OPEN ECONOMY, REDISTRIBUTION, AND THE AGGREGATE IMPACT OF EXTERNAL SHOCKS

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Two important features of emerging market business cycles:

- High consumption volatilities (Aguiar and Gopinath, 2007);
- Subject to international spillovers.

Recent advances in closed-economy literature: important to consider the effect of distribution and heterogeneity (Kaplan, Moll and Violante, 2018; Auclert, 2019).

- Open economy: foreign shocks and exchange rate fluctuations introduce additional layers of exposure.
- Aggregate stabilization policy: need micro-level empirical/quantitative support.

This paper: The role of household heterogeneity and redistribution in the transmission of foreign shocks.
Unequal exposure to shocks has aggregate implications through **redistribution**: (Auclert, 2019)

- Redistribution channels: systematic relationships between household exposure and **marginal propensity to consume** (MPC).
- High-MPC households lose more from adverse shocks ⇒ aggregate impact amplified.

**This paper**: redistribution channels in the open economy.

**Example**: currency devaluation puts downward pressure on consumption through:

- Pass-through to constrained households’ consumption basket.
- Revaluation of constrained households’ foreign-currency debt.
1. Analytical decomposition: aggregate consumption response to external shocks.
   . Key sufficient statistics for redistribution channels: $\text{Cov}(\text{MPC}_i, \text{Exposure}_i)$.

2. Document heterogeneity in exposure; measure redistribution channels in data.
   . Estimate covariances from Uruguay household survey data.

3. Quantitative model: general equilibrium impact.
   . Heterogeneous agent New Keynesian (HANK) model for a small open economy.
   . Key features: partially dollarized balance sheet and consumption basket.
   . Calibrate model to macro and micro moments of Uruguay.
   . Quantify the role of redistribution channels via counterfactual comparisons.
Uruguay data: redistribution through foreign-currency assets – most important.

- Highly concentrated dollar savings on wealthy (unconstrained) households.
- More even distribution of dollar borrowings.
- \( \text{Cov}(\text{constrained}_i, \text{net dollar wealth}_i) = -0.645. \)
- Other channels: covariance \( \approx 0. \)

Quantitative model: currency depreciates after foreign monetary tightening.

- Redistribution through asset revaluation: substantial amplification.
  - Baseline calibration (Uruguay 2017): 25 bps \( \uparrow i^* \Rightarrow 26 \) bps \( \downarrow C. \)
  - “Heavy dollarization” experiment (Hungary 2008): 1.8 times larger decline of \( C. \)

- Constrained households’ consumption more exposed to devaluation.
  - Moderate amplification relative to homothetic model.
Extension of analytical closed-economy HANK literature:

- Analytical decomposition of consumption to highlight the role of redistribution.
  Auclert (2019); Clayton, Jaravel and Schaab (2018)
- Heterogeneous incidence from aggregate shocks.
  Alves, Kaplan, Moll and Violante (2020); Broer, Kramer and Mitman (2021)

Heterogeneous agents and international macro

- Redistribution channels in the open economy:
  Kekre and Lenel (2021); Guo, Ottonello and Perez (2021).
  This paper: amplification/dampening effect through interaction with MPC

- HANK models in the open economy:
  De Ferra, Mitman and Romei (2020); Hong (2020); Auclert, Rognlie, Souchier and Straub (2021); Ferrante and Gornemann (2021)
  This paper: tightly calibrates model to household balance sheet data; focuses on the contribution of redistribution
Identifying redistribution channels: Analytical decomposition

Measuring redistribution channels: Empirical analysis using micro-data

Understanding GE impact: Quantitative model
Two periods \((t \in \{0, 1\})\), perfect foresight. (Permanent) heterogeneity in:

- **Consumption** of tradable (\$-priced) and nontradable goods.
- **Asset** endowed at period 0: peso- (a) and dollar-denominated nominal bond (b).
- **Income** sourced from tradable (\$-denominated T) and nontradable (N) sectors.

**Household** \(i\): maximize CRRA utility over consumption subject to

\[
\begin{align*}
  c_{i0}^N + q_0 c_{i0}^T + \frac{c_{i1}^N + q_1 c_{i1}^T}{R} &= \gamma_i^N y_0^N + q_0 \gamma_i^T y_0^T + \frac{\gamma_i^N y_1^N + q_1 \gamma_i^T y_1^T}{R} + \frac{a_{i0}}{p_0^N} + q_0 b_{i0}
\end{align*}
\]

\(y_i\): PV of disposable income

with consumption bundle \(c_{it} = (c_{it}^T)^{1-\alpha_i} (c_{it}^N)^{\alpha_i}; R \equiv (1 + i_1)/(p_1^N/p_0^N)\).
Consider a perturbation in the form of

\[
\{ dq, dp, dR, dy_j \}_{j \in \{N, T\}}
\]

RER: Peso depreciates
Real domestic interest rate ↑
Nontradable price ↑
Income from sector j ↑

Assumptions: \( q_0 = q_1 = q; y^j_1 \) determined in the “long run”.

