

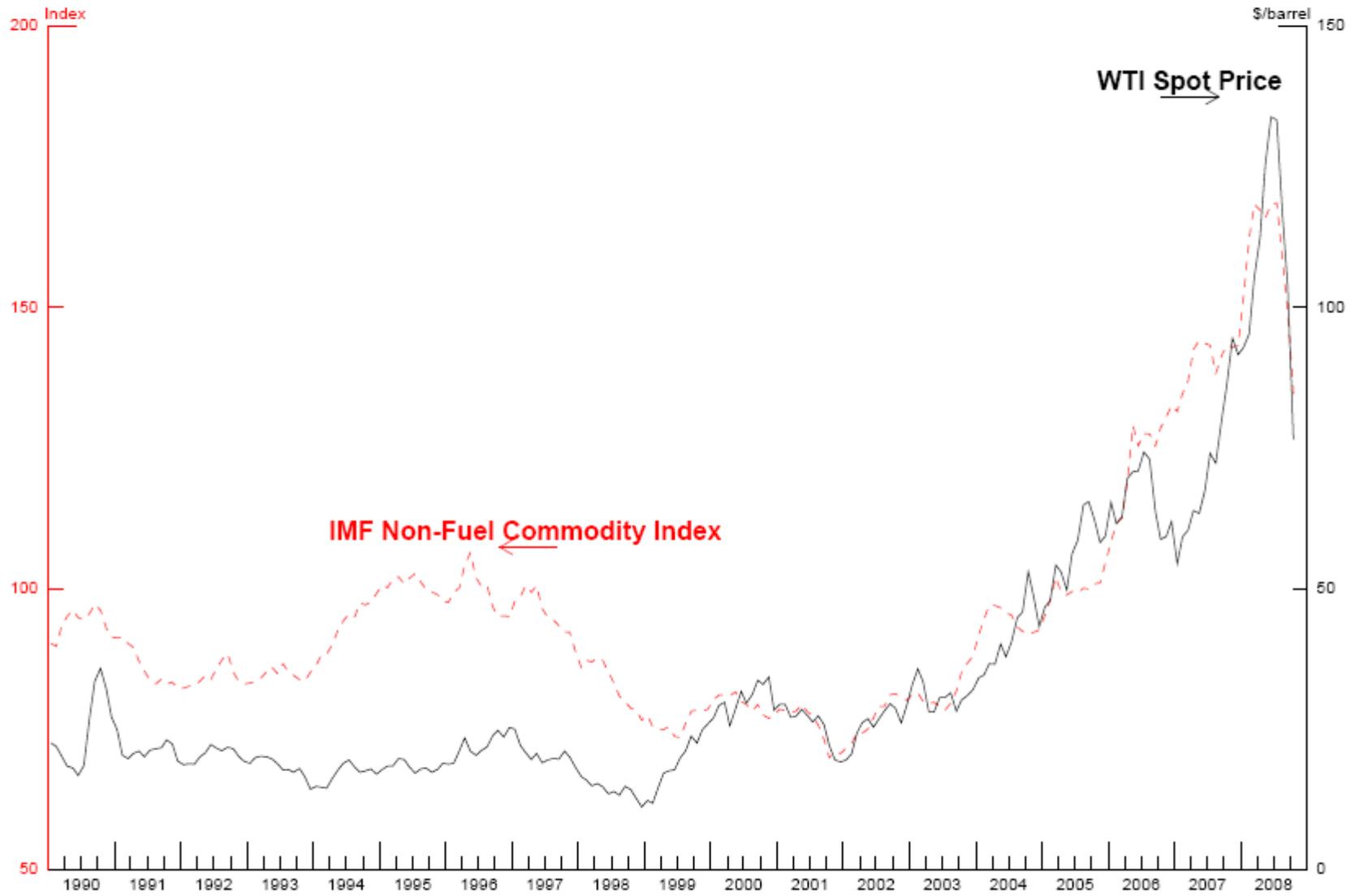


“Developing Countries, Commodity  
Prices, and the Global Transmission  
of Inflation”

Christopher Erceg, Luca Guerrieri,  
and Steven Kamin

Federal Reserve Board  
November 20, 2008

Figure 1: Global Commodity Prices



Why the behavior of commodity prices  
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# Why the behavior of commodity prices remains important:

- Commodity prices still elevated
- Prior runup exacerbated financial turmoil
  - Reduced disposable income in importing countries
  - Inflationary effects constrained monetary policies from addressing turmoil
- Recent downturn in commodity prices exacerbating turmoil in exporting countries
- Once conditions normalize, commodity prices may resume rise

So, why have commodity prices risen so much in recent years?

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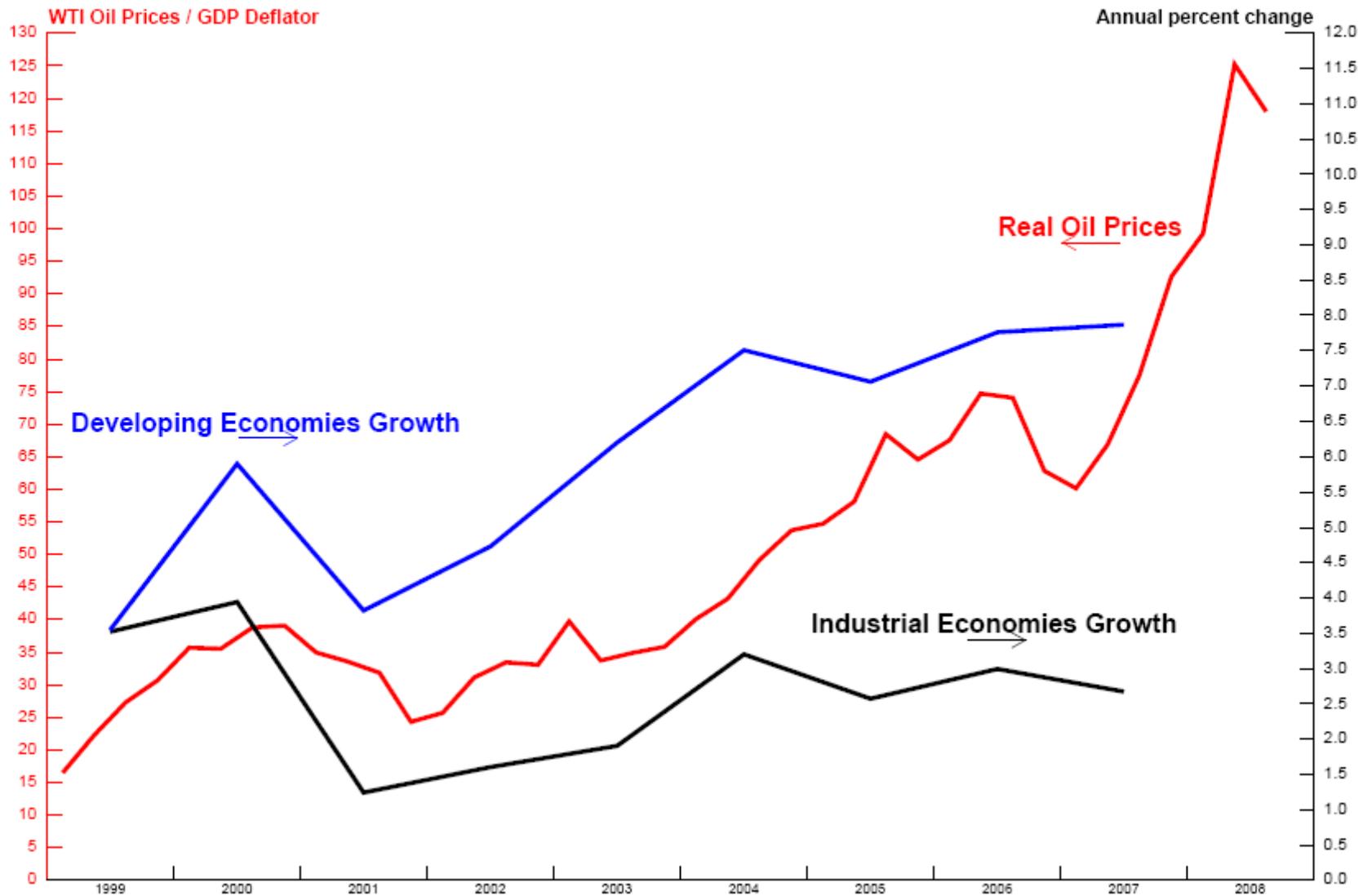
1. Fundamentals of supply and demand

# So, why have commodity prices risen so much in recent years?

## 1. Fundamentals of supply and demand

- Demand: rapid developing country growth

Figure 2: Recent Global Real GDP Growth and Real Oil Prices



Source: Wall Street Journal; Bureau of Economic Analysis; IMF WEO Database, October 2007.

**Table 1: Sources of Growth of Oil Consumption**

	<u>Oil Consumption</u> <u>Growth Rate</u> (2000-2006) (percent change)	<u>Contribution to World</u> <u>of Oil Consumption</u> (2000-2006) (percentage points)
<b>1. World</b>	1.7	1.7
<b>2. Developing</b>	3.7	1.4
<b>3. Asia</b>	4.8	0.8
<b>4. China</b>	7.8	0.6
<b>5. India</b>	2.1	0.1
<b>6. Latin America</b>	1.6	0.1
<b>7. Brazil</b>	0.4	0.0
<b>8. Industrial</b>	0.5	0.3
<b>9. United States</b>	0.8	0.2

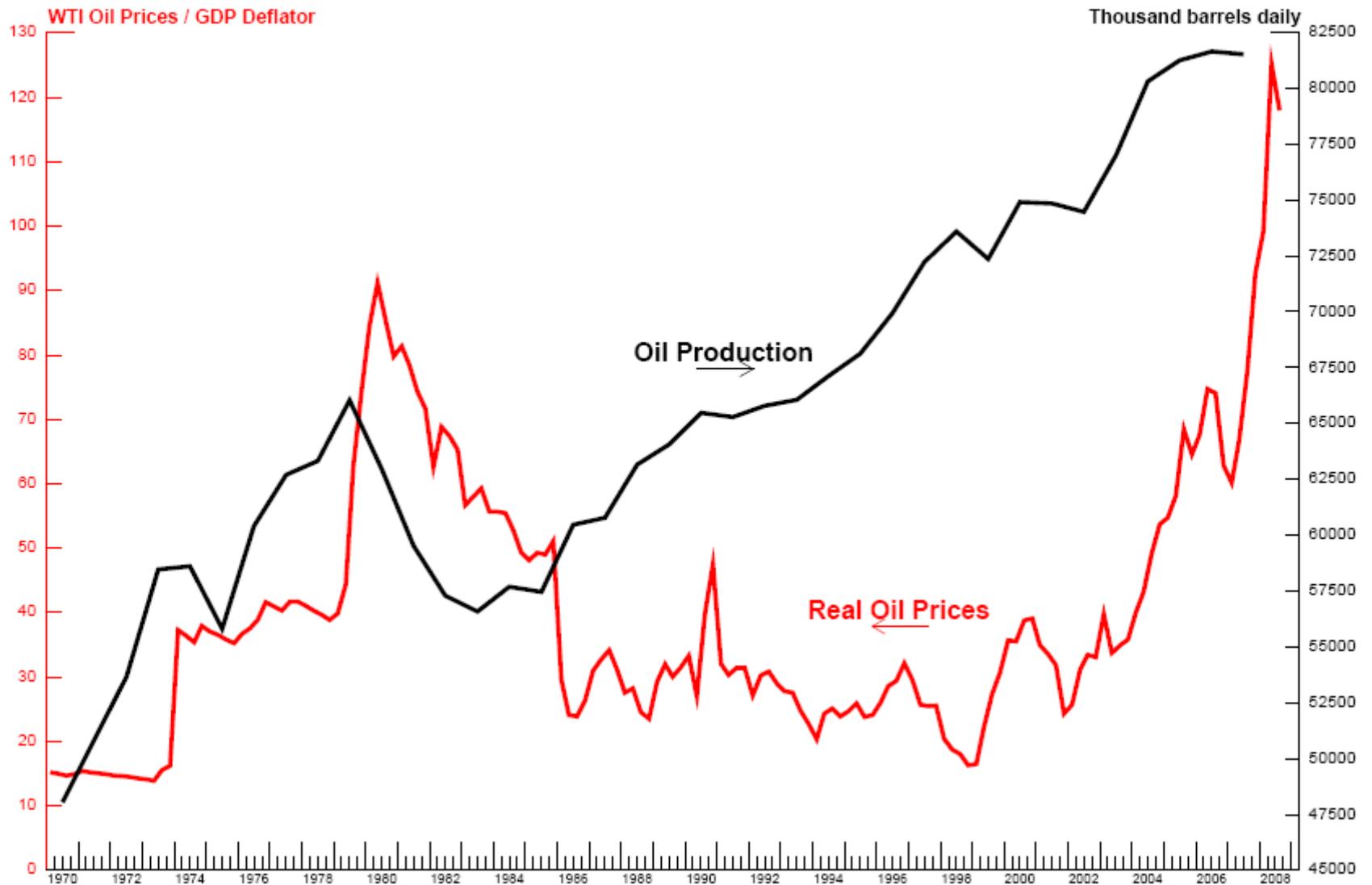
Source: International Energy Agency

# So, why have commodity prices risen so much in recent years?

## 1. Fundamentals of supply and demand

- Supply: slow growth of capacity, bad weather, geo-political constraints

Figure 3: World Oil Production and Real Oil Prices



Source: Wall Street Journal; Bureau of Economic Analysis; BP Statistical Review of World Energy, June 2007.

