International Macroeconomics - Session II

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Acknowledgement

This lecture draws partly on lecture notes by Morten Ravn, EUI

Recap: Last section

- Key definitions and concepts
- Obstfeld and Rogoff (2000)
  - Issues:
    - Intratemporal vs. Intertemporal Trade
    - Risk-sharing via financial assets, or terms of trade
    - Difficult to account for empirical behaviour of exchange rates
  - Models
    - Static vs dynamic
    - Perfect foresight vs. uncertainty
    - N country world vs. small-open economy
  - Puzzles for the simple theory
    - Home bias in trade
    - Lack of intertemporal trade
    - Home bias in financial assets
    - Lack of risk-sharing
    - (Also: ER puzzles)

This session: International Business Cycles

- Focus on dynamic/ short-run effect of shocks, and its transmission to domestic economy and other countries.
- How are shocks transmitted between countries?
- How do business cycles comove between countries?
- Can a 2-country version of the simple neoclassical model, with intertemporal consumption smoothing, capital accumulation, and flexible labour supply account for this?
- Do equilibrium properties differ across asset market structures?
- And what role do the terms of trade play?

What this session doesn't answer...

- Why might markets be incomplete? (Treated later.)
- Why do we observe very persistent LR movements in foreign asset positions and RER?
- Are frictions in goods trade important?
- How about rigidities in nominal prices?

Learning points

- Capital accumulation dynamics are crucial for trade dynamics with productivity shocks.
- Preference shocks work quite well, government expenditure shocks do not.
- Bond economy surprisingly similar to complete markets, unless shocks are very persistent.
- Next section:
  - In models with several goods, the elasticity of substitution is crucial for equilibrium dynamics.

Roadmap for this section

1. International Business Cycle-Facts
2. The frictionless 2 country real business cycle model and its puzzles
3. Does the model with incomplete markets work better?
4. Next section:
   - Multigood models, terms of trade insurance and the real exchange rate

International Business Cycle-Facts

Moments of the data

- Variance and within-country covariance of main macro variables
- Cross-country correlation
- Var and Cov of Open economy variables (X,M,CA)
- Volatility of international variables (RER, ToT), and correlation with others

Filtering

- Isolate business cycle frequencies, and make data stationary
- Options: Difference, HP- or Band Pass Filter
- Here: HP filter unless o/wise indicated

Business Cycles in OECD countries

B. Volatility relative to own-country output

	US	Australia	Austria	Canada	France	Germany	Italy	Japan	Switzerland	UK
output	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
consumption	0.71	0.59	0.94	0.86	0.95	0.77	0.78	1.10	0.65	1.14
investment	3.35	2.75	2.43	2.78	2.94	2.48	1.99	2.56	2.04	2.35
employment	0.62	0.34	1.31	0.87	0.58	0.64	0.31	0.36	0.68	0.77
gov't purchases	0.68	0.93	0.38	0.55	0.70	0.69	0.23	0.62	0.39	0.63
net exports	0.25	0.83	0.78	0.47	0.88	0.56	0.80	0.71	0.72	0.74

Source: Baxter 1995

Business Cycles in OECD countries

C. Correlation with own-country output

	US	Australia	Austria	Canada	France	Germany	Italy	Japan	Switzerland	UK
output	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
consumption	0.82	0.61	0.74	0.88	0.67	0.69	0.86	0.79	0.85	0.85
investment	0.97	0.79	0.79	0.57	0.83	0.88	0.86	0.93	0.84	0.68
employment	0.91	0.09	0.62	0.75	0.90	0.63	0.54	0.80	0.84	0.54
gov't purchases	0.01	0.22	-0.36	-0.32	0.18	0.17	0.21	-0.12	0.16	0.04
net exports	-0.37	-0.05	-0.63	-0.35	-0.33	-0.21	-0.73	-0.32	-0.66	-0.40

Source: Baxter 1995

Export and import in OECD countries

Table 2. Moments of open economy variables

Country	s(ex)/s(y)	s(im)/s(y)	s(nx/y)	cor(ex,y)	cor(im,y)	cor(nx/y,y)
France	2.77	4.16	0.80	0.62	0.78	−0.42
	(0.19)	(0.26)	(0.06)	(0.07)	(0.04)	(0.10)
Australia	3.16	5.93	1.56	0.17	0.28	−0.22
	(0.34)	(0.91)	(0.15)	(0.12)	(0.09)	(0.09)
Canada	2.66	3.20	0.95	0.67	0.82	−0.31
	(0.22)	(0.16)	(0.07)	(0.05)	(0.05)	(0.10)
Italy	2.31	2.77	0.91	0.25	0.74	−0.54
	(0.28)	(0.22)	(0.07)	(0.09)	(0.06)	(0.08)
Japan	3.48	4.82	0.88	−0.04	0.54	−0.49
	(0.44)	(0.55)	(0.07)	(0.10)	(0.07)	(0.08)
Switzerland	1.65	2.46	1.13	0.66	0.80	−0.50
	(0.16)	(0.24)	(0.08)	(0.06)	(0.03)	(0.07)
UK	1.82	2.50	1.05	0.47	0.62	−0.31
	(0.22)	(0.22)	(0.08)	(0.08)	(0.06)	(0.09)
US	2.58	3.10	0.56	0.34	0.78	−0.40
	(0.28)	(0.22)	(0.03)	(0.08)	(0.04)	(0.08)
Germany	2.37	1.85	0.99	0.44	0.66	−0.88
	(0.25)	(0.14)	(0.07)	(0.07)	(0.06)	(0.11)
Sweden	3.02	3.42	1.59	0.33	0.26	0.03
	(0.30)	(0.37)	(0.16)	(0.10)	(0.10)	(0.10)

All data Hodrick–Prescott filtered. Standard errors computed by GMM. 's' denotes standard deviation. Numbers in parentheses are standard errors; 'cor' denotes correlation; ex: exports; im: imports; nx/y: net-exports to output.

