Complete-market (CM) vs Bond-only (BO) models of the international business cycle transmissions

Source M Baxter HBIE III

Stylized facts once again

Using filtered data, we have seen that one can established the following:

- C and I strongly procyclical
- C is less volatile than Y, Y is less volatile than I
- Net Export are countercyclical
- Cyclical movements in Y,C,I, and employment are positive correlated across countries

Plus:

- I (capital goods) plays a dominant role in the fluctuations of net export (current account) at business cycle frequencies: I booms are associated with CA deficits.

Goal of the analysis

Compare response to productivity shocks of complete market (CM) and bond only (BO) economies using single-good model.

Key result: asset market restrictions are less important (a) the less persistent is the shock (reducing the benefits from risk-sharing!) and (b) the more rapidly the shock is 'transmitted' abroad (intuition: it tends to be a global shock!).

Table 2.1
Business cycles in 10 OECD countries

	US	Australia	Austria	Canada	France	Germany	Italy	Japan	Switzerland	UK
A. Volatility (% per quarter)										
Output	2.00	1.48	1.26	1.60	0.96	1.46	1.80	1.32	2.06	1.56
Consumption	1.43	0.87	1.18	1.37	0.92	1.12	1.41	1.45	1.33	1.78
Investment	6.70	4.06	3.05	4.45	2.83	3.61	3.59	3.37	4.20	3.66
Employment	1.24	0.51	1.65	1.39	0.56	0.94	0.55	0.47	1.40	1.19
Gov't purchases	1.36	1.38	0.47	0.88	0.67	1.00	0.41	0.82	0.81	0.98
Net exports	0.51	1.23	0.99	0.75	0.85	0.82	1.45	0.93	1.47	1.16
B. Volatility relative to own-country output										
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
C. Correlation with own-country output										
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
D. Cross-correlation with same U.S. variable										
Output	1.00	0.60	0.54	0.81	0.46	0.85	0.49	0.66	0.48	0.64
Consumption	1.00	−0.13	0.45	0.46	0.42	0.64	0.04	0.49	0.48	0.42
Investment	1.00	0.21	0.57	0.00	0.22	0.66	0.39	0.59	0.38	0.46
Employment	1.00	−0.17	0.58	0.50	0.36	0.60	0.11	0.48	0.43	0.68
Gov't purchases	1.00	0.46	0.31	0.08	−0.18	0.40	0.23	0.06	−0.01	−0.10
Net exports	1.00	0.03	0.29	−0.10	−0.25	−0.23	−0.28	−0.59	−0.10	−0.11

Data source: OECD and IMF, provided by David Backus; sample period is 1970:1–1990:1. All variables except net exports are in logarithms; all variables filtered with the $BP_{12}(6, 32)$ approximate band-pass filter described in Baxter and King (1994).

One sector stochastic growth model

Preferences

Infinite-horizon model with C and leisure in UF. UF is

$$U_t = \theta \ln C_t + (1 - \theta) \ln L_t$$

- If labor supply is inelastic: (a) wealth is the primary determinant of the level of consumption and (b) consumption growth is determined by r.

- If labor supply is elastic (c) wealth also determines the level of leisure and (d) labor is re-allocated intertemporally in response to change in r.

- Moreover, with a CRRA UF, labor supply responds to temporary (but not to permanent) changes in the real wage w.

Technology

$$Y_t = A_t K^{1-\alpha} (X_t N_t)^{\alpha}$$

where A_t is stochastic, X is labor augmenting technical changes, assumed to grow at a constant rate.

The firm problem is to maximize the PDV of the expected cash flow $d_s = Y_s - I_s - w_s N_s$ whereas investment entails adjustment costs

$$K_{t+1} = (1 - \delta) K_t + \phi (I_t / K_t) K_t$$

Note (e) labor demand depends on K and productivity, (f) investment depends on Tobin's q.

Solution assumptions and calibration

The model does not have an analytical solution in general. Baxter uses Euler equation approach to model solution as in King Plosser and Rebelo (1987).

