Measuring and Attaining Energy Security in OECD Economies: An Economic Perspective

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National Capital Area Chapter

U.S. Association for Energy Economics

By

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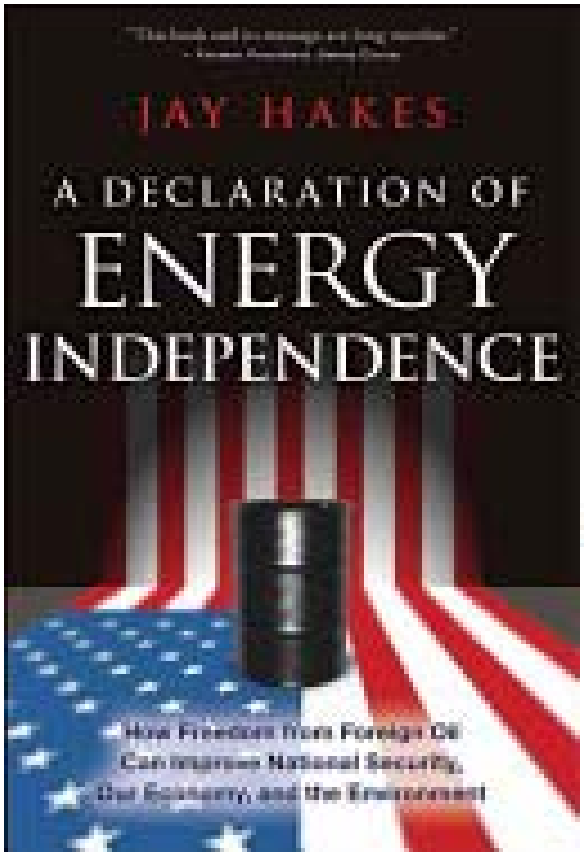
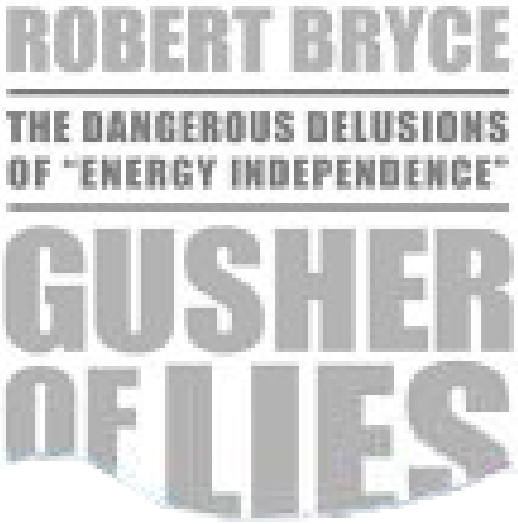
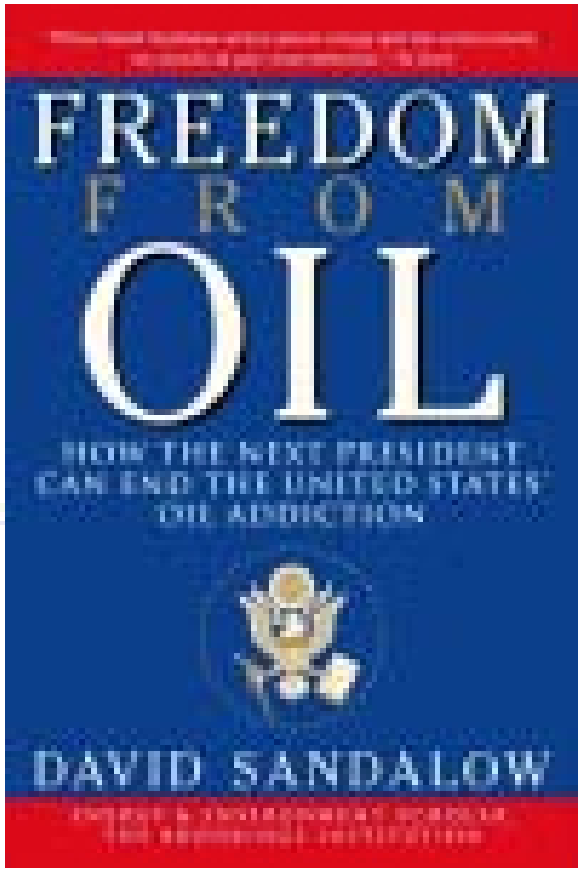
Motivation

- Concern of policymakers all over the globe
  - U.S. Congress: 90+ bills mention ‘energy security’
  - Other countries
    - An Energy Policy for Europe, European Commission, 2007
    - Cebu Declaration on East Asian Energy Security, 2007
- Energy independence is also a popular concern