Source: Ravn 1997

Cross-Country Correlations

Table 1. Cross country correlations of output components

Variable	Mean	Range	Positive	Negative
Output[a]	0.420	[−0.123;0.754]	44(38)	1(0)
Consumption[a]	0.283	[−0.215;0.709]	38(29)	7(2)
Government Spending[a]	0.042	[−0.285;0.435]	28(6)	17(5)
Total investments[a]	0.342	[−0.265;0.698]	41(36)	4(1)
Exports[a]	0.250	[−0.169;0.607]	36(26)	9(0)
Imports[a]	0.340	[−0.191;0.722]	40(34)	5(1)
Employment[b]	0.342	[−0.200;0.715]	35(28)	1(1)
Productivity[b]	0.376	[0.169;0.725]	36(31)	0(0)

[a]Computed for 45 country pairs
[b]Computed for 36 country pairs (Sweden excluded)
Note: Sample moments computed from Hodrick–Prescott filtered variables. Standard errors computed by using GMM. 'Mean' is the mean correlation over the country-pairs. 'Range' gives the minimum and the maximum correlation within the country pairs. 'Positive' ('Negative') gives the number of positive (negative) point estimates and the number in parentheses is the number of correlations that are significantly larger (smaller) than zero.

Source: Ravn 1997

Real Exchange rates and relative consumption

Table 3. Unconditional Correlations

	With real US$ rate				With real effective exch. rate			
	e^{us}	p^{US}/p^i	c^i	c^i/c^{us}	e^{eff}	p^w/p^i	c^i	c^i/c^w
I. First differences, full sample								
Australia	0.99	0.03	-0.03	-0.02	0.99	0.04	-0.03	-0.03
Canada	0.97	0.18	0.07	-0.01	0.97	0.18	0.02	0.05
Denmark	0.99	-0.07	0.09	-0.01	0.92	0.10	0.07	0.04
France	0.99	-0.12	-0.22	-0.28	0.94	0.24	-0.11	-0.12
Italy	0.99	-0.13	-0.34	-0.40	0.96	0.12	-0.30	-0.26
Japan	0.98	0.12	0.12	0.02	0.97	0.17	0.07	0.09
Netherlands	0.99	0.00	-0.09	-0.20	0.87	0.43	0.03	-0.01
New Zealand	0.98	0.23	0.12	0.11	0.96	0.18	0.11	0.13
Norway	0.98	0.17	0.02	-0.11	0.93	0.23	0.23	0.19
Switzerland	0.99	-0.06	-0.07	-0.21	0.97	0.22	0.04	0.01
UK	0.99	0.04	0.03	-0.04	0.99	0.18	0.12	0.11
US	-	-	-	-	0.99	-0.16	-0.05	-0.13
II. First differences, 1960-1972.4								
Australia	0.81	0.77	0.39	0.34	-	-	-	-
Canada	0.95	0.15	0.06	0.12	0.94	0.17	0.09	0.13
Japan	0.82	0.37	0.25	0.24	0.83	0.47	0.22	0.26
UK	0.97	0.18	0.08	0.10	0.95	0.27	0.32	0.27
US	-	-	-	-	0.97	0.24	0.19	0.19
III. First differences, 1973.1-1998.4								
Australia	0.99	0.00	-0.06	-0.06	-	-	-	-
Canada	0.97	0.19	0.09	-0.05	0.97	0.19	0.02	0.02
Japan	0.99	0.10	0.04	0.02	0.99	0.16	0.09	0.10
UK	0.99	0.10	0.03	-0.07	0.97	0.16	0.10	0.10
US	-	-	-	-	0.99	-0.22	-0.10	-0.18

See notes to Table 2.

International Business Cycle-Facts - Summary

1. Business cycles are similar across countries
2. Exports are less pro-cyclical than imports, so the TB is counter-cyclical.
3. Output, employment, investment and consumption are positively correlated across countries.
4. Consumption is less correlated across countries than income.
5. RER volatility is an order of magnitude higher in flexible ER regimes.
6. The correlation between the RER and all real variables, incl. relative consumption, is small.

International Business Cycle - Literature and Roadmap

- One good model with complete markets
  1. Backus, Kehoe and Kydland JPE 1992
  2. Ravn, JIMF 1997
- Incomplete markets: trade in bonds and the importance of persistence
  1. Baxter (1995), Baxter and Crucini (1995)
- Next session: Country-specific traded goods
  1. With CM: Backus, Kehoe and Kydland AER 1994
  2. With IM: Hethcote and Perri (2000), Corsetti, Dedola and Leduc (2008)

A benchmark stochastic 2 country production model

A benchmark model: General setup

- 2 countries of equal size, discrete time
- Agents: representative infinitely lived agents, competitive firms and a government for each country
- Single perishable good used for consumption and investment and government consumption
- Consumers have identical preferences across countries i

$$U_i = E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}, l_{it}) \tag{1}$$

A benchmark model: Technology, Govmt., Uncertainty

- Technology CRTS with persistent shocks

$$y_{i,t} = exp(A_{it} k_{it}^{1-\alpha} n_{it}^{\alpha})$$
$$y_{i,t} = exp(A_{it}) k_{it}^{1-\alpha} n_{it}^{\alpha}$$

  where $n_{it} = 1 - l_{it}, A_t = [A_{1t}, A_{2t}]' = RA_t + \epsilon_{t+1}$ and ϵ_{t+1} has var-cov matrix Ω.