Productivity shocks are modelled as follows

$$\begin{bmatrix} \ln A_t \\ \ln A_t^* \end{bmatrix} = \begin{bmatrix} \rho & \upsilon^* \\ \upsilon & \rho^* \end{bmatrix} \begin{bmatrix} \ln A_{t-1} \\ \ln A_{t-1}^* \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix}$$

where ρ is the 'persistence parameter', while υ is the 'diffusion' (or spillover) parameter and

$$E\left(\varepsilon, \varepsilon^*\right)\left(\varepsilon, \varepsilon^*\right)' = \begin{bmatrix} \sigma_\varepsilon & \psi \\ \psi & \sigma_\varepsilon \end{bmatrix}$$

Note that ψ measures the cross country correlation of innovation to productivity. Basic view: movements in productivity are highly persistent $\rho > 0$, and are correlated internationally $\psi > 0$. Evidence on spillover is mixed, $\upsilon > 0$.

Calibration:

20% of time devoted to market work in Steady State, $\beta = .9875$, the growth rate of labor augmenting technical change is .4%, depreciation is 2.5% per quarter, labor income as a fraction of GDP is .58.

- Experiment: **Permanent country-specific productivity shocks**
  - Unanticipated permanent increase in the level of total factor productivity by 1% in the home country only.
  - No technological spillovers.

CASE 1

Small country (only 1% of world economy) with fixed labor input

- Key: no real interest rate effect, no wage effect. Only 'wealth effect' in terms of PDV of net income.

Y and I responds identically in both economies (CM BO): investment boom and rising path of output.

- BO economy: Consumption increases with Home wealth.

- CM economy: because of risk sharing, C does not move much. World wealth and consumption is only marginally affected by the shock in a small economy.

...case 1 continued

- BO economy: NX is negative for a number of periods, then turns positive (consumption smoothing).

- CM economy: NX is also negative on impact, as implied by the efficient allocation of world investment, responding to higher productivity of the home country. NX though quickly turn positive, but without implying any changes in the international distribution of wealth.

  - A caveat on CA in CM: there are many ways to decentralize the equilibrium that may not be consistent with the accounting practice.

- Note: with a permanent shock, the response of the CA (NX) is larger than the response of I. This is not consistent with the data.

