A Parsimonious Macroeconomic Model for Asset Pricing

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Outline

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   - Motivation
   - Contribution

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   - Macro vs. Asset Pricing

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Outline

1 Introduction
   • Motivation
   • Contribution

2 Model

3 Results

4 Conclusion

5 Discussion

Guvenen

A Parsimonious Macroeconomic Model for Asset Pricing
Asset Prices and the Business Cycle

- Getting asset prices and macroeconomic quantities in a GE model with production is hard:
  1. Equity premium, risk-free rate level/volatility, predictability, etc.
  2. Counter-cyclical labor hours.

- This paper proposes a new mechanism based on data:
  1. Limited Stock Market Participation: Until 1990’s about 2/3 of individuals did not hold any stocks at all;
  2. Heterogeneity in EIS: Stock market participants have a higher EIS (Blundell et al., REStud, 1994)\(^1\).

\(^1\)EIS estimates are actually all over the place.
Complementing Existing Literature

1. Heterogeneous trading technologies (Chien et al., WP, 2009):
   - Richer set of limits on access to financial markets in a more tractable endowment economy setting.

2. GE with production and recursive preferences (Kaltenbrunner & Lochstoer, WP, 2008):
   - Examines interaction of recursive prefs and technology shocks;
   - KL2008 is the benchmark model for my discussion.

3. GE with production, recursive preferences and limited participation (Gomes & Michaelides, RFS, 2008):
   - Similar, full-specified GE model that concludes limited participation less important.
Neoclassical growth model with capital adjustment costs:

1. Discrete time, infinite horizon;
2. One firm with C-D technology and costly capital adjustment;
3. Two consumer-types with E-Z preferences:
   - Different EIS and trading technology;
   - Financial markets incomplete w.r.t. aggregate risk;
   - No background/idiosyncratic risk.
Two groups of consumers differ along two dimensions:

1. Trading technology ("limited participation");
2. Elasticity of intertemporal substitution.

"Stockholders" ($i = h$) vs. "Non-Stockholders" ($i = n$):

- Fixed fraction of stockholders ($\mu$);
- Stockholders less concerned about smoothing ($\text{EIS}^h > \text{EIS}^n$);
- Stockholders able to hold corporate bonds and stocks;
- Neither faces idiosyncratic risk.
Representative Consumers: Preferences

- E-Z time-nonseparable preferences:

\[ U_t^i = \left\{ (1 - \beta) u^i(C_t, 1 - l_t) + \beta \left( \mathbb{E}_t \left[ (U_{t+1}^i)^{1-\alpha} \right] \right)^{\frac{1-\rho^i}{1-\alpha}} \right\}^{\frac{1}{1-\rho^i}} \]

- Constant risk preferences:
  - \( \alpha \) is (common) coefficient of relative risk aversion;
  - \( 1/\rho^i \) is (heterogenous) elasticity of intertemporal substitution.
Representative Consumers: Preferences

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\[
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\]

- Constant risk preferences:
  - \(\alpha\) is (common) coefficient of relative risk aversion;
  - \(1/\rho^i\) is (heterogenous) elasticity of intertemporal substitution.

Three specifications for intraperiod utility considered...
Two Representative Consumers: Preferences

1. **CONS**: $u(c, 1 - l) = c^{1-\rho^i}$
   - Labor supplied inelastically.
Two Representative Consumers: Preferences

1. “CONS”: \( u(c, 1 - l) = c^{1 - \rho^i} \)

2. “CD”: \( u(c, 1 - l) = (c^\gamma(1 - l)^{1 - \gamma})^{1 - \rho^i} \)

- \( \gamma, \rho^i \) jointly pin down EIS, fraction of time devoted to work, and (Frisch) labor supply elasticity w.r.t. wages;
- Different \( \rho^i \) implies heterogeneity in Frisch elasticity;
- This is problematic and will be discussed later.
Two Representative Consumers: Preferences

1. “CONS”: \( u(c, 1 - l) = c^{1 - \rho_i} \)
2. “CD”: \( u(c, 1 - l) = \left( c^\gamma (1 - l)^{1 - \gamma} \right)^{1 - \rho_i} \)
3. “GHH”: \( u(c, 1 - l) = \left( c - \psi \frac{1 + \gamma}{1 + \gamma} \right)^{1 - \rho_i} \)

- MRS cons./leisure independent of level of consumption;
- Three parameters now pin down:
  1. Labor supply elasticity \((1/\gamma)\);
  2. EIS \((1/\rho_i)\);
  3. \(\psi\) pins down the MRS between consumption and leisure.