- Ultimate sources of the perturbation: flexible.
- Leads to perturbation in household consumption policy \( dc_{i0}. \)
- Perturbation has aggregate impact \( dC_0(\equiv E_t[dc_{i0}]). \)
Household heterogeneity reflected in:

- Marginal propensity to consume ($\text{MPC}_i \equiv \frac{\partial c_i}{\partial PV \text{ disposable income } y_i}$).
- Expenditure on tradables (pass-through of $dq$).
- Dollar and peso legacy wealth (revaluation due to $dq$ and $dp$).
- Income composition from each sector (directly affected by $dy^{j}_0$, revalued by $dq$).
- Unhedged interest rate exposure (to $dR$) (Auclert, 2019).

... and results in different behavioral responses $dc_{i0}$. 

Equations
A DECOMPOSITION OF AGGREGATE CONSUMPTION

Aggregate up consumption decision at HH level:

\[ dC_0 = \overline{MPC}_0 \times \overline{E}_0 + \text{Cov}_1(\text{MPC}_{i0}, E_{i0}) \]

Simplifying assumptions and definitions

Equations

Redistribution channel: sufficient statistic

Open-economy redistribution channels:

(+: Positive covariance ⇒ \(dC_0\) increase under a positive perturbation)

\[ E_{i0} : \begin{cases} 
+ \text{Sector income share}_i \times dy^i_0 & \text{[Earnings heterogeneity]} \\
+ \text{ Tradable income share}_i \times dq & \text{[Foreign-currency earnings]} \\
+ \text{ Nominal$ wealth}_i \times dq & \text{[Fisher (foreign-currency)]} \\
- \text{ Nominal peso wealth}_i \times dp & \text{[Fisher (local-currency)]} \\
- \text{ Tradable expenditure}_i \times dq & \text{[Consumption expenditure]} 
\end{cases} \]
Identifying redistribution channels: Analytical decomposition

Measuring redistribution channels: Empirical analysis using micro-data

Understanding GE impact: Quantitative model
Measuring covariances: Combined Uruguay household surveys

- Currency composition of assets and liabilities.
- Product-level consumption expenditure.
- Socio-demographic information, income, employment.

Why Uruguay? Beyond data availability...

- Financial dollarization: 70% of all deposits; 50% of all loans.
  (Toscani, 2018)
- Goods-market dollarization: 14% share in CPI basket.
  (Toscani, 2018; Drenik and Perez, 2021)
Goal: Estimate \( \text{Cov}(\text{MPC}_i, \text{Exposure}_i) \Rightarrow \text{Cov}(\text{HtM}_i, \text{Exposure}_i) \)

- Infer (poor and wealthy) hand-to-mouth (\text{HtM}) status.  
  - \text{HtM}: Liquid wealth (cash + savings account) less than \(0.5 \times \text{monthly income}\).  
    (Kaplan, Violante and Weidner, 2014)  
  - Distinguish between poor and wealthy \text{HtM} based on net illiquid wealth.

- Impute hand-to-mouth label in consumption expenditure data. 
  - Objective household characteristics (logit model) + relevant interview questions.

- Manually identify tradable goods/industries.  
  Cravino and Levchenko (2017); Drenik and Perez (2021).

- Currency breakdown available for:  
  - liquid assets (cash + savings account).  
  - illiquid debt (mortgage, auto, personal loan).
• Large share of hand-to-mouth households. ▶ Details
  . Both datasets (balance sheet and consumption expenditure): $\sim 75\%$.
  . Of all households: less than 30% with positive liquid wealth.