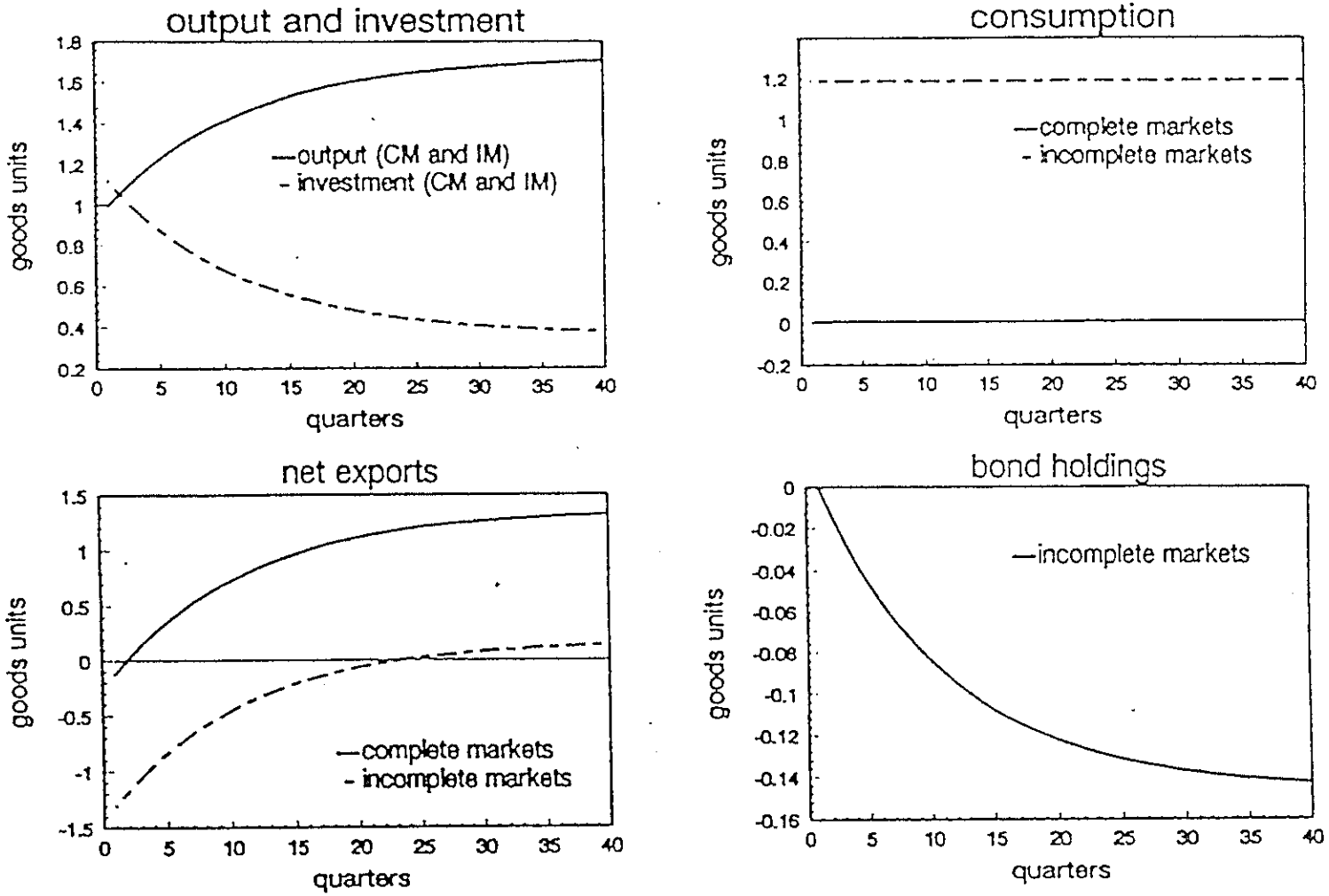

Figure 5.2. Permanent productivity shock in a small open economy with fixed labor input.

CASE 2.

Small country (only 1% of world economy) with elastic labor input (Key: add wage effects).

- Output and investment increase more in the CM than in the BO economy.

- The response of labor input is positive and large in CM, but negative in BO. why?
  - In BO economy, a positive wealth effect raises consumption of both C and leisure.
  - In the CM case: As labor is immobile internationally, the efficient response of home residents to an increase in productivity at home is to work and produce more, increasing world wealth. With risk pooling, the additional wealth is then distributed among the countries in the world.

– Since the home country is small, its share of the additional output is negligeable, while the increase in home labor input is substantial. The home level of utility actually falls. This is the 'negative wealth shock' induced by the increase in productivity. Overall, the negative wealth effect raises labor input, offsetting the effect of an increasing real wage.

– Note that labor input increases over time, in response to an increasing real wage: K accumulation raises the marginal product of capital. For this reason, in BO economies, Y and I increases less with an elastic labor supply, relative to the case of a fixed labor supply. NX same as before.

