The great moderation and the US external imbalance

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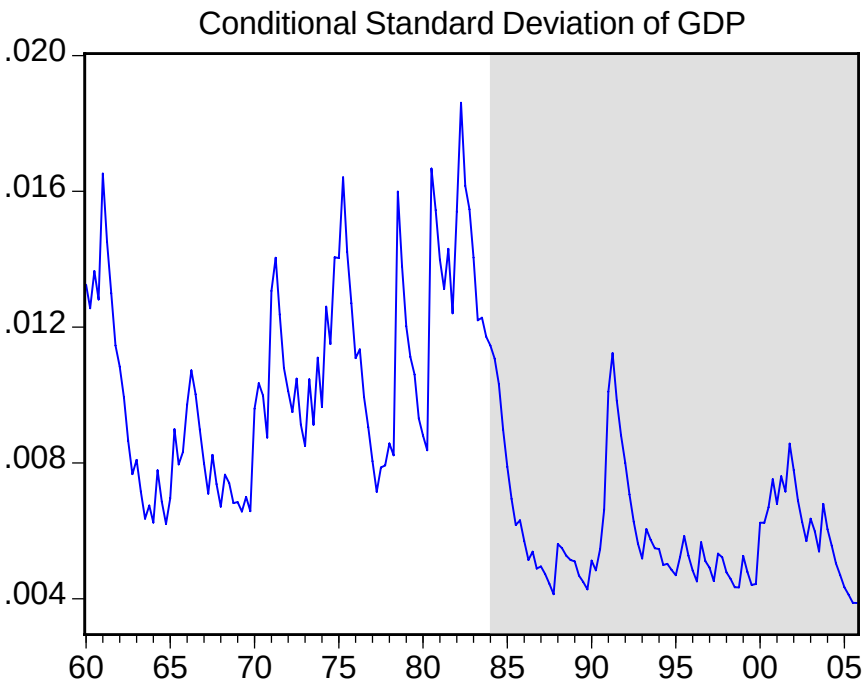
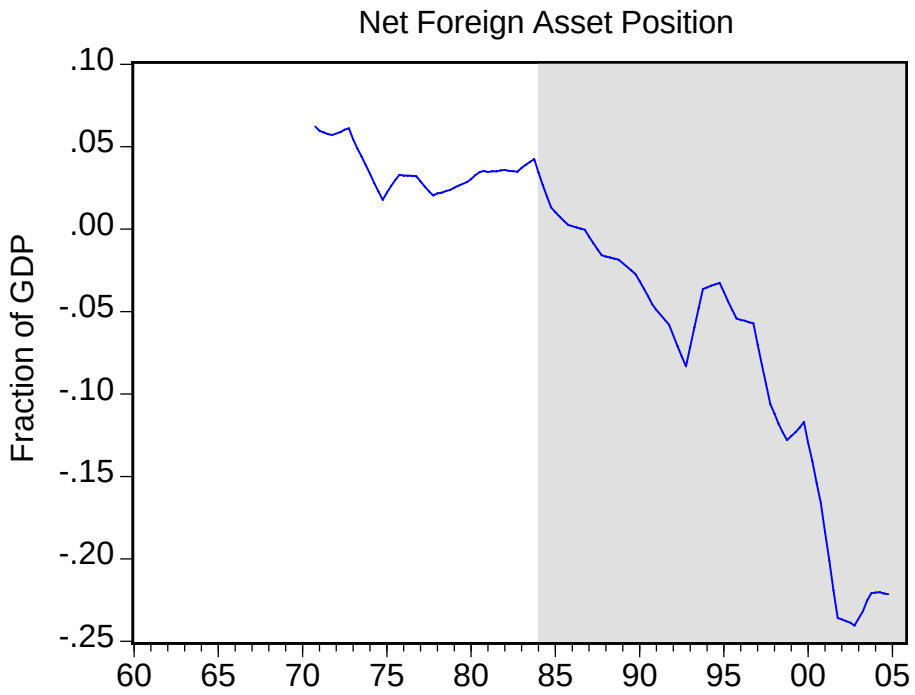
1984


Conditional Standard Deviation of GDP
.020
.016
.012
.008
.004
60
65
70
75
80
85
90
95
00
05


Net Foreign Asset Position
Fraction of GDP
.10
.05
.00
-.05
-.10
-.15
-.20
-.25
60
65
70
75
80
85
90
95
00
05

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- Analyzes and measures how much of the US external imbalance it can explain
- Contributions
  - Introduce a "new" fundamental in the debate on the US external adjustment
  - Understand patterns of international capital flows in environments with time varying risk

What are the links?

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  It causes a fall in relative precautionary savings motive $\longrightarrow$ Increases scope for international inter-temporal trade $\longrightarrow$ US imbalance

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- Consumption link If *great moderation* greater in US than abroad *and* international risk-sharing incomplete:
  It causes a fall in relative precautionary savings motive $\longrightarrow$ Increases scope for international inter-temporal trade $\longrightarrow$ US imbalance
- Investment link Changing relative risk between US and Row should change international allocation of capital $\longrightarrow$ affect net foreign asset positions

How big are these effects?

- Write the simplest open economy model which

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- Write the simplest open economy model which
  - Has country specific risk and precautionary saving motive
  - Has explicit investment decisions
  - Captures second moments effects and (potentially) changes in steady states