# So, why have commodity prices risen so much in recent years?

## 1. Fundamentals of supply and demand

- Question: why did prices continue to rise through mid-2008, even as growth expectations were being cut back?

So, why have commodity prices risen so much in recent years?

## 2. Speculators

- Growing scope and sophistication of futures markets
- More recent bust in other asset classes
- Reach for return as Fed cut interest rates

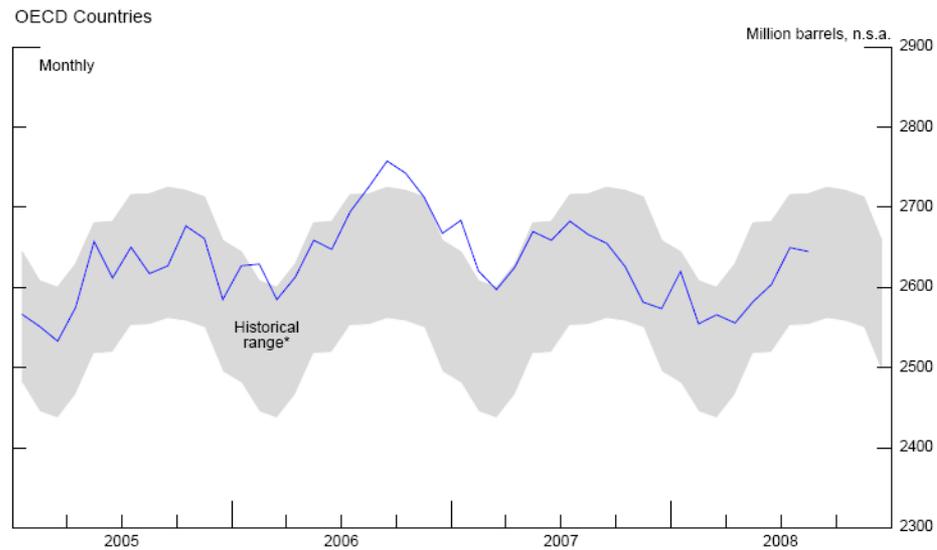
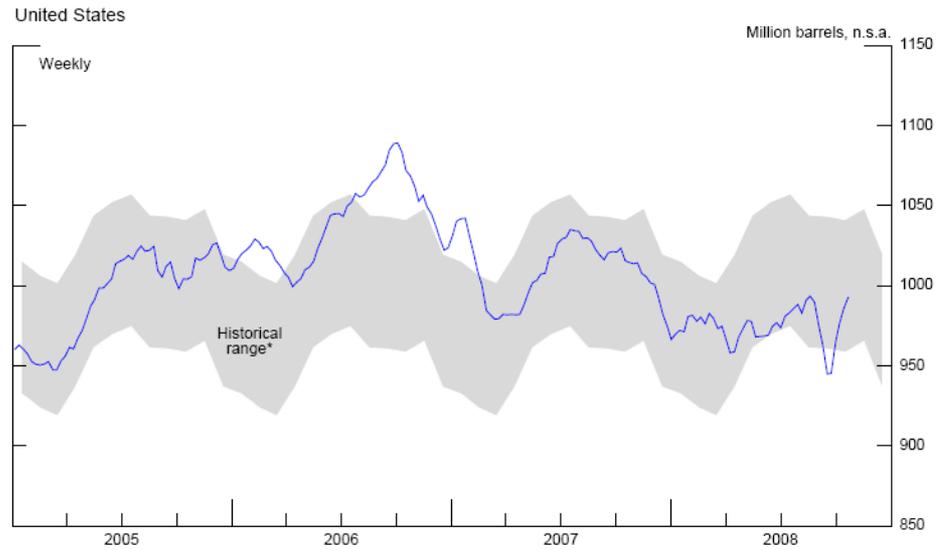
So, why have commodity prices risen so much in recent years?

## 2. Speculators

However:

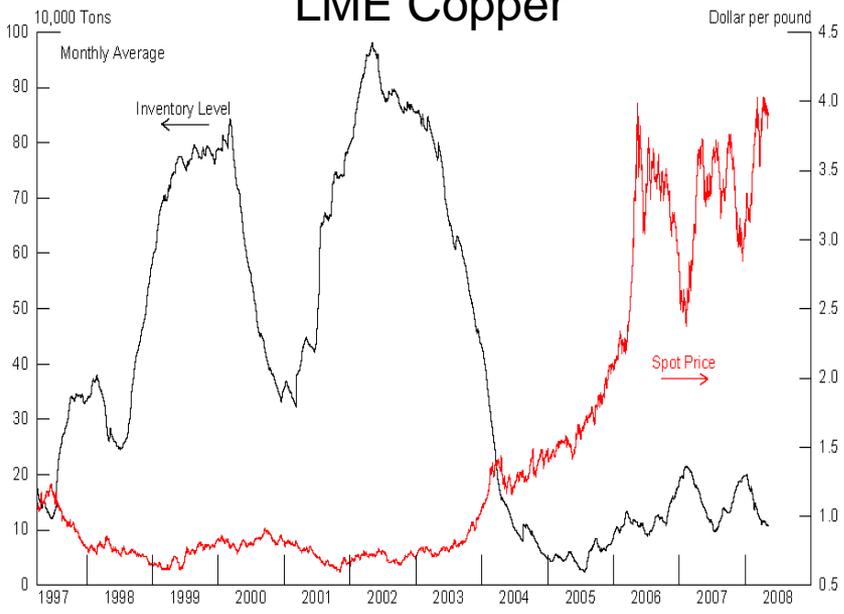
- If speculators pushed commodity prices above equilibrium levels,
- Should lower demand, raise supply,
- And cause rising inventories

Figure 4: Crude Oil and Petroleum Product Inventories

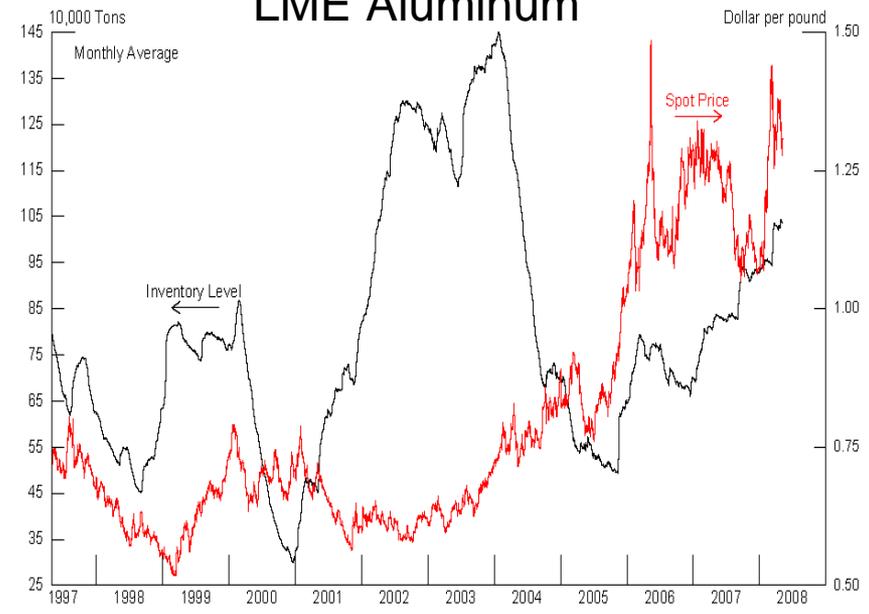


\*5-year average level +/- 1 standard deviation.  
Source: U.S. Department of Energy and International Energy Agency.

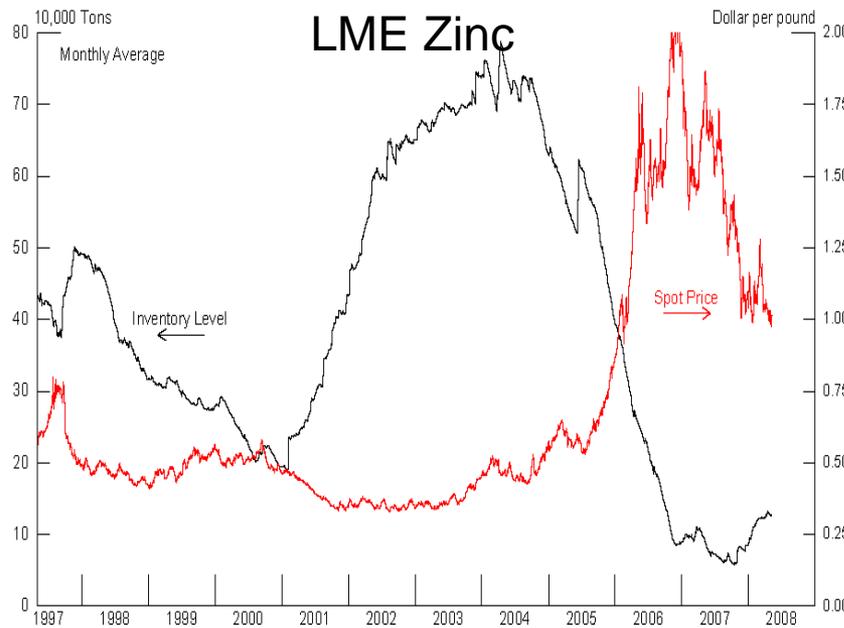
# LME Copper



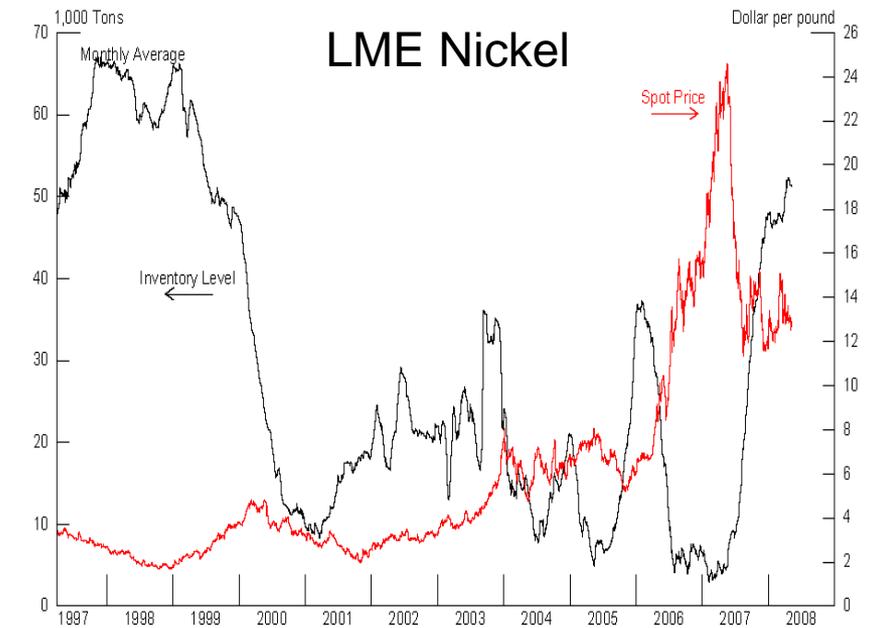
# LME Aluminum



# LME Zinc



# LME Nickel



So, why have commodity prices risen so much in recent years?