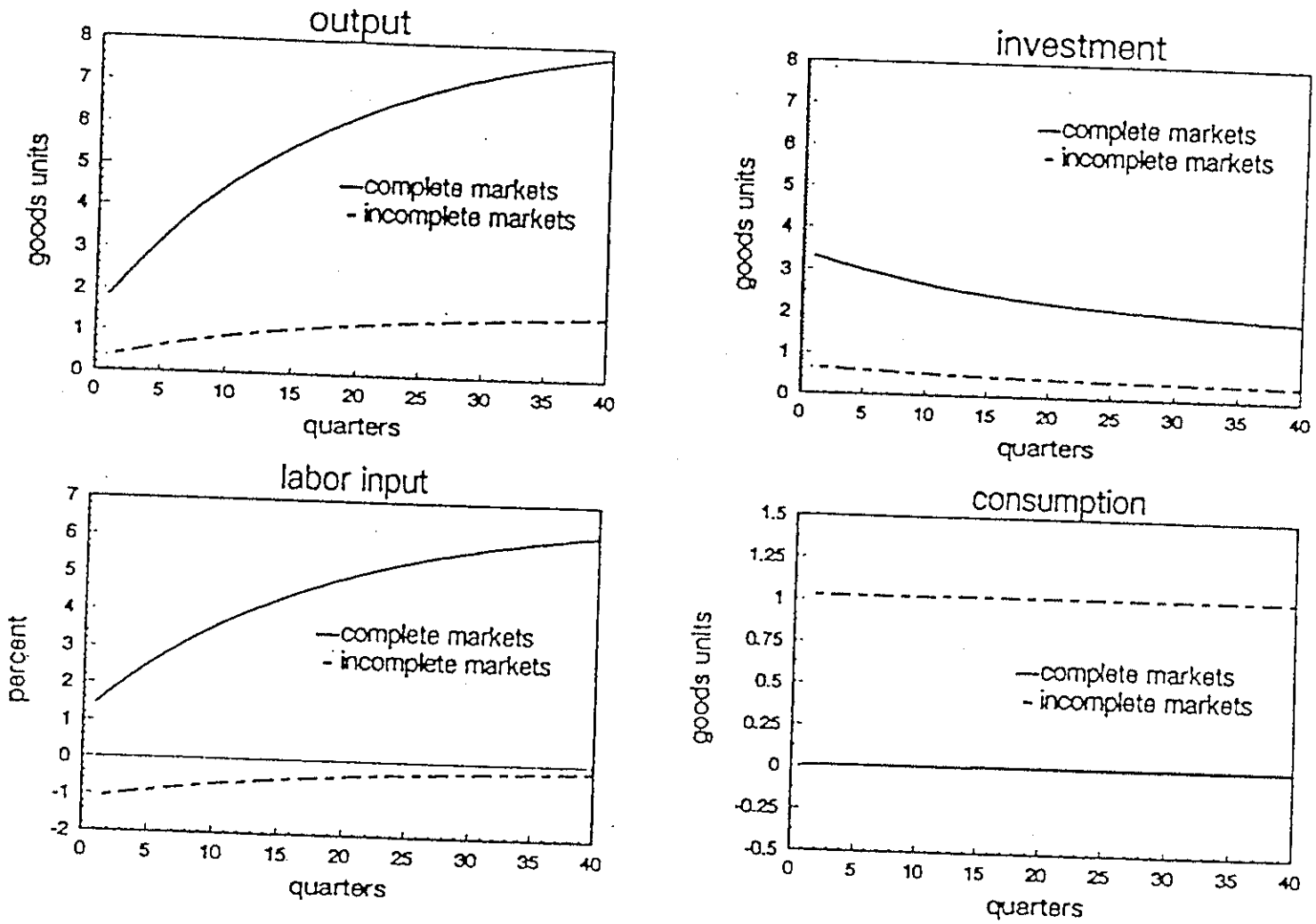

Figure 5.3. Permanent productivity shock in a small open economy with variable labor.

CASE 3. Large country with fixed labor

Add interest rate effect. Not much of a change with a 'permanent shock.'.

- Consumption path is affected (upward sloping), since interest rate raises temporarily after the shock.

- Important result: the CA deficit is smaller than the Investment 'boom'. The change in the interest rate generates additional domestic saving.

CASE 4. Large country with flexible labor

- Labor supply response depends on asset structure: negative wealth effect in CM increases it, positive wealth effect decreases it in BO.

- C rises in both CM and BO.
  - With CM, the leading factor is the increase in the real wage, that offsets the negative wealth effect of the shock (the interest rate effect only changes the time profile of C).
  - In the BO economy, both wealth and real wage effects increase C.

Compared with the small open economy case: I is smaller because of the response of r. For the same reason, C rises by less (individuals postpone consumption). Same picture as before regarding NX.

