Inequality, Demand Composition, and the Transmission of Monetary Policy

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What We Do In This Paper
What We Do In This Paper

- Document three empirical facts about the Eurozone:
  1. *Across countries and households*: Non-tradable consumption increases with income
  2. *Across countries*: Non-tradable consumption shares increase with income inequality
  3. *Monetary Policy*: Weaker effects for economies with higher non-tradable consumption

- Rationalize the empirical findings in a HANK model with non-homothetic preferences
Empirical Findings
Data

- **Sample:**
  - 2000-2020: Euro area countries (19)

- **Consumption & Income:**
  - Household consumption & income (Eurostat, HBS, NSO)
  - Classify consumption (COICOP) as non-tradable, tradable and housing
  - Non-tradable consumption share: $\omega_N = \frac{C_N}{C_N + C_T}$

- **Inequality:**
  - Gini index for disposable income (HFCS, Eurostat)
  - Wealth share by percentile (WID)
  - Share of HtM agents (Almgren, Gallegos, Kramer & Lima, 2022)

- **Monetary Policy:**
  - Shocks for 2000-2020 from Jarocinski & Karadi (2020)
Non-tradable Consumption across Households
Non-tradable Consumption across Households

Empirical Results

Country
- Austria
- Belgium
- Cyprus
- Estonia
- Finland
- France
- Germany
- Greece
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Portugal
- Slovakia
- Slovenia
- Spain
Inequality and Consumption Baskets across Countries
Define:

* $n$ for country
* $Y_n$ dependent variable
* $Gini_n$ as average 2000-2020 Gini on net income

$$ Y_n = \alpha + \beta Gini_n + \gamma' X_n + \epsilon_n $$
Inequality and Consumption Baskets across Countries

Define:
- $n$ for country
- $Y_n$ dependent variable
- $Gini_n$ as average 2000-2020 Gini on net income

$$Y_n = \alpha + \beta Gini_n + \gamma' X_n + \epsilon_n$$

where $X_n$ includes:
- average 2000-2020 GDP per capita
- average 2000-2020 old-age dependency ratio
- average 2000-2020 size of government
- average 2000-2020 trade balance

Regression weighted with average 2000-2020 GDP.
More Unequal Countries Have Higher Non-tradable Shares

Introduction

Empirical Results

Model
Monetary Policy and Non-tradable Consumption
Monetary Policy and Non-tradable Consumption

- Study the effect of monetary policy shocks using local projection
  - Control for countries’ non-tradable consumption shares
Monetary Policy and Non-tradable Consumption

Study the effect of monetary policy shocks using local projection
  * Control for countries’ non-tradable consumption shares

Define:
  * $y$ dependent variable
  * $\omega_n$ avrg. 2000-2020 non-tradable consumption share for country $n$
  * $h$ for horizon in quarters $h = 0, \ldots, 12$
  * $p$ for the number of lags $p = 3$
  * $\phi_n$ country fixed effects
  * $i$ as JK (2020) monetary policy shocks
Study the effect of monetary policy shocks using local projection
* Control for countries’ non-tradable consumption shares

Define:
* $y$ dependent variable
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IRFs for group $j$ are constructed from the sequence $\{\beta^h_j\}_{h=0}^{12}$ and $\{\gamma^h_j\}_{h=0}^{12}$ from the estimated equation

$$y_{t+h,n} - y_{t-1,n} = \alpha^h + \beta^h i_t + \gamma^h (i_t * \tilde{\omega}_n) + \sum_{s=1}^{p} \Gamma^h_s y_{t-s,n} + \phi_n + u_{t+h,n}$$

Introduction  Empirical Results  Model
Monetary Policy and Non-tradable Consumption

Note: IRF to a one standard deviation contractionary Monetary Policy shock.
Check point: Empirics
Three facts:
1. High-income households consume more non-tradable goods
2. Higher income inequality leads to higher aggregate non-tradable consumption share
3. Countries with higher non-tradable consumption shares react less to the MP shock
Check point: Empirics