Note that GHH is the preferred specification...
Two Representative Consumers: Preferences

1. “CONS”: \( u(c, 1 - l) = c^{1 - \rho^i} \)

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     1. Labor supply elasticity \((1/\gamma)\);
     2. EIS \((1/\rho^i)\);
     3. \(\psi\) pins down the MRS between consumption and leisure.

Note that GHH is the preferred specification...
Technology

1. CRS production technology: \( Y_t = Z_t L_t^{1-\alpha} K_t^\alpha \)

2. TFP shocks: \( \ln Z_t = \sigma \epsilon \sum_{j=0}^{t} \phi^j \epsilon_{t-j}, \quad \epsilon_j \sim \text{i.i.d.} N(0,1) \)
   - Shocks transitory \((\phi < 1)\) and homoscedastic;
   - Economy is stationary, i.e., not growing over time.

3. LOM capital: \( K_{t+1} = (1 - \delta) K_t + \Phi \left( \frac{I_t}{K_t} \right) K_t \)
   - \( \Phi(\cdot) \) captures symmetric, convex capital adjustment costs;
   - No adjustment cost if investing at SS rate.
1. Price-taking, homogenous-good producing firm;
2. Firm maximizes ex-dividend value s.t. LOM capital:

\[ P_t^s = \max \{ I_{t+j}, L_{t+j} \} \sum_{j=1}^{\infty} \beta^j \Lambda_{t,t+j}^h D_{t+j} \]

- \( \Lambda_{t,t+j}^h \) is representative stockholder’s IMRS.
Capital structure of firm:

1. One common share (equal to ex-dividend value of firm);
Representative Firm: Dividends

Capital structure of firm:

1. One common share (equal to ex-dividend value of firm);
2. One perpetuity with face value $\chi K_{ss}$ and coupon $1 - P^f_t$:
   - Same as rolling over 1-pd bond(s) with total face value $\chi K_{ss}$, so bonds in constant supply with some price $P^f_t$;

$$D_t = Y_t - W_t L_t - I_t - \chi K_{ss} + P^f_t \chi K_{ss}$$

- Corporate debt introduced to model financial leverage ($\chi$) on asset prices (see Danthine & Donaldson, REStud, 2002).
Consumer’s Problem: Non-Stockholder

- Let $B$ and $\Upsilon = (K, B, Z)$ denote bond holdings of non-stockholders and the aggregate state vector, resp.;
- $b'$ and $\omega$ are bond holdings and financial wealth;
- Non-stockholder’s problem can be formulated recursively as:

$$V^n(\omega; \Upsilon) = \max_{c, l, b'} \left[ (1 - \beta)u^n(c, 1 - l) + \beta \left[ \mathbb{E} Z V^h_{t+1}(\omega'; \Upsilon')^{1-\alpha} \right]^{\frac{1-\rho^n}{1-\alpha}} \right]^{\frac{1}{1-\rho^n}}$$

s.t. \[c + P^f(\Upsilon) \cdot b' \leq \omega + W(K, Z) \cdot l\]

\[\omega' = b'\]

\[b' \geq B\]

\[K' = \Gamma_K(\Upsilon), \quad B' = \Gamma_B(\Upsilon)\]
Consumer’s Problem: Stockholder

- Stockholder’s problem can be formulated recursively as:
- As before, but stock holdings $s' \neq 0$;

\[
V^h(\omega; \Upsilon) = \max_{c, l, b', s'} \left[ (1 - \beta) u^h(c, 1 - l) + \beta \left[ \mathbb{E}_Z V_{t+1}^h(\omega'; \Upsilon')^{1-\alpha} \right]^{\frac{1}{1-\alpha}} \right]^{\frac{1}{1-\rho^h}}
\]

s.t. \[c + P^f(\Upsilon) \cdot b' + P^s(\Upsilon) \cdot s' \leq \omega + W(K, Z) \cdot I\]

\[\omega' = b' + (P^s(\Upsilon') + D(\Upsilon)) \cdot s'\]

\[b' \geq B\]

\[K' = \Gamma_K(\Upsilon), \quad B' = \Gamma_B(\Upsilon)\]
Decisions, prices, and LOMs for aggregate capital/bond holdings of non-stockholders \( \{ V^i, c^i, l^i, b^i', s', W, I, L, P^s, P^f, \Gamma_K, \Gamma_B \} \) s.t.:

1. **Optimality:**
   - Given prices and LOMs, HH-types maximize utility;
   - Given \( W \) and \( \Lambda^h \), firm maximizes value.