  Note: immobile labour but free trade in goods (and capital).

- Capital accumulates according to $k_{it+1} = (1 - \delta)k_{it} + x_{it}$
- Governments finance exogenous spending by lump-sum taxes

  $\ln g_{t+1} = (1 - \rho) lng + \rho lng_t + u_{it}$
- Uncertainty summarised by state of the world s_t: $s_t = \{\epsilon_t, u_{it}\}$

Complete Markets and First WT

- Complete markets
- Exploit 1st welfare theorem: With complete markets, competitive equilibrium allocation is solution to appropriate social planner's problem with initial country weights μ_1, μ_2.

Social planner's problem

$$max_{\{c_{it},k_{it+1},l_{it}\}} E_0[\sum_i \mu_i \sum_{t=0}^{\infty} \beta^t u(c_{it}, 1-n_{it})]$$

subject to

$$\sum_i c_{it} + x_{it} \leq \sum_i exp(A_{it}) F(k_{it}, n_{it}) - g_{it} \quad (2)$$

$$k_{it+1} = (1-\delta)k_{it} + x_{it} \quad (3)$$

$$k_{i0} \text{ given} \quad (4)$$

First order conditions

$\forall\ s_t$:

1. $c_{it}:\ \mu_i u_c(c_{it}, 1-n_{it}) = \lambda_t$
   Implies perfect risk sharing - relative marginal utility is constant across states $\frac{u_c(c_{it},1-n_{it})}{u_c(c_{jt},1-n_{jt})} = \frac{\mu_j}{\mu_i}$
2. $n_{it}: \frac{u_n(c_{it},1-n_{it})}{u_c(c_{it},1-n_{it})} = exp(A_{it}F_n(k_{it}, n_{it})$
   Efficient provision of labour effort requires MRS=MRT state by state in both countries.
3. $k_{it+1}: \lambda_t = E_t[\beta\lambda_{t+1}(exp(A_{it+1})F_k(k_{it+1}, n_{it+1}) + 1 - \delta)]$
   $= E_t[\beta\lambda_{t+1}(exp(A_{jt+1})F_k(k_{jt+1}, n_{jt+1}) + 1 - \delta)]$
   Investment equalises expected marginal productivity of capital.
4. So Consumption risks are perfectly shared, while factors are employed according to productivity.

Interpretation

Consumption risk sharing

$$\frac{u_c(c_{it}, 1 - n_{it})}{u_c(c_{jt}, 1 - n_{jt})} = \frac{\mu_j}{\mu_i} \tag{5}$$

1. Implies that redistributive shocks (that leave aggregate world variables unchanged) have no impact on allocation. And aggregat e volatility has minimum weighted utility cost.
2. Note that (5) does not imply constant consumption ratios. For $\frac{c_j}{c_i}$ to be constant, need to assume
   - 2.1 Separability of utility in l and c (U_c unaffected by l)
   - 2.2 CRRA preferences

Effect of technology shocks $A_{10} > 0$

- $t = 0$:
  - Output and labour productivity are increased on impact. So labour (demand) in 1 rises.
  - Persistence implies higher productivity of capital and labour in country 1 in period 1. So capital moves to country 1 - investment increases there, but decreases in 2.
  - Consumption increases from higher WORLD wealth (wealth effect), but decreases from higher investment to build k for tomorrow (substitution effect), both effects are the same in both countries. Increase in relative labour supply in country 1 may change relative consumption.

Effect of technology shocks $A_{10} > 0$

- $t > 0$: "Make hay while the sun shines" in country 1 (BKK)
  1. Higher productivity and capital in 1 implies higher labour effort, which may change consumption depending on the cross-elasticity with consumption.
  2. Lower capital in 2 implies optimally lower labour supply.
- Yields strong positive correlation in consumption, negative correlation in investment and hours.
- No relative wealth effects.

Step back: Key elements of the model

1. Capital accumulation: gives chance of countercyclical NX from investment dynamics, as consumption smoothing delivers procyclical NX.
2. Flexible labour supply: increases investment and output response to Prod shocks.
3. Complete markets: Wealth and substitution effects of shocks are shared.

Quantitative Results: BKK 1992

1. 2 country version of Kydland and Prescott (1982), no government shocks
2. Introduce 3rd factor: inventories
3. "Time to build" capital formation: capital adjusts slowly to investment.
4. Time dependence in utility from leisure.

Calibration

1. Symmetric world (US plus clone)
2. CD preferences over c, l
3. Parameters chosen to match great ratios (c/y,i/y,labour share) and real interest rate
4. Shocks estimated on US-Europe, "symmetricised": SD 0.00852, correlation 0.258, and AR(1) parameter matrix

$$R = \begin{matrix} 0.906 & 0.088 \\ 0.088 & 0.906 \end{matrix}$$

Model Solution and computation

1. Linearisation around symmetric non-stochastic steady state
2. Compute moments from HP-filtered data of 50 sequences of 100 periods