Facts about Great Moderation in the G3

- Fact 1. In US decline in BC volatility large across all frequencies

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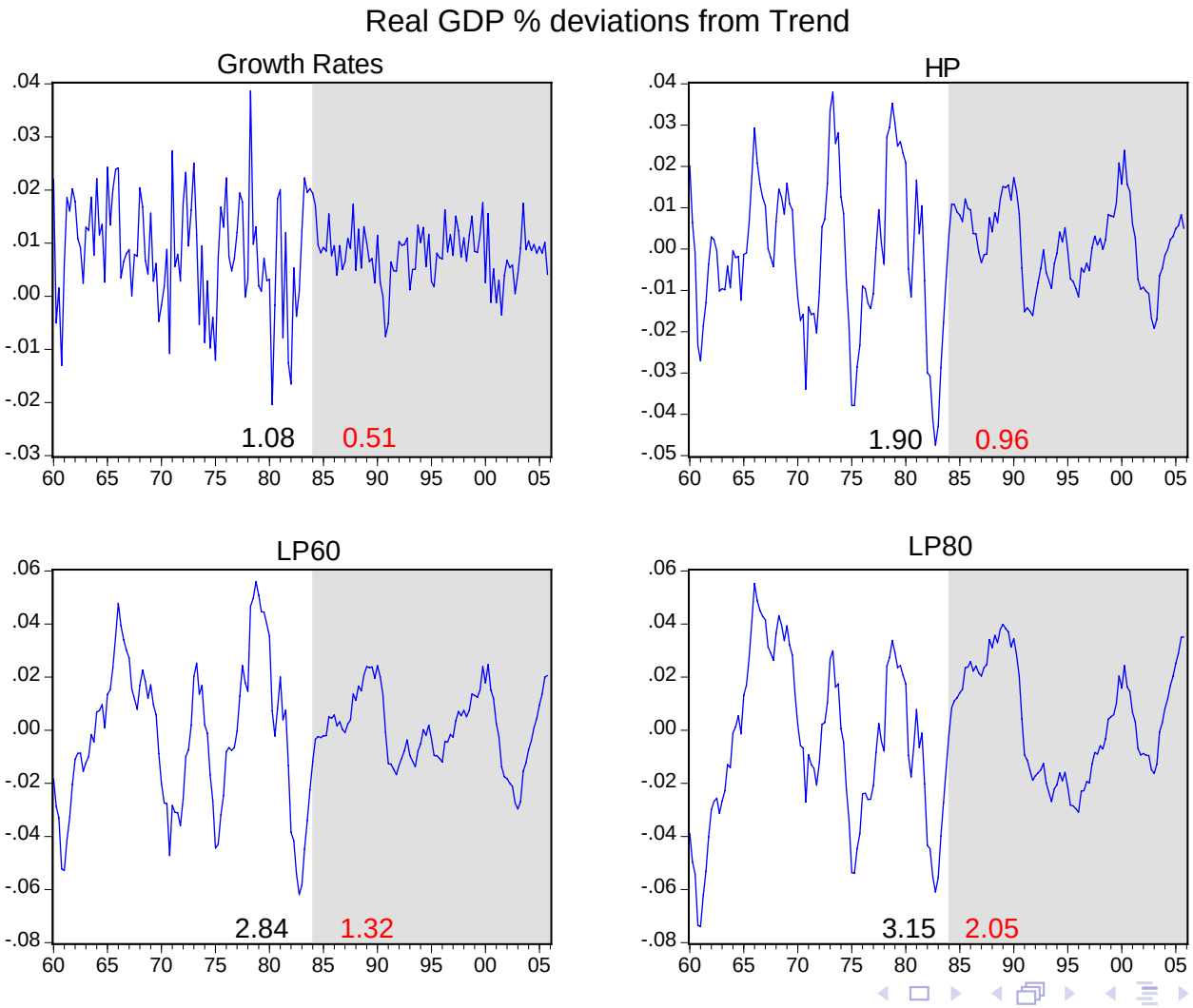
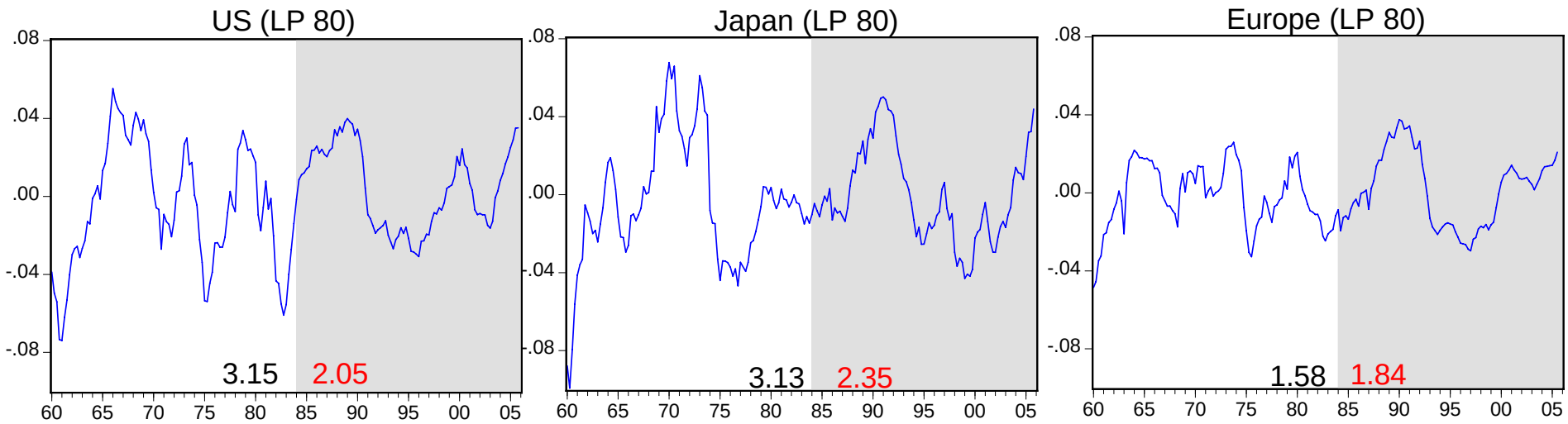
- Fact 2. Decline in BC volatility in US larger than in Europe or Japan at most frequencies

The US great moderation across frequencies



Changes in BC volatility in the G3



Changes in BC volatility in the G3

Filter	Country	% Std. Dev. 60.1-83.4	84.1-05.4	Change
Growth	US	1.08	0.51	-0.57
	Japan	1.25	0.78	-0.47
	EU	0.77	0.42	-0.35
HP	US	1.90	0.96	-0.94
	Japan	1.68	1.12	-0.56
	EU	1.08	0.73	-0.35
HP80	US	3.15	2.05	-1.10
	Japan	3.13	2.35	-0.88
	EU	1.58	1.84	+0.26

Model overview

- Two countries, one good
- Business cycles driven by country specific TFP shocks, with time varying volatility
- Competitive factor markets and full risk sharing within a country (repr. agent)
- Only asset traded internationally is a non-contingent bond, subject to constraints
- Agents choose between consumption, investment in domestic capital and international bonds

The model, I

Preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} c_{it}^{1-\sigma}$$

Technologies:

$$\begin{aligned} y_{it} &= A_{it} k_{it-1}^{\theta} l_{it}^{1-\theta} \\ k_{it} &= (1-\delta) k_{it-1} + x_{it} - \phi(k_{it-1}, x_{it}) \end{aligned}$$