Recent books on energy security



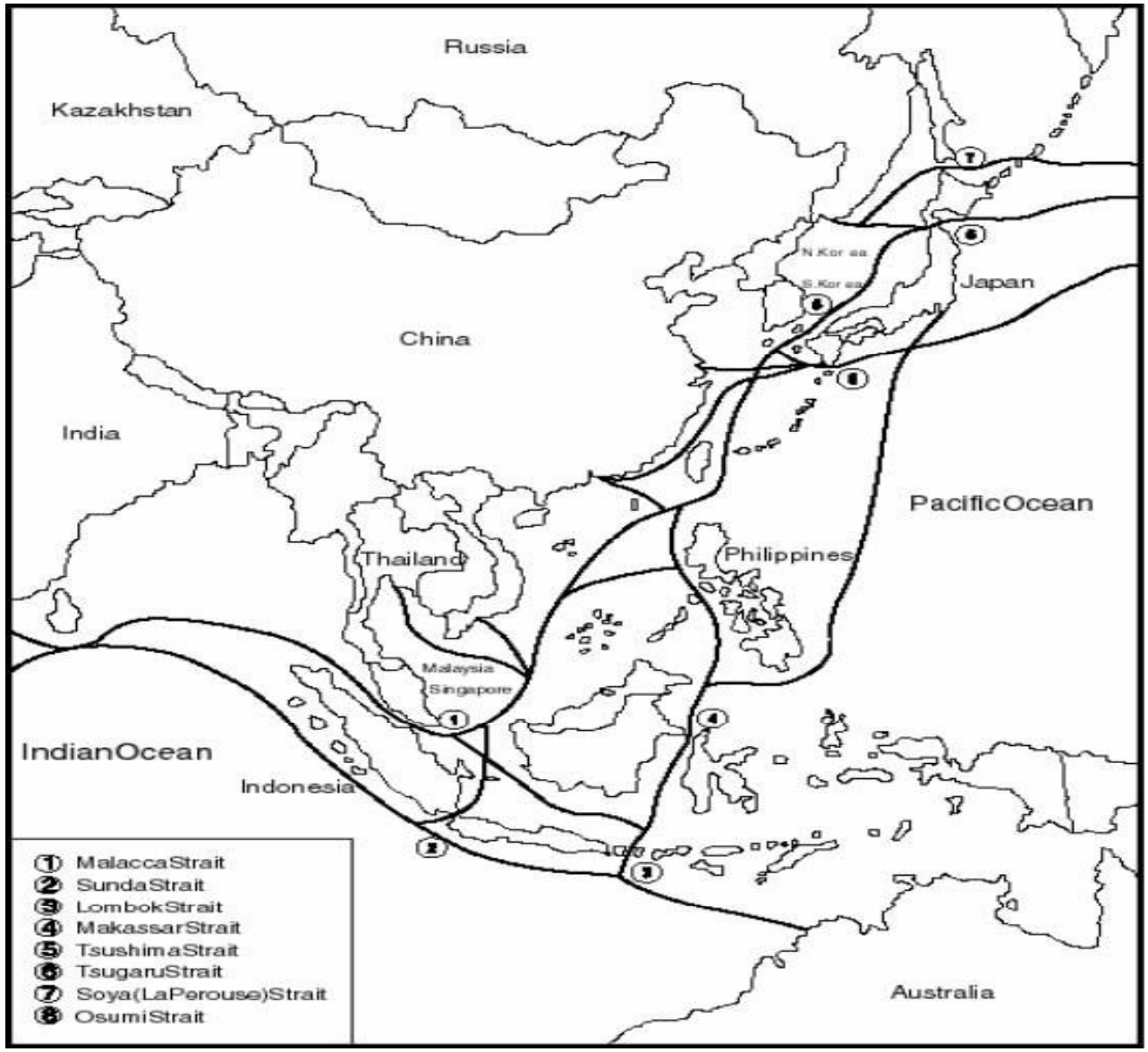


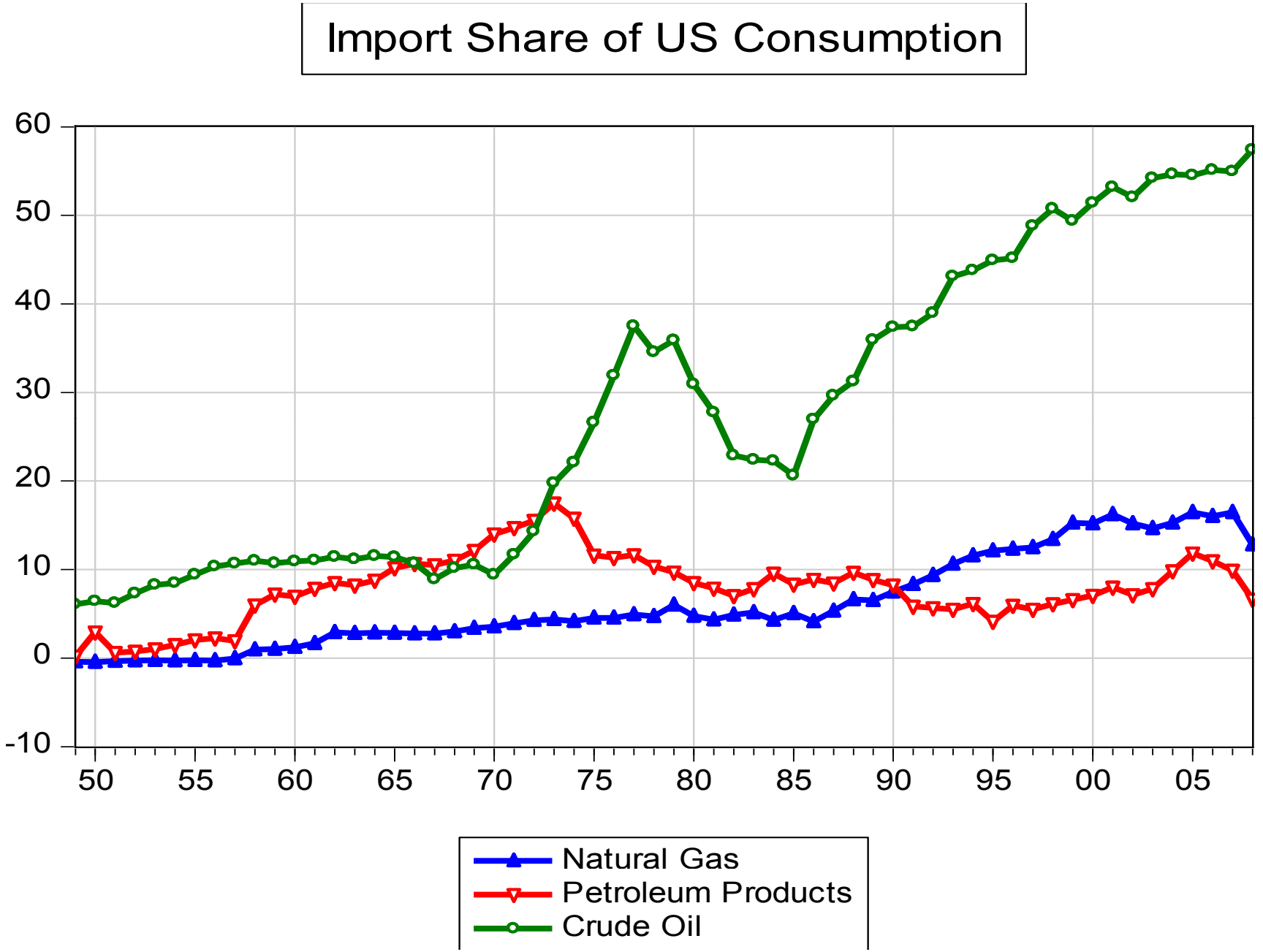


See Loungani (2009), "The Elusive Quest for Energy Independence," *International Finance*, for a critical review of these books

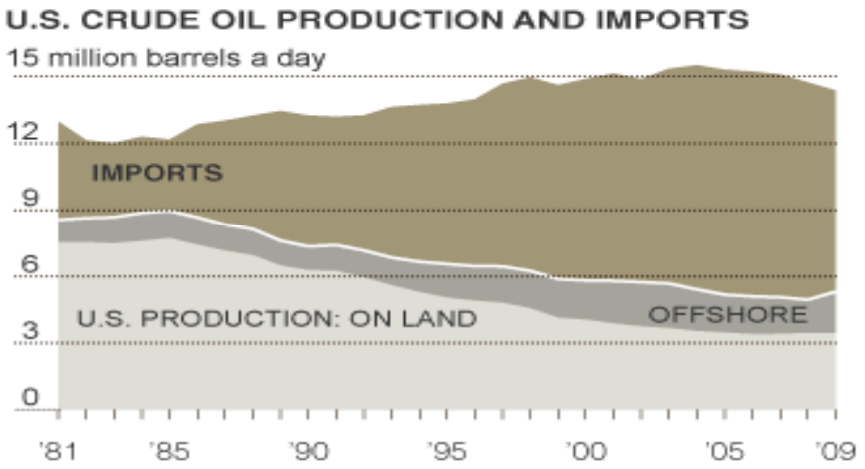
Major Global Chokepoints for Oil				
Chokepoint	Approx. 2007 Shipments MBD	Width at Narrowest Point	Source of Oil	Destination of Oil
Strait of Hormuz	17-18	21 miles	Persian Gulf	Asia, Japan, Western Europe, and U.S.
Bab el-Mandeb	3.5	18 miles	Persian Gulf	All Asia and Pacific Region
Strait of Malacca	16-17	1.7 miles	Persian Gulf and West Africa	
Bosporus Strait	2.5	0.5 mile	Caspian Region	Western and Southern Europe
Suez Canal and Sumed Pipeline	4.5	1,000 feet	Persian Gulf Saudia Arabia in particular	Europe and U.S.
Panama Canal	0.5	110 feet	U.S.	U.S. and Central America

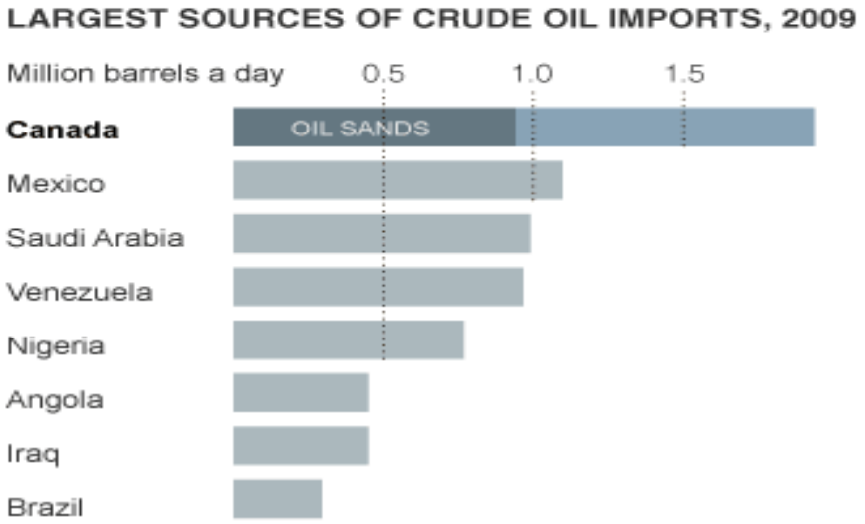
About 45MBD in 2010 passes through the chokepoints. Slightly more than half Global consumption.
What are sources of disturbances?
Are there alternative routes?