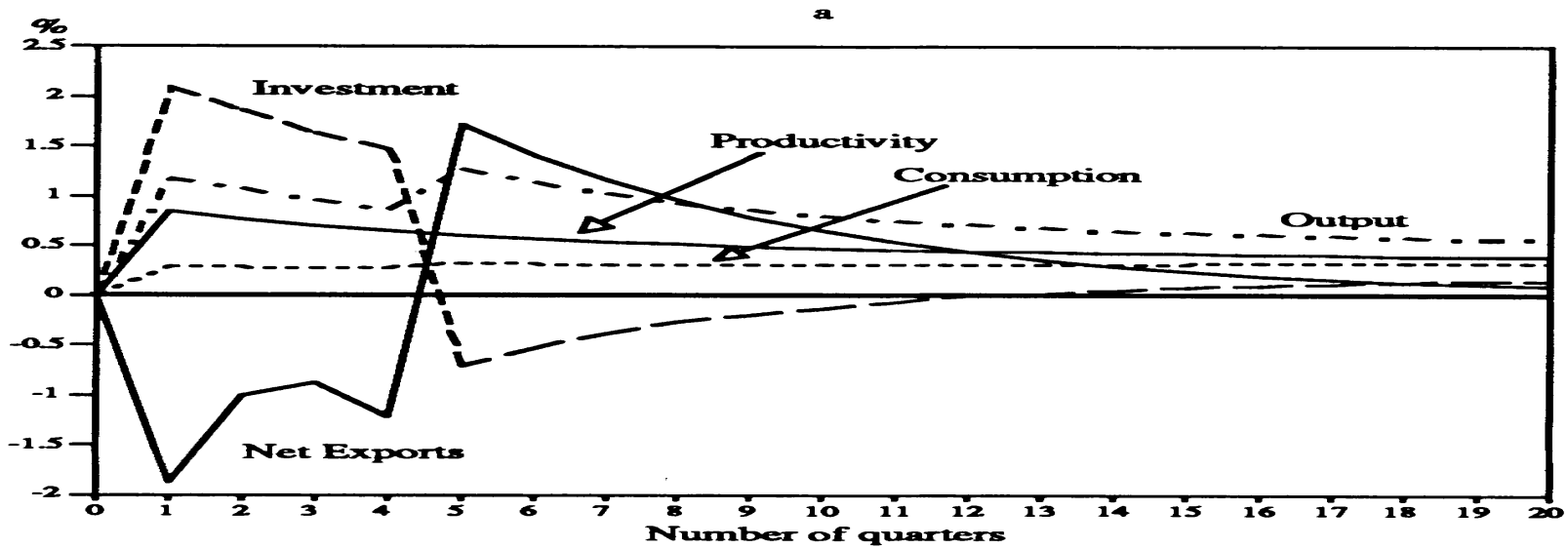
Results

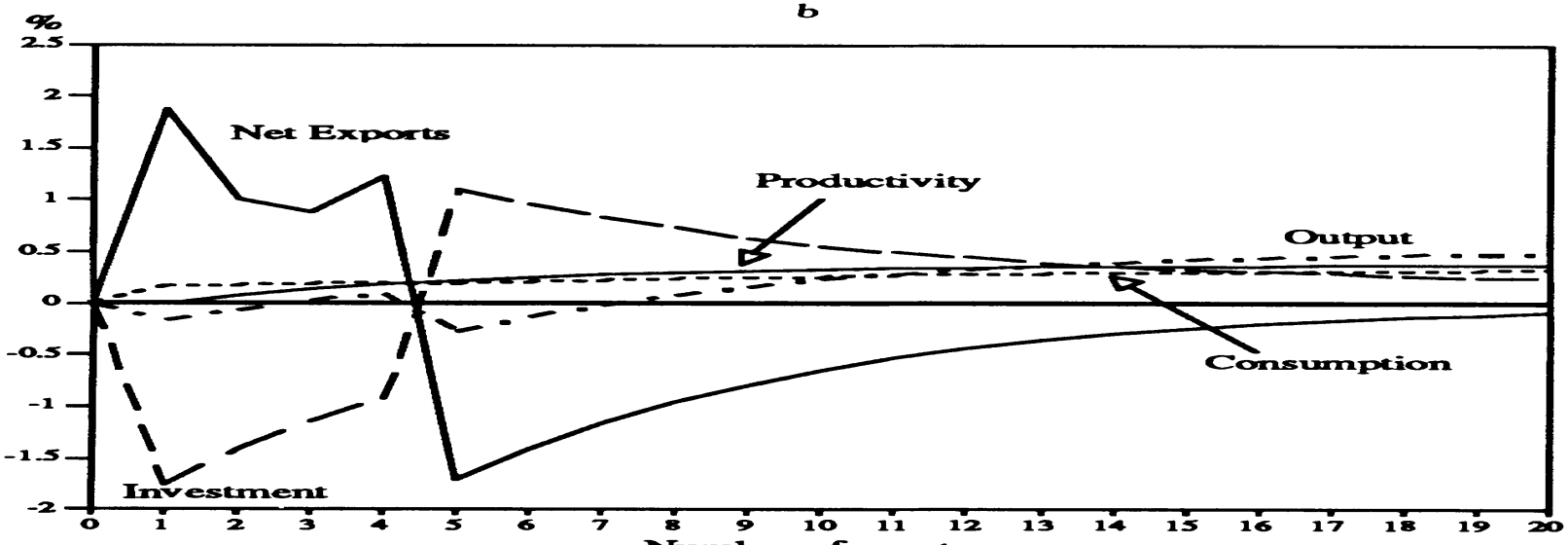
Moments of the model economy

Properties of Alternative Economies

Statistics	Data	Benchmark Economy	Alternative Economy: Spillovers: Asymmetric	Spillovers: Large	High Risk Aversion	Durable Leisure	One-Quarter Time to Build	Trading Frictions: Trans. Cost	Trading Frictions: Autarky
A. STANDARD DEVIATIONS (%)									
Output	1.71	1.55	1.54	1.33	1.37	2.03	2.24	1.38	1.33
		(.27)	(.24)	(.19)	(.23)	(.30)	(.32)	(.21)	(.20)
Net Exports/Output	.45	2.90	3.08	.66	2.57	3.83	8.78	.16	—
		(.41)	(.43)	(.08)	(.37)	(.54)	(1.00)	(.03)	
B. STANDARD DEVIATIONS RELATIVE TO OUTPUT									
Consumption	.49	.40	.42	.47	.55	.31	.30	.44	.48
		(.06)	(.06)	(.08)	(.08)	(.06)	(.05)	(.07)	(.07)
Fixed Investment	3.15	10.94	10.60	3.05	9.67	12.81	31.47	2.60	2.31
		(1.86)	(1.83)	(.46)	(1.59)	(1.62)	(2.54)	(.47)	(.45)
C. CONTEMPORANEOUS CROSS-CORRELATIONS WITH OUTPUT									
Consumption	.76	.79	.76	.89	.88	.71	.76	.82	.91
		(.10)	(.14)	(.03)	(.06)	(.12)	(.10)	(.07)	(.03)
Fixed Investment	.90	.27	−.08	.73	.33	−.01	−.01	.88	.90
		(.09)	(.13)	(.07)	(.09)	(.08)	(.05)	(.03)	(.03)
Net Exports/Output	−.28	−.02	.30	−.07	−.11	.23	.11	−.02	—
		(.11)	(.12)	(.15)	(.11)	(.08)	(.05)	(.16)	
D. INTERNATIONAL CONTEMPORANEOUS CROSS CORRELATIONS									
Foreign and Domestic Output	.70	−.18	−.26	.38	−.11	−.46	−.58	.02	.11
		(.19)	(.16)	(.15)	(.19)	(.16)	(.13)	(.17)	(.17)
Foreign and Domestic Consumption	.46	.88	.85	.95	.74	.84	.69	.91	.73
		(.04)	(.11)	(.02)	(.09)	(.06)	(.10)	(.03)	(.10)
Saving and Investment Rates	.69	.28	−.04	.74	.36	−.02	−.01	.90	.90
		(.07)	(.13)	(.06)	(.07)	(.06)	(.04)	(.03)	(.03)

Response to a technology shock





Summary

1. Model overstates variability of investment, despite time to build, etc.