3. Lower interest rates, but not speculation

So, why have commodity prices risen so much in recent years?

### 3. Lower interest rates, but not speculation

- Lower interest rates reduced cost of holding inventories, increasing demand and prices
- However, as noted earlier, inventories were not rising

So, why have commodity prices risen so much in recent years?

### 3. Lower interest rates, but not speculation

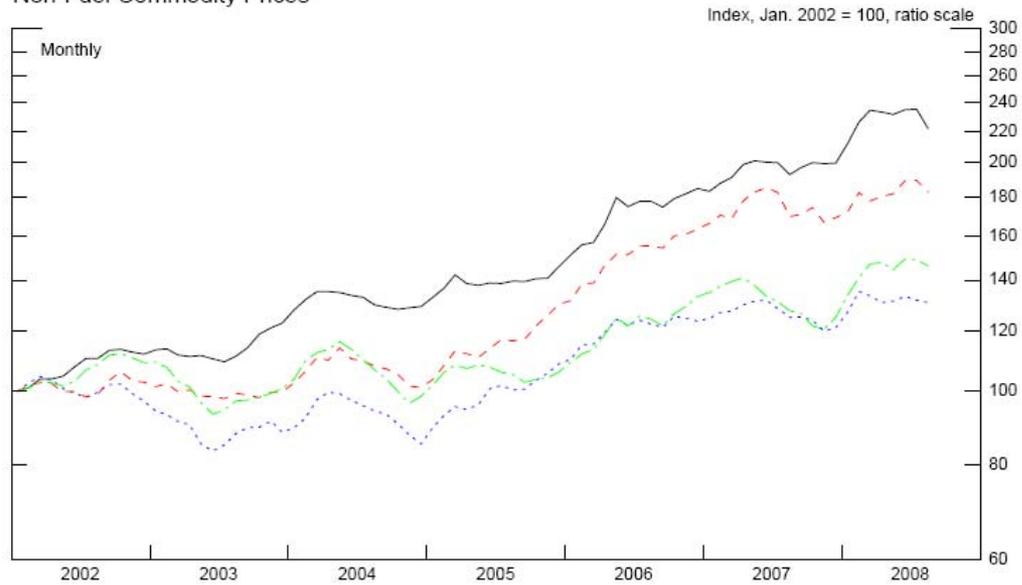
- Lower interest rates reduced the exchange value of the dollar, pushing up dollar value of commodities
- However, dollar fell 25% 2002 to mid-2008, while
  - Oil prices rose over 350%
  - Non-oil commodity prices rose over 100%

**Figure 5: Commodity Prices in Various Currencies**

Spot Price of West Texas Intermediate Crude Oil



Non-Fuel Commodity Prices



So, why have commodity prices risen so much in recent years?

#### 4. Dollar bloc story

# So, why have commodity prices risen so much in recent years?

## 4. Dollar bloc story

- Many developing countries, especially in East Asia, pegged to dollar – “dollar bloc”
- Loosening of Fed monetary policy after 2000 meant dollar bloc countries had to loosen too.
- Economic overheating, rising demand for commodities
- Surge in commodity prices

Apart from the Gulf States, few countries still peg their currencies to the dollar, but most try to limit the amount of appreciation. This means that as the Fed cuts rates there is pressure on emerging economies to do the same, to prevent capital inflows pushing up their exchange rates...In the face of rising inflation, emerging economies should be lifting interest rates, not cutting them, but their rigid currency policies makes this hard. In turn, continued surging demand in emerging economies boosts commodity prices.

*The Economist*, May 8, 2008

## Objective of paper:

- Assess the dollar bloc explanation for rise in commodity prices
- Focus on the case of oil

# Plan of talk:

1. Describe SIGMA, the Fed's forward- looking, dynamic, multi-country, general equilibrium model
2. Simulate impact of U.S. monetary loosening, with and without a dollar bloc
3. Simulate alternative, fundamental shocks: higher world GDP growth, lower world oil production
4. Assess the "dollar bloc" premise

# 1. SIGMA: forward-looking, dynamic, multi-country, general equilibrium model

## ■ Forward-looking, dynamic:

- Agents have perfect foresight
  - Habit persistence and other rigidities influence short-run responses, creating more realistic dynamics
- Consumption depends on permanent income in long run, more inertial in short run
- Investment depends on Tobin's  $Q$ , but adjustment costs slow responses
- Trade also subject to adjustment costs

# 1. SIGMA: forward-looking, dynamic, multi-country, general equilibrium model

- Forward-looking, dynamic (continued):
  - Inflation determined by New Keynesian Phillips Curve: lagged inflation, marginal costs of production, and expected inflation
  - Government spending exogenous, but lump-sum taxes adjusted to satisfy intertemporal budget constraint

# 1. SIGMA: forward-looking, dynamic, multi-country, general equilibrium model

## ■ Multi-country:

### • U.S.:

- 25 percent of world GDP
- Policy interest rates set by Taylor rule (inflation, GDP growth, past interest rates)

### • Developing Asia/Latin America (DA-LA):

- 20 percent of world GDP
- Currencies pegged to U.S. dollar, policy interest rates set to U.S. rate

### • Rest of world (ROW)

- 55 percent of world GDP
- Floating currencies, Taylor-rule interest rates

# 1. SIGMA: forward-looking, dynamic, multi-country, general equilibrium model

## ■ General equilibrium:

- Within economies, developments in different sectors interdependent
- International interdependence as well:
  - Trade
  - Finance (uncovered interest parity)
  - Global oil market

# 1. SIGMA: forward-looking, dynamic, multi-country, general equilibrium model

## ■ Oil sector:

- Price equates global demand and supply
- Supply: fixed
- Demand:
  - Responds rapidly to changes in GDP, with unit elasticity
  - Responds slowly to changes in price (half-life of 10 years)
    - 1-year elasticity of .05
    - Long-run elasticity of  $1/2$

## 2. Simulate impact of U.S. monetary loosening, with and without a dollar bloc

### Simulation experiment:

- Negative shock to U.S. consumption, sufficient to lower real federal funds rate by 200 basis points
  - Similar to actual decline in real fed funds rate during 2004-2007 below 1990-2003 average

Figure 21: Real United States Interest Rates

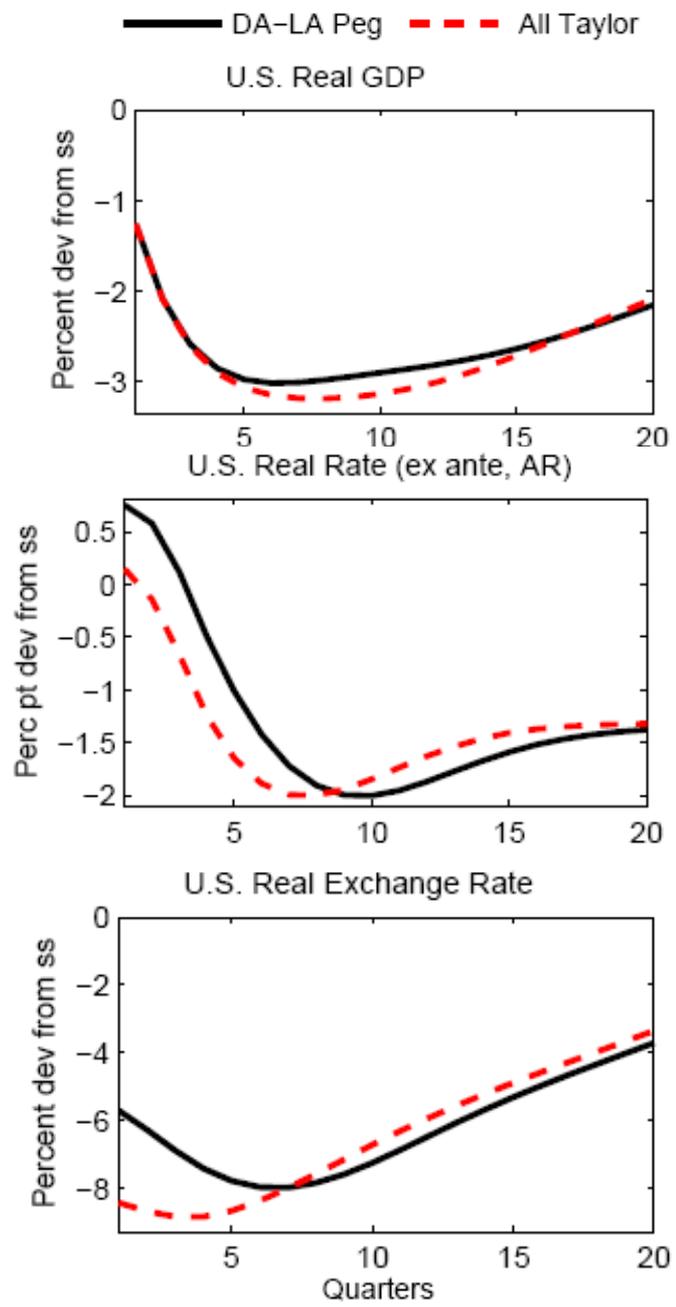


## 2. Simulate impact of U.S. monetary loosening, with and without a dollar bloc

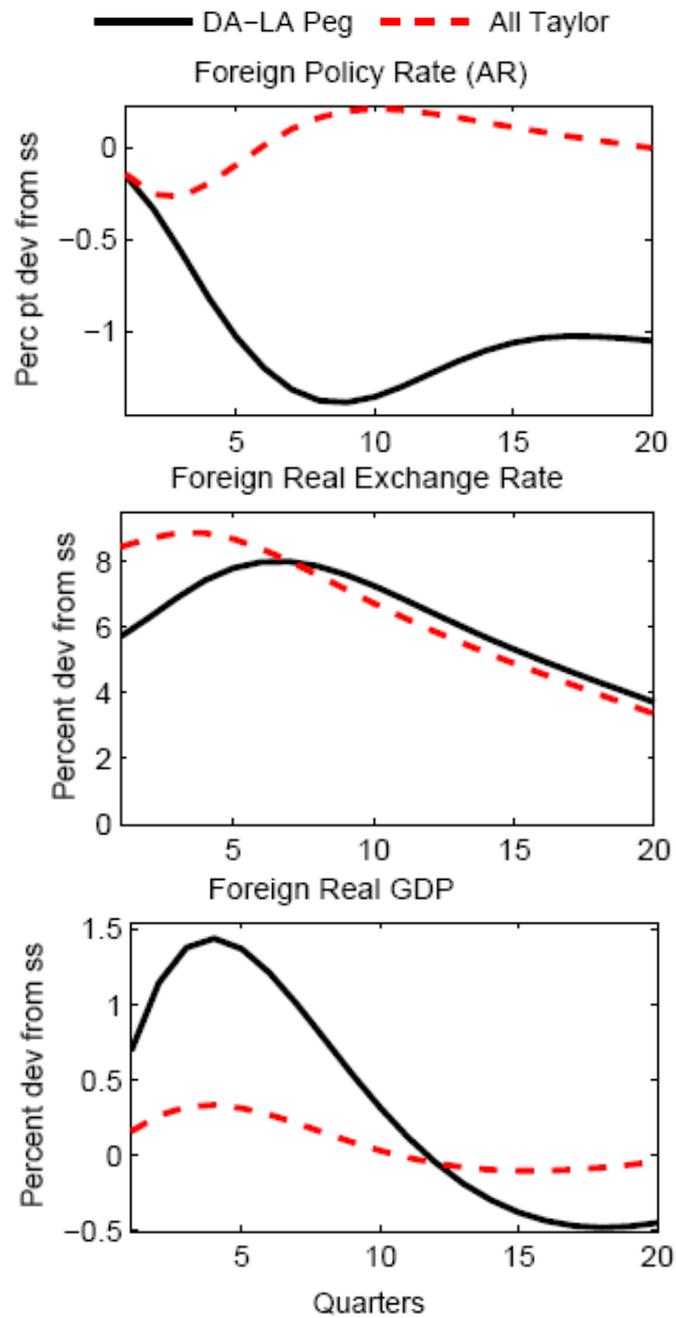
### Simulation experiment:

- Negative shock to U.S. consumption, sufficient to lower real federal funds rate by 200 basis points
  - Similar to actual decline in real fed funds rate during 2004-2007 below 1990-2003 average
- Perform simulation under two different assumptions:
  - DA-LA peg
  - All currencies float, all countries follow Taylor rule

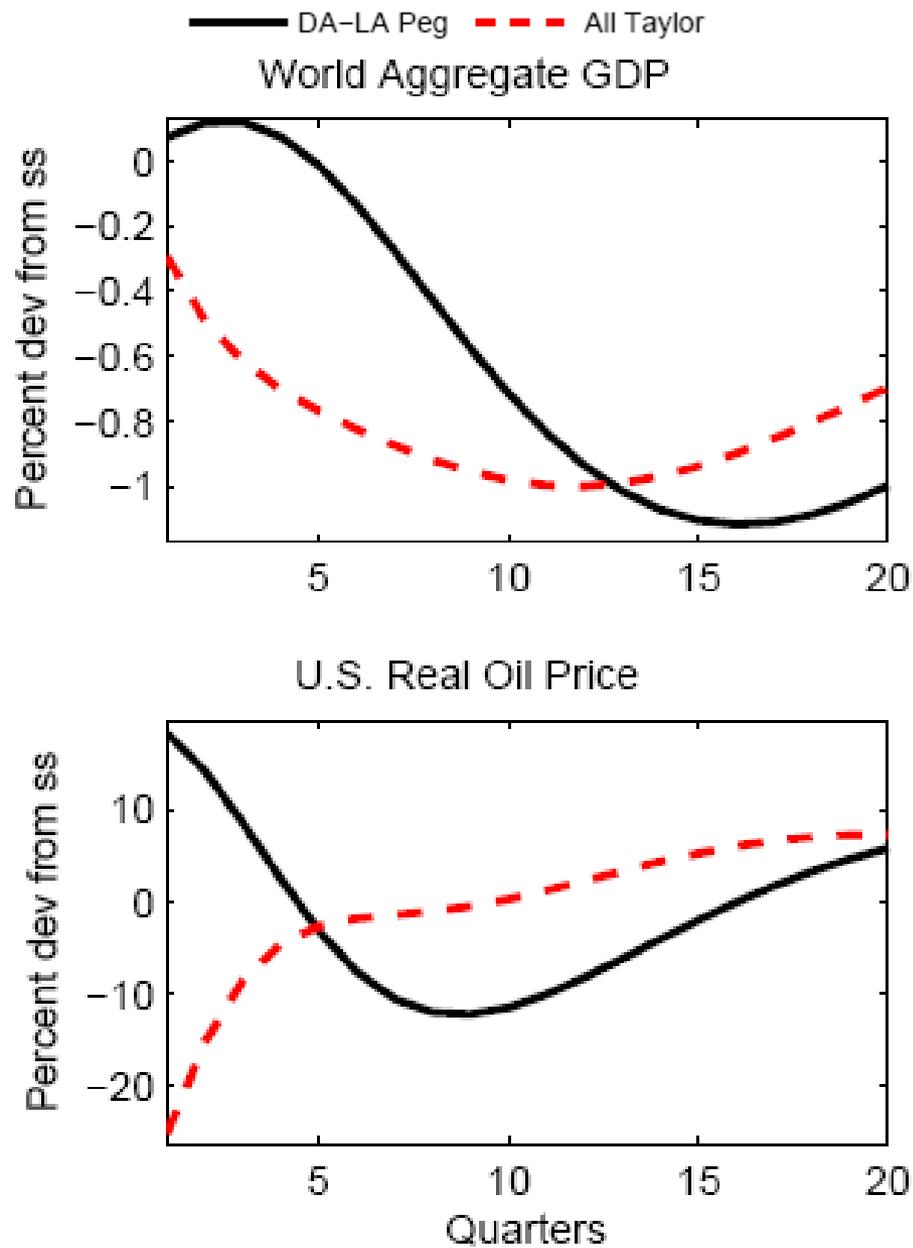
**Figure 6: U.S. Aggregate Demand Shock**



**Figure 7: U.S. Aggregate Demand Shock (Foreign Responses)**



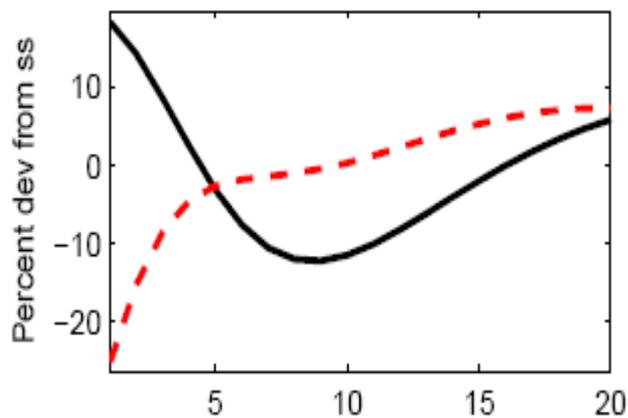
**Figure 8: U.S. Aggregate Demand Shock**



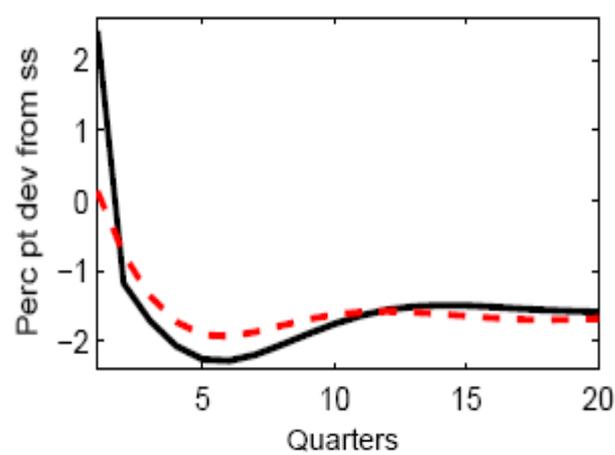
# Figure 9: U.S. Aggregate Demand Shock

— DA-LA Peg    - - - All Taylor

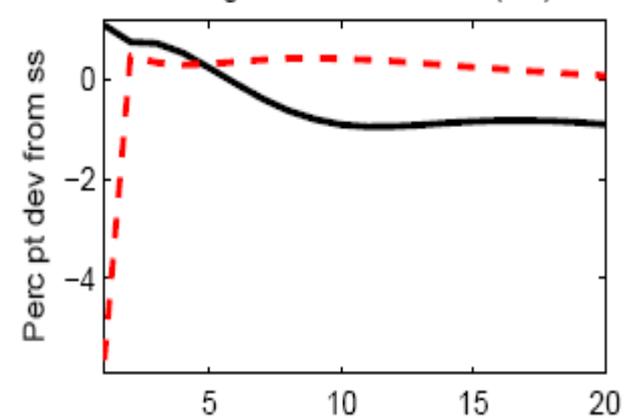
## U.S. Real Oil Price



## U.S. Headline Inflation (AR)



## Foreign Headline Inflation (AR)



## 2. Simulate impact of U.S. monetary loosening, with and without a dollar bloc

Bottom line:

- U.S. monetary loosening can explain rise in oil prices but not its persistence
  - Foreign GDP returns to baseline
  - Spike in oil prices subsequently pushes down demand

## 2. Simulate impact of U.S. monetary loosening, with and without a dollar bloc

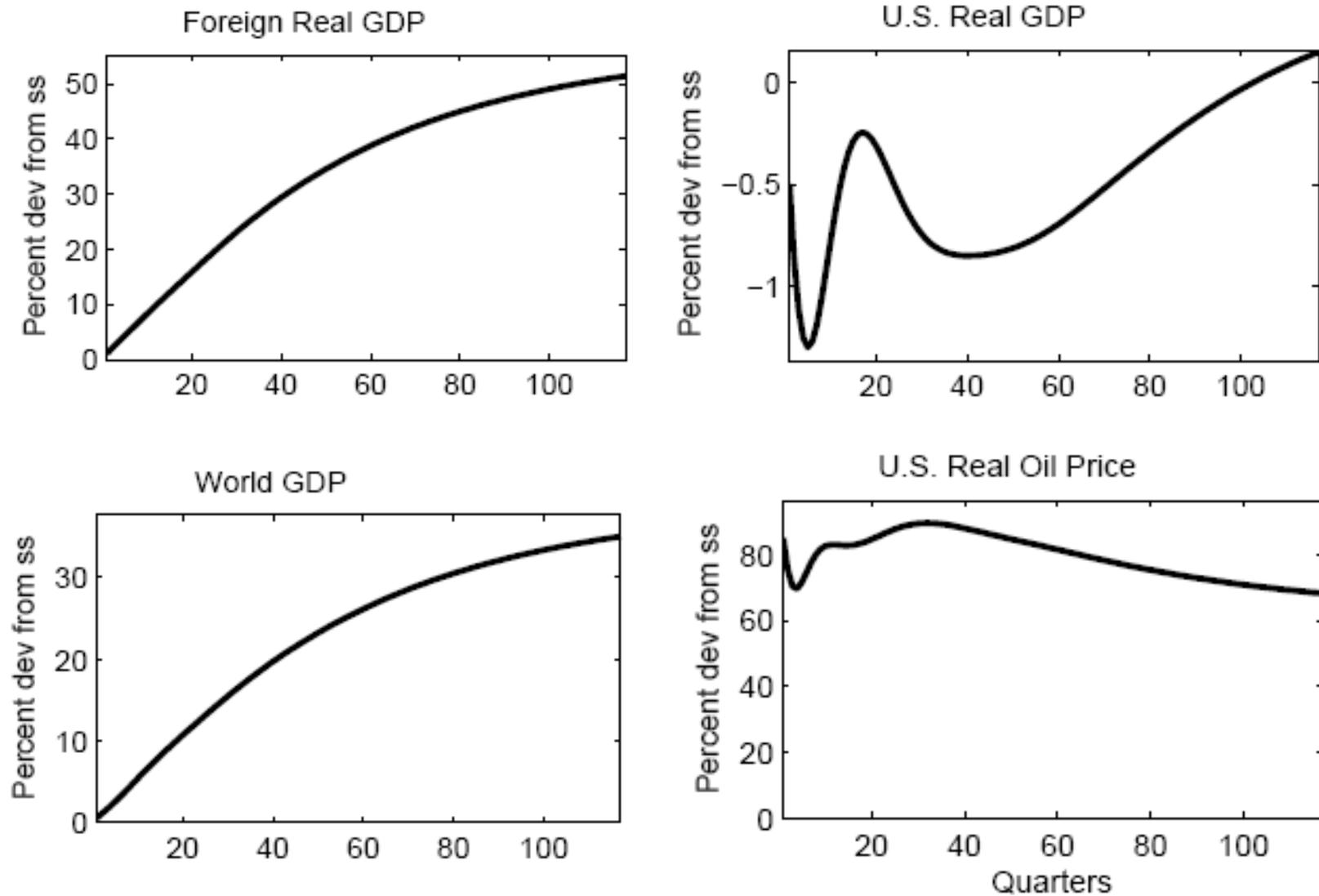
- Explaining persistent rise in oil prices requires a shock that persistently affects growth of global supply or demand.