Russia
Kazakhstan
China
India
Japan
N Kor ea
S Kor ea
Thailand
Philippines
Malaysia
Singapore
PacificOcean
IndianOcean
Indonesia
Australia
① MalaccaStrait
② SundaStrait
③ LombokStrait
④ MakassarStrait
⑤ TsushimaStrait
⑥ TsugaruStrait
⑦ Soya(LaPerouse)Strait
⑧ OsumiStrait


Import Share of US Consumption
60
50
40
30
20
10
0
-10
50
55
60
65
70
75
80
85
90
95
00
05
Natural Gas
Petroleum Products
Crude Oil

Sources of Oil: Countries vs. Environment??





Sources: NYT 5/18/2010,Energy Information Administration; IHS Cera; TransCanada

Framework

- Short-run security
  - Increased diversification in sources of supply
- Medium-run security
  - Lower macro sensitivity to energy shocks
- Long-run security
  - Lower use of energy per unit of income

Short-run security: indices of diversification in supply

$$CSI = \sum_i \left(\frac{NPI_i}{C}\right)^2 * 100$$

$$NPI_i = \max\{0, M_{ij} - X_{ij}\}$$

Short-run security: diversification--adjustment for political risk

$$CSI_{pol} = \sum_{i} [(\frac{NPI_i}{C})^2 * POL_i]$$

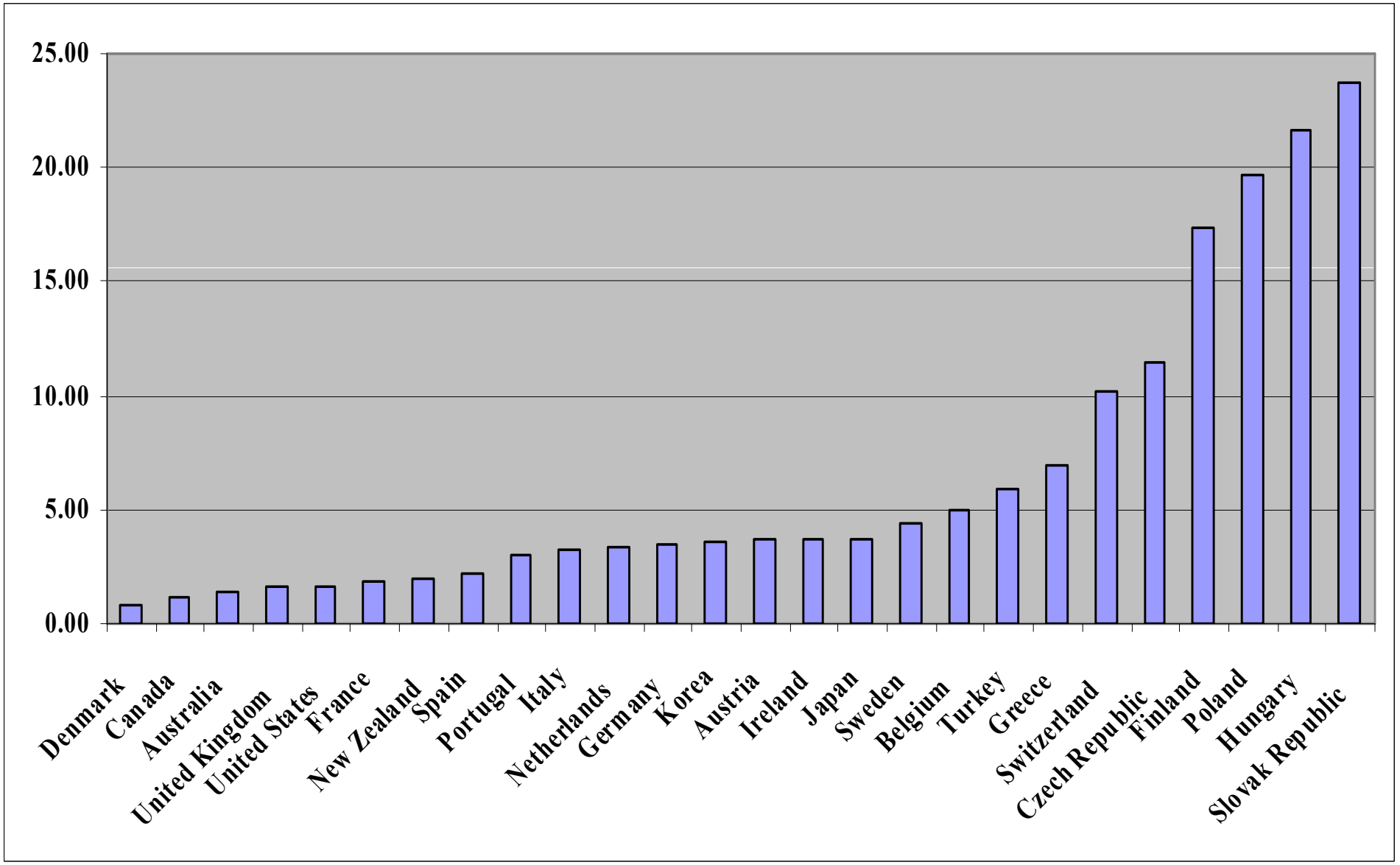
$$POL_i = [100 - ICRG_i / 100]$$

Short-run security: diversification: adjustment for country size

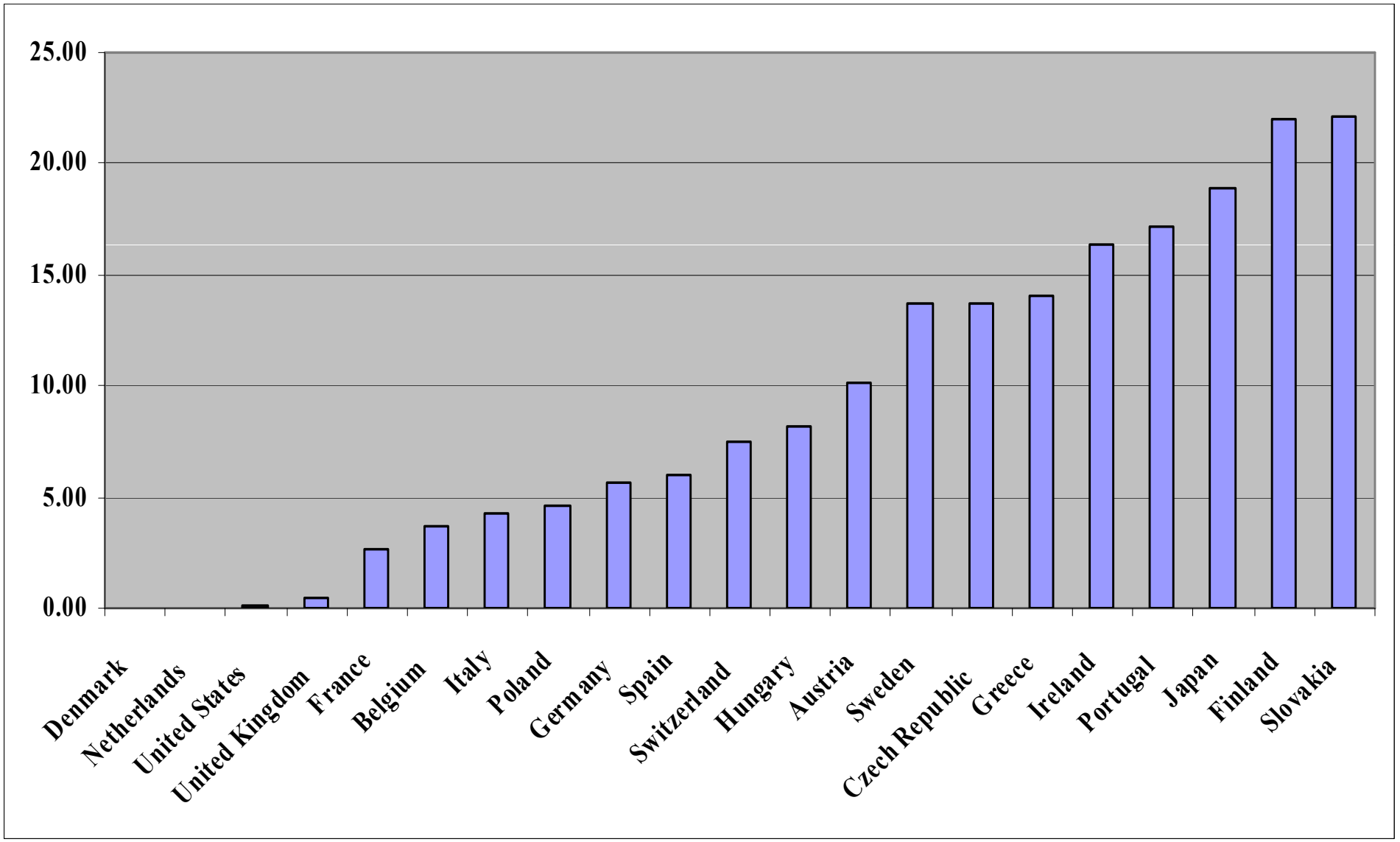
$$CSI_{size} = \sum_{i} [(\frac{NPI_i}{C})^2 \times e^{(1/SIZEi)}]$$

SIZE = ratio of world imports of a fuel source to the country's imports