• Unbalanced distribution of dollar wealth. ▶ Breakdown
  . Dollar savings increasingly concentrated at wealthy households.
  . Similar propensity to take on dollar debt across households. ▶ Plot

• Consumption of tradable goods basket: Lowest for poor-HtM households.
  . Major non-tradable expenditure: housing and utility. ▶ Statistics

• Inverted-U pattern between labor income and tradable sector employment.
  . Non-tradable sectors employ both ends of skill spectrum. ▶ Plot
<table>
<thead>
<tr>
<th>Covariate</th>
<th>Shock</th>
<th>Cov (s.e.)</th>
<th>Impact on dC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net nominal dollar wealth</td>
<td>Devaluation</td>
<td>-0.645 (0.024)</td>
<td>-</td>
</tr>
<tr>
<td>Net nominal peso wealth</td>
<td>Inflation</td>
<td>-0.005 (0.027)</td>
<td>+</td>
</tr>
<tr>
<td>Tradable income</td>
<td>Output/Income</td>
<td>-0.011 (0.002)</td>
<td>-</td>
</tr>
<tr>
<td>Tradable consumption expenditure</td>
<td>Devaluation</td>
<td>-0.045 (0.003)</td>
<td>+</td>
</tr>
</tbody>
</table>

+: dampen consumption contraction; -: amplify consumption contraction.

- $-$Fisher channel covariance driven by liquid dollar wealth (cash + savings account):

\[
\text{Cov(HtM, Wealth}^\$\text{)} = -0.645 = -0.660 - (-0.015)
\]

- Consumption expenditure channel (<0): low-MPC households more exposed due to high overall expenditure, despite a small tradable share.
EMPIRICAL ANALYSIS: SUMMING UP

• Large proportion of liquidity-constrained households in emerging markets.
  - Explains large average MPC and aggregate consumption volatility (Hong, 2020).

• Measured moments associated with redistribution channels:
  - Unequal foreign-currency wealth revaluation: large; amplify contraction.
  - Unequal ER pass-through to consumption: small; dampen contraction.
  - Other channels: ~ zero effect.
  - Quantitative model: Focus on foreign-currency Fisher and consumption expenditure channel.

• Practical implications:
  - Distribution of dollar hedges matters for agg. consumption response to devaluation.
Identifying redistribution channels: Analytical decomposition

Measuring redistribution channels: Empirical analysis using micro-data

Understanding GE impact: Quantitative model
• A small open economy, populated by ex-ante homogeneous households.

• Stone-Geary preference over T and NT, biased towards tradables.
  . Captures consumption expenditure channel.

• HH works in both sectors, hours and nominal wages decided by labor union.
  . Symmetric, idiosyncratic productivity processes for both sectors (AR1).
  . Labor union aggregates individual preference over tradable/nontradable labor.

• Incomplete asset markets with liquid and illiquid nominal wealth.
  . Within each class: peso/dollar-denominated asset/debt (more later).
  . For both asset classes: Zero net borrowing constraint.
  . Illiquid assets: higher return (firm ownership); pay adjustment cost upon deposit/withdraw.
HOUSEHOLD BALANCE SHEET IN THE MODEL

Structure of liquid (b) and illiquid (a) wealth, determined at time t:

\[
\begin{align*}
\text{b}_{it+1} &\equiv q_{t}b_{it+1}^{\$} + p_{t}^{-1}b_{it+1}^{\text{peso}} \\
\text{a}_{it+1} &\equiv v_{it+1} - q_{t}a_{it+1}^{\$} - p_{t}^{-1}a_{it+1}^{\text{peso}}
\end{align*}
\]

- real dollar savings
- real peso savings
- real asset
- dollar debt
- peso debt

- Return on liquid wealth components: predetermined by domestic and foreign monetary authorities.

- No aggregate risk: Individual components perfectly substitutable.
  - Equilibrium currency composition is indeterminate with no-arbitrage.
  - Study MIT-shock transition: no-arbitrage violated on impact (more later).
  - Accommodates arbitrary composition of steady-state balance sheet (e.g., data).
Firms

• Tradable sector: flexible price; DRS technology with labor as input.
  
  . World price of tradable goods $\equiv 1$ \Rightarrow price in LC = NER.

• Nontradable sector: same technology as tradable firms; faces downward-sloping demand curve for each variety; sticky price à la Rotemberg.

Policy

• Exogenous nominal interest rate on dollar liquid bond, set by foreign authorities.

• Domestic monetary authority: pre-sets $t + 1$ return on peso liquid bond based on current inflation and depreciation.
  
