Planned Future of Additions to HARK

1. Endogenous labor supply models Link
2. Durable goods models Link
3. Various bits, large and small Link

The Future of HARK: Incorporating Labor (1/4)

Model of labor supply on intensive margin:

$$u(c,\ell) = ((1-\ell)^{\alpha} c)^{1-\rho}/(1-\rho),$$

$$v_t(b_t,\theta_t) = \max_{c_t,\ell_t} u(c_t,\ell_t) + \beta \cancel{D}_t \mathbb{E}_t \left[(\psi_{t+1}\Gamma_t)^{1-\rho} v_{t+1}(b_{t+1},\theta_{t+1}) \right] \text{ s.t.}$$

$$y_t = \ell_t \theta_t, \qquad \ell_t \in [0,1],$$

$$a_t = m_t + y_t - c_t, \qquad a_t \geq \underline{a},$$

$$b_{t+1} = R/(\Gamma_t \psi_{t+1}) a_t,$$

$$\psi_{t+1} \sim F_{\psi t+1}(\psi), \qquad \theta_{t+1} \sim F_{\theta t+1}(\theta), \quad \mathbb{E}[\psi_{t+1}] = 1.$$

The Future of HARK: Incorporating Labor (2/4)

Model of labor supply on extensive margin:

$$u(c,\ell) = c^{1-\rho}/(1-\rho) - \alpha\ell,$$

$$v_t(b_t,\theta_t,\ell_{t-1}) = \max_{c_t,\ell_t} u(c_t,\ell_t) + \beta\cancel{D}_t\mathbb{E}_t\left[(\psi_{t+1}\Gamma_t)^{1-\rho} v_{t+1}(b_{t+1},\theta_{t+1},\ell_t)\right]$$

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The Future of HARK: Incorporating Labor (3/4)

Model of endogenous employment search:

$$u(c,s) = ((1-s)^{\alpha} c)^{1-\rho}/(1-\rho),$$

$$v_t(m_t, e_t) = \max_{c_t, s_t} u(c_t, s_t) + \beta \not{D}_t \mathbb{E}_t \left[(\psi_{t+1}\Gamma_t)^{1-\rho} v_{t+1}(m_{t+1}, e_{t+1}) \right] \text{ s.t.}$$

$$a_t = m_t - c_t, \qquad a_t \geq \underline{a}, \qquad s_t \in [0,1],$$

$$m_{t+1} = R/(\Gamma_t^e \psi_{t+1}) a_t + \theta_t e_{t+1} + \underline{b}(1 - e_{t+1}),$$

$$\text{Prob}(e_{t+1} = 1 | e_t = 0) = s_t, \qquad \text{Prob}(e_{t+1} = 0 | e_t = 1) = \mho,$$

$$\psi_{t+1} \sim F^e_{\psi t+1}(\psi), \qquad \theta_{t+1} \sim F_{\theta t+1}(\theta), \quad \mathbb{E}[\psi_t] = 1.$$

The Future of HARK: Incorporating Labor (4/4)

Applications of `Market` for labor models:

- Non-trivial calculation of $L_t = \int_0^1 \ell_{it} p_{it} \theta_{it} di$ for Cobb-Douglas
- Disutility of employment search and probability of job loss depend on labor market slackness
- Can look at behavior in response to change in SS, etc

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The Future of HARK: Durable Goods (1/3)

General durable goods model:

$$u(c, d) = (c^{\alpha}, d^{1-\alpha})^{1-\rho}/(1-\rho).$$

$$v_t(m_t, d_t) = \max_{c_t, i_t} u(c_t, d_t) + \beta \not{D}_t \mathbb{E}_t \left[(\psi_{t+1}\Gamma_t)^{1-\rho} v_{t+1}(m_{t+1}, d_{t+1}) \right] \text{ s.t.}$$

$$a_t = m_t - c_t, \quad a_t \geq \underline{a},$$

$$D_t = d_t + g(i_t), \quad d_{t+1} = (1-\delta_{t+1})D_t, \quad \delta_{t+1} \sim F_{\delta}(\delta),$$

$$m_{t+1} = R/(\Gamma_t \psi_{t+1}) a_t + \theta_{t+1},$$

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The Future of HARK: Durable Goods (2/3)

Variations of durable goods model require different solvers:

- Easiest case: $g(i_t)$ is concave, $i_t \in \mathbb{R}$. Every end-of-period state (a_t, D_t) associated with *some* beginning of period state.
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- Somewhat harder: $g(i_t) = \pi i_t$. One locus in (a_t, D_t) space is optimal; each point on optimal (a_t, D_t) locus associated with locus in (m_t, d_t) space.

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- Even harder: $g(i_t) = \widehat{g}(i_t) + K\mathbf{1}(i_t \neq 0)$, with $\widehat{g}(0) = 0$ and $\widehat{g}(\cdot)$ concave. Must check $i_t = 0$ soln everywhere, discont.

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- Just ugh: $g(i_t) = \pi i_t + K\mathbf{1}(i_t \neq 0)$, $i_t \geq 0$.

The Future of HARK: Durable Goods (3/3)

Applications for `Market` with durable goods:

- Endogenous pricing of durable good: housing market
- Dynamics of demand for durables after an aggregate shock
- Some specifications overlap with health models

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The Future of HARK: Small To-Do Items

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- Advanced features on more solvers: cubic spline interpolation
- Various numeric methods detached from particular models

The Future of HARK: Heavy Lifting

If you're feeling ambitious or are comfortable with HARK:

- Incorporate `opencl4py` with basic consumption-saving model. "Repack" model inputs into memory buffers, pass to OpenCL solver. OpenCL simulator: easier, big gains for some models.

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- Models of firm creation / bankruptcy / investment / hiring

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