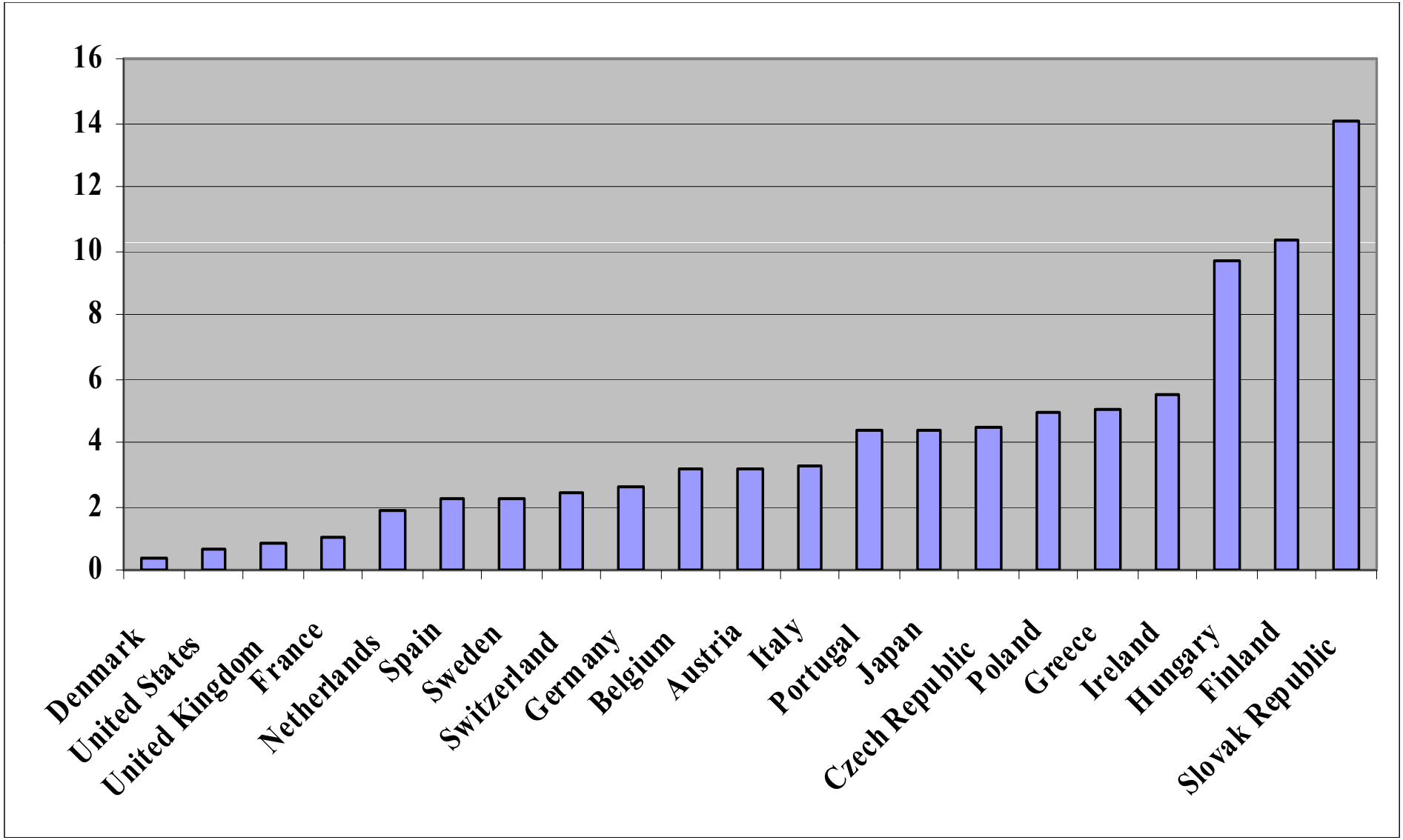
Diversification index for oil, 2008



Diversification index for natural gas, 2007



Diversification index, weighted



Diversification in supply sources: main findings

- Once political risk of suppliers is taken into account, diversification in supply sources has increased since 1990 for most countries

- Adjustment for size does not make a big difference, except for U.S. in the case of oil

Diversification and Vulnerability

Energy Diversification Based on CSI Values in 2007				
		Natural Gas		
		Low Vulnerability CSI < 3	**Medium Vulnerability 3<CSI<10**	**High Vulnerability CSI > 10**
Crude Oil	**Low Vulnerability CSI < 3**	Denmark, France, UK, US, Canada		
	Medium Vulnerability 3<CSI<10	Netherlands	Belgium, Germany, Italy, Poland, Spain	Austria, Greece, Ireland, Japan, Korea, Portugal, Sweden
	High Vulnerability CSI > 10		Switzerland	Czech Rep., Finland, Hungary, Slovak Rep.

Domestic Production Opportunities – "Independence"

Source: NYT 5/11/2010,

Diversification in supply sources: refinements underway

- Include other energy sources
- Allow for interfuel substitution
- Account for distance between point of consumption and supply sources
- Use energy reserves of the energy suppliers instead of their imports

Is There a Relationship Between Macroeconomic Activity and Oil (Energy) Prices?