The model, II

Shocks

$$\begin{bmatrix} A_{1t} \\ A_{2t} \end{bmatrix} = \begin{bmatrix} \rho & \psi \\ \psi & \rho \end{bmatrix} \begin{bmatrix} A_{1t-1} \\ A_{2t-1} \end{bmatrix} + \begin{bmatrix} M(t)\varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

$$\begin{bmatrix} \varepsilon_1(s^t) \\ \varepsilon_2(s^t) \end{bmatrix} \to N(0, \Sigma), \qquad \Sigma = \begin{bmatrix} \sigma_\varepsilon^2 & \eta\sigma_\varepsilon^2 \\ \eta\sigma_\varepsilon^2 & \sigma_\varepsilon^2 \end{bmatrix}$$

The model, III

Constraints:

$$\begin{aligned} c_{it} + x_{it} + \frac{b_{it}}{R_t} &\leq y_{it} + b_{it-1} \\ b_{it} &\geq -\bar{b}\bar{y} \end{aligned}$$

Equilibrium:

$$\begin{aligned} c_{1t} + x_{1t} + c_{2t} + x_{2t} &= y_{1t} + y_{2t} \\ b_{1t} + b_{2t} &= 0 \end{aligned}$$

The experiment

- Before 1984 world is in symmetric equilibrium in equal volatility of TFP shocks ($M(t) = 1 \forall t$)
- In 1984 agents in both countries learn that volatility in US TFP shocks has permanently fallen ($M(t) = 1 - \lambda < 1 \forall t$)
- Compute the expected path of variables before and after the change
- Analog to impulse response to a change in second moment

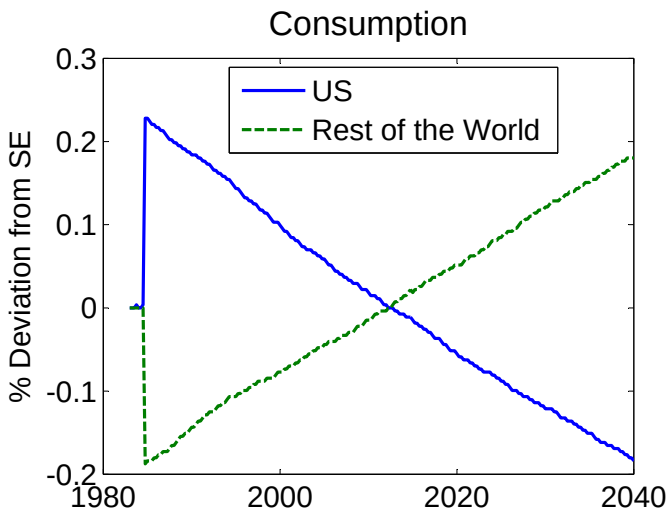
Key parameters

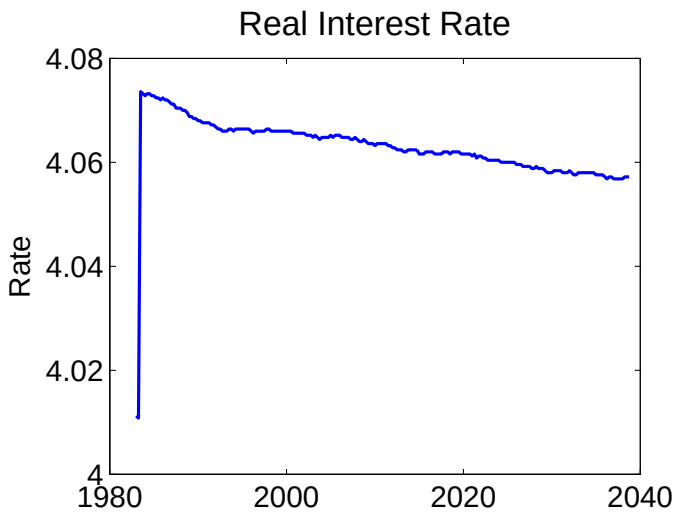
- Relative risk aversion: $\sigma = 5$
- Persistence of TFP shocks: $\rho = 0.98$
- Relative reduction in volatility of US shocks innovation: set it so that, given persistence, model matches the fall in HP80 standard deviation ratio between US and G3: $\lambda = 30\%$
- Borrowing constraint: 100% of GDP

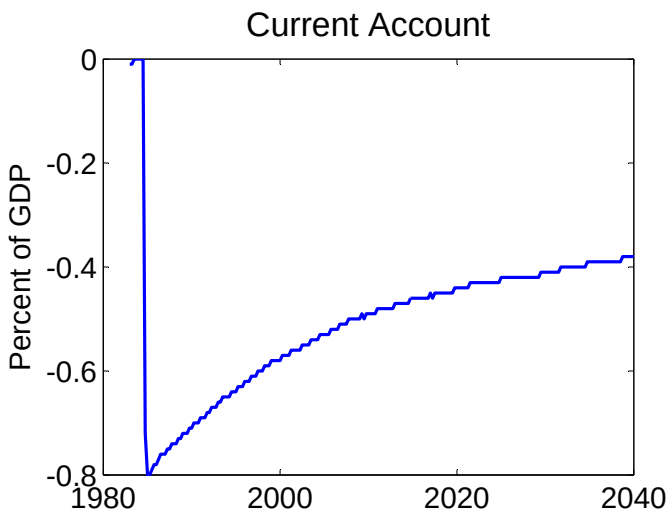
Imbalances and consumption dynamics

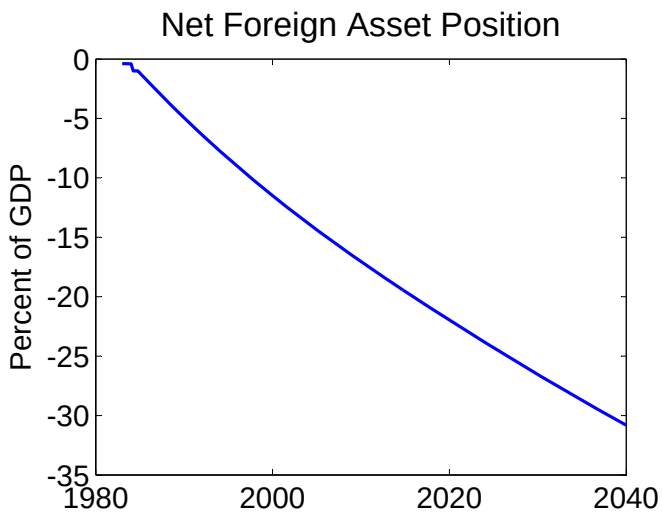
- Risk faced by US consumers fall
- US precautionary motive falls, equivalent to an increase in US discounting
- US increases preference for consumption today relative to consumption tomorrow, increases US borrowing
- Increase scope for international inter-temporal trade results in increase in interest rate and steady state imbalance.