Three facts:
1. High-income households consume more non-tradable goods
2. Higher income inequality leads to higher aggregate non-tradable consumption share
3. Countries with higher non-tradable consumption shares react less to the MP shock

Fact 3 is at odds with standard HANK models
* Introduce non-homotheticity (Facts 1+2) to rationalize Fact 3

Today: Simple model + mechanism
* Full quantitative model in the paper
The Model
Environment

- Small open economy in a monetary union, $P_t^T = 1$
- Two households: (R)icardian and Hand-to-Mouth (H)
- Two goods: Tradable (T) and Non-tradable (N)
  * Tradable price rigidity < Non-tradable price rigidity
- Perfect labor mobility across sectors
Households

- Indirect utility function (Boppart (2014))

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{1}{\varepsilon} \left[ \left( \frac{e_{j,t}}{P^N_t} \right)^\varepsilon - 1 \right] - \frac{\nu}{\gamma} \left[ \left( \frac{P^T_t}{P^N_t} \right)^\gamma - 1 \right] \right) \]

where
* \( e_{j,t} \) is the nominal expenditure
* \( P^N_t \) is the price of Non-tradable good (Luxury good)
* \( P^T_t \) is the price of Tradable good

- Inelastic labor supply
Household Budget Constraint

▶ Budget constraint:

\[
e_{j,t} = P^T_t c^T_{j,t} + P^N_t c^N_{j,t}
\]

\[
= W_{j,t} l_{j,t} + \prod_{j,t} + \mathbb{1}_R(P^T_t R_{t-1} B_{j,t} + R^n_{t-1} B^n_{j,t}) - \mathbb{1}_R(P^T_t B_{j,t+1} + B^n_{j,t+1})
\]

▶ We engineer the model so that:

- Ricardian household gets \(\kappa\)% of total output \((P^T_t Y^T_t + P^N_t Y^N_t)\)
- Hand-to-mouth household gets \((1 - \kappa)\)% of total output \((P^T_t Y^T_t + P^N_t Y^N_t)\)
First-Order Conditions

\[ c_{j,t}^N = \frac{1 - \nu \varpi(P^N_t, P^T_t, e_{j,t})}{\nu \varpi(P^N_t, P^T_t, e_{j,t})} \frac{P^T_t c_{j,t}}{p_t^N} \]  

(NT Demand)

\[ \varpi(P^N_t, P^T_t, e_{j,t}) \equiv \left( \frac{p^N_t}{e_{j,t}} \right)^\varepsilon \left( \frac{p^T_t}{p^N_t} \right)^\gamma \]  

(Expenditure shares)
First-Order Conditions

\[ c_{j,t}^N = \frac{(1 - \nu \varpi(p_{t}^N, p_{t}^T, e_{j,t}))}{\nu \varpi(p_{t}^N, p_{t}^T, e_{j,t})} \frac{p_t^T c_{j,t}}{p_t^N} \]  

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(Expenditure shares)
First-Order Conditions

\[ c_{j,t}^N = \frac{\left(1 - \nu \varpi(P_t^N, P_t^T, e_{j,t})\right)}{\nu \varpi(P_t^N, P_t^T, e_{j,t})} P_t^T c_{j,t}^T \frac{P_t^T c_{j,t}^T}{P_t^N} \]  

(NT Demand)

\[ \varpi(P_t^N, P_t^T, e_{j,t}) \equiv \left(\frac{P_t^N}{e_{j,t}}\right)^\varepsilon \left(\frac{P_t^T}{P_t^N}\right)^\gamma \]  

(Expenditure shares)

\[ \rightarrow \text{If } \varepsilon = \gamma = 0, \text{ then } c_{j,t}^N = (1 - \nu) P_t^N P_t^T c_{j,t}^T. \]
First-Order Conditions

\[ c_{j,t}^{N} = \frac{\left(1 - \nu \omega(P_t^{N}, P_t^{T}, e_{j,t})\right) P_t^{T} c_{j,t}}{\omega(P_t^{N}, P_t^{T}, e_{j,t})} \]

