Intl. Business Cycles with Endogenous Incomplete Mkts.

- Kehoe & Perri (Econometrica, 2002)

- Same basic set-up as Baxter & Crucini (IER, 1995), except market incompleteness is endogenous. It arises from limited commitment.

- Countries can renege on contracts subject to the cost of living in autarky from then on.

- This limits risk sharing. Countries that experience good luck (positive productivity shocks) must be rewarded by receiving extra consumption. A key technical challenge to solving these models is that the temptation to renege is endogenous, since it depends on each country's existing capital stock (it is assumed that if a country reneges it retains control of the capital located within its borders).

Findings

- Limited Commitment reduces cross-country consumption correlations, and increases cross-country income correlations.

- Limited Commitment causes investment & employment to be positively correlated across countries, as in the data. In BKK and Baxter-Crucini they are negatively correlated across countries.

Intuition

Enforcement/Participation Constraints act a lot like (intl.) capital adjustment costs. The social planner is reluctant to allocate too much capital to a country, since this would increase its autarky value and make the country more likely to renege in the future.

Basic Set-Up

Same as in BKK + Baxter-Crucini: 2 symmetric countries, 1 good, Capital is internationally mobile, labor isn't (country specific labor is what <u>defines</u> a country).

Preferences

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t) U(c_i(s^t), \ell_i(s^t))$$

$$U(c,\ell) = \frac{1}{1-\sigma}\left[c^{\gamma}(1-\ell)^{1-\gamma}\right]^{1-\sigma}$$

s^t = history of events up to and including period t. $s^t = (s_0, s_1, s_2, \dots s_t)$

Technology

$$y_i(s^t) = F\left(k_i(s^{t-1}), A_i(s^t)\ell_i(s^t)\right)$$

$$F(k, A\ell) = k^\alpha (A\ell)^{1-\alpha}$$

Resource Constraints

$$\sum_{i=1,2}\left[c_i(s^t) + k_i(s^t)\right] = \sum_{i=1,2}\left[F\left(k_i(s^{t-1}), A_i(s^t)\ell_i(s^t)\right) + (1-\delta)k_i(s^{t-1})\right]$$

Next, let $V_i(k_i(s^{t-1}), s^t)$ = value of autarky for country i

$$V_i(k_i(s^{t-1}), s^t) = \max \sum_{r \geq t}^{\infty} \sum_{s^r} \beta^{r-t} \pi(s^r | s^t) U\left(c_i(s^r), \ell_i(s^r)\right)$$

s.t.

$$c_i(s^r) + k_i(s^r) = F\left(k_i(s^{r-1}), A_i(s^r)\ell_i(s^r)\right) + (1-\delta)k_i(s^{r-1})$$

where $r \geq t$ and

$\pi(s^r | \pi^t)$ = conditional probability of s^r given s^t

Participation Constraints (for all t)

$$\sum_{r\geq t}^{\infty} \sum_{s^r} \beta^{r-t} \pi(s^r|s^t) U(c_i(s^r), l_i(s^r)) \geq V_i(k_i(s^{t-1}), s^t)$$

Planner's Problem

$$\max_{c_i, l_i, k_i} \left\{ \lambda_1 \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t) U(c_1(s^t), l_1(s^t)) + \lambda_2 \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t) U(c_2, l_2 \right.$$

Pareto weight

Pareto weight

s.t. 1.) Aggregate Resource Constraint

2.) 2 participation/enforcement constraints for every period + history

Note, participation constraints depend on the future.

$\Rightarrow$ Problem is non-recursive

$\Rightarrow$ Solution = Add Lagrange Multipliers to the state. [Marcet + Marimon (1999) Kydland + Prescott (1980)]

Let $\mu_i(s^t)$ be the multiplier on i's Part. Constraint

Note we can write,

$$\sum_{t=0}^{\infty} \beta^t \mu_t \sum_{j=0}^{\infty} \beta^j U(C_{t+j}) = \mu_0\left[U(c_0)+\beta U(c_1)+\beta^2 U(c_2)+\cdots\right]$$
$$+\beta\mu_1\left[U(c_1)+\beta U(c_2)+\beta^2 U(c_3)+\cdots\right]$$
$$+\beta^2\mu_2\left[U(c_2)+\beta U(c_3)+\beta^2 U(c_4)+\cdots\right]$$
$$+\cdots$$

