BKK the EZ Way (Backus-Kehoe-Kydland the Epstein-Zin Way) by Colacito, Croce, Ho & Howard

Harjoat S. Bhamra

UBC & Imperial

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Outline

- Aim
- Why do we care?
- Model Summary & Results
- Comments

Paper's aim:

- Design a **international production-based model with endogenous labor**
  - matches a large number of moments from international asset pricing and macro
  - capital does not always flow to most productive country
- Key features
  - Epstein-Zin preferences
  - More home bias in consumption than investment (macro variables)
  - Heterogenous productivity of vintage capital (asset prices)

Improving the world economy

- Unlike the stars, the sun etc., the economy is not wholly a feature of nature. Much of the economy would not exist without humans. Human actions impact the economy. The economy is supposed to improve human welfare.

- Would like to use general equilibrium models of the world economy to help design welfare improving policies.

  - What form should the US and EU trade agreement take? Who gains and by how much. Do some countries gain more than others? Does anyone lose out?
  - Should there be a Eurozone and who should be in it? How large are the welfare gains?
  - How large are the welfare costs of international business cycles?
  - How much should we invest in education? What type of education? Which countries?

- Starting point for this: an international ge model, which is reasonably close to both the international macro and asset pricing data.

- This paper provides an example of a 2 country production economy, which is close to both the international macro and asset pricing data.

Model Summary

- 2 countries: home and foreign
  - home: good X
  - foreign: good Y
- Representative consumer-worker in each country
  - Demand for consumption
  - Supply of labor
- Production technologies: output in a country depends on labor supply from that country, capital stock and exogenous production technology
- Capital accumulation depends on depreciation and investment from home and foreign sources
- Financial markets dynamically complete: competitive eqm obtained as a Pareto efficient allocation from social planner's problem

Social Planner's Problem

$$\sup \mu_0 W_0 + (1 - \mu_0) W_0^* \tag{1}$$

s.t.

$$\overbrace{X_t}^{\text{home cons of gd } X} + \overbrace{X_t^*}^{\text{foreign cons of gd } X} + \overbrace{I_{x,t}}^{\text{home inv in gd } X} + \overbrace{I_{y,t}}^{\text{home inv in gd } Y} \leq \overbrace{F(A_t, K_t, N_t)}^{\text{output good } X} \tag{2}$$

$$\overbrace{Y_t}^{\text{home cons of good } Y} + \overbrace{Y_t^*}^{\text{foreign cons of good } Y} + \overbrace{I_{x,t}^*}^{\text{foreign inv in gd } X} + \overbrace{I_{y,t}^*}^{\text{foreign inv in good } Y} \leq \overbrace{F(A_t^*, K_t^*, N_t^*)}^{\text{output good } Y} \tag{3}$$

and

$$K_t \leq (1 - \delta) K_{t-1} + \overline{\omega}_t \, G(I_{x,t-1}, I_{x,t-1}^*) \tag{4}$$

$$K_t^* \leq (1 - \delta) K_{t-1}^* + \overline{\omega}_t^* \, G(I_{y,t-1}, I_{y,t-1}^*) \tag{5}$$

- controls: $X_t, X_t^*, I_{x,t}, I_{y,t}, N_t$ & $Y_t, Y_t^*, I_{x,t}^*, I_{y,t}^*, N_t^*$
- constraints hold at each date t
- Pareto weights are time-varying $\mu_1 \neq \mu_0$: EZ preferences [Dumas, Uppal & Wang]

Epstein-Zin preferences

- Created to
  - disentangle preferences over states from preferences over date
  - distinguish between consumption smoothing over states (risk sharing) and consumption smoothing over time (intertemporal consumption smoothing)
- Used in production-based asset pricing in combination with long-run risks (Bansal & Yaron, Lochstoer & Kaltenbrunner) to
  - keep risk-free rate low
  - need additional features to increase equity risk premium

RRA	2	2	10	10	
EIS	1/2	1/2	1/10	1.1	
$E[r_f]$	5.48	5.27	4.27	2.21	0.86
$E[r_k^{ex}]$	0.01	0.01	0.08	0.08	5.71