  . Weight on inflation: $\phi_\pi$; weight on depreciation: $\phi_e$. 
## Targeted moments:

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid savings to GDP ratio</td>
<td>0.08</td>
<td>0.10</td>
<td>IMF (2017), De Rosa (2019)</td>
</tr>
<tr>
<td>Illiquid wealth to GDP ratio</td>
<td>2.54</td>
<td>2.54</td>
<td>De Rosa (2019)</td>
</tr>
<tr>
<td>Hand-to-mouth agent share</td>
<td>0.76</td>
<td>0.77</td>
<td>EFHU-3</td>
</tr>
<tr>
<td>Relative hours, tradable vs. nontradable</td>
<td>0.40</td>
<td>0.40</td>
<td>SEDLAC</td>
</tr>
<tr>
<td>Tradable share in aggregate consumption</td>
<td>0.44</td>
<td>0.44</td>
<td>ENGIH</td>
</tr>
<tr>
<td>Tradable share of top income quintile</td>
<td>0.415</td>
<td>0.416</td>
<td>ENGIH</td>
</tr>
</tbody>
</table>
• Matches tradable expenditure share across income distribution.

• Pattern of MPC distribution matches comparable Peruvian data (Hong, 2020).

• PE response to wealth revaluation: C ↓ 3.3% in response to 14% decline in illiquid wealth, in line with Hungarian devaluation experience of 2008. (Gyöngyösi, Rariga and Verner, 2021).
Main experiment: foreign monetary tightening (25 bps)

Wealth revaluation: violation of no-arbitrage at time 0

Given dollar share functions $s^b, s^\$:

$$
1 + r^{b,p}(b_0) = (1 + r^*_0) \frac{q_0}{q_{-1}} \cdot s^b(b_0) + (1 + r^b_0) \cdot (1 - s^b(b_0))
$$

Ex-post real return: liquid wealth

$$
1 + r^{a,p}(a_0) = (1 + r^a_0) (1 + s^\$(a_0)) - \left[ (1 + r^*_0) \frac{q_0}{q_{-1}} - r^b_0 \right] \frac{s^\$(a_0)}{q^a_0/a_0}
$$

Ex-post real return: illiquid wealth

Illiquid portfolio: assume peso value of real asset $v_0$ does not respond to revaluation shocks.
STEP FUNCTION CALIBRATION OF DOLLAR SHARES IN WEALTH

(a) Liquid wealth \( s^b(b) \)

(b) Illiquid wealth \( s^a(a) \)

<table>
<thead>
<tr>
<th></th>
<th>HtM covariance</th>
<th>MPC covariance</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Model</td>
<td>Data</td>
</tr>
<tr>
<td>Liquid Saving(_i) ( s) - Illiquid Debt(_i) ( s )</td>
<td>-0.495</td>
<td>-0.645</td>
</tr>
<tr>
<td>Liquid Saving(_i) ( s )</td>
<td>-0.541</td>
<td>-0.660</td>
</tr>
</tbody>
</table>
Goal: Isolate the contribution of redistribution channels.

Foreign-currency Fisher channel:

- Vary $\text{Cov}(\text{MPC}_i, \text{Net } \$ \text{ wealth})$ by adjusting initial $\$ \text{ share distribution}.$
- Control for aggregate $\$ \text{ wealth}: E_i [b_{i0}^\$ + a_{i0}^\$] dq \text{ constant}$.
- Compare baseline calibration (Uruguay 2017) with:
  1. Zero dollar borrowing in illiquid wealth.
  2. Large dollar borrowing (Hungary 2008).
  3. Full deposit dollarization (Bocola and Lorenzoni, 2020; Montamat, 2020).

Consumption expenditure channel:

Compare consumption response with recalibrated homothetic model.
### FOREIGN-CURRENCY WEALTH REVALUATION: AMPLIFICATION

<table>
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<tr>
<th>Variable/Statistic</th>
<th>(1) Baseline</th>
<th>(2) No illiquid dollar</th>
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<tr>
<td>Aggregate $ wealth</td>
<td>0.220</td>
<td>0.220</td>
</tr>
<tr>
<td>Cov($MPC_{i,b}$, Liquid Saving$_i$)</td>
<td>-0.137</td>
<td>-0.085</td>
</tr>
<tr>
<td>Cov($MPC_{i,a}$, Illiquid Debt$_i$)</td>
<td>0.003</td>
<td>0</td>
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**Time-0 deviation from steady state (bps):**

<p>| | | |</p>
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<td>Consumption (C)</td>
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<td>-22.82</td>
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<td>RER (q)</td>
<td>8.55</td>
<td>8.34</td>
</tr>
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- Baseline calibration: real depreciation; consumption contracts (26 bps).
- Shuffling all dollar debt to offset liquid savings weakens FC Fisher channel by 11.7% in relative terms.
**FOREIGN-CURRENCY WEALTH REVALUATION: AMPLIFICATION**

