Reassessing the Role of Heterogeneity to Understand Business Cycles

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Heterogeneity and Inequality are a Sign of the Times

- It has increased a lot recently with hard to predict consequences.

- It permeates many facets of life:
  - Consumption
  - Politics
  - Migration
  - Family Formation
  - Health and Longevity

- But as Macroeconomists, should we care?
They do not do a very good job.

- Sources of Shocks
  - Technology (Nobody has ever seen them)
  - Preference (patience, markups), what are they?
  - Monetary (as in New Keynesian Models) are two small

- It requires an unsuitably large Frisch Elasticity of Labor to move employment.

- There is a lot of wealth that can be used efficiently to weather changes in available resources.

- The Great Recession has highlighted its shortcomings as it is a large recession.
Heterogeneous Households only (not firms today).

Why could they generate larger fluctuations?

- First set of Empirical Reasons

1. Recessions hit (lower earnings, more unemployment) more vulnerable (poor) households more.

2. Poor households have a higher Marginal Propensity to Consume out of income than rich households.
### Data: Marginal Distributions (Sorted by each variable)

#### Heterogeneity (Inequality) in 2006: Marginal Distributions

<table>
<thead>
<tr>
<th>Mean (2006$)</th>
<th>y</th>
<th>c</th>
<th>a</th>
<th>SCF 07 a</th>
</tr>
</thead>
<tbody>
<tr>
<td>62,549</td>
<td>43,980</td>
<td>291,616</td>
<td>497,747</td>
<td></td>
</tr>
<tr>
<td>%Share: Q1</td>
<td>4.5</td>
<td>5.6</td>
<td>-0.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>Q2</td>
<td>9.9</td>
<td>10.7</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Q3</td>
<td>15.3</td>
<td>15.6</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Q4</td>
<td>22.8</td>
<td>22.4</td>
<td>13.0</td>
<td>11.9</td>
</tr>
<tr>
<td>Q5</td>
<td>47.5</td>
<td>45.6</td>
<td>82.7</td>
<td>82.5</td>
</tr>
<tr>
<td>90 – 95</td>
<td>10.8</td>
<td>10.3</td>
<td>13.7</td>
<td>11.1</td>
</tr>
<tr>
<td>95 – 99</td>
<td>12.8</td>
<td>11.3</td>
<td>22.8</td>
<td>25.3</td>
</tr>
<tr>
<td>Top 1%</td>
<td>8.0</td>
<td>8.2</td>
<td>30.9</td>
<td>33.5</td>
</tr>
</tbody>
</table>

- **a**: Bottom 40% holds basically no wealth
- **y, c**: Less concentrated
### Heterogeneity (Inequality) in 2006: Joint Distributions (Sorted by wealth)

<table>
<thead>
<tr>
<th>Q.a</th>
<th>% Share of:</th>
<th>Exp.Rate c/y (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y</td>
<td>c</td>
</tr>
<tr>
<td>Q1</td>
<td>8.6</td>
<td><strong>11.3</strong></td>
</tr>
<tr>
<td>Q2</td>
<td>10.7</td>
<td><strong>12.4</strong></td>
</tr>
<tr>
<td>Q3</td>
<td>16.6</td>
<td>16.8</td>
</tr>
<tr>
<td>Q4</td>
<td>22.6</td>
<td>22.4</td>
</tr>
<tr>
<td>Q5</td>
<td>41.4</td>
<td>37.2</td>
</tr>
</tbody>
</table>

- **Wealth-rich earn more and save at a higher rate**
- **Bottom 40% hold no wealth, still account for almost 25% of spending**

Wealth is measured as the total amount owned by a household. The table above shows the joint distribution of expenditures and income for different wealth quintiles. The bottom 40% of wealth holders account for almost 25% of spending, indicating a significant portion of aggregate demand is derived from households with relatively little disposable income. This highlights the importance of considering the heterogeneity in wealth distribution when analyzing economic policies and their impact on spending behavior.
1 Models of Employment not Hours: Misery is concentrated.

2 Poor households (those that consume most of their income) are now poorer.

3 All this allows in principle the Jensen inequality to do its job: The mean behavior is not the same that the behavior of the mean. Quantitatively it requires

1 Nonlinear decision rules (at least on the low levels of income and wealth)

2 A lot of agents in the states where their behavior is non linear (close to zero cash in hand).
Krusell Smith (1997-98) broke the fear of computational unfeasibility. They showed how to solve for equilibria in these (then) monster looking thingies.