2. **Market Clearing:**
   - Bond, stock and labor markets clear.

3. **Aggregate Consistency:**
   - LOMs are consistent with individual behavior/beliefs.
Before I put parameters up, things to note:
Baseline Calibration

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1. Model is calibrated for 1880-1991:
   - This rationalizes fixed participation rate of 20%;
   - Explains large empirical volatility of risk-free rate.
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1. Model is calibrated for 1880-1991:
   - This rationalizes fixed participation rate of 20%;
   - Explains large empirical volatility of risk-free rate.

2. Model is solved at *monthly* frequency:
   - Approximate frequency of decision-making;
   - Model AP moments time-aggregated to match *annual* data;
   - Macro moments time-aggregated to match *quarterly* data.
Baseline Calibration

Before I put parameters up, things to note:

1. Model is calibrated for 1880-1991:
2. Model is solved at \textit{monthly} frequency:
3. All parameters are picked in standard fashion, except \((\alpha, \sigma_\epsilon)\):
   - Chosen to match Sharpe ratio of 0.25 (0.32 in data) & \(\sigma(\Delta y)\);
   - Gives \(\sigma_\epsilon = 1.5\% > 0.7\%\) from post-war Solow residuals;
   - Recall KL2008 calibrate \((\xi, \sigma_\epsilon)\) to:
     1. \(\sigma(\Delta c) \& \sigma(\Delta c)/\sigma(\Delta y)\);
     2. Sharpe ratio of equity returns.
## Baseline Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters calibrated outside the model</td>
<td></td>
</tr>
<tr>
<td>$\beta^*$</td>
<td>Time discount rate</td>
</tr>
<tr>
<td>$1/\rho^h$</td>
<td>EIS of stockholders</td>
</tr>
<tr>
<td>$1/\rho^n$</td>
<td>EIS of non-stockholders</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Participation rate</td>
</tr>
<tr>
<td>$\phi^*$</td>
<td>Persistence of aggregate shock</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Capital share</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Adjustment cost coefficient</td>
</tr>
<tr>
<td>$\delta^*$</td>
<td>Depreciation rate</td>
</tr>
<tr>
<td>$\overline{B}$</td>
<td>Borrowing limit</td>
</tr>
<tr>
<td>$\chi$</td>
<td>Leverage ratio</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters calibrated inside the model (to match targets)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^*_\xi$</td>
<td>Standard deviation of shock (%)</td>
</tr>
<tr>
<td>$\alpha^h = \alpha^n$</td>
<td>Relative risk aversion</td>
</tr>
<tr>
<td></td>
<td>1.5/1.5/1.1</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Guvenen A Parsimonious Macroeconomic Model for Asset Pricing
Outline

1. Introduction
2. Model
3. Results
   - Asset Pricing: Unconditional Moments
   - Asset Pricing: Conditional Moments
   - Macroeconomic Quantities
   - Macro vs. Asset Pricing
4. Conclusion
5. Discussion
Focus on CONS model, since intuition easier to explain;
  - Show robust to GHH preferences over \((c, l)\) later.

Before I put AP moments up, things to note:

1. When remove heterogeneity in EIS \((=0.1)\), results broadly in line with “LRR I” in KL2008;
2. Results robust to changes in RRA of non-stockholders.
### Numbers: CONS (Inelastic Labor Supply) Model

