Heterogeneity in Macroeconomics
The Compositional Inequality Perspective

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Plan of the Presentation

1. Motivation
2. Framework
3. Database
4. Results
5. Implications
6. Conclusion
1 Motivation

2 Framework

3 Database

4 Results

5 Implications

6 Conclusion
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.
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)
- OLG models: Stiglitz (2015), Mattauch et al. (2022)
- ABM: Dosi et al. (2010), Botta et al. (2021), Palagi et al. (2021)
1 Motivation

2 Framework

3 Database

4 Results

5 Implications

6 Conclusion
Compositional Inequality

Illustration

- $1,000 per month
- $10,000 per month

- $10,000 K per month
- $0 W per month

- $0 K per month
- $1,000 W per month

- $0 K per month
- $10,000 W per month

- $1,000 K per month
- $0 W per month

- $20 K
- $80 W

- $800 K per month
- $200 W per month
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)
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** (≈ equality line for Gini)
   - describes the distribution whereby all individuals have the same composition of capital and labor income

2. **Actual-concentration curve** (≈ Lorenz curve for Gini)
   - describes the actual way capital income is distributed across the income distribution

3. **Maximum-concentration curve** (≈ 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

![Concentration Curve Diagram]

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

Ranaldi and Palagi

Heterogeneity in Macroeconomic
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

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

The IFC ranges between 1 and $-1$

Denote $I_{kl}$ and $I_{sc}$ 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

Rich and poor are identical in ownerships and behaviors

Rich save capital income & poor consume labor income
Motivation

Framework

Database

Results

Implications

Conclusion
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**: ≈ 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

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Table: List of countries and years covered
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

\[
s = \alpha - \frac{2B_{sc}}{G} \mathcal{I}_{sc} \tag{2}
\]

where \( \alpha = \frac{G_s R_s s}{G} \) is the share of saving inequality to inequality overall and \( G \) 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
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$t$ statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
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$t$ statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Figure: Marginal effects of $I_{kl}$ and $I_{sc}$ 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
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

Endowment Heterogeneity

Behavioral Heterogeneity
Motivation

Framework

Database

Results

Implications

Conclusion
Conclusion

- Framework to study household heterogeneity from an empirical perspective

- Compositional inequality is used to proxy two types of heterogeneity: \textit{behavioral} and \textit{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!