Expected Responses (High adj. costs)









Investment dynamics, I

From FONC for investment and bonds we get,

$$R = \frac{cov(F'_{k1}u'_{c1})}{\mathbb{E}(u'_{c1})} + \mathbb{E}F'_{k1} = \frac{cov(F'_{k2}u'_{c2})}{\mathbb{E}(u'_{c2})} + \mathbb{E}F'_{k2}$$

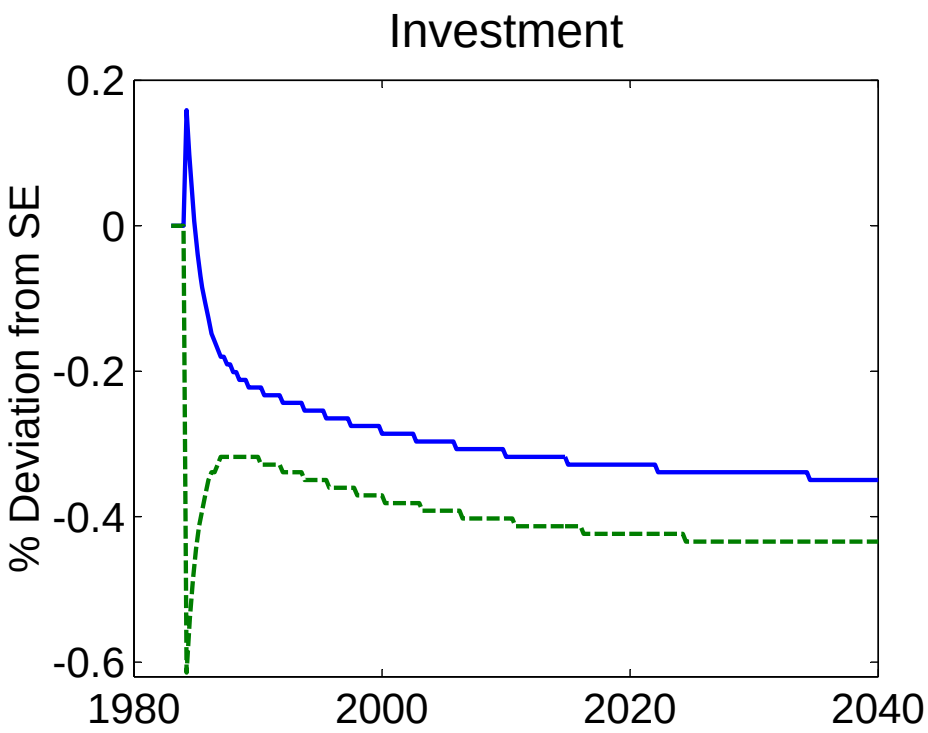
$\mathbb{E}F'_{ki}$ = Exp. return to capital net of adj. costs,
$0 > \frac{cov(F'_{ki}u'_{ci})}{\mathbb{E}(u'_{ci})}$ = Risk premium term.

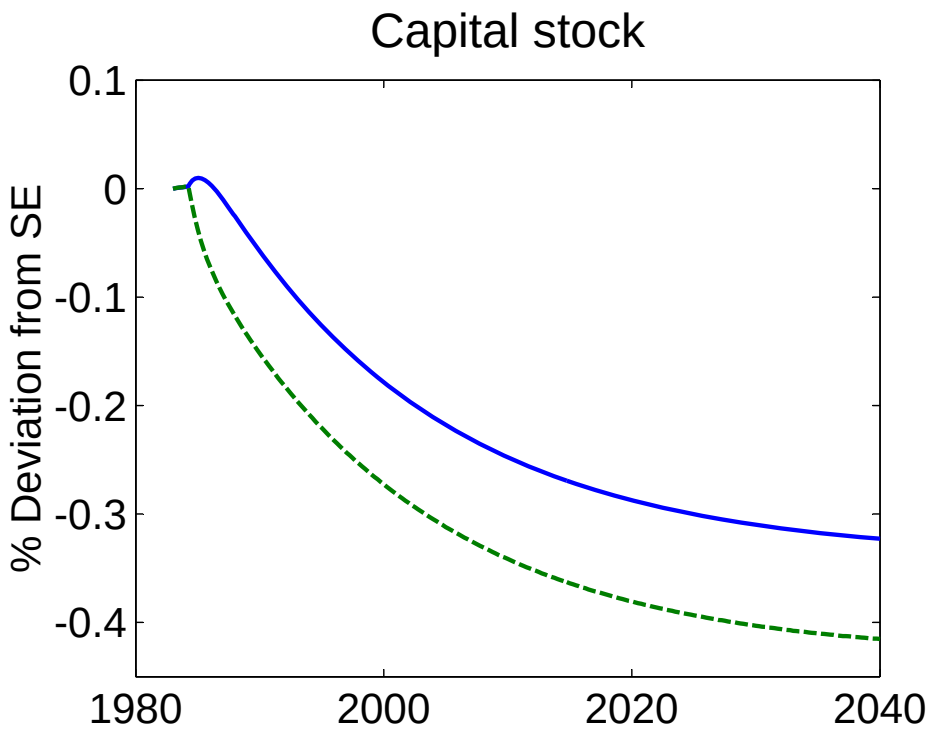
Investment dynamics, II

$$\mathbb{E}F'_{k1} - \mathbb{E}F'_{k2} = \frac{cov(F'_{k2}u'_{c2})}{\mathbb{E}(u'_{c2})} - \frac{cov(F'_{k1}u'_{c1})}{\mathbb{E}(u'_{c1})}$$