$$= \mu_0 U(c_0)+\beta(\mu_0+\mu_1)U(c_1)+\beta^2(\mu_0+\mu_1+\mu_2)U(c_2)+\cdots$$

$$= \sum_{t=0}^{\infty} \beta^t M_t U(C_t) \quad \text{where } M_t = M_{t-1}+\mu_t$$

$$\mu_{-1} = 0$$

M_t = Original planning weight + sum of past multipliers on part. constraint

$$M_i(s^{-1}) = \lambda_i$$

Planner's Lagrangian now can be written,

$$\sum_{t=0}^{\infty}\sum_{s^t}\sum_i \beta^t \pi(s^t)\Big[M_i(s^{t-1})U(c_i(s^t), l_i(s^t))$$
$$+\mu_i(s^t)\left[U(c_i(s^t), l_i(s^t)) - V_i(k_i(s^{t-1}), s^t)\right]\Big]$$

+ resource constraint

Note: Terms involving future in the Part. Constraints are captured by M_i terms

FOCs

$$\frac{U_{1c}(s^t)}{U_{2c}(s^t)} = \frac{M_2(s^{t-1}) + \mu_2(s^t)}{M_1(s^{t-1}) + \mu_1(s^t)}$$

Note, each country's Pareto weight is endogenous. It increases when its participation constraint binds.

$$-\frac{U_{i\ell}(s^t)}{U_{ic}(s^t)} = F_{i\ell}(s^t)$$

$$U_{ic}(s^t) = \beta \sum \pi(s^{t+1}|s^t)\left\{\frac{M_i(s^{t+1})}{M_i(s^t)} U_{ic}(s^{t+1})\left[F_{ik}(s^{t+1}) + (1-\delta)\right] - \frac{\mu_i(s^{t+1})}{M_i(s^t)} V_{ik}(s^{t+1})\right\}$$

Distorted Euler Eqs.
Capital Accumulation "taxed"

Decentralization

1.) Govt. of each country can tax capital income and payments to foreigners.

2.) Govts. sequentially choose tax policies to maximize welfare of domestic residents.

3.) Except for govt. tax policy, private markets operate perfectly + competitively.

The solution of this dynamic game replicates the solution to the constrained Pareto Problem

Solution Strategy

Define,

$$\nu_i(s^t) = \frac{\mu_i(s^t)}{M_i(s^t)}$$ } Normalized PC multipliers $0 \le \nu_i \le 1$

$$z(s^t) = \frac{M_2(s^t)}{M_1(s^t)}$$ } Endogenously evolving relative weight on Country 2

Note,

$$M_i(s^t)\left[1-\nu_i(s^t)\right] = M_i(s^{t-1})$$

$$\Rightarrow z(s^t) = \frac{1-\nu_1(s^t)}{1-\nu_2(s^t)}\, z(s^{t-1})$$ } Markov Process for rel. Pareto weight.

Note, if $\nu_1 > \nu_2$ then $z(s^t) < z(s^{t-1})$

Now the state vector is,

$$x_t = \left(s_t,\, k_1(s^{t-1}),\, k_2(s^{t-1}),\, z(s^{t-1})\right)$$

and the control vector is,

$$\text{controls}: \left(c_i(x_t),\, k_i(x_t),\, l_i(x_t),\, z(x_t),\, \nu_i(x_t)\right)$$

Solve by discrete-state policy function iteration,

1.) Guess initial policy functions. Assume PC don't bind

2.) Use policy functions to compute value functions.

3.) Check to see if PC is satisfied

4.) If one country's constraint is violated, use the PC to update value function + update policy functions

Repeat for all grid points!

Calibration

$\beta = .99$ $\sigma = 2$ $\gamma = .36$

$\alpha = .36$ $\delta = .025$

$$\begin{pmatrix} \log A_{1t} \\ \log A_{2t} \end{pmatrix} = \begin{bmatrix} a_1 & a_2 \\ a_2 & a_1 \end{bmatrix} \begin{pmatrix} \log A_{1t-1} \\ \log A_{2t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}$$