<table>
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<td>-0.472</td>
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<td>Consumption (C)</td>
<td>-25.93</td>
<td>-22.82</td>
<td>-48.02</td>
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<tr>
<td>RER (q)</td>
<td>8.55</td>
<td>8.34</td>
<td>10.04</td>
</tr>
</tbody>
</table>

- “High $ liability”: resembles Hungarian environment pre-2008 (HH FX loan at 16.9% GDP).
- FC Fisher channel much stronger, driven by both liquid and illiquid dollar distributions.
- Amplifying impact: $1.8 \times$ baseline.
### FOREIGN-CURRENCY WEALTH REVALUATION: AMPLIFICATION

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<th>(3) High dollar liability</th>
<th>(4) Deposit &amp; liability dollarization</th>
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<td>Aggregate $ wealth</td>
<td>0.220</td>
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<td>(\text{Cov}(\text{MPC}_{i,b}, \text{Liquid Saving}_i))</td>
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<td>-0.472</td>
<td>-0.184</td>
</tr>
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<td>0.003</td>
<td>0</td>
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<td>0.005</td>
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<tr>
<td>Consumption (C)</td>
<td>-25.93</td>
<td>-22.82</td>
<td>-48.02</td>
<td>-28.86</td>
</tr>
<tr>
<td>RER (q)</td>
<td>8.55</td>
<td>8.34</td>
<td>10.04</td>
<td>8.74</td>
</tr>
</tbody>
</table>

- Full deposit dollarization, coupled by more liability dollarization.
- Wealthier households save in $ by even more ⇒ more unequal dollar insurance distribution.
- Strengthens FC Fisher channel by 11%.
## Consumption Expenditure Channel: Benchmark vs. Homothetic Model

<table>
<thead>
<tr>
<th>Variable/Statistic</th>
<th>(1) Nonhomothetic</th>
<th>(2) Homothetic</th>
<th>Homothetic model:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average MPC</td>
<td>0.642</td>
<td>0.645</td>
<td>• Larger MPC.</td>
</tr>
<tr>
<td>Aggregate dollar wealth</td>
<td>0.220</td>
<td>0.220</td>
<td>• Larger average ERPT (spending × depreciation).</td>
</tr>
<tr>
<td>Aggregate tradable expenditure</td>
<td>0.646</td>
<td>0.724</td>
<td>• ERPT dist. more pro-poor.</td>
</tr>
<tr>
<td>( \text{Cov}(\text{MPC}_i, b, \text{Tradable Spending}_i) )</td>
<td>-0.068</td>
<td>-0.085</td>
<td>• Shock impact on C dampened by 0.5 bps.</td>
</tr>
<tr>
<td>( \text{Cov}(\text{MPC}_i, b, \text{Liquid Saving}_i) )</td>
<td>-0.137</td>
<td>-0.122</td>
<td></td>
</tr>
<tr>
<td>( \text{Cov}(\text{MPC}_i, a, \text{Illiquid Debt}_i) )</td>
<td>0.003</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
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</table>
Backward-looking policy rule:

\[(1 + i_{t+1}) = (1 + \bar{r})(1 + \pi_t)\phi_\pi (e_t/e_{t-1})\phi_e.\]

Baseline: \(\phi_\pi = 1.5, \phi_e = 0.5.\)

As weight on NER (\(\phi_e\)) increases:

- Real depreciation muted.
- Smaller drop in consumption.
- No significant inflation-output tradeoffs.
This paper:

- Identifies redistribution channels from theory.
- Evaluates the empirical and quantitative relevance of redistribution channels.

Main findings:

- Uruguay data: lack of dollar insurance by constrained households constitutes the most pronounced redistribution channels.
- Quantitative model: heavy dollarization of balance sheets is an important amplifying force. Homothetic model features weaker redistribution through ERPT.

Practical implications:

- Targeted macroprudential policies in the financial market and de-dollarization policies in the goods market help mute the redistribution channels.

Future research: Optimal policy; bank/firm redistribution channels.
APPENDIX
Assume:
- $i_0 = i_0^* = 0$.
- $\gamma_i^j(y_t^j) = \gamma_i^j \cdot y_t^j, j \in \{T, N\}$ (Werning, 2015; Clayton, Jaravel and Schaab, 2018).