<table>
<thead>
<tr>
<th></th>
<th>US Data</th>
<th>CONS Model</th>
<th>CONS Model</th>
<th>CONS Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha^h, \alpha^n$</td>
<td>6/6</td>
<td>6/6</td>
<td>6/6</td>
<td>6/12</td>
</tr>
<tr>
<td>$1/\rho^h, 1/\rho^n$</td>
<td>0.3/0.1</td>
<td>0.3/0.3</td>
<td>0.1/0.1</td>
<td>0.3/0.1</td>
</tr>
<tr>
<td><strong>A. Stock and Bond Returns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E(R^p)$</td>
<td>6.17</td>
<td>5.46</td>
<td>2.44</td>
<td>7.65</td>
</tr>
<tr>
<td>$\sigma(R^p)$</td>
<td>19.4</td>
<td>21.9</td>
<td>15.3</td>
<td>27.2</td>
</tr>
<tr>
<td>$\sigma(R^g)$</td>
<td>19.3</td>
<td>20.6</td>
<td>14.7</td>
<td>27.0</td>
</tr>
<tr>
<td>$E(R^p)/\sigma(R^p)$</td>
<td>0.32</td>
<td>0.25</td>
<td>0.16</td>
<td>0.28</td>
</tr>
<tr>
<td>$E(R^f)$</td>
<td>1.94</td>
<td>1.31</td>
<td>3.20</td>
<td>0.24</td>
</tr>
<tr>
<td>$\sigma(R^f)$</td>
<td>5.44</td>
<td>6.65</td>
<td>4.55</td>
<td>8.52</td>
</tr>
<tr>
<td><strong>B. Price-Dividend Ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E(P^s/D)$</td>
<td>22.1</td>
<td>27.2</td>
<td>25.9</td>
<td>29.5</td>
</tr>
<tr>
<td>$\sigma(\log(P^s/D))$</td>
<td>26.3</td>
<td>26.6</td>
<td>13.8</td>
<td>38.7</td>
</tr>
<tr>
<td>$\sigma(\Delta \log D)$</td>
<td>13.4</td>
<td>19.1</td>
<td>14.0</td>
<td>24.2</td>
</tr>
<tr>
<td><strong>C. Consumption Growth Volatility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma(\Delta \log c^h)$</td>
<td>$&gt; 1.5-2.0^b$</td>
<td>2.42</td>
<td>0.78</td>
<td>1.12</td>
</tr>
<tr>
<td>$\sigma(\Delta \log c^n)$</td>
<td></td>
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</tr>
</tbody>
</table>

- Should this be the return on default-free corporate debt?
Limited participation:
- Concentrates capital income risk among stockholders;
- Firm’s returns are pro-cyclical;
- Stockholders demand premium for holding onto their firm.
Mechanism: Source of Equity Premium

1. Limited participation:
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2. Heterogeneity in EIS:
   - Non-stockholders face wage risk;
   - They have greater desire for consumption-smoothing;
   - They need bonds more, as other agent who can adjust stocks;
   - During recession they want to reduce wealth, which requires interest payments by stockholders;
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   - During recession they want to reduce wealth, which requires interest payments by stockholders;
   - Effect on stockholder’s consumption growth:
     - More volatile $\implies$ increases unconditional MPR.
**Mechanism: Source of Equity Premium**

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   - During recession they want to reduce wealth, which requires interest payments by stockholders;
   - Effect on stockholder’s consumption growth:
     - More volatile $\implies$ increases unconditional MPR.

**Can quantify this effect in the model...**
Mechanism: Source of Equity Premium

Variance decomposition of consumption growth:

\[ c^h = \left[ W + \frac{\theta ZK^\theta L^{1-\theta} - I}{\mu} \right] - \frac{(B - P^f \cdot B')}{\mu} \]

\[ \implies \sigma^2 [\Delta \ln c^h] \approx \sigma^2 [\Delta \frac{a^h}{A^h}] + \sigma^2 [\Delta \ln A^h] + 2\sigma \left[ \Delta \ln A^h, -\Delta \frac{a^h}{A^h} \right] \]

- \( A^h \) reflects wage and dividend income;
- \( a^h \) are net interest payments made by stockholder/firm-owner;
- \( A^n, a^n \) reflect wage and interest payments for non-stockholder.
1. Interest payments constitute < 1% of average consumption;
2. Stockholders have more volatile consumption growth:
   - In bad times \((\Delta \ln A^h < 0)\) stockholders interest payments increase \((\Delta \frac{a^h}{A^h} > 0)\);
   - Timing effect leads to greater consumption variance, larger unconditional MPR, and counter-cyclical MPR (more later).
Mechanism: Source of Equity Premium
Value function of Non-Stockholder
Mechanism: Source of Equity Premium
Value function of Stockholder
Mechanism: Review

1. Non-stockholder *really* wants to smooth consumption:
   - Saves in boom;
   - Dissaves in bust.

2. In bust, wages drop so they roll over fewer bonds with firm/stockholder;

3. Stockholder holds more bonds and must reduce consumption.
Mechanism: Low Volatility of Risk-Free Rate

1. Level of risk-free rate:
   - Will discuss later...
Mechanism: Low Volatility of Risk-Free Rate

1. Level of risk-free rate:
   - Will discuss later...

2. Volatility of the risk-free rate:
   - Lower than other studies and more so with endogenous labor;
Mechanism: Low Volatility of Risk-Free Rate