### 3. Simulate impact of higher foreign GDP growth

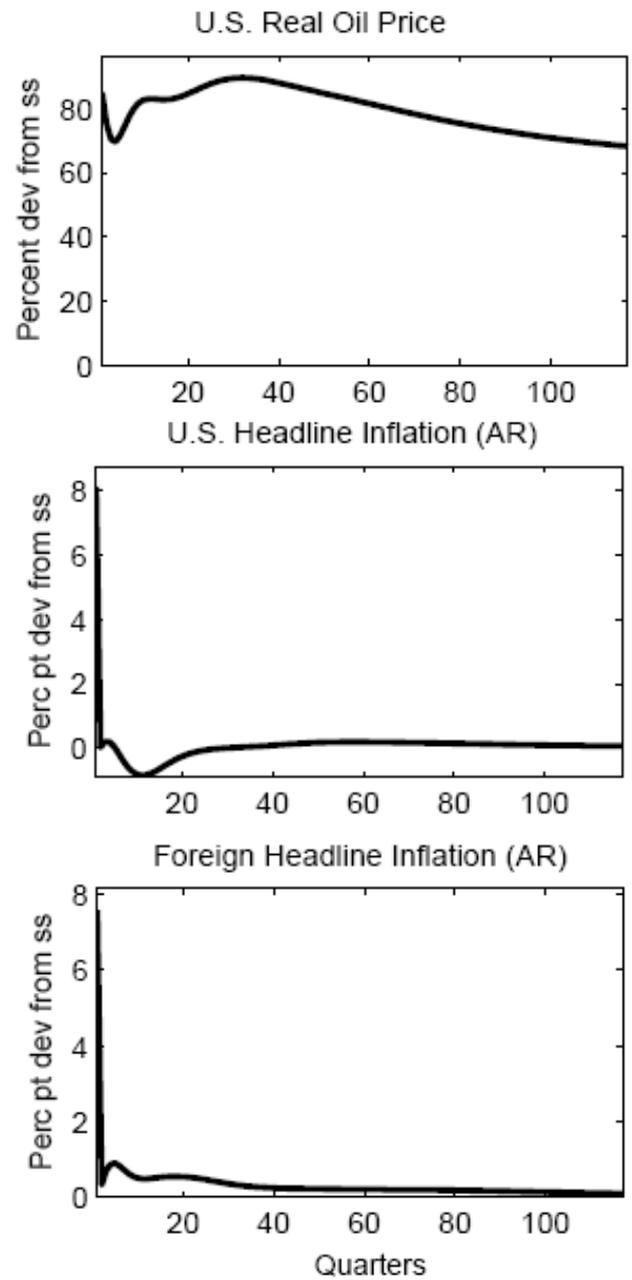
#### Simulation experiment:

- Positive shock to foreign productivity growth that boosts foreign GDP growth 1.5 percentage points above baseline
  - Consistent with rise in world GDP growth (IMF WEO) to 5 percent during 2004-2007, about 1 percentage point higher than average of preceding 2 decades.
  - Will assume the DA-LA region maintains dollar peg

**Figure 10: Foreign Technology Growth Shock**



# Figure 11: Foreign Technology Growth Shock

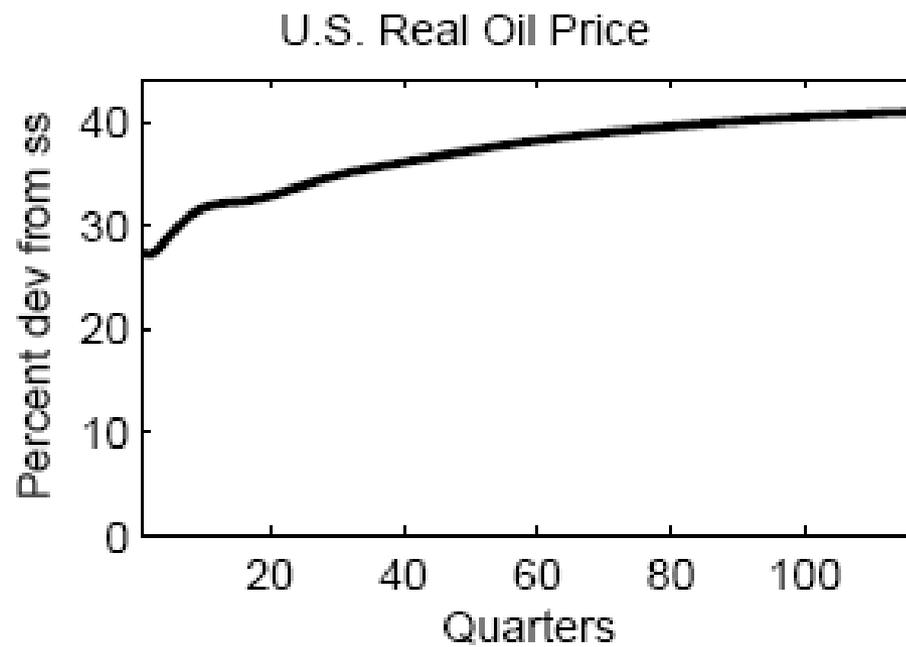
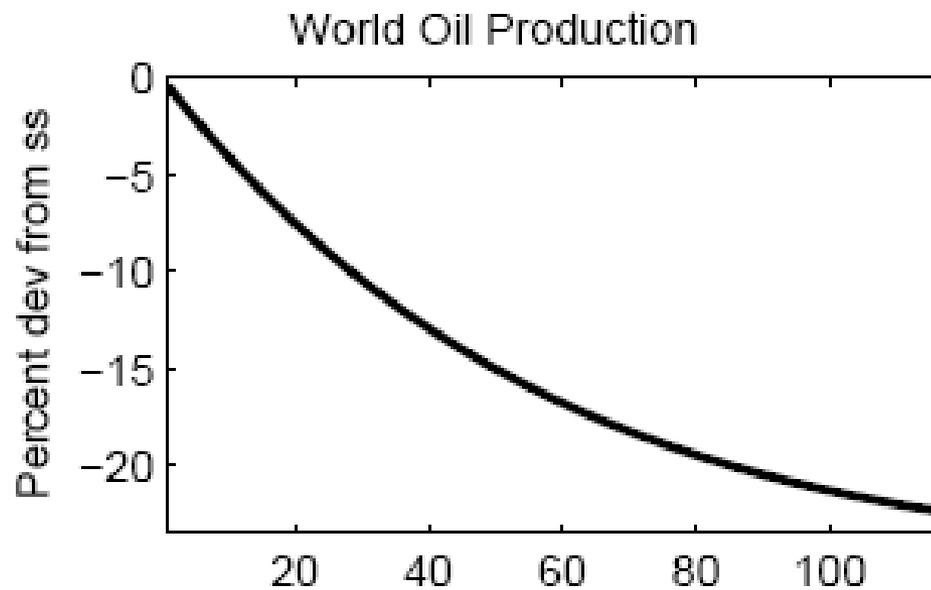


### 3. Simulate impact of lower oil production growth

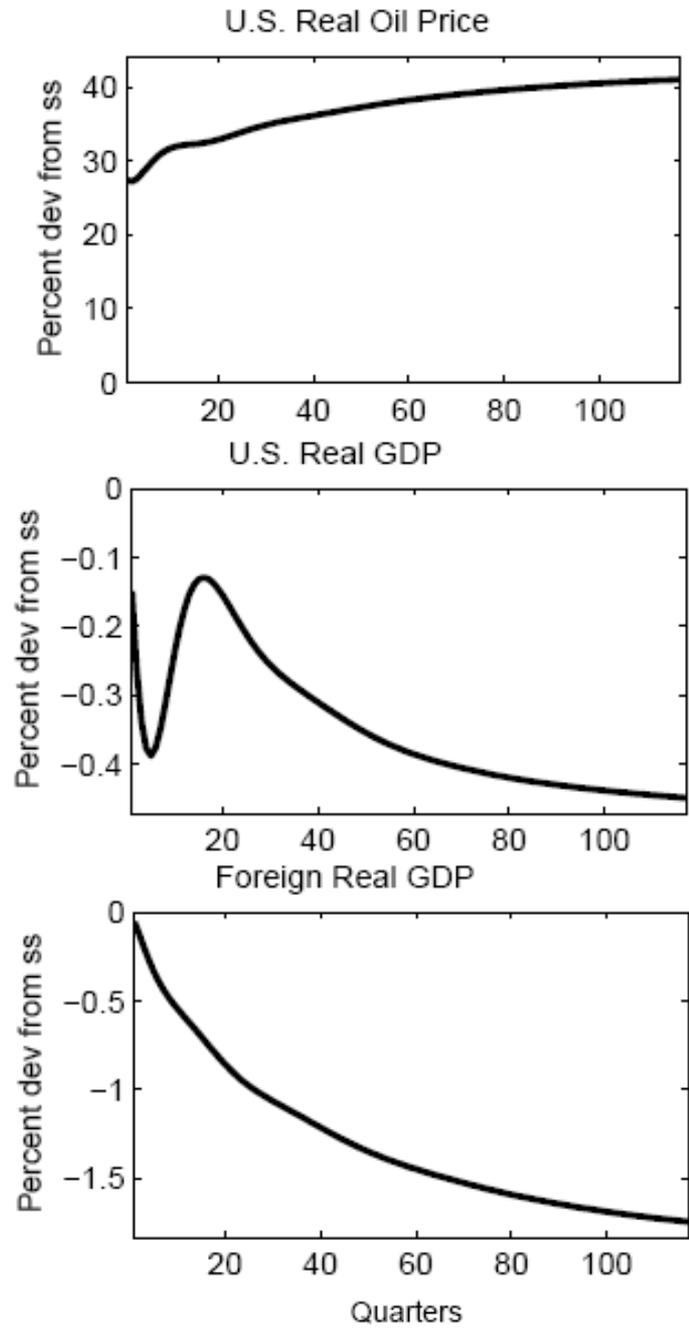
#### Simulation experiment:

- Negative shock to supply that lowers growth of global oil production 1.5 percentage points below baseline
  - Consistent with fall in growth of world oil production from about 2 percent annually to ½ percentage point during 2004-2007.
  - Will assume the DA-LA region maintains dollar peg