**Present-value budget constraint:** \( (q_t \equiv e_t/p_t^N) \)

\[
c_0^N + q_0c_T^0 + \frac{c_1^N + q_1c_T^1}{R} = \gamma_i^N y_0^N + q_0 \gamma_i^T y_0^T + \frac{\gamma_i^N y_1^N + q_1 \gamma_i^T y_1^T}{R} + \frac{a_{i0}}{p_0^N} + q_0 b_{i0}
\]

R \equiv (1 + \frac{i_1}{(p_1^N/p_0^N)}): \text{real interest rate from } t = 0 \text{ to } 1.

For perturbation:
- Follow CJS to consider period 1 as the long run, to abstract away from perturbations to long-run output $y_1^N$ and $y_1^T$.
- Further restricted to the case in which $q_0 = q_1 = q$. 

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Haonan Zhou
Redistribution in the open economy 2
Proposition 1

Under the posited perturbation:

\[ dc_{i0} = -\sigma^{-1}(1 - \kappa_i^{-1}q^{1-\alpha_i}MPC_{i0})c_{i0} \frac{dR}{R} + MPC_{i0} \cdot \left[ \kappa_i^{-1}(1 - \alpha_i)q_1^{-\alpha_i}(c_{i0} + R^{-1}c_{i1}) + \gamma_i^T q(y_0^T + R^{-1}y_1^T) \right] \frac{dq}{q} + \left( qb_{i0} \frac{dq}{q} - p^{-1}a_{i0} \frac{dp}{p} \right) - \left( \kappa_i^{-1}(1 - \alpha_i)q_1^{1-\alpha_i}(c_{i0} + R^{-1}c_{i1}) + \gamma_i^T q(y_0^T + R^{-1}y_1^T) \right) \frac{dq}{q} \]

where \( MPC_{i0} \equiv \frac{\partial c_{i0}}{\partial y_i} \) and \( \kappa_i \equiv (1 - \alpha_i)^{1-\alpha_i} \alpha_i^{\alpha_i} \).
Proposition 3

Under the posited perturbation:

\[
\begin{align*}
\text{Substitution} & : \quad dC_0 = -\sigma^{-1}\mathbb{E}[c_{i0}(1 - \kappa_i^{-1}q^{1-\alpha_i}MPC_{i0})] \frac{dR}{R} + p^{-1}[\overline{\text{MPC}} \cdot \mathbb{E}[\omega_{i1}] + \text{Cov}(\text{MPC}_{i0}, \omega_{i1})] \frac{dR}{R} \\
\text{Unhedged interest rate exposure} & : \quad \text{Cov}(\text{MPC}_{i0}, \omega_{i1}) \frac{dR}{R} \\
\text{Aggregate income} & : \quad \overline{\text{MPC}} \cdot (dy_0^N + qdy_0^T) + \text{Cov}(\text{MPC}_{i0}, \gamma_i^N)dy_0^N + q\text{Cov}(\text{MPC}_{i0}, \gamma_i^T)dy_0^T \\
\text{Earnings heterogeneity} & : \quad \left[ q(\overline{\text{MPC}} \cdot \mathbb{E}[b_{i0}] + \text{Cov}(\text{MPC}_{i0}, b_{i0})) \right] \frac{dq}{q} - p^{-1}(\overline{\text{MPC}} \cdot \mathbb{E}[a_{i0}] + \text{Cov}(\text{MPC}_{i0}, a_{i0})) \frac{dp}{p} \\
\text{Fisher (foreign currency)} & : \quad \overline{\text{MPC}} + \text{Cov}(\text{MPC}_{i0}, \gamma_i^T)q(y_0^T + R^{-1}y_1^T) \frac{dq}{q} - \overline{\text{MPC}} \cdot \Xi + \text{Cov}(\text{MPC}_{i0}, \Xi_{i,0}) \frac{dq}{q} \\
\text{Price of earnings} & : \quad \Xi_{i,0} = \kappa_i^{-1}q^{1-\alpha_i}(1 - \alpha_i)(c_{i0} + R^{-1}c_{i1}).
\end{align*}
\]
### AVAILABLE ASSET AND DEBT INFORMATION

<table>
<thead>
<tr>
<th>Classification</th>
<th>Asset</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquid</strong></td>
<td>Cash holding</td>
<td>Credit card balance</td>
</tr>
<tr>
<td></td>
<td>Bank savings account</td>
<td></td>
</tr>
<tr>
<td><strong>Illiquid</strong></td>
<td>Housing</td>
<td>Mortgages</td>
</tr>
<tr>
<td></td>
<td>Auto</td>
<td>Auto debt</td>
</tr>
<tr>
<td></td>
<td>Owned businesses</td>
<td>Bank debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other credit institution debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family members and friends</td>
</tr>
</tbody>
</table>

