

# Rationale and economic basis for oil reserves: Why should a consumer country build reserves?

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November 30, 2004

Presented at the Symposium:

**PETROLEUM STOCKPILING IN  
THE 21ST CENTURY**

Houston, TX



# Outline of Presentation

- I. Review **history of oil shocks**
- II. Summarize what is known on **costs of shocks** to oil consuming countries
- III. List economic and non-economic **motivations** for holding emergency buffer stocks
- IV. Describe results from estimating the **economic net benefits of stockholding**
  - for a variety of countries
- V. Discuss **interactions** of regional stockpiles
  - motivations for cooperation and coordination among stockholding countries.

# 4 Major Types of Oil Market Disruptions, from 1950 to 2003

Type	Number	Duration (months)	Size (% world supply)
Accidents	5	5.2	1.1
Internal Political Struggles	9	6.5	2.3
International Embargos/ Economic Disputes	4-6**	11.0 (6.1*)	6.2
Wars in Middle East	4-7**		
Total/Average	24	8.1 (6.0*)	3.7

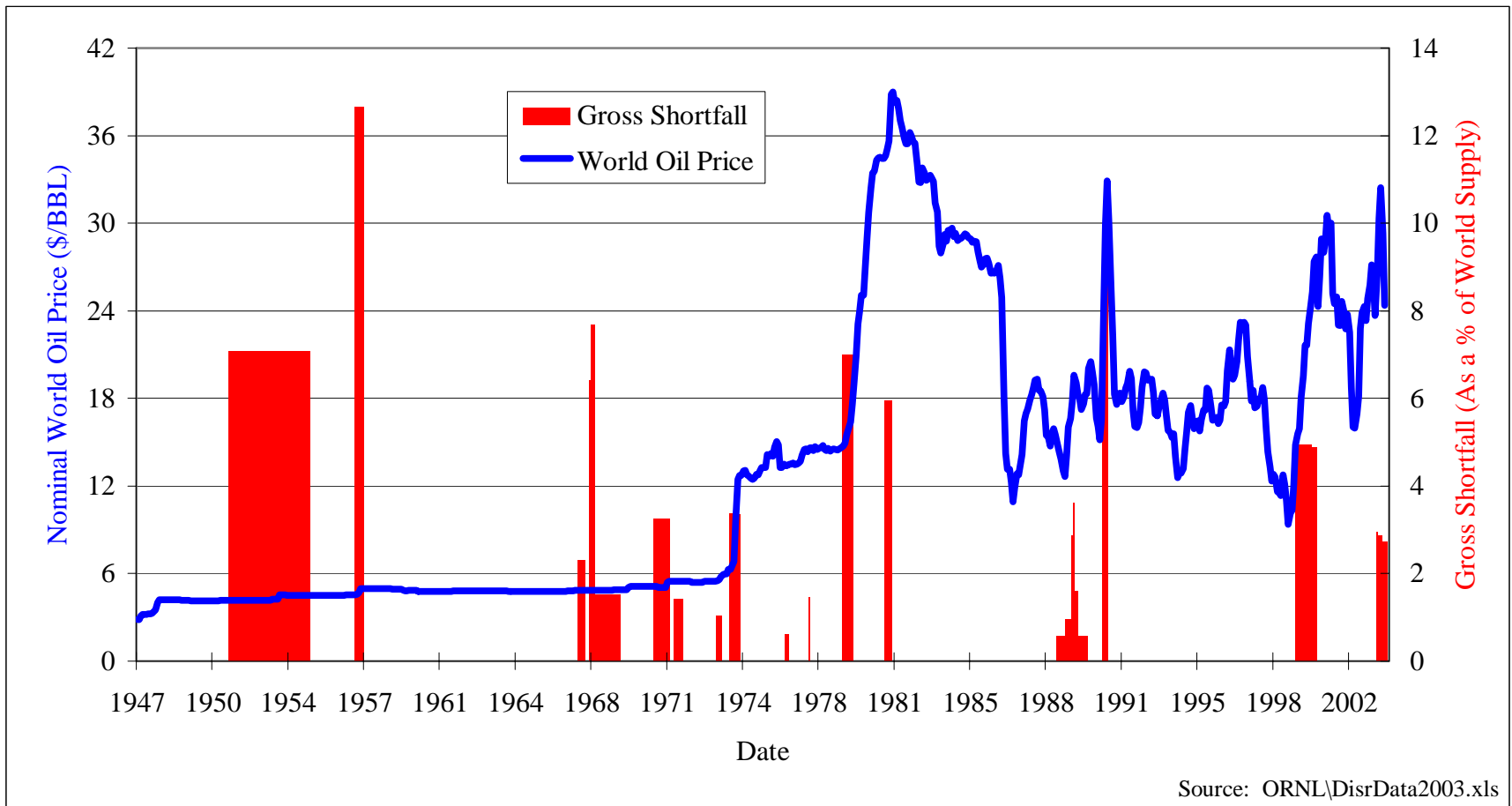
Notes: \*Excluding 44 month Iranian Oilfield Nationalization.