**Figure 12: Negative Oil Supply Shock**



# Figure 13: Negative Oil Supply Shock



**Figure 14: Negative Oil Supply Shock**

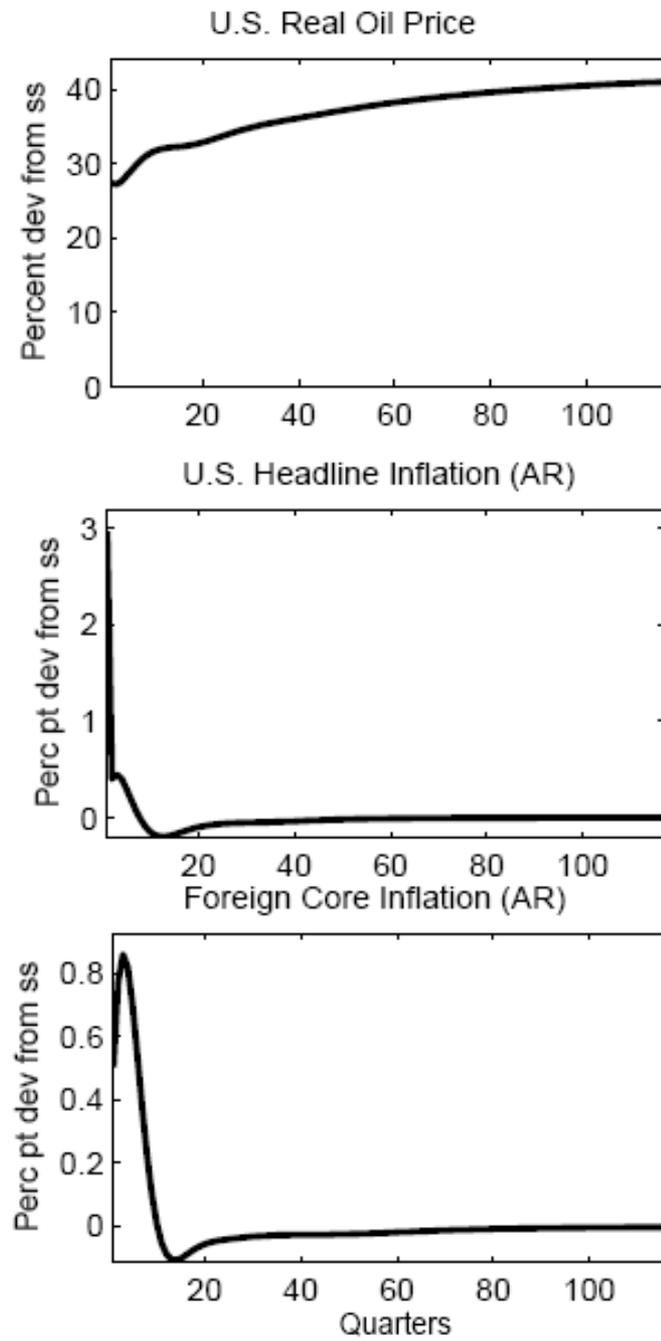
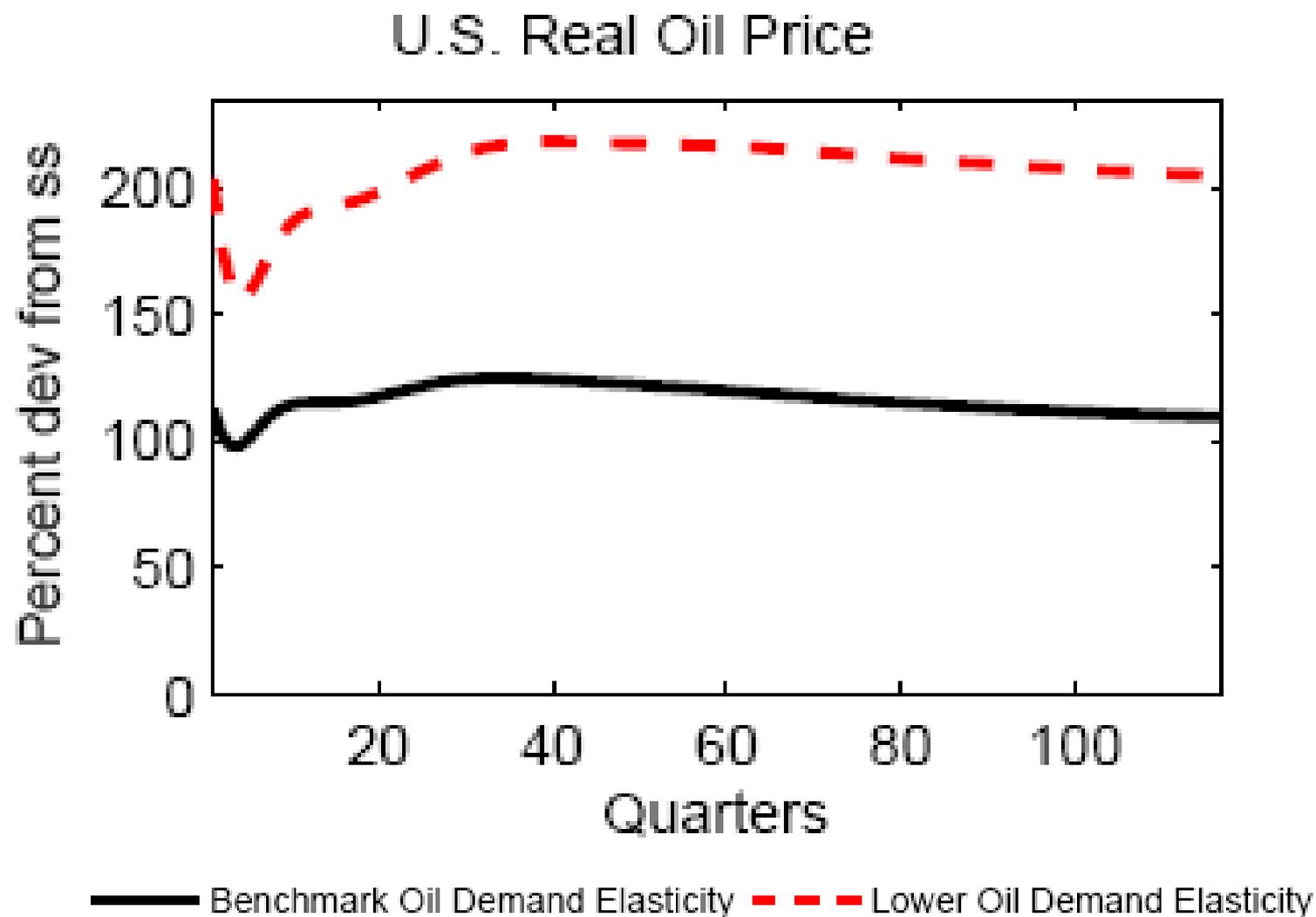


Figure 15: Combined Positive Foreign GDP and Negative Oil Supply Shocks

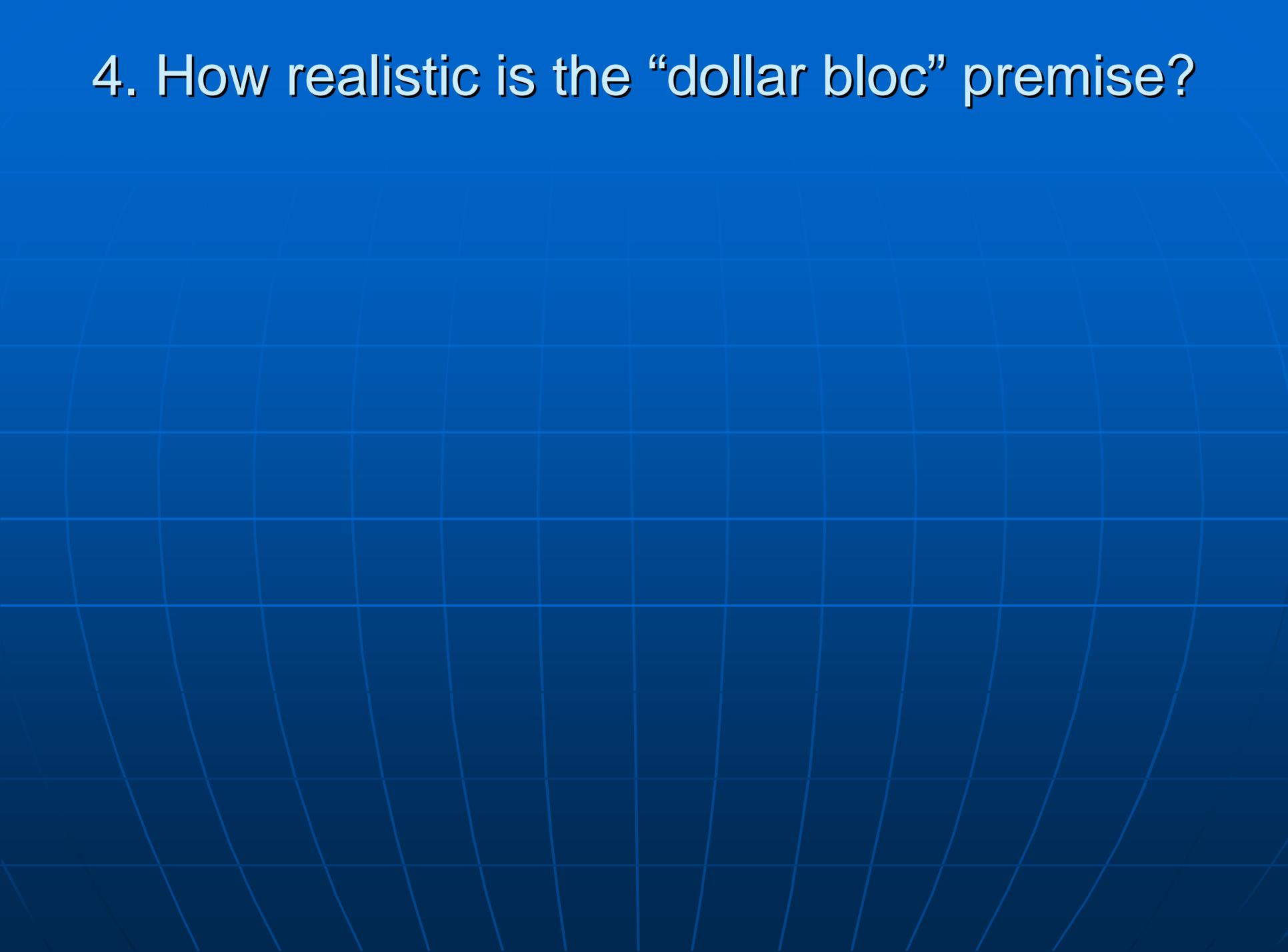


### 3. Simulate impact of higher foreign GDP growth, lower oil production growth

Bottom line:

- Persistent shocks to the demand for oil (foreign growth) and supply of oil (lower production) can explain runup in oil prices better than the “dollar bloc” story.

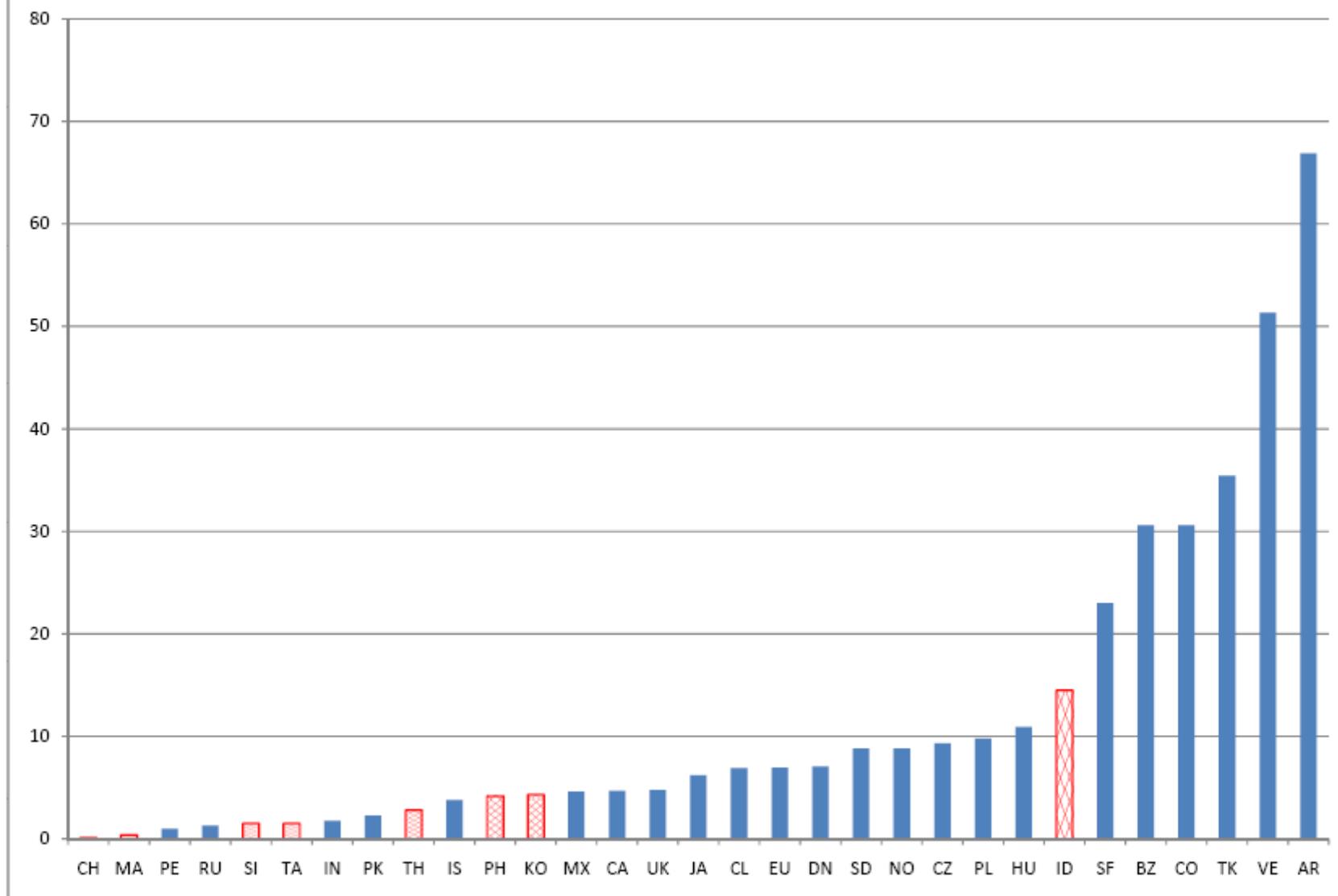
4. How realistic is the “dollar bloc” premise?