- Non-mortgage, non-credit card debt: back out stock amount from monthly payment share and totals.
- Liquid asset: bunching at specific values (maximum: 30,000 dollars).
- Stock holdings and owned businesses: rare in the data.
- Currency breakdown available for liquid assets and illiquid debt.
  - Peso/Indexed/Readjustable/Dollar for mortgages.
  - Assume credit card debt is taken out in Uruguayan pesos.
In general, following Kaplan, Violante and Weidner (2014):

<table>
<thead>
<tr>
<th></th>
<th>Poor-HtM</th>
<th>Wealthy-HtM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net liquid wealth</strong></td>
<td>$\geq 0$ and $\leq$ half monthly income or $\leq 0$ and $\leq -$half monthly income</td>
<td></td>
</tr>
<tr>
<td><strong>Net illiquid wealth</strong></td>
<td>$\leq 0$</td>
<td>$&gt; 0$</td>
</tr>
</tbody>
</table>

- For households with negative net illiquid wealth ($\sim 10\%$ of total): assume unobserved illiquid assets; use net housing+auto as individual illiquid state.
- Robustness: using net housing+auto as illiquid state for all households.

- **Net nominal position**: net liquid wealth $-$ illiquid debt.
A two-step procedure, incorporating additional information from ENGIH:

1. Fit a multinomial logit model to the EFHU data (with households categorized in non-HtM, poor-HtM and wealthy-HtM), on a set of household characteristics. Predict using the model based on the same characteristics in ENGIH data.

2. Adjust HtM prediction, exploiting additional survey questions:
   - **HtM → N-HtM**: monthly expenses on all categories of consumption are sufficient or more than sufficient for household needs.
   - **N-HtM → P-HtM**: monthly spending on all categories of consumption are insufficient to meet household needs.
   - **HtM → N-HtM**: gap between actual income and lower-bound of estimated income that satisfy household needs is more than one half of the actual income (in the spirit of Kaplan, Violante and Weidner (2014)), while no category-specific expenses are insufficient.
   - **N-HtM → W-HtM**: the gap between actual and estimated lower bound is negative.
## Household financial survey:

<table>
<thead>
<tr>
<th></th>
<th>Non-HtM</th>
<th>Poor HtM</th>
<th>Wealthy HtM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population share (%)</td>
<td>23.34</td>
<td>21.24</td>
<td>55.42</td>
</tr>
<tr>
<td>Average age</td>
<td>50.23</td>
<td>50.35</td>
<td>50.00</td>
</tr>
<tr>
<td>Median monthly income (USD)</td>
<td>2904</td>
<td>1428</td>
<td>1958</td>
</tr>
<tr>
<td>Average monthly income (USD)</td>
<td>3619</td>
<td>1639</td>
<td>2357</td>
</tr>
<tr>
<td>Has credit cards (% within group)</td>
<td>84.55</td>
<td>43.36</td>
<td>57.64</td>
</tr>
</tbody>
</table>

- Large share of hand-to-mouth households in Uruguay (> 75%).
  - Likely indicates high average MPC (Hong, 2020).

- Clear distinction between HtM and N-HtM in income, credit card access.
## HOUSEHOLD BALANCE SHEETS AND EXCHANGE RATE EXPOSURE

### (Unit: US $)

<table>
<thead>
<tr>
<th></th>
<th>Non-HtM</th>
<th>Poor HtM</th>
<th>Wealthy HtM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Illiquid debt:</strong> Median (if &gt; 0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>5000</td>
<td>1500</td>
<td>2666</td>
</tr>
<tr>
<td>Peso</td>
<td>3772</td>
<td>1448</td>
<td>2145</td>
</tr>
<tr>
<td>US$</td>
<td>3255</td>
<td>625</td>
<td>2500</td>
</tr>
<tr>
<td><strong>Net liquid wealth:</strong> Median</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>3000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peso</td>
<td>375</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>US$</td>
<td>2625</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Net liquid wealth:</strong> Average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>8845</td>
<td>0.38</td>
<td>50.49</td>
</tr>
<tr>
<td>Peso</td>
<td>1937</td>
<td>-17.87</td>
<td>-11.80</td>
</tr>
<tr>
<td>US$</td>
<td>6908</td>
<td>18.25</td>
<td>62.29</td>
</tr>
</tbody>
</table>

**Large degree of wealth inequality:**
- Only 29% of households have positive liquid wealth.

**Currency composition:**
- (Wealthy) households predominantly save in $...
- and borrow in pesos / indexed to CPI.
- $ saving rate increasing in wealth.
- Distribution of $ wealth highly concentrated.
Sample selection across datasets:

- At least one household member answers the survey (no proxy-only households).
- Household head age between 25 to 79.