They also found out a property of these models: Quasilinearity.

1. The aggregate law of motion is (almost) linear. So effectively no Jensen inequality.

2. Moreover, most agents are in the most linear part of the state space/

Heterogeneous agents models are like Rep Agent models for business cycle purposes. Also confirmed in life-cycle models.
Why in those models Heterogeneity did not matter much?

- Agents had plenty of wealth for the purpose of effectively smoothing consumption across time (even in high wealth dispersion models due to $\beta'$s differences).

- Agents that do worse do not do so badly. Unemployment is short lived and lives no scars.

- So early models did not have
  1. Enough higher Marginal Propensity to Consume of low wealth people
  2. Enough Low wealth people
Augmented Krusell and Smith (1998)

Exogenous aggregate shock $Z$ moves TFP and unemp $\Pi_Z(u)$. Recessions are rare but severe ($Y$ drops $\approx 7\%$) and long (5 years)

$$Y = Z^* K^{\alpha} N(Z)^{1-\alpha}$$

Exogenous individual income risk

- Unemp risk $s \in \{u, e\}$. Increases in recessions (8.4\% vs. 5.3\%).
- Income risk $y$.

Individual preference heterog. and some life cycle to have poor agents.

Unemployment insurance system with size $\rho = 50\%$. 
## Inequality in the Benchmark Economy

<table>
<thead>
<tr>
<th>Net Worth</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Share held by:</td>
<td>PSID, 06</td>
<td>SCF, 07</td>
</tr>
<tr>
<td>Q1</td>
<td>-0.9</td>
<td>-0.2</td>
</tr>
<tr>
<td>Q2</td>
<td>0.8</td>
<td>1.2</td>
</tr>
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</tr>
<tr>
<td>Gini</td>
<td>0.77</td>
<td>0.78</td>
</tr>
</tbody>
</table>

- Get’s inequality almost right at the very bottom
But Still overstates consumption shares and rates of the rich.

Rudimentary life cycle is crucial for level of consumption rates and their decline with wealth.
Consumption Decline from a Large TFP Shock (4%)

<table>
<thead>
<tr>
<th>% Share:</th>
<th>Models*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KS</td>
</tr>
</tbody>
</table>

| ΔC             | -1.9%   | -2.9%   | -2.4%   |

- Still Relative Minor Action.
- If we were to think of Endogenous Labor, it would be Worse (Guerrieri-Lorenzoni-2009)
Still Small Effects of Modelling Heterogeneity even with a Silly Theory of the Great Recession (4% TFP drop)

1. Small Response of household Consumption.
2. Automatic Stabilizers do their job (smaller role of Heterogeneity)
3. Other margins (investment, labor) not clearly helped by household Heterogeneity.

Some other features could add some further action


But not by much
A Parallel Story with New Keynesian Models

- Heterogeneous Agent environments have also been used in New Keynesian environments and some of the same findings go through:
  - Kaplan et al. (2016)
  - Luetticke (2015)
  - Bayer et al. (2015)
  - McKay and Reis (2016)
  - Ravn and Sterk (2012)
  - Gornemann, et al. (2016)

- The main feature is to imply a larger drop in consumption to that in Rep agent Models.
Where do we go from here

- There are still three margins that when combined with inequality can give us the possibility of larger fluctuations:
  
  1. Assets are not very liquid (Kaplan et al. (2016)): Pension plans, financial transactions,
  
  2. Wealth disappears: We need to model wealth differently than accumulated output: Asset Prices that can move dramatically.
  
  3. Expenditures play a role in productivity and reallocation is costly.

- These margins open the door to other type of shocks (financial shocks, government policy shocks, perception shocks) to make up for TFP or markup Shocks.
Heterogeneity and the new margins

- Liquidity of Assets
  - The portfolio composition of households of different wealth levels is very different. Liquidity is a property of asset type. Models should replicate portfolios by wealth levels.

- Wealth Destruction
  - In Rep Agent Models assets are priced by their shadow value. Proper movements of assets (houses) should include transactions and a theory of their determination. Moreover, Bankruptcies destroy wealth and redistribute wealth. (Hedlund various papers, Head, Lloyd-Ellis & Sun (14), Huo & Rios-Rull (14), Kaplan, Mitman & Violante (16), Head, Sun & Zhou (15)).