1. Level of risk-free rate:
   - Will discuss later...

2. Volatility of the risk-free rate:
   - Lower than other studies and more so with endogenous labor;
   - Demand shocks move price less, given flatter demand curve:
     1. *Heterogeneity in EIS*: A higher average EIS results in a flatter bond demand curve;
     2. *Limited participation*: Equity acts as a partial substitute for stockholders, making their bond demand more elastic.
Mechanism: Low Volatility of Risk-Free Rate

Bond Supply and Demand

Representative Agent Model with Low EIS

Limited Participation Model

- $B^h$: stockholders' supply
- $B^n$: non-stockholders' demand
- $B^h$, $B^n$: Bond supply
- $B_1$, $B_2$: Bond demand

Price Volatility

Quantity of Bond

Price of Bond

0.5

1

1.25

1.5

0.75

0.5

0
Mechanism: Low Volatility of Risk-Free Rate
Bond Supply and Demand

How to interpret second picture? Isn’t bond supply fixed?
Mechanism: Low Volatility of Risk-Free Rate
Bond Supply and Demand

- Bonds are in fixed positive supply in this model;
- Equilibrium demand curve will be a weighted sum of these two;
- It will be more elastic and hence price will be less responsive to demand-side shocks.
With CD preferences over leisure-consumption, AP looks bad;

With GHH preferences, AP moments largely intact;

Less adjustment in labor to smooth consumption. Why?
  - No wealth effect on labor supply choice;
  - Labor hours strongly pro-cyclical due to pro-cyclical wages and (calibrated) substitution effect.

Hence marginal utility still volatile when labor endogenous and MPR does not fall too much.
### Numbers: Return Predictability

<table>
<thead>
<tr>
<th>Horizon (k)</th>
<th>US Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>$R^2$</td>
</tr>
<tr>
<td>A. Stock Returns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-.21</td>
<td>.07</td>
</tr>
<tr>
<td>2</td>
<td>-.36</td>
<td>.12</td>
</tr>
<tr>
<td>3</td>
<td>-.41</td>
<td>.13</td>
</tr>
<tr>
<td>5</td>
<td>-.70</td>
<td>.23</td>
</tr>
<tr>
<td>7</td>
<td>-.87</td>
<td>.27</td>
</tr>
<tr>
<td>B. Excess Returns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-.22</td>
<td>.09</td>
</tr>
<tr>
<td>2</td>
<td>-.39</td>
<td>.14</td>
</tr>
<tr>
<td>3</td>
<td>-.47</td>
<td>.15</td>
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<tr>
<td>5</td>
<td>-.77</td>
<td>.26</td>
</tr>
<tr>
<td>7</td>
<td>-.94</td>
<td>.33</td>
</tr>
</tbody>
</table>

- $P_s/D$ forecasts (excess?) returns in this model. Why?
**Mechanism: Source of Return Predictability**

1. $P^s/D$ is pro-cyclical:
   - Following a $Z$-shock, $P^s$ jumps immediately;
   - Dividends and capital move by less due to adjustment costs:
     - (Dividends counter-cyclical? Ambiguous and not discussed.)
   - Hence, $\text{Cov}[Z, P^s/D] > 0$.

2. Equity premium is counter-cyclical:
   - Follows from counter-cyclical conditional variance of:
     1. Consumption growth of stockholders (explained);
     2. Returns (not explained, obvious?).
   - Hence, interpreted as a price of risk ($\lambda^h_t$), as opposed to a quantity of risk ($\beta_t$), effect...
Mechanism: Why is ERP Counter-Cyclical?

- CONS model under CRRA preferences:
  \[
  \mathbb{E}_t [R_{t+1}^{ep}] \approx \alpha \cdot \sigma_t[R_{t+1}^{ep}] \cdot \sigma_t[\Delta \ln c_{t+1}^h] \cdot \rho_t[\Delta \ln c_{t+1}^h, R_{t+1}^{ep}]
  \]
  (a) Counter-cyclical, increases 18% boom to bust (ignore);
  (b) Counter-cyclical, increases 39% boom to bust;
  (c) Stable and close to one over cycle ($\beta$ constant?).

Counter-cyclical consumption growth volatility due to interest payments by stockholders during recessions;
Counter-cyclical ERP follows from counter-cyclical MPR.
Mechanism: Why is ERP Counter-Cyclical?