2. Backus-Smith puzzle: Cross-country correlation of consumption much larger than of output.
3. Comovement puzzle: Cross-country correlations of output, employment, and investment are negative.
4. Net exports are much more volatile and less counter-cyclical than in the data

Excursion: Taste shocks

1. Change preferences to

$$U_i = E_0 \sum_{t=0}^{\infty} \beta^t u(d_{it}^c c_{it}, l_{it}) \tag{6}$$

with $d_{it}^c = \rho^d d_{it}^c + h_{it}^c$

2. Consumption risk sharing

$\lambda_t = d_{it}^c u_c(d_{it} c_{it}, 1 - n_{it}) = d_{jt}^c u_c(d_{jt} c_{jt}, 1 - n_{jt})$ then implies

$$\frac{d_{it}^c u_c(d_{it} c_{it}, 1 - n_{it})}{d_{jt}^c u_c(d_{jt} c_{jt}, 1 - n_{jt})} = \frac{\mu_j}{\mu_i} \tag{7}$$

$\rightarrow$ Taste shocks lead to fluctuations in relative consumption, lower correlation c_i, c_j

3. First order condition for labour supply reads

$$\frac{u_n(d_{it} c_{it}, 1 - n_{it})}{d_{it}^c u_c(d_{it} c_{it}, 1 - n_{it})} = exp(A_{it}) F_n(k_{it}, n_{it}) \tag{8}$$

Taste shocks

1. For simplicity, consider separable log-utility

$$U_i = E_0 \sum_{t=0}^{\infty} \beta^t d_{it}^c log c_{it} + B log(1 - n_{it}) \tag{10}$$

2. Consumption risk sharing: $c_{it} = \frac{d_{it}^c}{d_{it}^c} c_{jt}$
3. First order condition for labour supply reads

$$\frac{B c_{it}}{1 - n_{it}} = d_{it} exp(A_{it} F_n(k_{it}, n_{it}) \tag{11}$$

$\rightarrow$ Taste shocks lead to fluctuations in hours, and positive cross-country correlation, since

$$\frac{1 - n_{it}}{1 - n_{jt}} = \frac{exp(A_{it}) F_n(k_{it}, n_{it})}{exp(A_{jt}) F_n(k_{jt}, n_{jt})} \tag{12}$$

Taste shocks

1. Investment is given by

$$1 = E_t[\beta \exp(A_{it}) F_k(k_{it}, n_{it}) \frac{d_{it+1} c_{it}}{d_{it} c_{it+1}}] \tag{13}$$