- Do they have a short-run and or a long-run effect?
- Does it matter if the price changes are transitory or permanent?
- What is the transmission mechanisms for energy price shocks?
- Do price shocks have symmetric effects?
- Is price volatility important?
- So, do oil adverse price shocks cause recessions?

Table 1
Dates of Oil Price Shocks and Recessions

(Positive) Oil Price Shocks	NBER Recession Dates
Dec-47	1948q4 (4)
Jun-53	1953q2 (4)
Feb-57	1957q3 (2)
Jan-60	1960q1 (3)
Mar-69	1969q3 (3)
Dec-70	
Jan-74	1973q4 (5)
Jul-74	
Jun-79	1980q1 (1)
Jan-81	1981q3 (4)
Aug-90	1990q2 (3)
Jun-00	2001q2 (?)
Nov-04	
Jan-07	2007q4(current)

Source: NBER and EIA

Recession Dates: Quarter of peak and (number of quarters until trough in GDP)

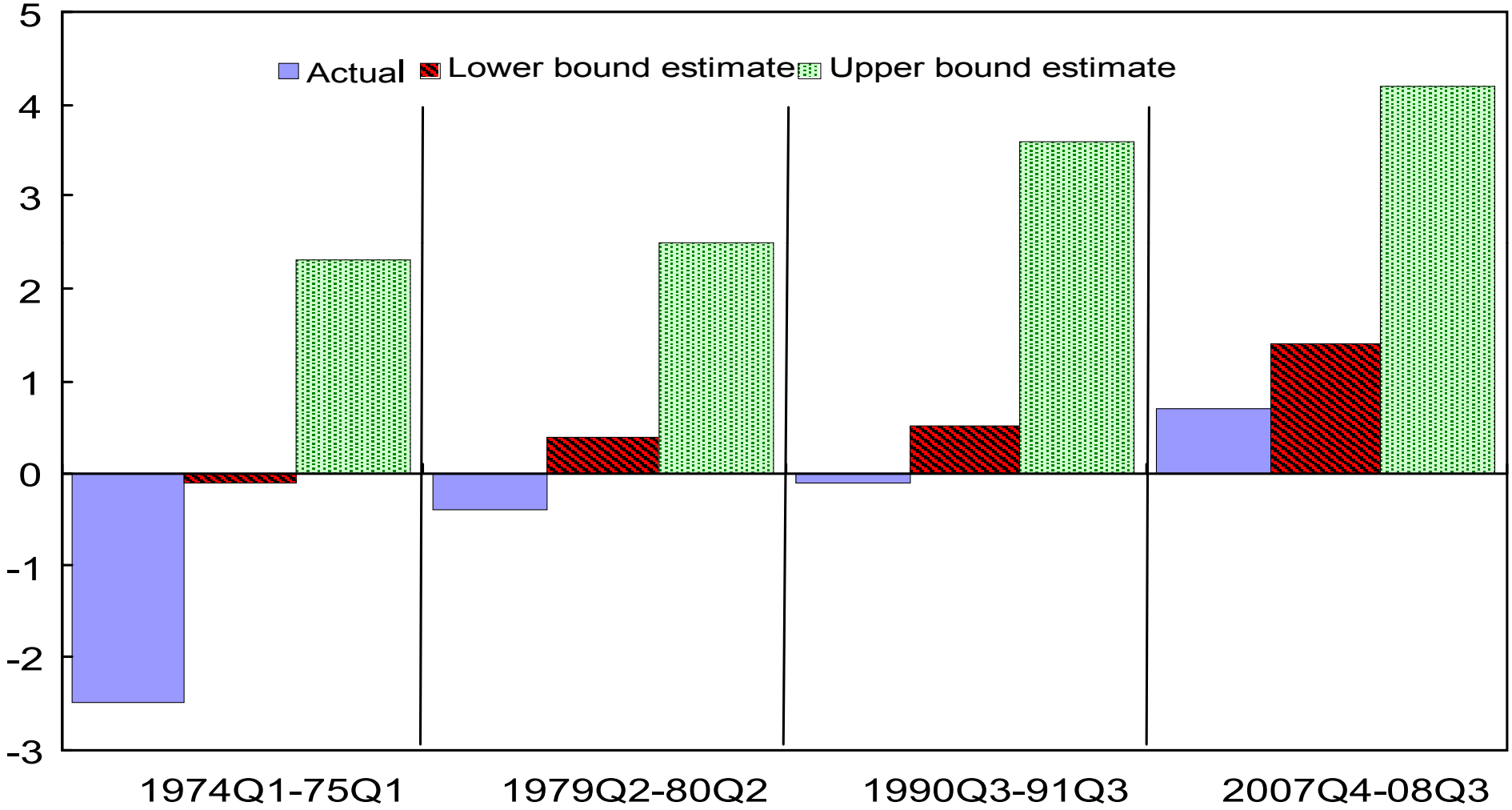
Macro sensitivity to oil shocks may be getting smaller

- Other negative shocks may have played a role in recessions; oil got the blame
- More flexible labor markets
- Better conduct of monetary policy
- Lower energy intensities

See Joutz (2008)

Medium-run security: macro response

Figure 2: Impact of Oil Shocks on U.S. GDP Growth



Notes: The lower and upper bound estimates show what real GDP growth would have been in the absence of oil shocks. Based on Hamilton (2009a)