EZ and international macro variables

Does not help much

- Model: $Corr(dc_t, dc_t^*) = 0.41 > 0.23 = Corr(dx_t^{tot}, dy_t^{tot})$

  - Perfect risk sharing: SDF for each rep agent must equalize for each date and state

$$M_{t+1} = \beta \left(\frac{\tilde{C}_{t+1}}{\tilde{C}_t} \right)^{-\frac{1}{\psi}} \left(\frac{U_{t+1}}{E_t[U_{t+1}^{1-\gamma}]^{\frac{1}{1-\gamma}}} \right)^{-\left(\gamma - \frac{1}{\psi}\right)} \tag{6}$$

  - Consumption growth across countries more highly correlated than output growth

- Data: $Corr(dc_t, dc_t^*) = 0.33 > 0.52 = Corr(dx_t^{tot}, dy_t^{tot})$

  - In the real world something else is happening: BKK anomaly

EZ preferences and Pareto weights

- Pareto weights: are they deterministic?
- Stationarity? Earlier work

More home bias in consumption than investment

Home agent consumption good aggregator has more weight on good X

Investment aggregator G: not so much weight on local investment

$$K_t = (1 - \delta)K_{t-1} + \overline{\omega}_t G(I_{x,t-1}, I^*_{x,t-1})$$

Impacts macro quantities

- $Corr(dc_t, dc_t^*) < Corr(dx_t^{tot}, dy_t^{tot})$

  - EZ preferences: agents share long-run risks embedded in continuation utilities

$$M_{t+1} = \beta \left(\frac{\tilde{C}_{t+1}}{\tilde{C}_t} \right)^{-\frac{1}{\psi}} \left(\frac{U_{t+1}}{E_t[U_{t+1}^{1-\gamma}]^{\frac{1}{1-\gamma}}} \right)^{-\left(\gamma - \frac{1}{\psi}\right)} \tag{7}$$

    - agents can equate their SDF's by keeping their continuation utilities highly correlated
    - easier to do when investment home bias is weaker $\rightarrow$ force agents to share risks via investment channel
    - SDF's can line up across dates and states because of continuation utilities, and so consumption does not have to line up as much across dates and states

- more volatile investment growth

- higher stock return vol

- risk premium still small

Heterogenous productivity of vintage capital

Has large impact on asset prices

- continuum of overlapping vintages of capital
- capital stock is a productivity- based weighted average of new and old investments
- older investments more exposed to productivity risk

$$K_t = (1 - \delta)K_{t-1} + \overline{\omega}_t G(I_{x,t-1}, I_{x,t-1}^*) \tag{8}$$

$$\overline{\omega}_t = e^{-(1-\phi_0)\frac{1-\alpha}{\alpha}(\Delta a_t - \mu)} \tag{9}$$

evolution of capital stock is stochastic

- higher risk premium

Comments/Suggestions

- Usefulness of EZ preferences well known now
- Focus on explaining economics behind how macro variables are impacted by assumption that there is more home bias in consumption than investment
    - Forcing volatility and correlation out of consumption and into utilities and perhaps investment
    - How large is $Var_t[U_{t+1}]$
    - How large is $Corr_t(U_{t+1}, U_{t+1}^*)$
    - Might help us understand why cross-country inv growth correlation has wrong sign (-ve instead of +ve)
- Focus on explaining economics behind how asset prices impacted by heterogenous productivity of vintage capital.
    - How does the mechanism differ from investment shocks (Kogan & Papanikolaou)?

Paper looks at many moments

- 27 moments in Table 4
- Remind us why these moments are important

Acknowledge shortcomings of framework

- Paper assumes home output is produced solely by home labor
  - Labor used to make a computer or a shoe is based in more than one country. Foreign outsourcing has increased since the 1970s [Feenstra, JEP, 1998, Integration of Trade and Disintegration of Production in the Global Economy, 1948 google cites]
- Labor cannot migrate across national borders
  - If we are interested in designing policies which are politically feasible, need to include migration

Conclusion

- Very interesting paper
- Less time on EZ and more time on international investment (macro) and capital vintages (asset pricing)
- Pick your favourite moments