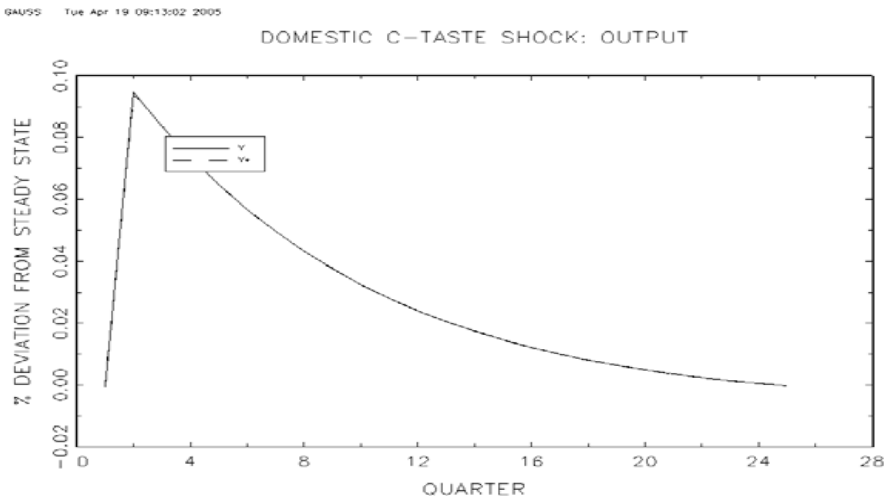
$$\tag{14}$$

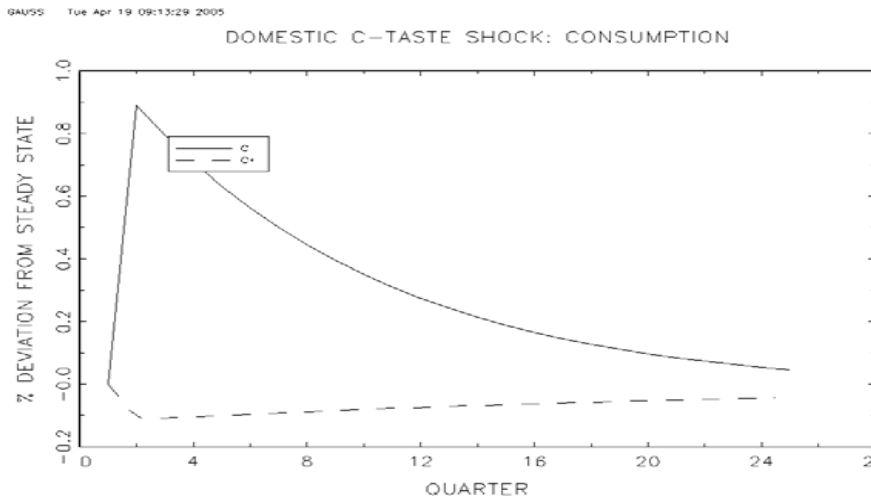
So investment falls as price of current consumption is high.

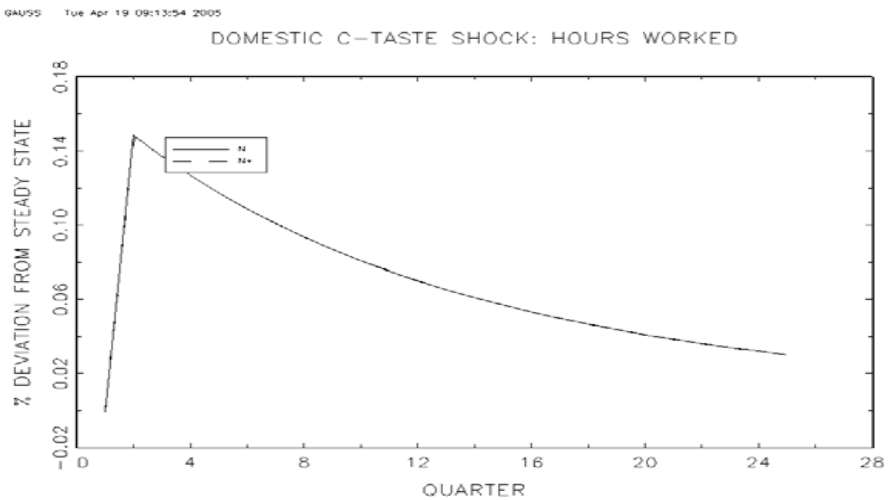
2. Investment is positively correlated across countries since

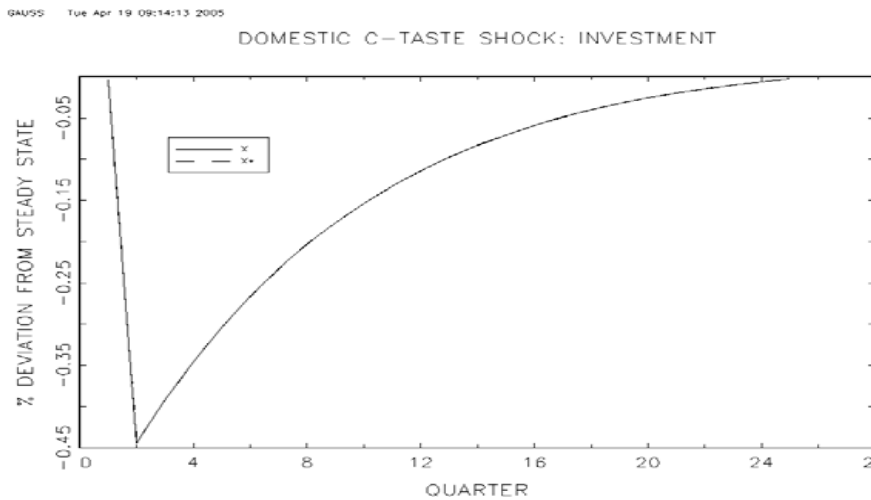
$$E_t[\lambda_{t+1}] = E_t[\exp(A_{it}) F_k(k_{it}, n_{it})] = E_t[\exp(A_{jt}) F_k(k_{jt}, n_{jt})] \tag{15}$$

Impulse responses









So far...

1. Complete markets: Imply...
   - *1.1* Perfect risk sharing $\longrightarrow$ Backus Smith Cons correlation puzzle
   - *1.2* Efficient allocation of capital and labour $\longrightarrow$ Comovement puzzle of negative $i/i*$,$n/n*$ correlation.
2. Now: Incomplete Markets: Trade in bonds only.
3. M. Baxter (1995) "International Trade and Business Cycles", Hb Int Economics.