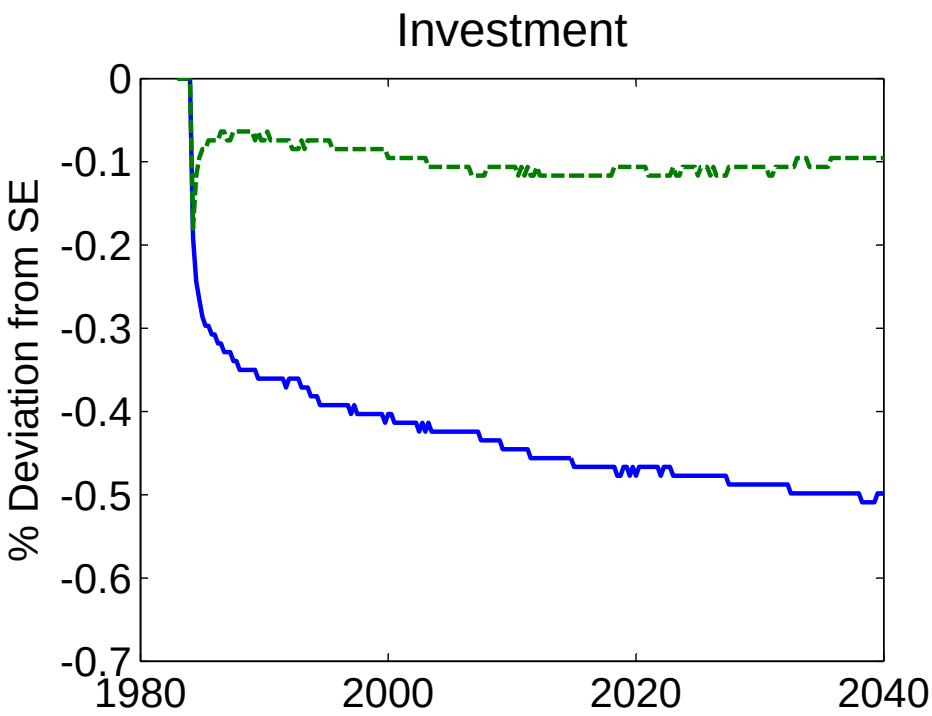
- *conditional on any state*, if US volatility falls, $cov(F_{k1}u'_{c1})$ falls in abs. value, $\mathbb{E}F'_{k1} - \mathbb{E}F'_{k2}$ falls too
- Increased capital/investment in US relative to RoW