(NT Demand)

\[ \omega(P_t^{N}, P_t^{T}, e_{j,t}) \equiv \left(\frac{P_t^{N}}{e_{j,t}}\right)^{\varepsilon} \left(\frac{P_t^{T}}{P_t^{N}}\right)^{\gamma} \]

(Expenditure shares)

→ If \( \varepsilon = \gamma = 0 \), then \( c_{j,t}^{N} = (1 - \nu) / \nu \frac{P_t^{T} c_{j,t}}{P_t^{N}} \).

\[ \left(\frac{e_{R,t+1}}{e_{R,t}}\right)^{1-\varepsilon} = \beta R_t^{n} \left(\frac{P_t^{N}}{P_{t+1}^{N}}\right)^{\varepsilon} \]

(Euler equation)

\[ R_t^{n} = R_t \frac{P_{t+1}^{T}}{P_t^{T}} \]

(No arbitrage condition)
Production

- Firms compete under perfect competition

- Production function:

\[ Y^h_t = (L^h_t)^{\alpha^h} \quad h = \{T, NT\} \]

- Profits:

\[ P^h_t Y^h_t - W^h_t L^h_t \quad h = \{T, NT\} \]

- Labor demand:

\[ W^h_t = \alpha^h P^h_t Y^h_t \]
Monetary Policy and Equilibrium

- Monetary union, fixed exchange rate, $P_t^T = 1$

- Non-tradable and tradable good markets clear

$$c_{N_t}^N + c_{R_t}^N = Y_t^N, \quad c_{R_t}^T + c_{R_t}^T = Y_t^T - B_{R_t} + B_{R_{t-1}}R_{t-1}$$

- Central bank supply zero bonds

$$B_t^N = 0$$

- Labor market clears:

$$L_{HtM_t}^T + L_{HtM_t}^{NT} = L_{HtM_t}, \quad L_{R_t}^T + L_{R_t}^{NT} = L_{R_t}$$
Income Inequality and Non-tradable Consumption Shares

- We want to statically match:
  - Fact 1: High-income households consume more non-tradable goods
  - Fact 2: Higher income inequality leads to high non-tradable consumption shares
We want to statically match:

- Fact 1: High-income households consume more non-tradable goods ✓
- Fact 2: Higher income inequality leads to high non-tradable consumption shares ✓
Monetary Policy and Non-tradable Consumption Shares

- We want to dynamically match:
  - Fact 3: Countries with high non-tradable consumption shares react less to the monetary policy shock.
We want to dynamically match:

- Fact 3: Countries with high non-tradable consumption shares react less to the monetary policy shock.

Define period 1 as short run and period 2+ as long run.

In period 1:

- $R_1$ increases (monetary policy shock)
- Non-tradable prices cannot adjust (extreme nominal rigidity)
- Unemployment in the non-tradable sector
Monetary Policy and Non-tradable Consumption Shares

- We want to dynamically match:
  - Fact 3: Countries with high non-tradable consumption shares react less to the monetary policy shock. ✓

![Graph showing the relationship between income inequality and percentage drop in output for homothetic and non-homothetic models.]

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<thead>
<tr>
<th>Introduction</th>
<th>Empirical Results</th>
<th>Model</th>
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</thead>
</table>
|              |                   |       | # 17
Two-sector TANK
Two-sector TANK

- Hand-to-Mouth Households
- Tradables (Flexible Prices)
- Non-tradables (Nominal Rigidities)
- Ricardian Households

Monetary shock
Two-sector TANK

- Hand-to-Mouth Households
- Tradables (Flexible Prices)
- Non-tradables (Nominal Rigidity)
- Ricardian Households

Monetary shock

Introduction  Empirical Results  Model
Monetary Policy affects Hand-to-Mouth households in two ways:

- **Initial effect**: Lower income from non-tradable sector
Two-sector TANK

- Monetary Policy affects Hand-to-Mouth households in two ways:
  - **Initial effect**: Lower income from non-tradable sector
Monetary Policy affects Hand-to-Mouth households in two ways:

