1)	(2)	(3)	(4)	(5)	(6)
	\mathcal{I}_{sc}	\mathcal{I}_{sc}	Macro saving	Macro saving	Macro saving	Macro saving
\mathcal{I}_{sc}			-0.338*** (-3.82)	-0.387*** (-5.32)	-0.395*** (-5.33)	
Gini income		0.845** (2.48)		0.903*** (4.06)	0.908*** (4.02)	
GDP per capita		0.000 (1.10)			-0.000000739 (-0.38)	
Population		-0.000 (-0.24)			-0.000253* (-1.87)	
\mathcal{I}_{kl}	0.0162 (0.22)	-0.0028 (-0.03)			-0.0587** (-2.09)	-0.0493 (-1.21)
country FE	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES
N	92	88	92	92	88	92

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

p.c. GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)
\mathcal{I}_{sc}	-1.874 (-0.46)	11.79* (1.92)	-1.523 (-0.36)	11.74* (1.90)	13.10** (2.32)	11.23* (1.77)	9.609 (1.72)
\mathcal{I}_{kl}	5.682** (2.22)	19.96*** (4.26)	5.706** (2.24)	20.10*** (4.51)	22.96*** (4.97)	21.02*** (4.66)	19.69*** (4.31)
$\mathcal{I}_{sc} \times \mathcal{I}_{kl}$		-27.49*** (-3.09)		-27.77*** (-3.32)	-31.25*** (-3.50)	-27.69*** (-3.10)	-24.54*** (-2.96)
Gini income			-3.982 (-0.36)	2.153 (0.19)	8.963 (0.85)	3.194 (0.29)	-3.620 (-0.41)
Current account balance					-0.113* (-1.78)		
Population						0.00940 (0.70)	
GDP per capita							-0.000134 (-1.04)
country FE	YES	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES	YES
<i>N</i>	84	84	84	84	81	81	81

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

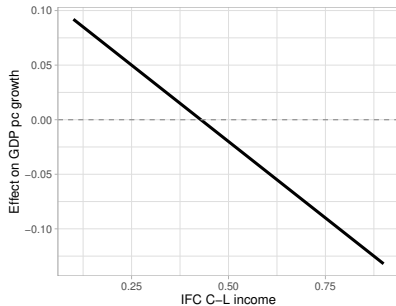
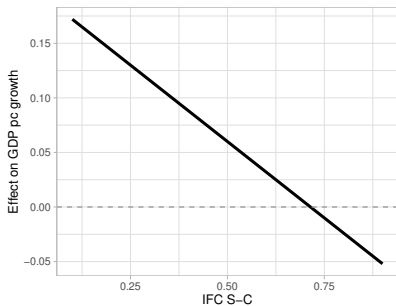


Figure: Marginal effects of \mathcal{I}_{kl} and \mathcal{I}_{sc} on GDP growth, respectively.

Summary

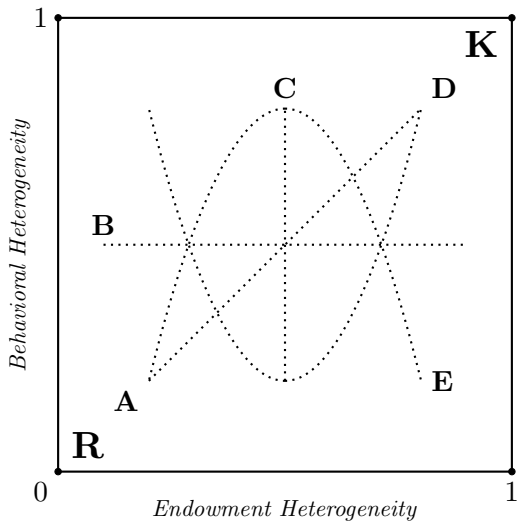
- No aggregate relationship between behavioral and endowment heterogeneity
 - ▶ → both types of heterogeneity should be considered independently in macro modelling
- Negative association between both behavioral and endowment heterogeneity and the aggregate saving rate
 - ▶ → the more equal the composition of savings and consumption, or of capital and labor, the higher the overall savings (and investment) rate
- Positive association between income inequality and behavioral heterogeneity
- Inverted U-shaped relationship between growth and household heterogeneity
 - ▶ → heterogeneity is first good than bad for growth

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Implications

- Macroeconomic models with heterogeneous agents should account for all possible combinations of endowment and behavioral heterogeneity
- Main limitations in macroeconomic models
 - ▶ Two-class models limit the extent of household heterogeneity (*Kaldorian, OLG, TANK*)
 - ▶ Fully heterogeneous models do not provide information on the association (copula) between composition and total income (*HANK, ABM*)
- How can we jointly model behavioral and endowment heterogeneity?
- How do specific initial conditions (in terms of behavioral and endowment heterogeneity) affect long-run macroeconomic dynamics?

Heterogeneity Box



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Conclusion

- Framework to study household heterogeneity from an empirical perspective
- Compositional inequality is used to proxy two types of heterogeneity: *behavioral* and *endowment heterogeneity*
- Heterogeneity matters and is country-specific
- Behavioral and endowment heterogeneity are negatively associated to the aggregate saving rate
- Heterogeneity is harmful (beneficial) for growth above (below) certain thresholds
- We encourage macroeconomic models with heterogeneous agents to account for the full spectrum of both types of heterogeneity

Thanks!