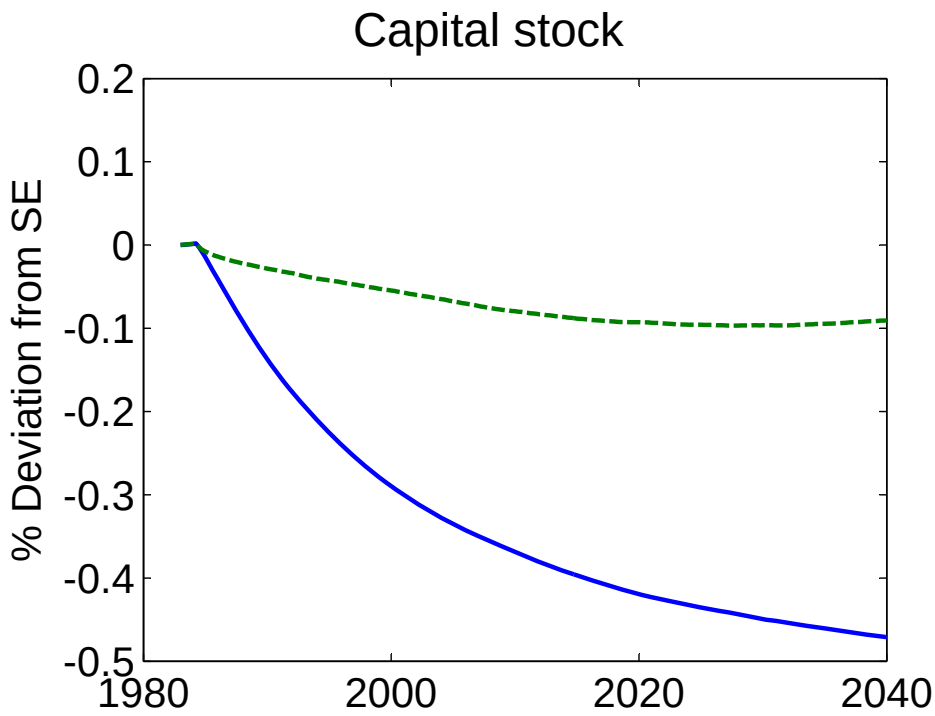
Conditional Investment dynamics

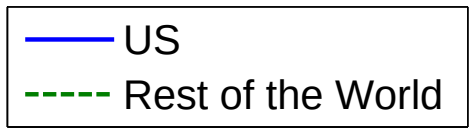




Unconditional Investment dynamics



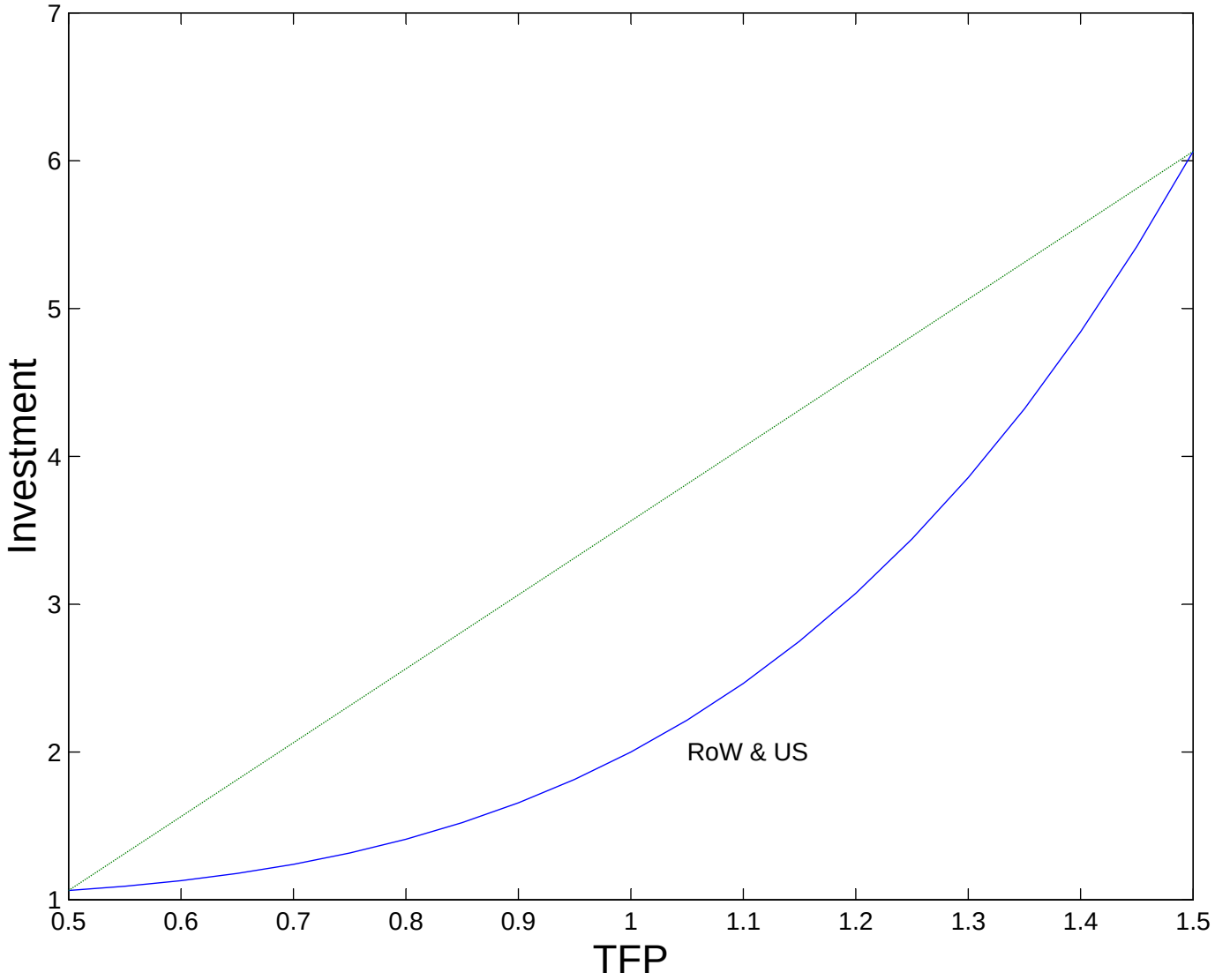




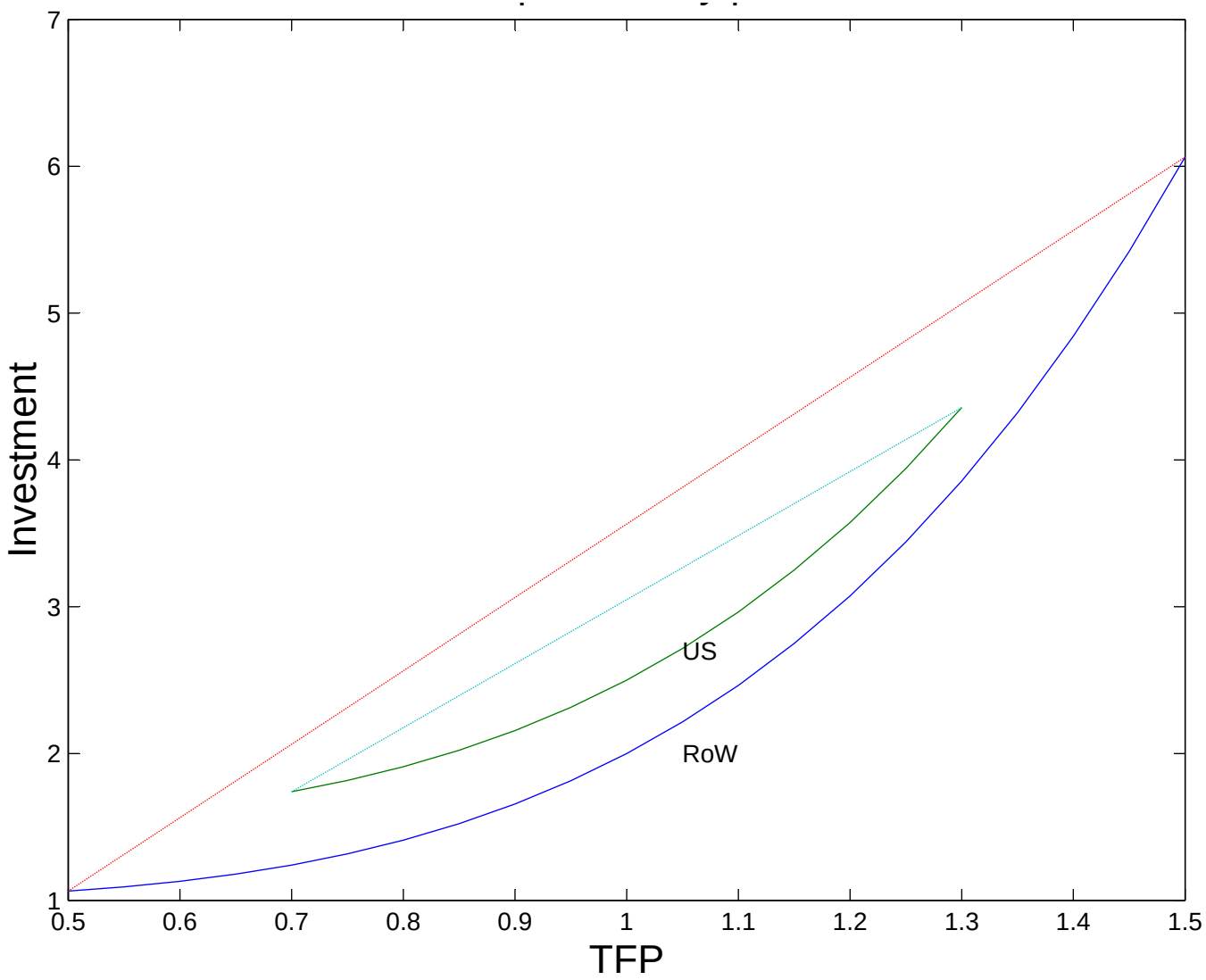
Why does the US invest less?