Environment

1. Preferences and technology as before, but countries only trade in bonds b_{it} that pay interest R_r in all states s_t.
2. The budget constraint is thus

$$c_{it} + b_{it+1} + x_{it} + g_{it} \leq R_t b_{it} + y_{it} \tag{16}$$

   plus no Ponzi condition for bonds.
3. 1st WT no longer holds, so look at competitive equilibrium.

Representative HH problem

$$max_{\{c_{it},n_{it},b_{it},k_{it+1}\}} E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}, 1 - n_{it}) \tag{17}$$

$$subject\ \ to \tag{18}$$

$$c_{it} + b_{it+1} + x_{it} + g_{it} \leq R_t b_{it} + y_{it} \tag{19}$$

$$y_{i,t} = exp(A_{it}) k_{it}^{1-\alpha} n_{it}^{\alpha} \tag{20}$$

$$k_{it+1} = (1 - \delta) k_{it} + x_{it} \tag{21}$$

$$b_{i,t} \leq \sum_{s=t}^{\infty} \Pi_t^s R_{i,t}^{-1} (y_{i,s} - g_{i,s}) \tag{22}$$

Competitive equilibrium

1. Set of prices R_t and allocation $\{c_{it}, k_{it}, b_{it}, n_{it}, g_{it}\}$,i=1,2 such that
2. Government balances its budget given g_t
3. Representative households solve their problem given R_t
4. Markets for bonds and capital clear.

Intuition: Productivity shocks in a small open economy

1. Small open economy assumption: Country i has no effect on world prices. Take S_t to be the subset of "world" events in history s_t.
2. Simplifies, as can abstract from general equilibrium effect on interest rates.
3. Clarifies intuition for difference between complete markets and trade in bonds only.

Excursion: Productivity shocks in a small open economy

1. **Complete markets**

$$\frac{\beta u_c(s_{t+1})}{u_{ct}} = \frac{q(s_{t+1})}{\pi(s_{t+1})} = \frac{q(S_{t+1})}{\pi(S_{t+1})} \tag{23}$$

2. So world prices determine MRS in c in all states, and country productivity shocks have no effect on consumption.
3. Asset payoffs offset shocks, so country shocks have no wealth effect.

Intuition: Productivity shocks in a small open economy

1. **Trade in uncontingent bonds**

$$\frac{R_{t+1}\beta E[u_c(s_{t+1})]}{u_{ct}} = 1 \tag{24}$$

2. World prices tie down **expected** MRS.
3. Given R, agents borrow and lend to smooth consumption.
4. E.g. $R = 1/\beta$, quadratic utility: agents consume annuity value of expected wealth.
5. But shocks have wealth effects, so change consumption.
6. Persistence is important: wealth effects stronger for more persistent shocks.
7. With $R = 1/\beta$, even transitory shocks have permanent effect on consumption.

Baxter (1995): A 2 country model

1. A positive shock to A_{it} has a positive wealth effect but negative substitution effect on consumption and leisure in i. Effect on j wealth depends on spillovers of productivity process.
2. FOC for bonds equalises expected MRS

$$E[\frac{u_c(c_{it+1}, 1-n_{it+1})}{u_c(c_{it}, 1-n_{it})}] = E[\frac{u_c(c_{jt+1}, 1-n_{jt+1})}{u_c(c_{jt}, 1-n_{jt})}] \quad (25)$$

3. FOC for k_{t+1} makes capital flow to high productivity country

$$\begin{aligned} &E[\exp(A_{it})F_k(k_{it}, n_{it})u_c(c_{it+1}, 1-n_{it+1})] \\ &= E[\exp(A_{jt})F_k(k_{jt}, n_{jt})u_c(c_{jt+1}, 1-n_{jt+1})] \end{aligned} \quad (26)$$