$a_1 = .95$ $a_2 = 0$ $\text{corr}(\varepsilon_1, \varepsilon_2) = .25$

TABLE II

BUSINESS CYCLE STATISTICS: BASELINE PARAMETERS

Statistic	Data	Economy with: No Adjustment Costs: Complete Markets	No Adjustment Costs: Bond	No Adjustment Costs: Enforcement	Adjustment Costs: Complete Markets	Adjustment Costs: Bond
Volatility						
% Standard deviations						
GDP	1.72 (.20)	2.01	1.94	1.33	1.37	1.34
Net Exports/GDP	0.15 (.01)	13.04	12.42	0.06	0.36	0.33
% Standard deviations relative to GDP						
Consumption	0.79 (.05)	0.19	0.21	0.28	0.27	0.29
Investment	3.24 (.17)	25.23	25.06	3.04	3.42	3.24
Employment	0.63 (.04)	0.56	0.54	0.50	0.52	0.49
Domestic Comovement						
Correlations with GDP						
Consumption	0.87 (.03)	0.90	0.93	0.93	0.90	0.94
Investment	0.93 (.02)	0.07	0.08	0.99	0.95	0.95
Employment	0.86 (.03)	0.99	0.99	0.99	0.99	0.99
Net Exports/GDP	−0.36 (.09)	0.06	0.06	0.27	−0.02	−0.05
International Correlations						
Home and Foreign GDP	0.51 (.13)	−0.46	−0.43	0.25	0.09	0.12
Home and Foreign Consumption	0.32 (.17)	0.28	0.13	0.29	0.77	0.62
Home and Foreign Investment	0.29 (.17)	−0.99	−0.99	0.33	−0.17	−0.09
Home and Foreign Employment	0.43 (.11)	−0.58	−0.53	0.23	−0.15	−0.04

Note: The statistics in the first 9 rows of the data column are calculated from U.S. quarterly time series, 1970:1–1998:4. The statistics in the last 4 rows of the data column are calculated from U.S. variables and an aggregate of 15 European countries. The data statistics are GMM estimates of the moments based on logged (except for net exports) and Hodrick-Prescott-filtered data with a smoothing parameter of 1,600. The numbers in parentheses are standard errors. The model statistics are computed from a simulation of 100,000 periods, where the relevant series have been logged and HP-filtered as the data series.

Source: See Appendix.

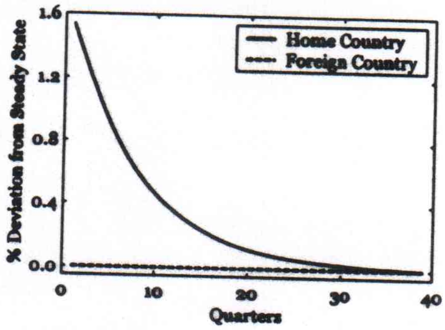

FIGURE 1.—Productivity shocks.

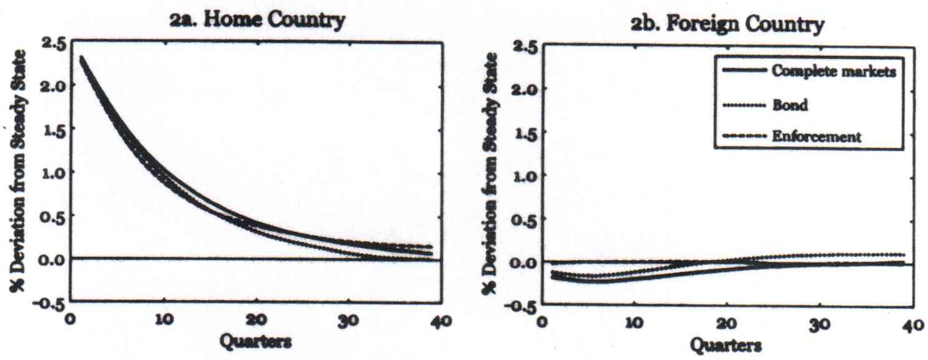

FIGURE 2.—Impulse responses to a home productivity shock—output.