 Tradable-nontradable classification: manual assignment.

- Consumption expenditure channel: takes into account dollarization of products. (Cravino and Levchenko, 2017; Drenik and Perez, 2021)
- Earnings heterogeneity channel: measures sectoral exposure to international trade. Label industries appearing in BCU export statistics as tradable.

Examples:

<table>
<thead>
<tr>
<th>Tradable</th>
<th>Product</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics, Furniture, Jewelry</td>
<td>Chemicals</td>
<td>Domestic services</td>
</tr>
<tr>
<td>Nontradable</td>
<td>Repair of electronics and jewelry</td>
<td></td>
</tr>
</tbody>
</table>

Haonan Zhou Redistribution in the open economy 10
Figure: Propensity to hold dollar asset and debt by income decile
## HAND-TO-MOUTH HOUSEHOLDS: CONSUMPTION EXPENDITURE

**Consumption expenditure survey**
(Imputed from household financial survey):

<table>
<thead>
<tr>
<th></th>
<th>Non-HtM</th>
<th>Poor HtM</th>
<th>Wealthy HtM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population share (%)</td>
<td>23.31</td>
<td>18.09</td>
<td>58.60</td>
</tr>
<tr>
<td>Average age</td>
<td>49.78</td>
<td>49.52</td>
<td>50.57</td>
</tr>
<tr>
<td>Median monthly income (USD)</td>
<td>2865</td>
<td>1164</td>
<td>1576</td>
</tr>
<tr>
<td>Average monthly income (USD)</td>
<td>3417</td>
<td>1268</td>
<td>1760</td>
</tr>
<tr>
<td>Tradable share in expenditure (%)</td>
<td>41.32</td>
<td>40.65</td>
<td>45.50</td>
</tr>
</tbody>
</table>

- Imputation successful in matching aggregate HtM share.
- On average: lower income for all groups.
- Poor HtM has lowest tradable share in expenditure, driven by:
  - Low spending share on vehicles (tradable);
  - High spending share on housing/utilities (nontradable).
• Inverted-U pattern between income decile and exposure to tradable sector.

• Nontradable sector: workers employed at both ends of skill spectrum.
Hungary: 17.3% real depreciation over Sep 2008-Mar 2009.

(Gyöngyösi, Rariga and Verner, 2021): Households with FC mortgage cut consumption by 4.5-5.3 percent relative to households with LC debt.

Compute model counterpart:

\[ \Delta = \frac{\int c(z, b, \xi \cdot a) d\lambda}{C}. \]

Estimate \( \xi \): Use average LTV of 0.62 from 2004 to 2008 (Verner and Gyöngyösi, 2020) \( \Rightarrow \xi = 0.859. \)

Policy function: \( c(z, b, \xi \cdot a) \) is obtained via interpolation.
An equilibrium consists of prices, quantities, individual policy rule, and a path of distributions \( \{ \lambda_t(z, b, a) \} \) such that

- All agents optimize.
- Central bank follows monetary policy rule.
- Markets clear for labor, nontradable consumption and illiquid assets. In particular, normalize aggregate equity to one, we have

\[
Q_t = \int a_t(z, b, a) d\lambda_{t-1} = A_t.
\]

- The balance-of-payment equation holds:

\[
q_t(C_T^t - Y_T^t + \Phi_t) + B_{t+1} = (1 + r^b_t)B_t
\]

\[
+ \int (r_t^b, p(b) - r^b_t) b d\lambda_t(z, b, a) + \int (r_t^a, p(a) - r^a_t) a d\lambda_t(z, b, a)
\]

\[
\text{Revaluation}
\]

where \( B_{t+1} \equiv \int b_{t+1}(z, b, a) d\lambda_t \). \( \Phi_t \equiv \int \Phi(a_{t+1}(z, b, a), a) d\lambda_t \) and \( r_t^b, p(b) = r^b_t \) and \( r_t^a, p(a) = r^a_t \) for \( t \geq 1 \).
Baseline calibration (blue):
- RER depreciation: 8.2 bps.
- Aggregate C: ↓ 26.3 bps.

Homothetic model (red):
- Little qualitative difference.
- Slightly larger depreciation.