## 4. How realistic is the “dollar bloc” premise?

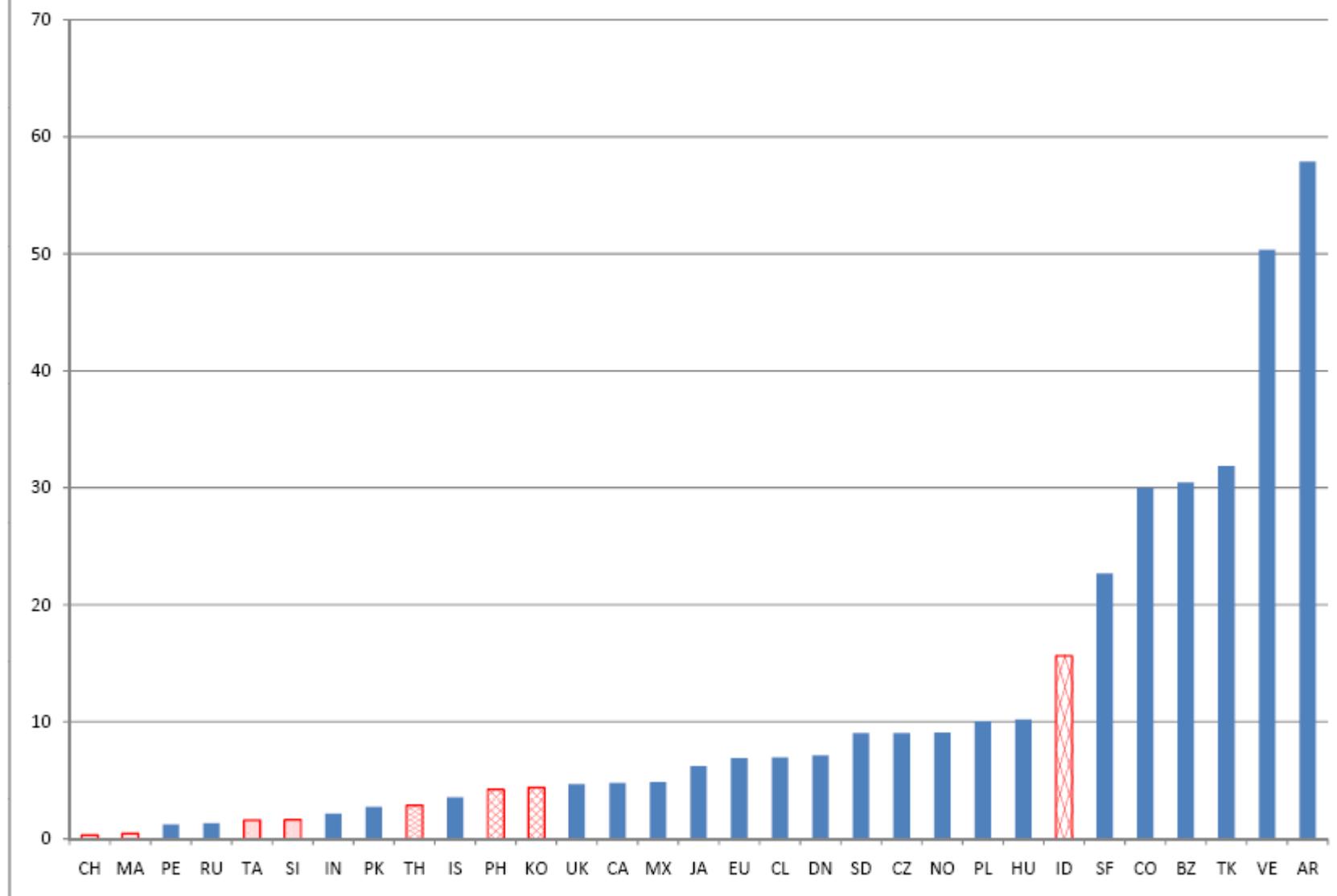
- Are East Asian currencies more closely tied to the dollar than other currencies?

Figure 16: Variance of Percent Changes in Nominal Exchange Rate Against Dollar\*



\* Monthly data, calculated over 2000-2007

Figure 17: Variance of Percent Changes in Real Exchange Rate Against Dollar\*



\* Monthly data, calculated over 2000-2007; deflated by U.S. and other countries' CPIs.

## 4. How realistic is the “dollar bloc” premise?

- Are East Asian monetary policies more closely tied to U.S. monetary policy than those of other countries?

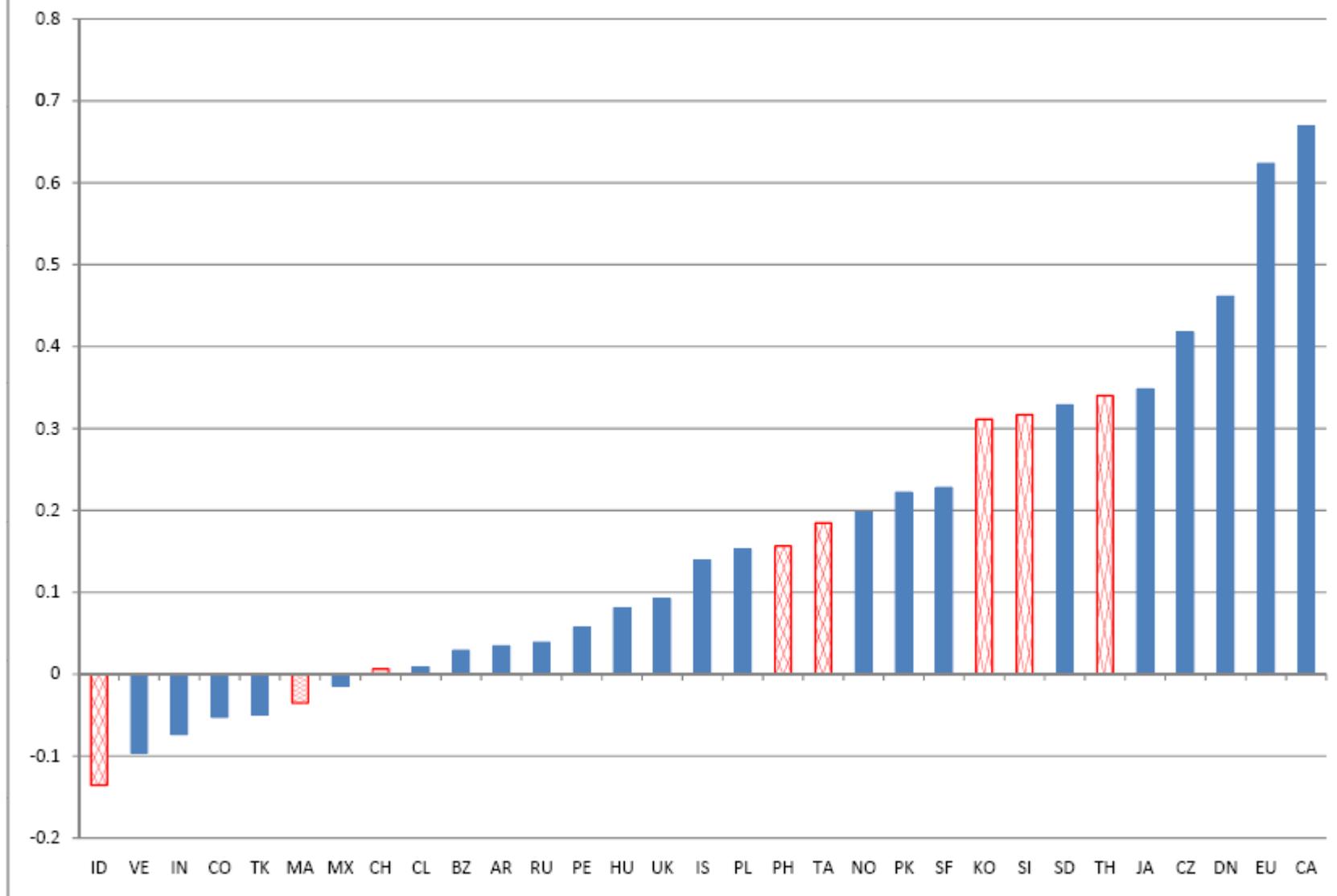
## 4. How realistic is the “dollar bloc” premise?

- Are East Asian monetary policies more closely tied to U.S. monetary policy than those of other countries?
  - Countries pegged to dollar must have interest rates equal to dollar interest rates only under certain conditions:
    - Perfect capital mobility
    - Perfectly substitutable assets
    - Expectations that the peg will be maintained

## 4. How realistic is the “dollar bloc” premise?

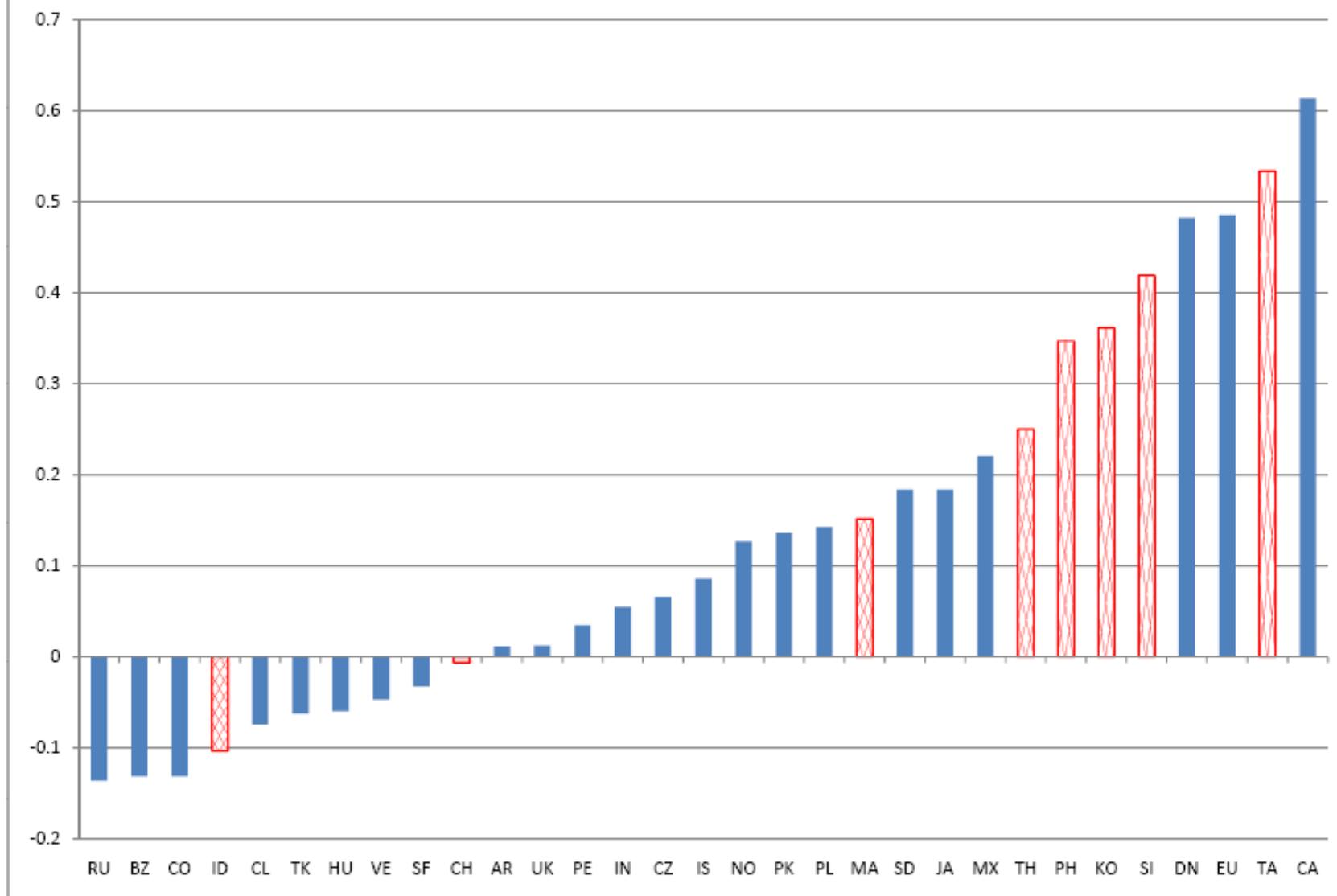
- If East Asian monetary policies are more closely tied to U.S. monetary policy, their policy interest rates should be more correlated with the U.S. federal funds rates.