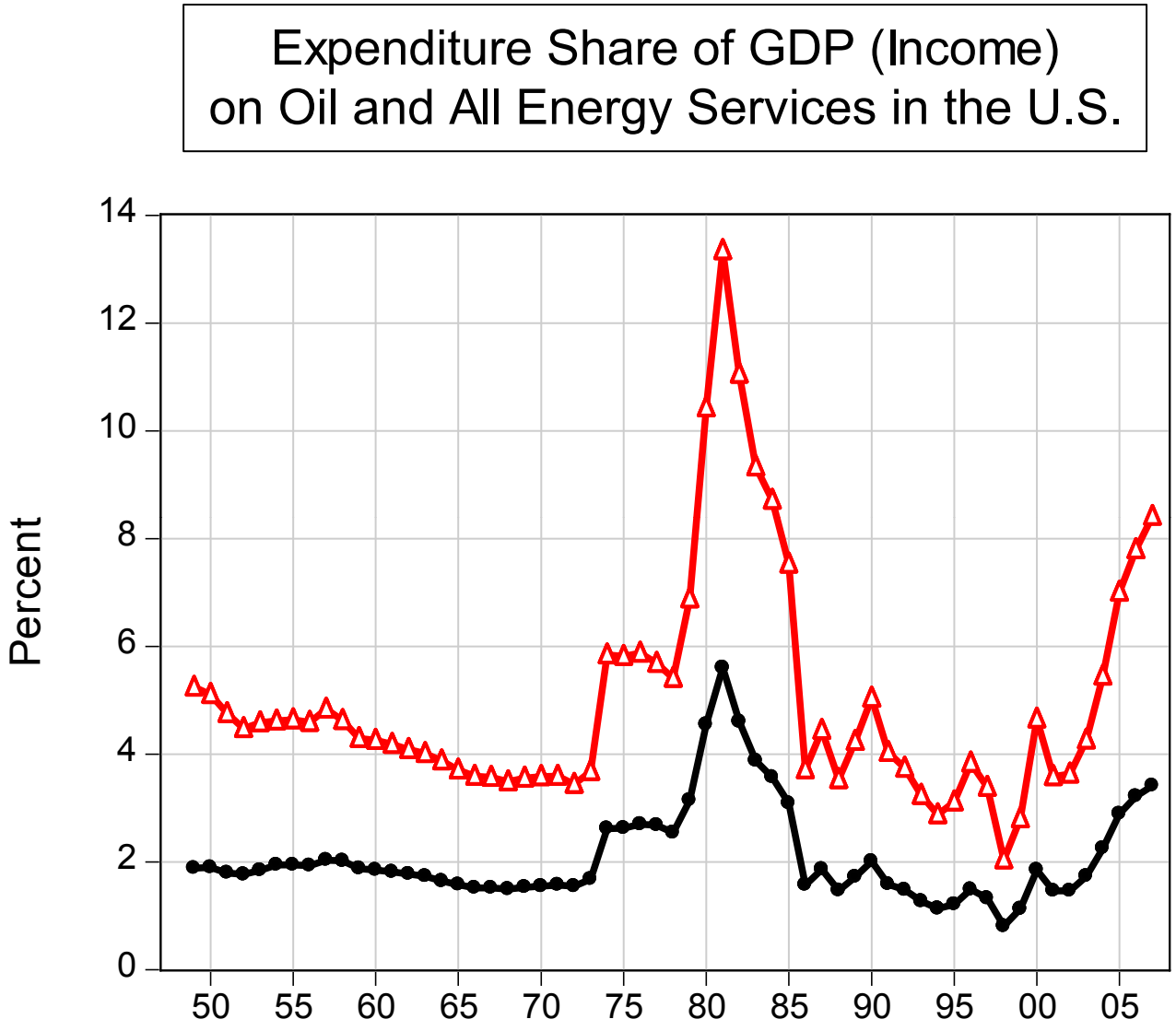
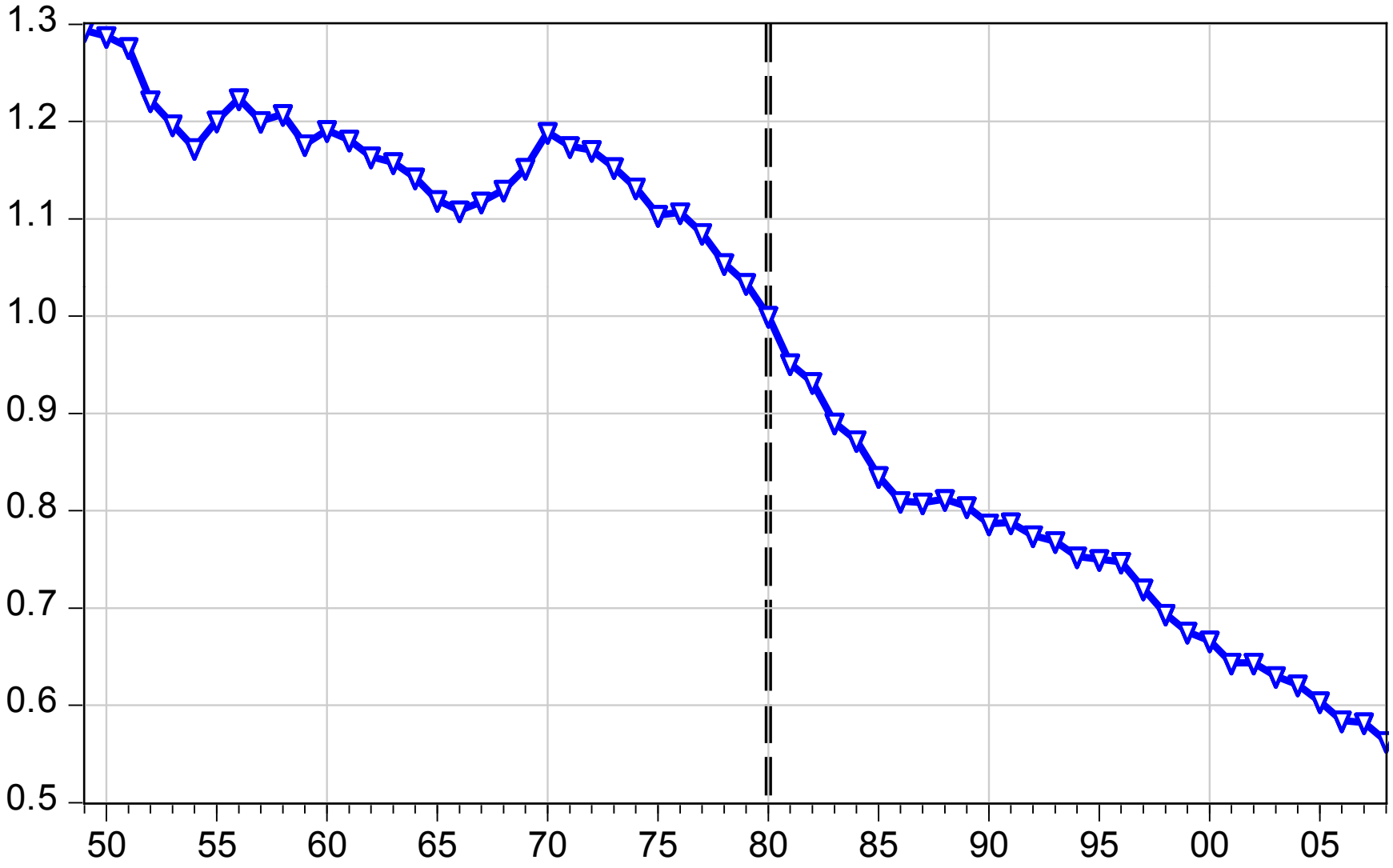
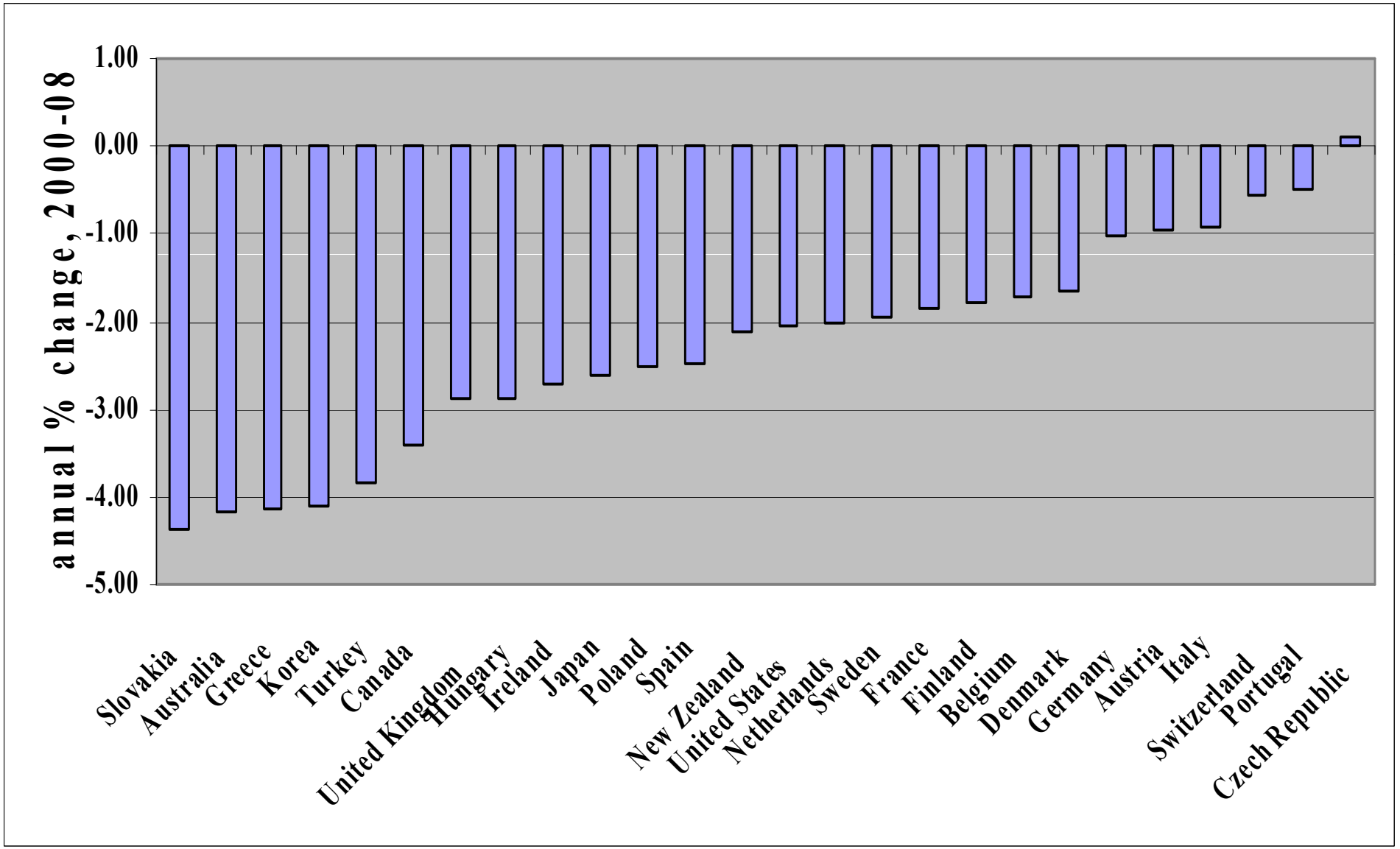