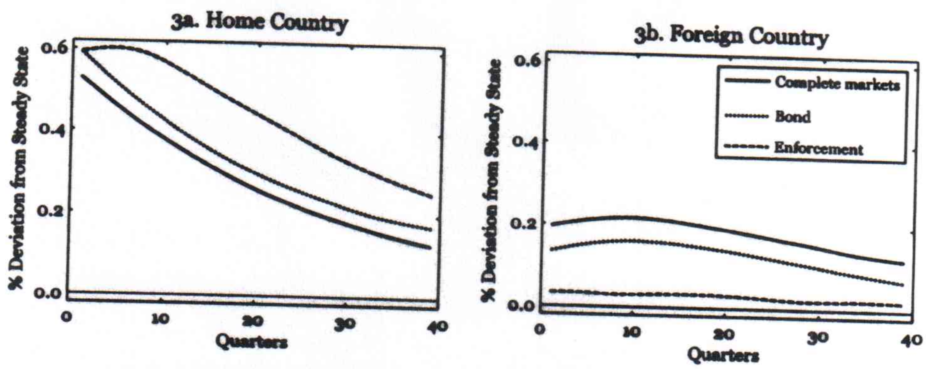

FIGURE 3.—Impulse responses to a home productivity shock—consumption.

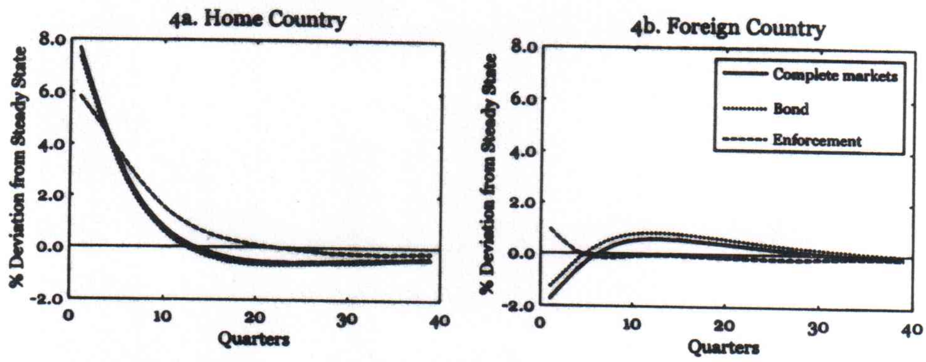

FIGURE 4.—Impulse responses to a home productivity shock—investment.

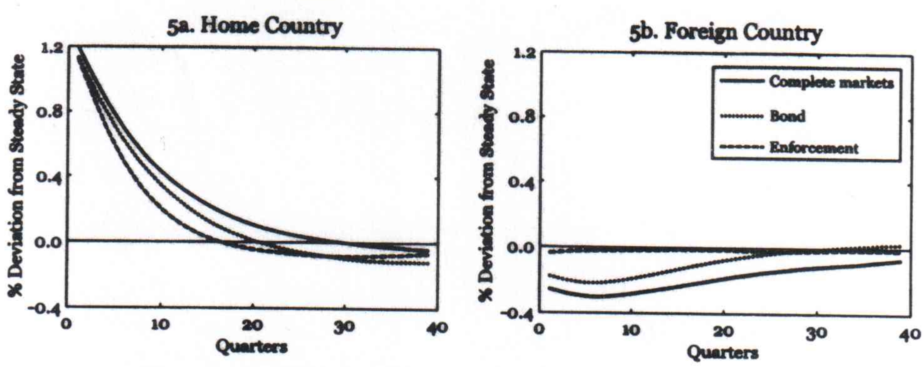

FIGURE 5.—Impulse responses to a home productivity shock—employment.

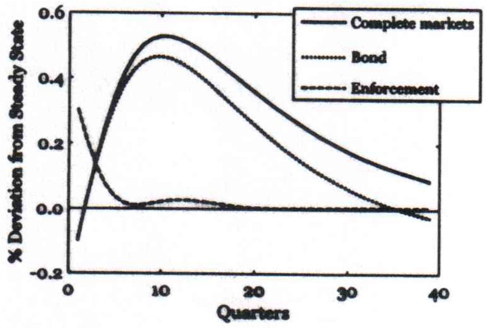

FIGURE 6.—Impulse responses to a home productivity shock—home country net exports.

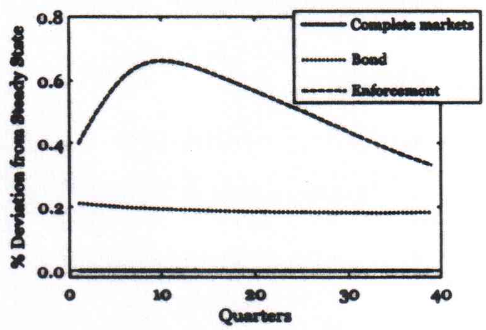

FIGURE 7.—Impulse responses to a home productivity shock—foreign/home ratio of marginal utilities.