- **Initial effect**: Lower income from non-tradable sector
- **Second effect**: Lower demand for non-tradable good
Monetary Policy affects Hand-to-Mouth households in two ways:

- **Initial effect:** Lower income from non-tradable sector
- **Second effect:** Lower demand for non-tradable good
- **Aggregate effect:** Increasing in the non-tradable sector size

### Two-sector TANK

- **Monetary shock**
- **Hand-to-Mouth Households**
- **Ricardian Households**
- **Tradables (Flexible Prices)**
- **Non-tradables (Nominal Rigidities)**
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - Perfect equality: Standard two-sector model

Introduction

Empirical Results

Model
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - Perfect equality: Standard two-sector model
  - Income inequality: Larger initial effect, smaller second effect

Diagram:
- 25% Hand-to-Mouth Households
- 15% Ricardian Households
- Monetary shock
- Tradables (Flexible Prices)
- Non-tradables (Nominal Rigidities)
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - Perfect equality: Standard two-sector model
  - Income inequality: Larger initial effect, smaller second effect

Introduction

Empirical Results

Model
Two-sector TANK with Non-homothetic Preferences

- Monetary Policy changes with income inequality:
  - Perfect equality: Standard two-sector model
  - Income inequality: Larger initial effect, smaller second effect
  - **Aggregate effect:** Decreasing in the non-tradable sector size

<table>
<thead>
<tr>
<th>Monetary shock</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand-to-Mouth Households</td>
<td>Tradables (Flexible Prices)</td>
</tr>
<tr>
<td>99%</td>
<td>Non-tradables (Nominal Rigidities)</td>
</tr>
</tbody>
</table>

- Ricardian Households

Introduction | Empirical Results | Model
Conclusion

- Document three empirical facts:
  1. *Across countries and households:* High-income households consume more non-tradable good
  2. *Across countries:* Higher income inequality leads to high non-tradable consumption share
  3. *Monetary Policy:* Weaker effects for economies with higher non-tradable consumption
     - At odds with standard HANK models

- Rationalize the empirical findings in a HANK model with non-homothetic preferences
Thank you very much!
Appendix
Data sources

- Consumption by sector per household (Eurostat, Household Budget survey, National Statistical Offices)
- Income per household by quintile (Eurostat)
- Gini index for disposable income (Eurostat)
- Wealth share by percentile (WID)
- HtM share by country from Almgren, Gallegos, Kramer & Lima, 2022
- Shocks from 2000-2020 from Jarocinski & Karadi (2020)
## Classification of sectors

<table>
<thead>
<tr>
<th>Non-tradables</th>
<th>Tradable</th>
<th>Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Alcoholic beverages, tobacco and narcotics</td>
<td>Actual rentals for housing</td>
</tr>
<tr>
<td>Good and services for routine household maintenance</td>
<td>Audio-visual, photographic and information processing equipment</td>
<td>Imputed rentals for housing</td>
</tr>
<tr>
<td>Hospital services</td>
<td>Clothing and footwear</td>
<td>Maintenance and repair of the dwelling</td>
</tr>
<tr>
<td>Miscellaneous goods and services</td>
<td>Electricity, gas and other fuels</td>
<td>Water supply and miscellaneous services</td>
</tr>
<tr>
<td>Operation of personal transport equipment</td>
<td>Food and non-alcoholic beverages</td>
<td></td>
</tr>
<tr>
<td>Out-patient services</td>
<td>Furniture and furnishings, carpets and other floor coverings</td>
<td></td>
</tr>
<tr>
<td>Postal services</td>
<td>Glassware, tableware and household utensils</td>
<td></td>
</tr>
<tr>
<td>Recreational and cultural services</td>
<td>Household appliances</td>
<td></td>
</tr>
<tr>
<td>Restaurants and hotels</td>
<td>Household textiles</td>
<td></td>
</tr>
<tr>
<td>Telephone and telefax services</td>
<td>Medical products, appliances and equipment</td>
<td></td>
</tr>
<tr>
<td>Transport services</td>
<td>Newspapers, books and stationery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other major durables for recreation and culture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other recreational items and equipment, gardens and pets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Package holidays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Purchase of vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telephone and telefax equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tools and equipment for house and garden</td>
<td></td>
</tr>
</tbody>
</table>
## Countries sorted by their Average Non-tradable share