- CONS model under CRRA preferences:
  \[
  \mathbb{E}_t [R_{t+1}^{ep}] \approx \alpha \cdot \sigma_t [R_{t+1}^{ep}] \cdot \sigma_t [\Delta \ln c_{t+1}^h] \cdot \rho_t [\Delta \ln c_{t+1}^h, R_{t+1}^{ep}]
  \]

- Argument goes as follows:
  (a) Counter-cyclical, increases 18% boom to bust (ignore);
  (b) Counter-cyclical, increases 39% boom to bust;
  (c) Stable and close to one over cycle (\(\beta\) constant?).

\[
\sigma_t^2 [\Delta \ln c_{t+1}^h] \approx \sigma_t^2 \left[ \Delta \frac{a_{t+1}^h}{A_{t+1}^h} \right] + \sigma_t^2 [\Delta \ln A_{t+1}^h] + 2\sigma_t \left[ \Delta \ln A_{t+1}^h, -\Delta \frac{a_{t+1}^h}{A_{t+1}^h} \right]
\]

- Counter-cyclical consumption growth volatility due to interest payments by stockholders during recessions;
- Counter-cyclical ERP follows from counter-cyclical MPR.
### Numbers: Macro Moments

<table>
<thead>
<tr>
<th>Leisure preferences</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CD</td>
</tr>
<tr>
<td><strong>Volatility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \sigma (Y) )</td>
<td>1.89 (0.21)</td>
<td>1.97</td>
</tr>
<tr>
<td>( \sigma (C) / \sigma (Y) )</td>
<td>0.40 (0.04)</td>
<td>0.92</td>
</tr>
<tr>
<td>( \sigma (I) / \sigma (Y) )</td>
<td>2.39 (0.06)</td>
<td>1.38</td>
</tr>
<tr>
<td>( \sigma (L) / \sigma (Y) )</td>
<td>0.80 (0.05)</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Correlation with Output</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \rho (Y, C) )</td>
<td>0.76 (0.05)</td>
<td>0.99</td>
</tr>
<tr>
<td>( \rho (Y, I) )</td>
<td>0.96 (0.01)</td>
<td>0.99</td>
</tr>
<tr>
<td>( \rho (Y, L) )</td>
<td>0.78 (0.05)</td>
<td>0.96</td>
</tr>
</tbody>
</table>
In RA models, labor hours are counter-cyclical:

- In boom ($\uparrow Z$), stock price increases;
- Wealth effect from stock ownership dominates substitution effect from increased wages;
- Labor hours drops during boom!
Quantities: Procylicality of Aggregate Hours

1. In RA models, labor hours are counter-cyclical:
2. In present model, wealth effect only for stockholders:
   - Non-stockholders experience no wealth effect!
   - In aggregate, hours will be procyclical!
   - Won’t stockholders still have counter-cyclical labor hours?
Quantities: Procylicalality of Aggregate Hours

1. In RA models, labor hours are counter-cyclical:
2. In present model, wealth effect only for stockholders:
   - Non-stockholders experience no wealth effect!
   - In aggregate, hours will be procyclical!
   - Won’t stockholders still have counter-cyclical labor hours?
   - Yes, for CD preferences;
   - However, GHH preferences disentangle wealth effects from labor supply, which permits procyclical hours for both groups.
1. In RA models, labor hours are counter-cyclical:

2. In present model, wealth effect only for stockholders:

3. Volatility of labor hours?
   - GHH prefs sorts this out for same reason.
Quantities: Wealth Distribution

- Stockholders own 92% of aggregate wealth on average:
  - Big improvement on previous models;
  - Cyclical nature of interest payments matters, not size!
  - Why include housing wealth when report data?
Assessing Trade-Off Between Macro & AP Moments

- Baseline: 
- $\alpha^h = 4, 6, 8, 10$
- $\xi = 0.7, 0.6, 0.5, 0.4, 0.3, 0.2$
- $\alpha^h = 10, 8, 6, 4$

Guvenen
A Parsimonious Macroeconomic Model for Asset Pricing
Assessing Trade-Off Between Macro & AP Moments

- Apparent “separation” between quantities and choice of RRA;
- But, inconsistent with calibration strategy (p16.):
  - Alludes to trade-off between Sharpe ratio and $\sigma(\Delta y)$;
  - If so, the picture and discussion (p36.) are rather misleading.
1. Introduction
2. Model
3. Results
4. Conclusion
5. Discussion
Conclusion

1. General equilibrium model with production:
   - Limited stock market participation;
   - Heterogeneity in EIS;
   - GHH intraperiod utility.