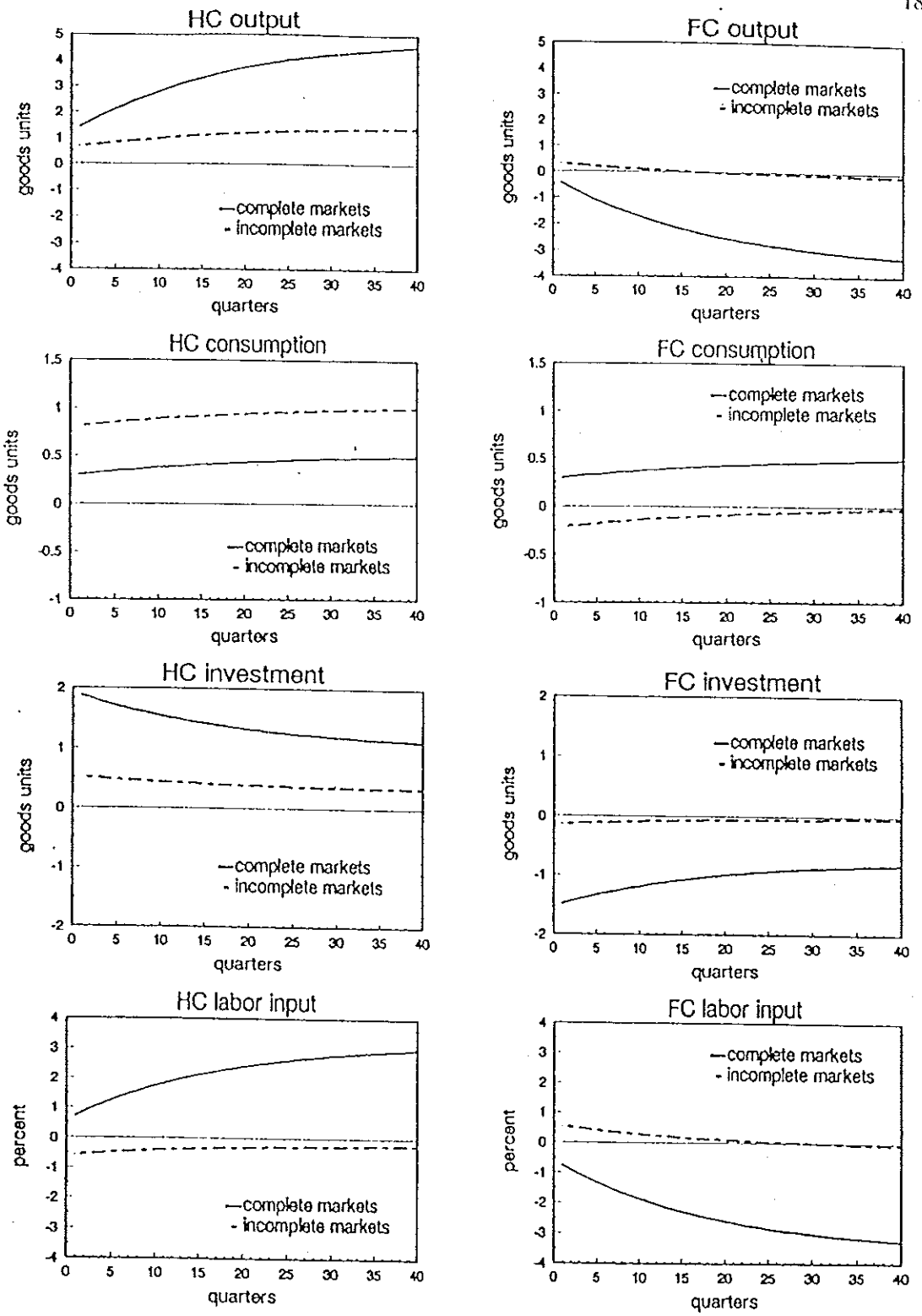

Figure 5.4. Permanent productivity shock in a large economy with variable labor.