Figure 2 (Red is Energy Share of Income and Black is Oil's share of Income)

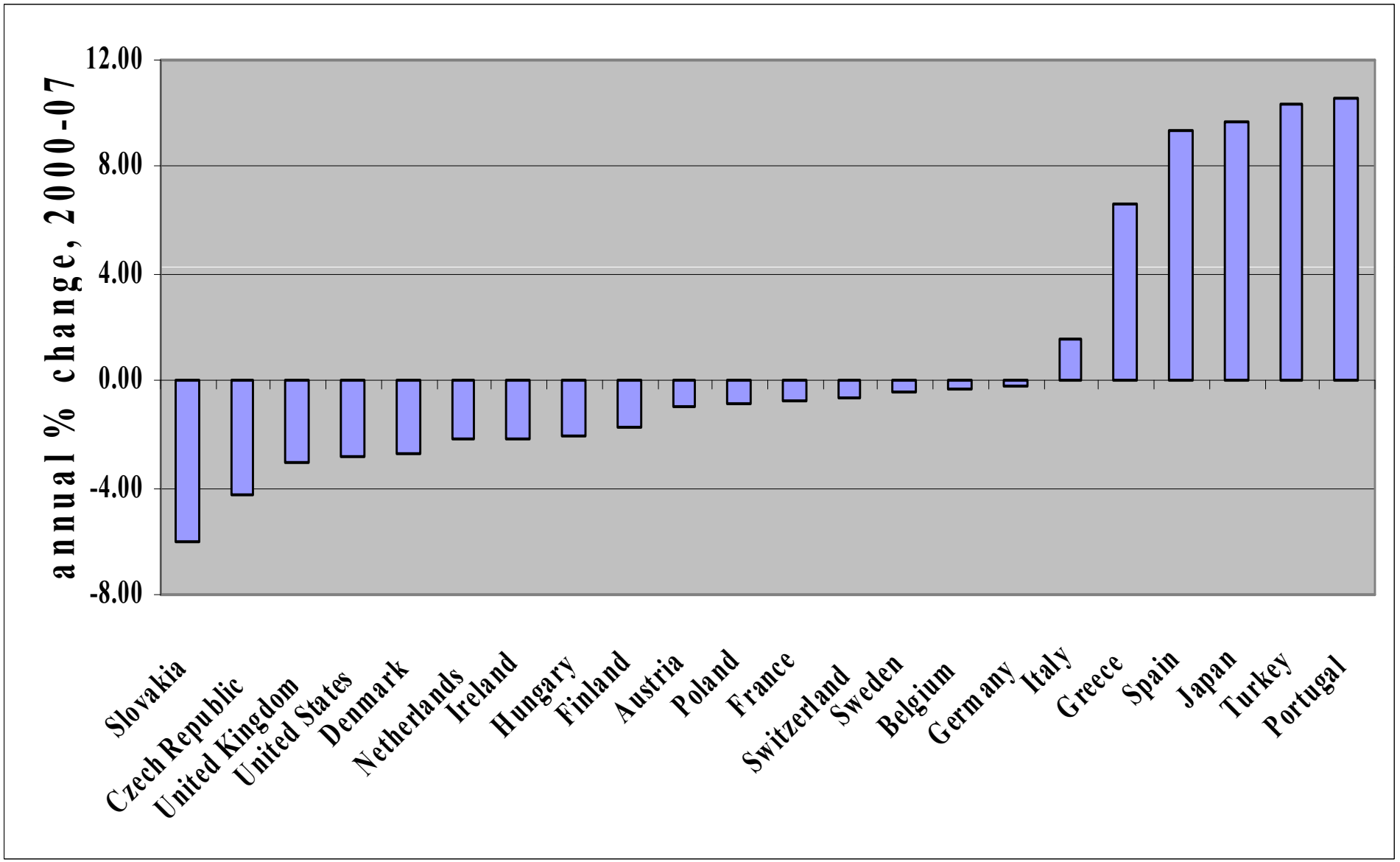
US Energy Intensity



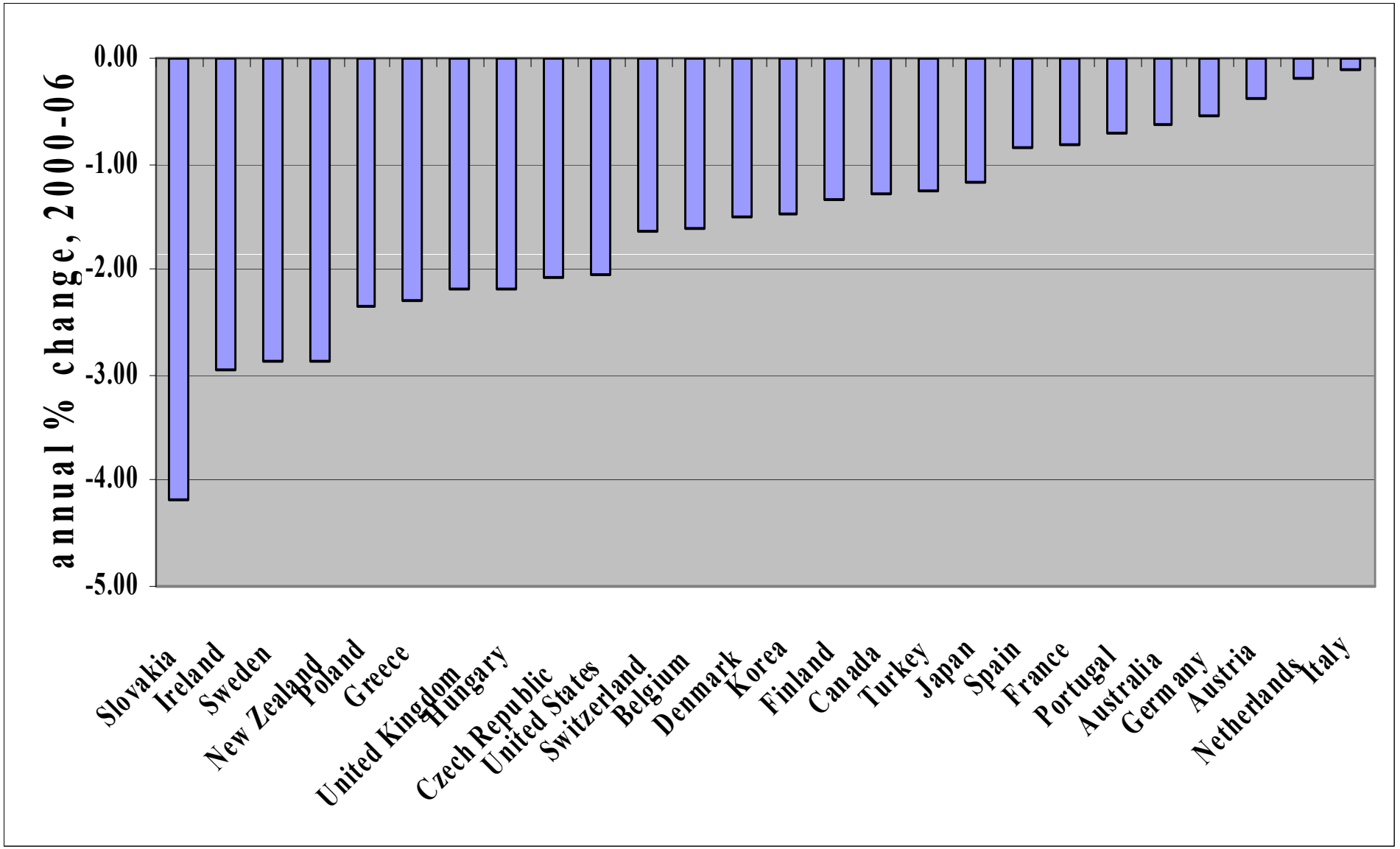
Long-run security: oil intensity



Long-run security: natural gas intensity



Long-run security: primary energy intensity



The World According to Adam or Analyzing World Oil Prices in a Demand and Supply Framework

World crude oil price projections can be analyzed using a demand and supply framework in economics. Equilibrium in the global oil market occurs where the demand and supply equal each other yielding the world oil market price. This is illustrated in the equation below with the demand function, , set equal to the supply function, .

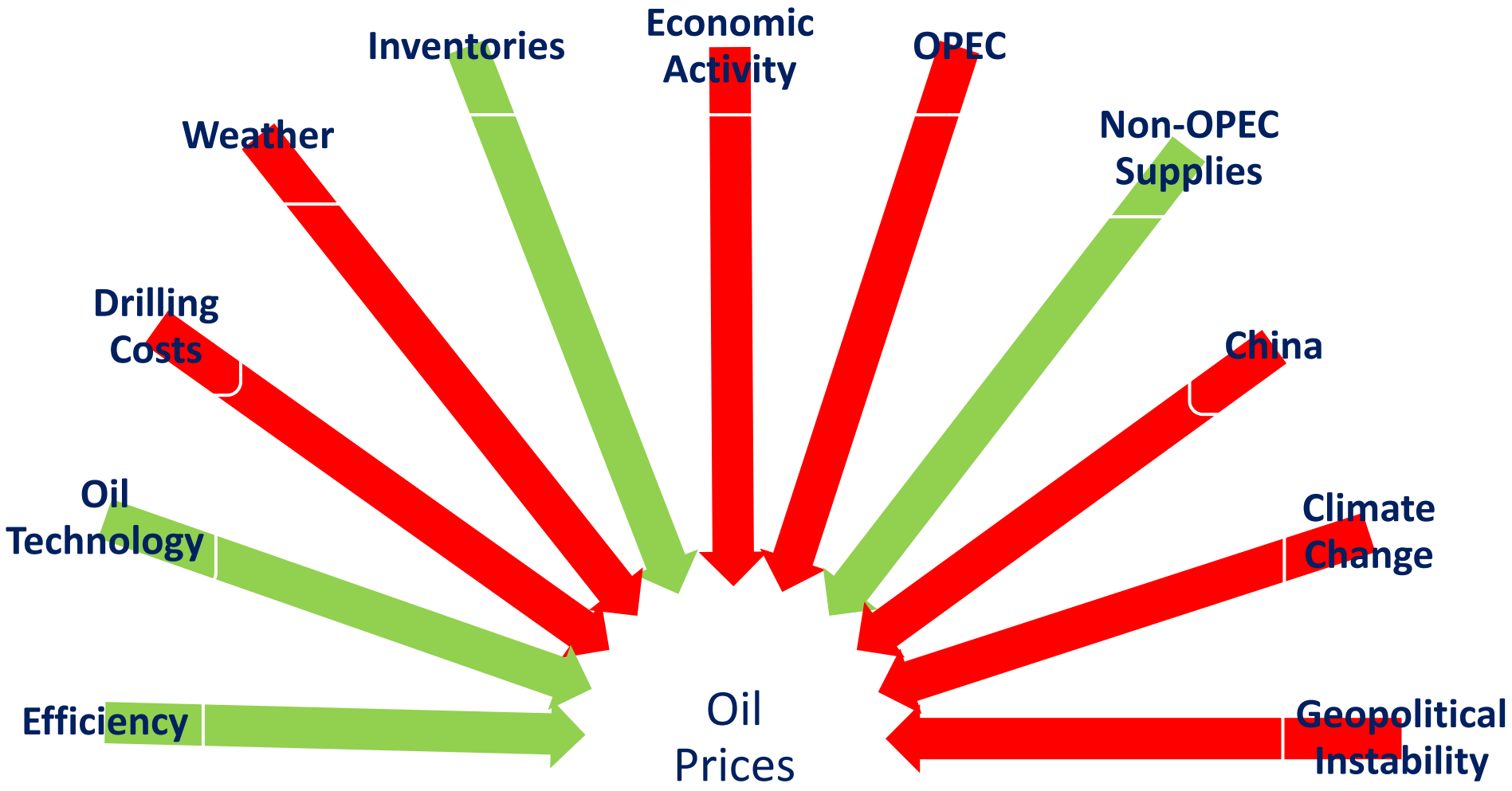
$$Q^{D}\left(\underset{-}{Poil};\ \underset{+}{GDP},\ Price\ of\ \underset{-}{Substitute\ Fuel},\ \underset{+}{Weather},\ \underset{+}{China},\ \underset{-}{Climate\ \Delta},\ \underset{-}{Efficiency}\right)$$

$$=$$

$$Q^{S}\left(\underset{+}{Poil};\ \underset{+}{OPEC},\ \underset{-}{NonOPEC},\ \underset{+}{Geopolitical},\ \underset{-}{Inventories},\ \underset{+}{Drilling\ Costs},\ \underset{-}{Oil\ Technology}\right)$$

Both functions relate the quantity to the price of oil. An increase in the price of oil leads a fall in quantity demanded of oil. While an increase in the price oil raises the quantity of oil supplied. These are in effect two curves which are conditioned upon a number of factors. The signs below each factor relate to the impact upon each curve for an increase in each.

Factors Affecting Oil Prices



Prices Decline **Prices Increase**

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Future work

- Refinements to diversification indices, as discussed
- Country-by-country estimates of short-run and medium-run responses of real GDP to energy shocks – work underway
- Rankings of energy intensities

►Combine these elements to get comprehensive measures of short-, medium-, and long-run security

►Individual country security vs. systemic security

Thank You

- Comments
- Suggestions