Solution and parameters

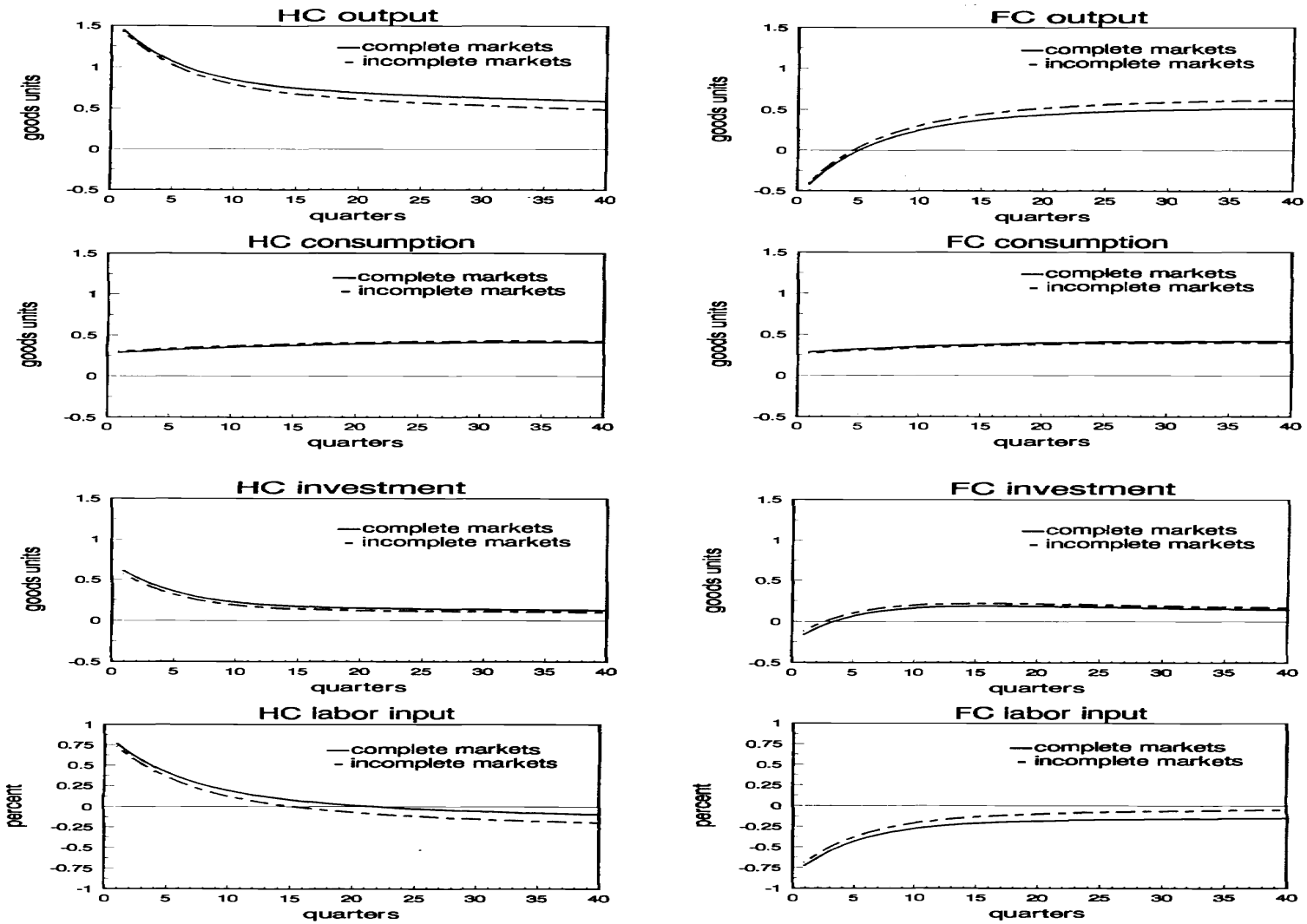
1. King Plosser and Rebelo (1987): solve system of log-linear approximations around non-stochastic steady state.
2. Problem: In SS $R = 1/\beta$, so transitory shocks have permanent effects on relative wealth, consumption and leisure.
3. Solution: Endogenous discount factor or debt-elastic interest rate to tie variables to steady state value.
4. Log-utility, parameters follow King, Plosser and Rebelo (1988).

2 specifications of productivity shocks

1. As in BKK (1992): Correlated transitory shocks with spillovers.
2. Correlated near permanent shocks.

Results

Impulse responses with BKK shocks



Source: Baxter 1995

Moments with CM and IM

A. Benchmark case: Trend-stationary shocks with correlated innovations

	Standard deviation		Relative std. dev.		Persistence		corr w/output, lag 0			Other Correlations	
	CM	IM	CM (1)	IM	CM	IM	CM	IM		CM	IM
output	1.69	1.04	1.00	1.00	0.93	0.92	1.00	1.00	y,y*	-0.55	0.20
consumption	0.79	1.06	0.47	1.02	0.91	0.90	0.48	0.94	c,c*	1.00	0.11
investment	9.14	4.09	5.41	3.93	0.90	0.90	0.73	0.76	i,i*	-0.93	-0.67
labor	1.19	0.30	0.70	0.29	0.94	0.94	0.88	0.13	N,N*	-0.99	-0.92
net exports	1.23	0.76	0.73	0.73	0.94	0.91	0.06	-0.25	s,i	0.76	0.45

CM: results for complete markets economy; IM: results for economy trading noncontingent bonds and goods only. Parameterization of this case is: $\rho=\rho^*=0.995$, $v=v^*=0$, $\text{corr}(\varepsilon,\varepsilon^*)=0.258$, $\text{var}(\varepsilon)=\text{var}(\varepsilon^*)=0.73$.

B. Trend-stationary shocks with large spillovers: The BKK parameterization

	Standard deviation		Relative std. dev.		Persistence		corr w/output, lag 0			Other Correlations	
	CM	IM	CM (1)	IM	CM	IM	CM	IM		CM	IM
output	1.32	1.31	1.00	1.00	0.89	0.89	1.00	1.00	y,y*	-0.25	-0.24
consumption	0.78	0.78	0.59	0.60	0.91	0.91	0.61	0.65	c,c*	1.00	1.00
investment	2.68	2.52	2.02	1.93	0.89	0.89	0.98	0.97	i,i*	-0.20	-0.10
labor	0.84	0.80	0.63	0.61	0.88	0.88	0.81	0.80	N,N*	-0.99	-0.99
net exports	0.64	0.64	0.48	0.49	0.89	0.89	0.78	0.78	s,i	0.92	0.90

CM: results for complete markets economy; IM: results for economy trading noncontingent bonds and goods only. Parameterization of this case is: $\rho=\rho^*=0.906$, $v=v^*=0.088$, $\text{corr}(\varepsilon,\varepsilon^*)=0.258$, $\text{var}(\varepsilon)=\text{var}(\varepsilon^*)=0.73$.

Source: Baxter 1995

Discussion

- CM and IM almost identical for transitory shocks that spill over to the other country.
- Only with near-permanent shocks and no spillovers, the two differ, as wealth effects are important.
- Wealth effects increase consumption at home by more, breaking $c, c*$ link, and making imports more procyclical, so NX countercyclical.
- Comovement puzzle for labour inputs and investment remains.

So far

- Transmission of shocks entirely via financial markets.
- But how about Real exchange rate movements, and fluctuations in ToT?
- $\longrightarrow$ Need multi-good model.
  1. Traded vs. non-traded goods.
  2. Country specific traded goods.

International Macroeconomics - Session II

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