- Moderation changes (the distribution of) TFP states
- Investment function convex in TFP (Oi 61)
- On average after moderation US invests less

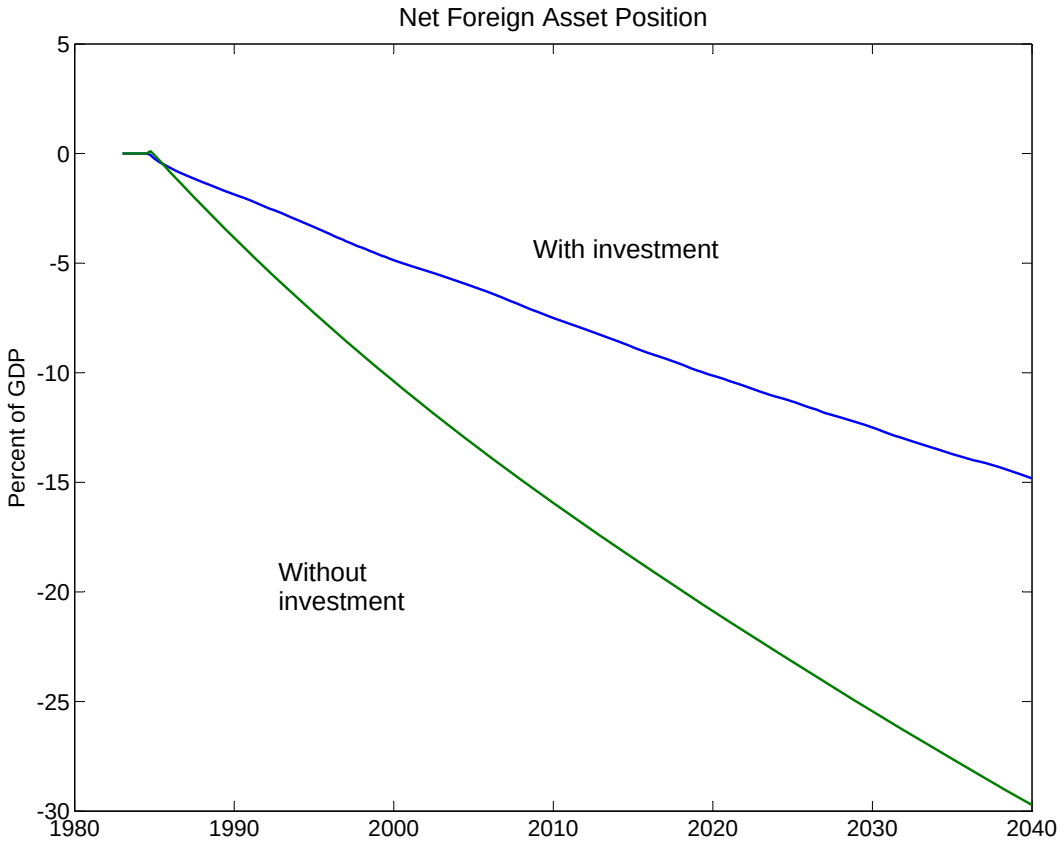
Investment and TFP (pre-moderation)



Investment and TFP (post-moderation)



Overall imbalances

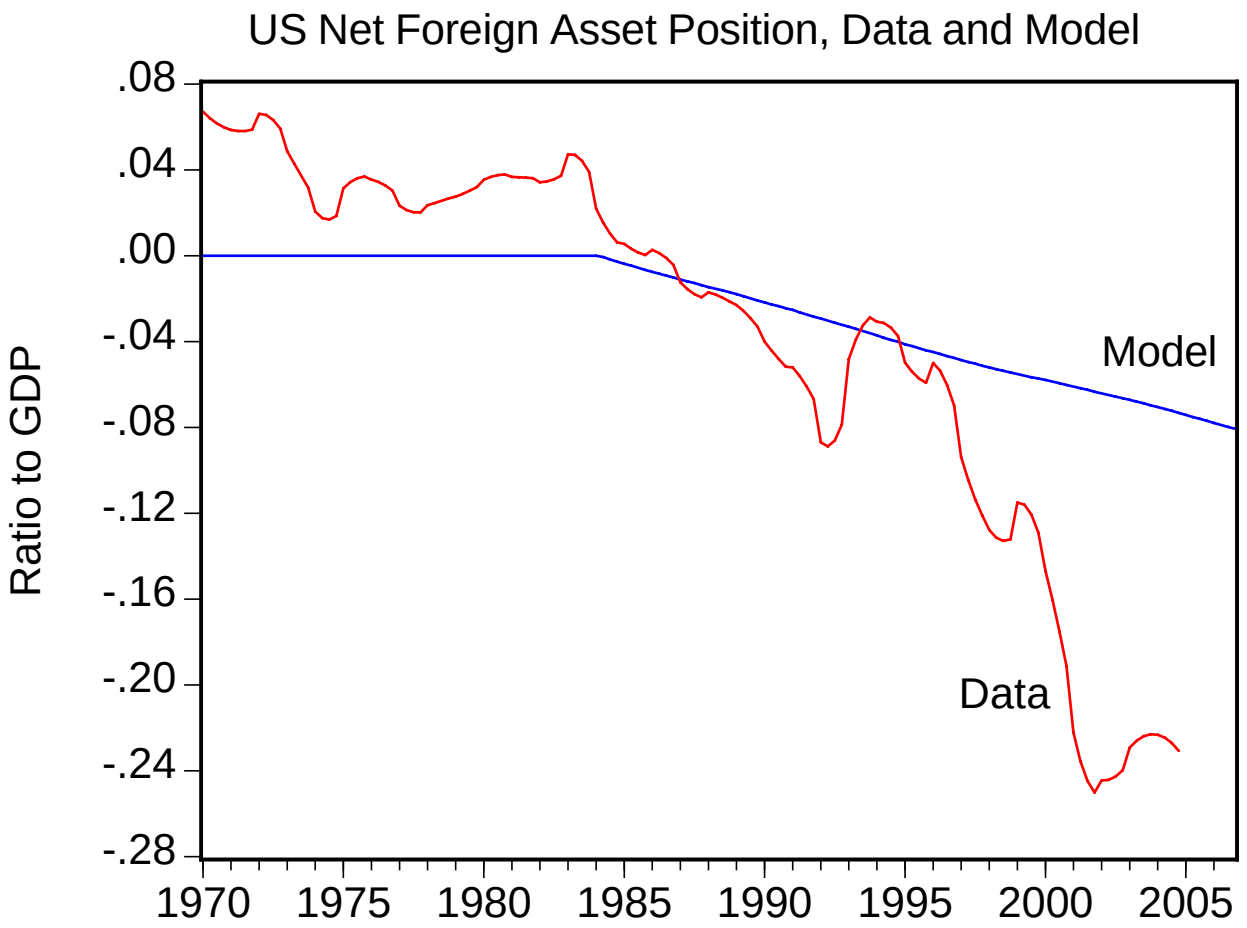


- Investment flows significantly affect the response of imbalance to GM

Overall assessment

- We do not wish to explain *total* US imbalances but rather assess the importance of our channel
- In 2006 US global imbalances 24% of GDP, imbalances vis-a-vis Europe and Japan 12%
- Under benchmark parameters, fall in volatility can generate an imbalance in 2006 of around 7.5%