Figure 18: Correlation of Nominal Interest Rate Changes with U.S. Rates\*



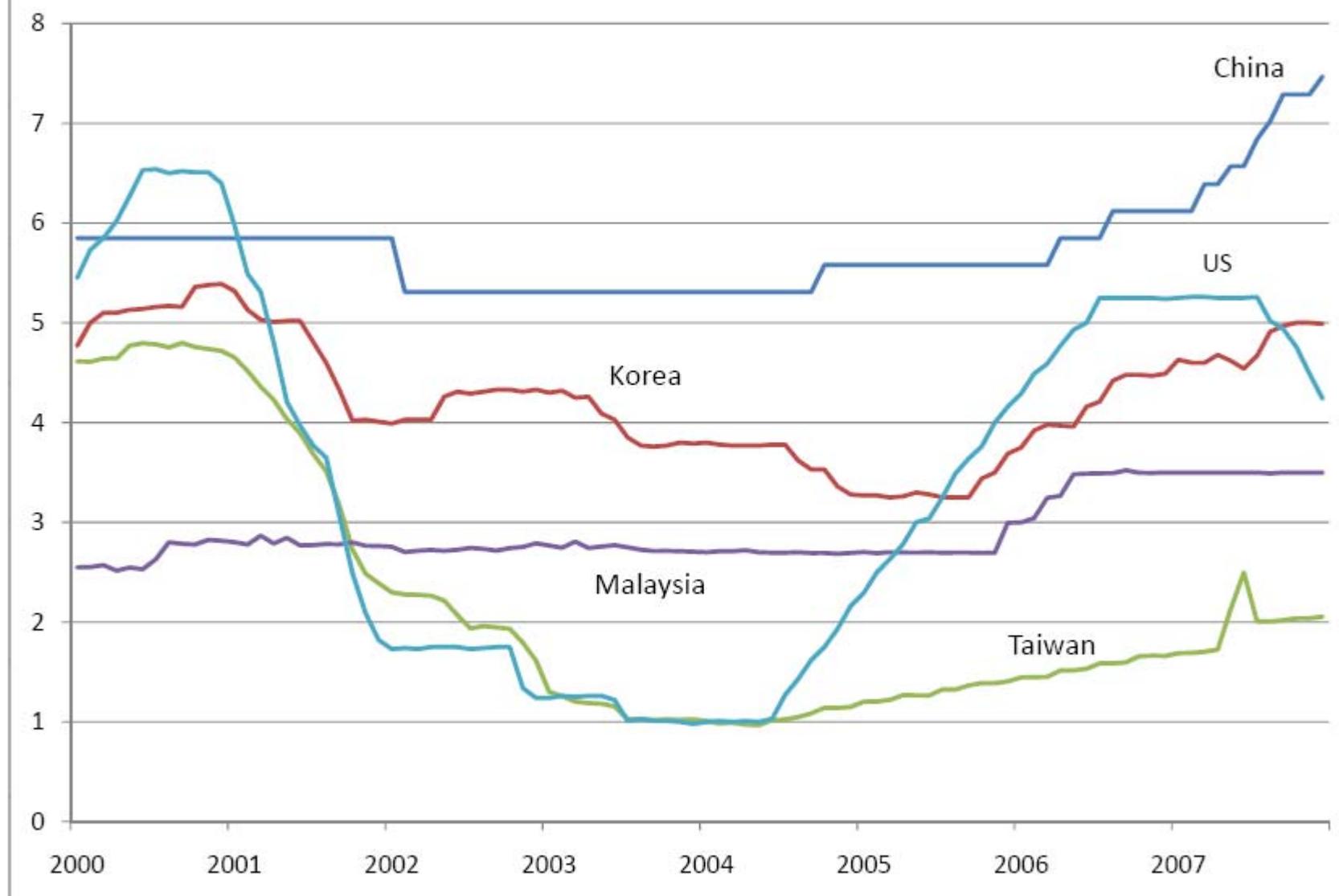
\* Monthly data on policy interest rates, 2000-2007

Figure 19: Correlation of Real Interest Rate Changes with U.S. Rates\*



\* Monthly data on real policy rates, 2000-2007; nominal rates deflated by trailing 12-month CPI inflation rate.

Figure 20: U.S. and Selected Developing Asian Interest Rates 2000-2007



## 4. How realistic is the “dollar bloc” premise?

- Why are euro area and Canadian interest rates more correlated with US rates than are East Asian interest rates?
- Do euro area and Canada have business cycles that are more similar to those of US?
- Does that explain why their interest rates are more correlated with US?
- If we control for cyclical influences of inflation and output on interest rates, can we identify an effect of US monetary policy on Asian interest rates?

**Table 2: Taylor Rule OLS Regression Estimates (2000-2007)**

$i =$	$\beta_0$	$+ \beta_1\pi$	$+ \beta_2IPGAP$	$+ \beta_3i_{t-1}$	$+ \beta_4i^{US}$	Adj. $R^2$	dw stat.
China	-0.16	0.01	0.01	1.03		0.97	2.12
	(0.12)	(0.01)	(0.01)	(0.02)			
	-0.01	0.02	0.01	0.99	0.01	0.97	2.12
	(0.16)	(0.01)	(0.01)	(0.03)	(0.01)		
Malaysia	0.03	0.02	0.00	0.98		0.98	2.31
	(0.05)	(0.01)	(0.00)	(0.02)			
	0.06	0.02	0.00	0.97	0.00	0.98	2.32
	(0.05)	(0.01)	(0.00)	(0.02)	(0.00)		
Singapore	0.06	0.02	0.01	0.96		0.95	1.79
	(0.05)	(0.02)	(0.00)	(0.02)			
	0.06	0.02	0.01	0.95	0.01	0.95	1.76
	(0.05)	(0.02)	(0.00)	(0.05)	(0.03)		
Taiwan	0.00	0.02	0.01	0.98		0.99	1.55
	(0.02)	(0.01)	(0.00)	(0.01)			
	-0.02	0.00	0.01	0.95	0.03	0.99	1.74
	(0.02)	(0.01)	(0.00)	(0.01)	(0.01)		

**Table 2: Taylor Rule OLS Regression Estimates (2000-2007)**

$i =$	$\beta_0$	$+ \beta_1\pi$	$+ \beta_2IPGAP$	$+ \beta_3i_{t-1}$	$+ \beta_4i^{US}$	Adj. $R^2$	dw stat.
Indonesia	0.53 (0.63)	0.13 (0.06)	0.12 (0.04)	0.82 (0.06)		0.72	2.48
	0.20 (0.73)	0.14 (0.06)	0.12 (0.04)	0.81 (0.06)	0.10 (0.11)	0.72	2.49
The Philippines	0.81 (0.32)	-0.06 (0.03)	0.04 (0.01)	0.93 (0.03)		0.91	1.16
	0.84 (0.31)	-0.05 (0.03)	0.03 (0.01)	0.90 (0.04)	0.05 (0.03)	0.91	1.15
Thailand	-0.01 (0.05)	0.07 (0.02)	0.00 (0.01)	0.94 (0.02)		0.97	1.95
	-0.04 (0.05)	0.07 (0.02)	0.00 (0.01)	0.92 (0.03)	0.02 (0.01)	0.97	1.96
Korea	0.21 (0.07)	-0.05 (0.01)	0.01 (0.00)	0.98 (0.02)		0.98	1.47
	0.23 (0.07)	-0.03 (0.01)	0.01 (0.00)	0.96 (0.02)	0.01 (0.01)	0.98	1.46

**Table 2: Taylor Rule OLS Regression Estimates (2000-2007)**

$i =$	$\beta_0$	$+ \beta_1\pi$	$+ \beta_2IPGAP$	$+ \beta_3i_{t-1}$	$+ \beta_4i^{US}$	Adj. $R^2$	dw stat.
Canada	0.16 (0.07)	0.02 (0.02)	0.18 (0.03)	0.94 (0.02)		0.98	1.44
	0.18 (0.07)	0.05 (0.02)	0.11 (0.04)	0.84 (0.03)	0.08 (0.02)	0.98	1.45
Euro Area	0.19 (0.09)	-0.06 (0.04)	0.05 (0.01)	0.98 (0.02)		0.99	0.73
	0.11 (0.08)	-0.03 (0.03)	0.02 (0.01)	0.93 (0.01)	0.05 (0.01)	0.99	0.97
United Kingdom	1.35 (0.35)	0.09 (0.10)	0.14 (0.07)	0.69 (0.07)		0.57	2.22
	2.63 (0.36)	-0.01 (0.09)	0.11 (0.06)	0.25 (0.09)	0.27 (0.04)	0.70	1.82
Japan	0.01 (0.01)	0.01 (0.01)	0.00 (0.00)	0.99 (0.02)		0.96	1.11
	0.00 (0.01)	0.02 (0.01)	0.00 (0.00)	0.96 (0.03)	0.01 (0.00)	0.96	1.16

**Table 3: Taylor Rule ML Regression Estimates (2000-2007)**

$i =$	$\beta_0$	$+ \beta_1\pi$	$+ \beta_2IP$	$+ \beta_3i_{t-1}$	$+ \beta_4i^{US}$	Adj. $R^2$	First obs.
China	0.15 (0.53)	0.05 (0.05)	-0.00 (0.10)	0.87 (0.16)	0.04 (0.18)	0.97	1991q2
Malaysia	-0.00 (0.30)	0.05 (0.15)	0.01 (0.02)	0.89 (0.11)	0.05 (0.09)	0.82	1980q1
Euro Area	-0.55 (1.83)	1.21 (5.00)	0.08 (0.05)	0.85 (0.72)	0.03 (0.16)	0.44	1990q1
United Kingdom	-0.07 (0.10)	0.19 (0.22)	0.07 (0.12)	0.80 (0.11)	0.23 (0.07)	0.96	1980q1

## 4. How realistic is the “dollar bloc” premise?

Bottom line:

- Asian currencies more tied to the dollar than other currencies, but only a few obviously fixed.
- Little evidence that Asian economies “import” US monetary policy.

# Conclusion

- “Dollar bloc” story can explain transitory—but not persistent—rise in oil prices.
- Higher GDP growth and production shortfalls better explain sustained rise.
- The “dollar bloc” is less rigidly tied to the dollar than its name implies.