- Expenditures play a role and adjustment is costly.
  - These are mechanisms that transform a drop in consumption into drops in TFP without reallocation of output to investment. Triggered by drops in Consumption.
Let me show an example of how this works

- A recession triggered by a shock to households’ ability to borrow.
- The environment includes ordered form +to- quantitative relevance
  - Real frictions that difficult the switch from production of consumption goods to exports or investment.
  - Houses that are traded with ownership requiring loan to value ratio. These houses are owned by the 2/3 richest households with the empirically relevant leverage.
  - Frictions in the goods markets that generate movements in measured GDP.
  - Some labor market frictions that limit wage adjustments.
  - Households that differ in job prospects.
  - Households can go bankrupt: lenders lose.
The Model Characteristics: Steady State

Enhanced Aiyagari-94 Heterogenous Agent Economy:

1. Multisector: Tradables and nontradables.
2. Houses (land) that need to be purchased to be enjoyed.
3. Endogenous productivity movements (frictions in goods markets).
4. Various job market frictions (including exogenous wage adjustments).
Households: Preferences

- Consumption requires payment and search. It is monotonic in both:
  - Negative Wealth shock cuts consumption and search.

- Households have to search for varieties, its number is a choice:
  \[ I_N = d \Psi^d(Q^g). \]
  - \( \Psi^d(Q^g) \): Probability (per search unit) of finding a variety.

- Households also like housing and dislike searching
  \[ u \left[ c_A(c_N, c_T) I_N^\rho, h, d \right] \]

- Most of consumption is non tradable and non investable.
Households: Endowments and Wealth

- Households differ in skill type. Low skilled are more prone to unemployment. They do not choose whether to work.

- Households either have a job $e = 1$ or not $e = 0$.
  - Type-dependent exogenous job destruction rate.
  - Job finding rate is type independent and depends on job creation by firms (workers are rationed) (Lei Nie (2013)).

- Households assets are in houses and/or in financial assets with a collateral constraint.
Households’ problem

\[
[\langle +1 \rangle - \rangle] V(\epsilon, e, a) = \max_{c, I_N, h, d} u(c, h, d) + \\
\beta \sum_{e', e', \theta'} \Pi^{\theta}_{e', \theta'} \Pi^{w}_{e'} \Pi^{\epsilon}_{e, e'} V[\epsilon', e', a'(b, h)] \quad \text{s.t.}
\]

\[
\int_0^{I_N} p_i c_i + p_h h + b = a + 1_{e=1} w \epsilon + 1_{e=0} w \quad \text{BC}
\]

\[
a'(b, h) = p_h h + R(b) b \quad \text{AA}
\]

\[
b \geq -\lambda p_h h \left[ \frac{1}{1 + r^*} - \zeta \right] \quad \text{FC}
\]

\[
I_N = d \Psi^d [Q^g] \quad \text{SC}
\]
An (MIT) financial shock hits

- We can estimate the extent of frictions to generate the Recession.
  1. Adjustment costs/Decreasing Returns of Tradables (Relative Change of Investment and Consumption and Expansion of Net Exports)
  2. Size of Frictions in goods markets: To match productivity changes.
  3. Wage rigidity: Directly from Wage dynamics:

- This involves looking at the transition.
Experiment: Tightening of credit

1. An Economy with Default
   - Over three months the down payment changes from 20% to 40%
   - The borrowing interest rate’s surcharge goes from zero to 1.%

2. Long Run Properties
   - Like in all heterogeneous agents models, more frictions imply that in the long run output and wealth end up being higher.
   - But in our economies the transition is associated to a recession.
What about Expansions: A Credit Cycle

Loan to value ratio $\lambda$
Another Experiment A Credit Cycle

Real output

Unemployment rate

TFP

Housing price

Ríos Rull (Penn) Reassessing the Role of Heterogeneity 30th CMSG 2016 27 / 29
Conclusions

- We should use routinely Heterogeneous Agents Models to study fluctuations.
  - Consumption is more responsive to Economic Conditions.
  - Asset (housing) trades generate sharp changes in wealth.
  - They have to include other features that complement Heterogeneity
    - Reallocation Frictions
    - Endogenous TFP
    - Some form of Wage Rigidity

- The Cost of using them is much lower than before. Dynare. (Newberry (16), Childers (16) Reiter, Algan et al)

- Provide natural environment for new mechanisms Disagreement in forecasts (Huo (16),).

- Not only Heterogeneity of households but of firms and financial entities.
Thank You for Coming and Listening!