2. Asset prices look good:
   - Volatile and counter-cyclical stockholder consumption growth generates volatile SDF and counter-cyclical MPR;
   - Is stockholder consumption consistent with the data?
   - Is the mechanism plausible?

3. Quantities appear to be fine too:
   - Mechanism yields procyclical aggregate hours;
   - GHH preferences yield procyclical hours for stockholders.
Outline

1. Introduction
2. Model
3. Results
4. Conclusion
5. Discussion
   - Empirical Evidence
   - Interpreting Mechanism
   - Revisiting KL2008
Empirical Evidence: Limited Participation

Does limited participation matter for asset pricing?

\[ u = \frac{1}{T} \sum_{t=1}^{T} \beta \left[ \frac{\sum_{i \in I} c_{t+1}^i}{\sum_{i \in I} c_t^i} \right]^{-\gamma} [R_{t+1} - R_{t+1}^f] \]

- Brav, Constantinides & Geczy (JPE, 2002) investigate EE errors using the complete markets SDF above;
- Only including individuals with large assets (weakly) reconciles EPP;
- V-J (JPE, 2002) does E-Z Euler eqn estimation and finds \( EIS^h >> EIS^n \).
Empirical Evidence: Stockholder Consumption
Is stockholder consumption consistent with model?

Vissing-Jorgensen (AER, 2009) uses CEX and IRS data:

1. For 1982-2006, consumption growth of rich more exposed to aggregate consumption growth than average consumer:
   - This is consistent with previous findings.
Empirical Evidence: Stockholder Consumption
Is stockholder consumption consistent with model?

Vissing-Jorgensen (AER, 2009) uses CEX and IRS data:

1. For 1982-2006, consumption growth of rich more exposed to aggregate consumption growth than average consumer:
   - This is consistent with previous findings.

2. *Income* exposure of rich is likely contributor to their higher consumption exposure;

3. **Key question:** Is wage or non-wage income more exposed?
   - From 1929-82, *non-wage* income is more highly exposed;
   - From 1982-2006, *wage* income is more highly exposed!
### Empirical Evidence: Stockholder Consumption

1929-82: Non-wage income key!

#### Table 3—Exposure of Income Growth by Income Percentile, 1929–1982

<table>
<thead>
<tr>
<th>Type of income</th>
<th>All tax units</th>
<th>Top 10 percent</th>
<th>Top 1 percent</th>
<th>Top 0.1 percent</th>
<th>Top 0.01 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1</td>
<td>2.9</td>
<td>8.9</td>
<td>27.6</td>
<td>83.6</td>
</tr>
<tr>
<td>Panel B: Average percent of income from source</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wage</td>
<td>69.8</td>
<td>66.0</td>
<td>42.0</td>
<td>30.1</td>
<td>18.0</td>
</tr>
<tr>
<td>Nonwage</td>
<td>30.2</td>
<td>34.0</td>
<td>58.0</td>
<td>69.9</td>
<td>82.0</td>
</tr>
<tr>
<td>Panel C: Aggregate consumption growth beta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.62</td>
<td>1.55</td>
<td>2.01</td>
<td>1.85</td>
<td>1.98</td>
</tr>
<tr>
<td></td>
<td>[7.22]</td>
<td>[10.87]</td>
<td>[7.25]</td>
<td>[4.74]</td>
<td>[4.31]</td>
</tr>
<tr>
<td>Wage</td>
<td>1.49</td>
<td>0.71</td>
<td>0.65</td>
<td>0.42</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>[5.66]</td>
<td>[4.55]</td>
<td>[2.97]</td>
<td>[1.30]</td>
<td>[0.45]</td>
</tr>
<tr>
<td>Nonwage</td>
<td>1.83</td>
<td>2.61</td>
<td>2.86</td>
<td>2.29</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td>[8.65]</td>
<td>[8.72]</td>
<td>[7.42]</td>
<td>[4.76]</td>
<td>[4.38]</td>
</tr>
</tbody>
</table>
Empirical Evidence: Stockholder Consumption
1982-2006: Wage income key!