Imbalances in Data and Model



Sensitivity of US imbalances (% of GDP) to

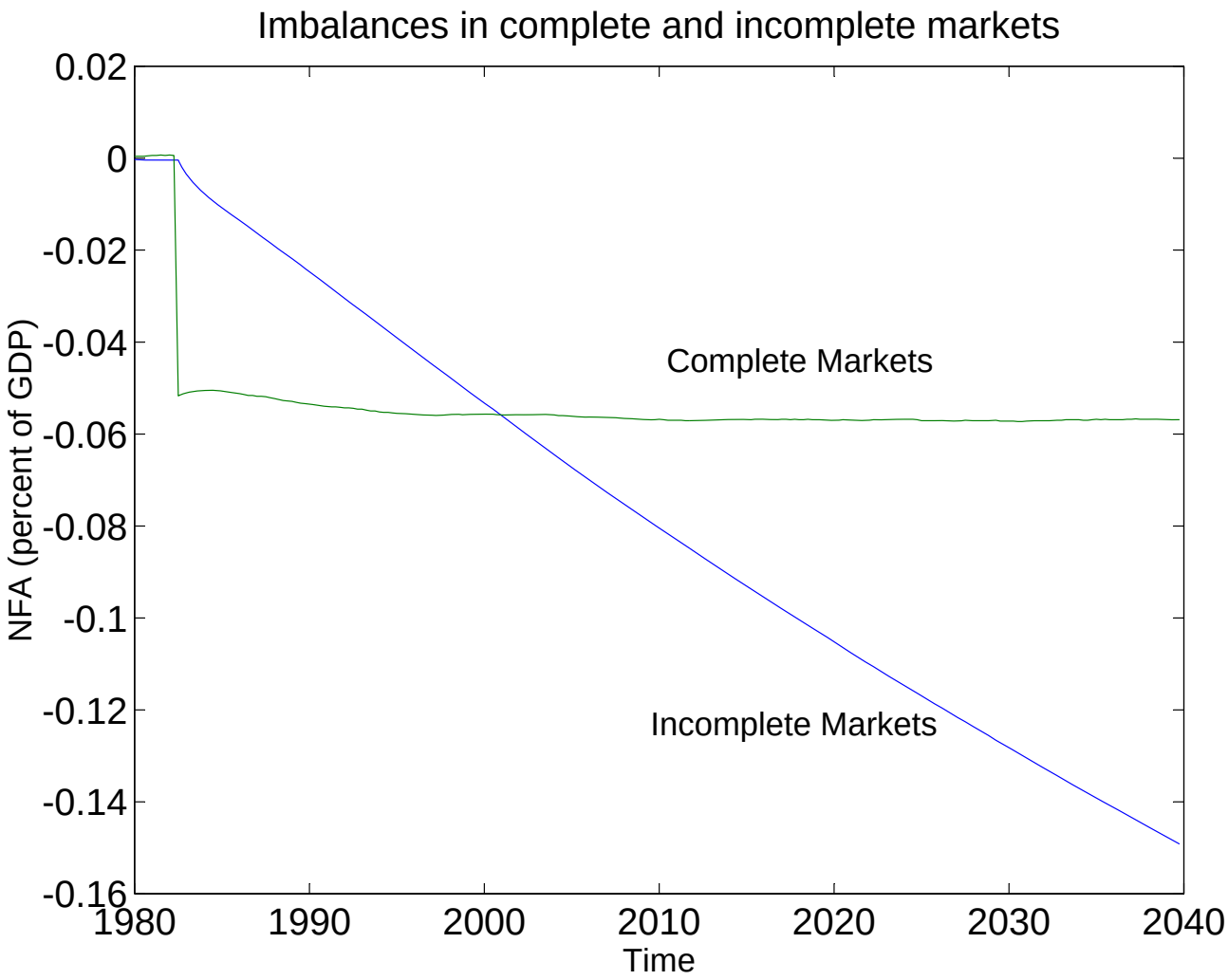
	Risk Aversion, σ			
	$\sigma = 2$	$\sigma = 5$	$\sigma = 8$	
Imb.	3.0	7.5	9.0	
	Borrowing Constraint (% of GDP) $\bar{b}$			
	$\bar{b} = 0$	$\bar{b} = .7$	$\bar{b} = 1$	$\bar{b} = 1.3$
Imb.	0	5.1	7.5	8.5
	Persistence of shocks, ρ			
	$\rho = 0.96$	$\rho = 0.98$	$\rho = 0.993$	
Imb.	6.2	7.5	12.0	
	Relative fall in US volatility, λ			
	$\lambda = 1/4$	$\lambda = 1/3$	$\lambda = 1/2$	
Imb.	6.0	7.5	9.2	

What happens with more intl diversification?

- Consider CM model: consumption equalized, investment response similar as in IM
- Different measure of NFA (forward v/s backward looking)

$$
\begin{aligned}
w(s^t) &= c(s^t) + x(s^t) - y(s^t) + \\
&\quad \sum_{s^{t+1}} w(s^{t+1}) q(s^{t+1}, s^t) \\
w(s^t) &= x(s^t) - x^*(s^t) + y^*(s^t) - y(s^t) + \\
&\quad \sum_{s^{t+1}} w(s^{t+1}) q(s^{t+1}, s^t)
\end{aligned}
$$

Imbalances in complete and incomplete markets



Imbalances in complete and incomplete markets

- In IM investment dynamics is unanticipated. RoW investing more leads to more RoW borrowing. Lowers overall US imbalance
- In CM investment dynamics is anticipated. RoW investing more leads to high RoW relative wealth. Only source of US imbalance.

Conclusion

- Why is US accumulating more and more external debt?
- We investigate a simple reason, i.e. US aggregate risk has decreased more than in other countries.
- Does not explain the whole imbalance but a non-trivial fraction, finding fairly robust
- Important to keep in mind when doing external adjustment analysis
- Help us understand the link between volatility, consumption and investment dynamics and imbalances