<table>
<thead>
<tr>
<th>Country</th>
<th>Non-tradable share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithuania</td>
<td>35</td>
</tr>
<tr>
<td>Slovakia</td>
<td>38</td>
</tr>
<tr>
<td>Estonia</td>
<td>38</td>
</tr>
<tr>
<td>Latvia</td>
<td>40</td>
</tr>
<tr>
<td>Slovenia</td>
<td>44</td>
</tr>
<tr>
<td>Finland</td>
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<tr>
<td>Germany</td>
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</tr>
<tr>
<td>Belgium</td>
<td>48</td>
</tr>
<tr>
<td>Italy</td>
<td>48</td>
</tr>
<tr>
<td>France</td>
<td>48</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Non-tradable share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxembourg</td>
<td>49</td>
</tr>
<tr>
<td>Portugal</td>
<td>50</td>
</tr>
<tr>
<td>Netherlands</td>
<td>51</td>
</tr>
<tr>
<td>Austria</td>
<td>51</td>
</tr>
<tr>
<td>Malta</td>
<td>52</td>
</tr>
<tr>
<td>Ireland</td>
<td>53</td>
</tr>
<tr>
<td>Greece</td>
<td>54</td>
</tr>
<tr>
<td>Spain</td>
<td>55</td>
</tr>
<tr>
<td>Cyprus</td>
<td>57</td>
</tr>
</tbody>
</table>
How does consumption change with income?
How does consumption change with income?
Inequality and the consumption basket
Inequality and the consumption basket
Does the national consumption basket matter for Monetary Policy?

[Graph showing real GDP (%) over quarters with two lines representing different NT share percentiles.]
Non-tradable output response

[Graph showing the response of real NT output (%) to different NT share quantiles over different quarters.]
Output response when controlling for the ZLB
Local Projection extensions

- Controlling for HtM share
- Controlling for Gini
- Controlling for wealth inequality
- Return
GDP response when controlling for Gini

\[ y_{t+h,n} - y_{t-1,n} = \alpha + \beta^h i_t + \gamma^h (i_t \ast \bar{\omega}_n) + \lambda^h (i_t \ast \bar{\text{Gini}}_c) + \sum_{s=1}^{p} \Gamma_s^h y_{t-s,n} + \phi_n + u_{t+h,n} \]  

(1)

**Figure** NT share

**Figure** Gamma Difference

**Figure** Lambda Difference

Notes: The IRF shows the response controlling for average net income inequality.
GDP response when controlling for wealth inequality

Notes: The IRF shows the response controlling for the average wealth share of the top 10 percent.
GDP response when controlling for HtM share

\[ y_{t+h,n} - y_{t-1,n} = \alpha + \beta^h i_t + \gamma^h (i_t \ast \bar{\omega}_n) + \lambda^h (i_t \ast H\bar{M}_c) + \sum_{s=1}^{p} \Gamma^h_s y_{t-s,n} + \phi_n + u_{t+h,n} \]  

\[ (2) \]

**Notes:** The IRF shows the response controlling for the share of HtM agents.
Production continued

- Optimal condition:

\[ W_t^R l_{R,t} = \alpha_h \kappa P_t^R Y_t^h \]
\[ W_t^{HtM} l_{HtM,t} = \alpha_h (1 - \kappa) P_t^h Y_t^h \]

- \( \kappa \) profits go to \( R \) and \( (1 - \kappa) \) to \( HtM \)

- Hence \( \kappa \) shapes the income inequality since:
  * Ricardian household gets \( \kappa (P_t^T Y_t^T + P_t^N Y_t^N) \)
  * Hand-to-mouth household gets \( (1 - \kappa) (P_t^T Y_t^T + P_t^N Y_t^N) \)