<table>
<thead>
<tr>
<th>Type of income</th>
<th>All tax units</th>
<th>Top 10 percent</th>
<th>Top 1 percent</th>
<th>Top 0.1 percent</th>
<th>Top 0.01 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1</td>
<td>3.2</td>
<td>10.7</td>
<td>41.3</td>
<td>157.9</td>
</tr>
</tbody>
</table>

**Panel A: Average income in group to average for all tax units**

<table>
<thead>
<tr>
<th>Type of income</th>
<th>All tax units</th>
<th>Top 10 percent</th>
<th>Top 1 percent</th>
<th>Top 0.1 percent</th>
<th>Top 0.01 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage</td>
<td>68.0</td>
<td>77.5</td>
<td>60.7</td>
<td>49.0</td>
<td>40.3</td>
</tr>
<tr>
<td>Nonwage</td>
<td>32.0</td>
<td>22.5</td>
<td>39.3</td>
<td>51.0</td>
<td>59.7</td>
</tr>
</tbody>
</table>

**Panel B: Average percent of income from source**

<table>
<thead>
<tr>
<th>Type of income</th>
<th>All tax units</th>
<th>Top 10 percent</th>
<th>Top 1 percent</th>
<th>Top 0.1 percent</th>
<th>Top 0.01 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage</td>
<td>1.98</td>
<td>2.60</td>
<td>4.69</td>
<td>7.30</td>
<td>8.62</td>
</tr>
<tr>
<td>Nonwage</td>
<td>5.14</td>
<td>3.32</td>
<td>2.62</td>
<td>2.64</td>
<td>2.59</td>
</tr>
</tbody>
</table>

**Panel C: Aggregate consumption growth beta**

<table>
<thead>
<tr>
<th>Type of income</th>
<th>All tax units</th>
<th>Top 10 percent</th>
<th>Top 1 percent</th>
<th>Top 0.1 percent</th>
<th>Top 0.01 percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage</td>
<td>1.86</td>
<td>2.53</td>
<td>5.44</td>
<td>9.86</td>
<td>15.22</td>
</tr>
<tr>
<td>Nonwage</td>
<td>2.25</td>
<td>2.03</td>
<td>2.80</td>
<td>3.51</td>
<td>2.71</td>
</tr>
</tbody>
</table>

Guvenen: A Parsimonious Macroeconomic Model for Asset Pricing
Empirical Evidence: Final Thoughts

1. Evidence that limited participation matters for asset pricing;
2. Guvenen’s mechanism:
   - Income data consistent with mechanism, but no consumption data for this time period...
   - Income data *inconsistent* with mechanism, for period with consumption data!
   - However, participation has *increased* from 1982-2006 (e.g., Favilukis, WP, 2008), which might explain inconsistency.
3. Heterogeneity in EIS?
   - No clear evidence that stockholders have higher EIS;
   - Results crucially depend on stockholders having PERU (later)…
How to Interpret Limited Participation in this Model?

- Non-stockholders are allowed to hold corporate debt?!
- Limited participation seems unnatural in this setup, but...
How to Interpret Limited Participation in this Model?

- Non-stockholders are allowed to hold corporate debt?!
- Limited participation seems unnatural in this setup, but...
- What if agents correspond to financial intermediaries?
- More natural if heterogeneity in trading technologies corresponds to trading restrictions on different financial intermediary-types...
  - What would asset pricing look like in this kind of model?
  - Is this a more sensible framework for analyzing policy?
- Useful direction for existing models with intermediaries?
  - Brunnermeier & Sannikov (WP, 2009);
  - He & Krishnamurthy (WP, 2008).
Corporate debt to allow positive supply of bonds:
- Leverage does not affect quantities;
- But, affects dividends and hence properties of asset returns.

Sensitivity of AP moments to bond market assumptions?
- Bonds in zero net supply?
- Government debt (Gomes & Michaelides, RFS, 2008)?
- Risk of corporate default?

Modeling the firm's capital structure:
- Allow bonds issued on $K_t$ not $K_{SS}$ (Jermann, JME, 1998);
- Allow issuance to become a control, i.e., $\chi_t$. 
A Parsimonious Model of the Firm?

- What about cash/retained earnings?
  - e.g., Riddick & Whited (JF, 2009).
- Implications for asset pricing?
  - Suppose costly equity financing over the cycle;
  - Firm has incentive to smooth dividends!
KL2008: Some Questions

1. Transitory technology shocks and recursive preferences:
   - Elasticity of intertemporal substitution:
     1. \( EIS^h = 0.3 \implies \text{prefer early resolution;} \)
     2. \( EIS^n = 0.1 \implies \text{prefer late resolution!} \)
   - In KL2008, stockholders would like transitory tech. shocks, so MPR lower relative to CRRA model;
   - Evident in \( EIS^h = EIS^n = 0.3 \) case...

2. Wages, dividends and cycle?
   - KL2008: wages too procyclical, so counter-cyclical dividends;
   - Cyclical properties of dividends/wages not discussed here!