Trend-stationary productivity shock with spillovers (Baxter and Crucini)

Consider the estimated process:

$$\begin{bmatrix} \ln A_t \\ \ln A_t^* \end{bmatrix} = \begin{bmatrix} .906 & .088 \\ .088 & .906 \end{bmatrix} \begin{bmatrix} \ln A_{t-1} \\ \ln A_{t-1}^* \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix}$$

with $\psi = .258$. Innovations are positively correlated and quickly transmitted across countries.

MAIN RESULT: *The response to a 1% shock to TFP is very similar across market structures.*

Is this surprising? First, wealth effects are small; second, the home shock is transmitted quickly abroad (nearly global shock). Even in the absence of risk pooling, the Foreign country can sustain an equilibrium path of consumption that is nearly identical to the Home C-path. A default-free bond allows the Foreign residents to borrow and increase C while waiting for the positive effect of the shock to materialize in their economy.

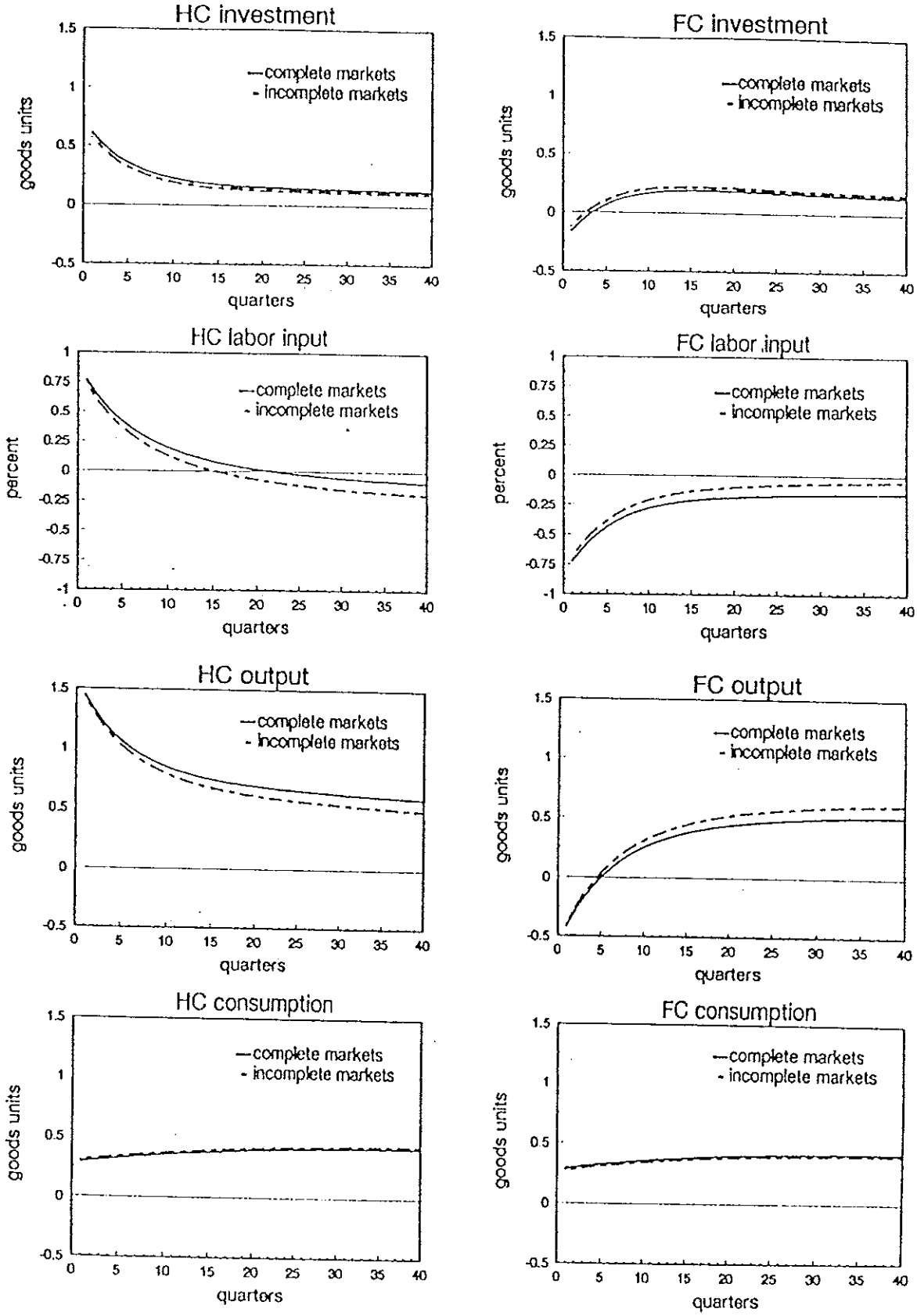

Figure 5.5. Trend stationary shocks with spillovers

Lesson:

- If shocks are not persistent and the transmission abroad is quick, restrictions on the asset markets have minimal effects on allocation.

However there is a problem with the prediction of this model:

- Home country runs a CA surplus associated with an I boom.

- Relative to permanent shocks, temporary shocks increase opportunities for intertemporal substitution: in the Home country, labor input increases on impact, then falls (temporary wage increase, smaller wealth effect with non-persistent shocks).

Permanent effects of temporary shocks

- In the closed economy version of the model, temporary shocks have no long run effects. In the two-country model and CM, the same result applies. International wealth distribution is invariant, and steady state labor input does not respond to temporary shocks.

- In BO economies, however, CA imbalances lead to international redistribution of wealth that shifts the SS labor supply in the two countries. Thus, in open economies, temporary shocks can induce a stochastic trend in macroeconomic variables.

Business cycle implications

Evidence on shocks: highly persistent, correlated across countries, weak evidence of 'transmission'.

- Baseline scenario: $\rho = .995$, $\upsilon = 0$, $\psi = .19$, $\sigma_{\varepsilon}^2 = .73$. One country is $1/2$ of the world, parametrized as to match the US.

Result:

- Y is more volatile in CM than BO (because of the labor supply movement), although neither replicate the data.

- CM: C is smoother than Y that is smoother than I.

- Relative to BO, CM has C less correlated with Y, labor input more correlated with Y.

Cross country implications:

- CM: Y correlations are too low, C too high

- BO: positive correlation of both Y and C, the former stronger than the latter. This is a good result, but correlation is weak compare to the data.

Saving-investment

- Both CM and BO predicts positive correlation between S and I (driven by productivity shocks).

- Against the interpretation of Feldstein-Horioka as evidence of imperfect financial market integration.

The international comovement problem

- I and labor input are negatively correlated across countries. The data show a positive correlation. Key: productivity shock in one country increases domestic I as well as the return to domestic labor input. Unless shocks are strongly correlated across countries, the comovement problem persists.

Consumption correlation

- The BO economy has a international output correlation above international consumption correlation, consistent with the data.

Spillovers and transmission

- Consider the parametrization of Backus et. al, positing $\upsilon = .088$. We know that BO and CM behave in the same way.

- Problem with this model's predictions:

  - net export are positively correlated with output – the foreign country wants to borrow waiting for the shock – (the correlation is negative in the data).

  - cross country output correlations are negative. (strongly positive in the data).

Small vs. large: Investment and net export is more volatile than in small economy. In a large economy, an endogenous increase in r reduces the I response to the shock; at the same time it increases S.

Table 6.1
Model predictions

	Standard deviation		Relative std. dev.		Persistence		Corr w/output, lag 0			Other correlations	
	CM	IM	CM	IM	CM	IM	CM	IM		CM	IM
A. Benchmark case: Trend-stationary shocks with correlated innovations											
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
B. Trend-stationary shocks with large spillovers: The BKK parameterization											
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: $\rho = \rho^* = 0.995, \nu = \nu^* = 0, \text{corr}(\varepsilon, \varepsilon^*) = 0.258, \text{var}(\varepsilon) = \text{var}(\varepsilon^*) = 0.73$.

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