\*\*Some events difficult to classify.

Sources: Event listing from U.S. EIA. Categorization by Paul Leiby, ORNL.

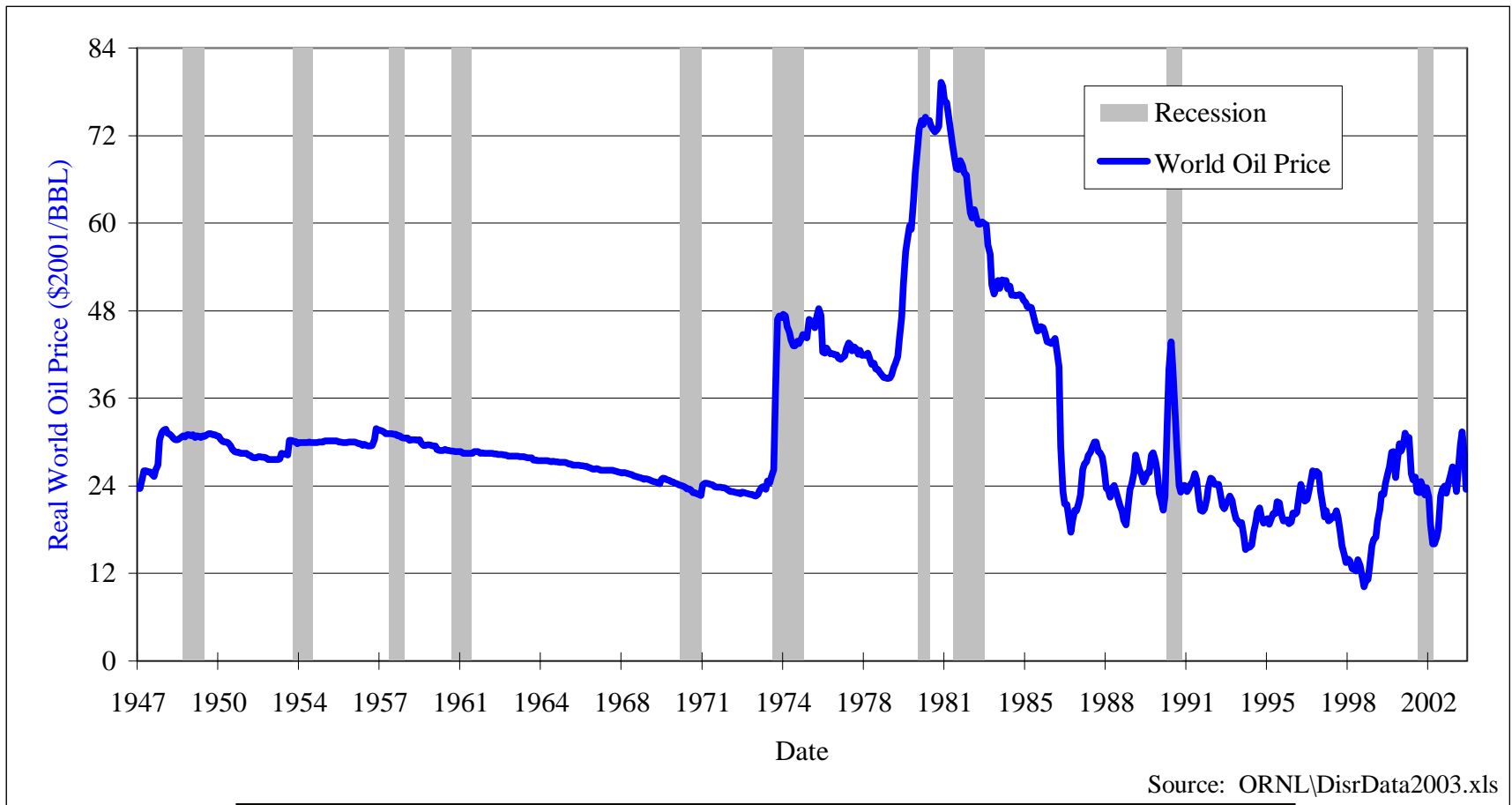
# Past Disruptions in Oil Supplies Have Created (Differing) Oil Price Spikes

(disruptions as % of World supply, nominal oil price)



# Past Oil Price Spikes Have Created Periods of Recession

(shaded areas denote US recessions, real oil price in 2001\$)

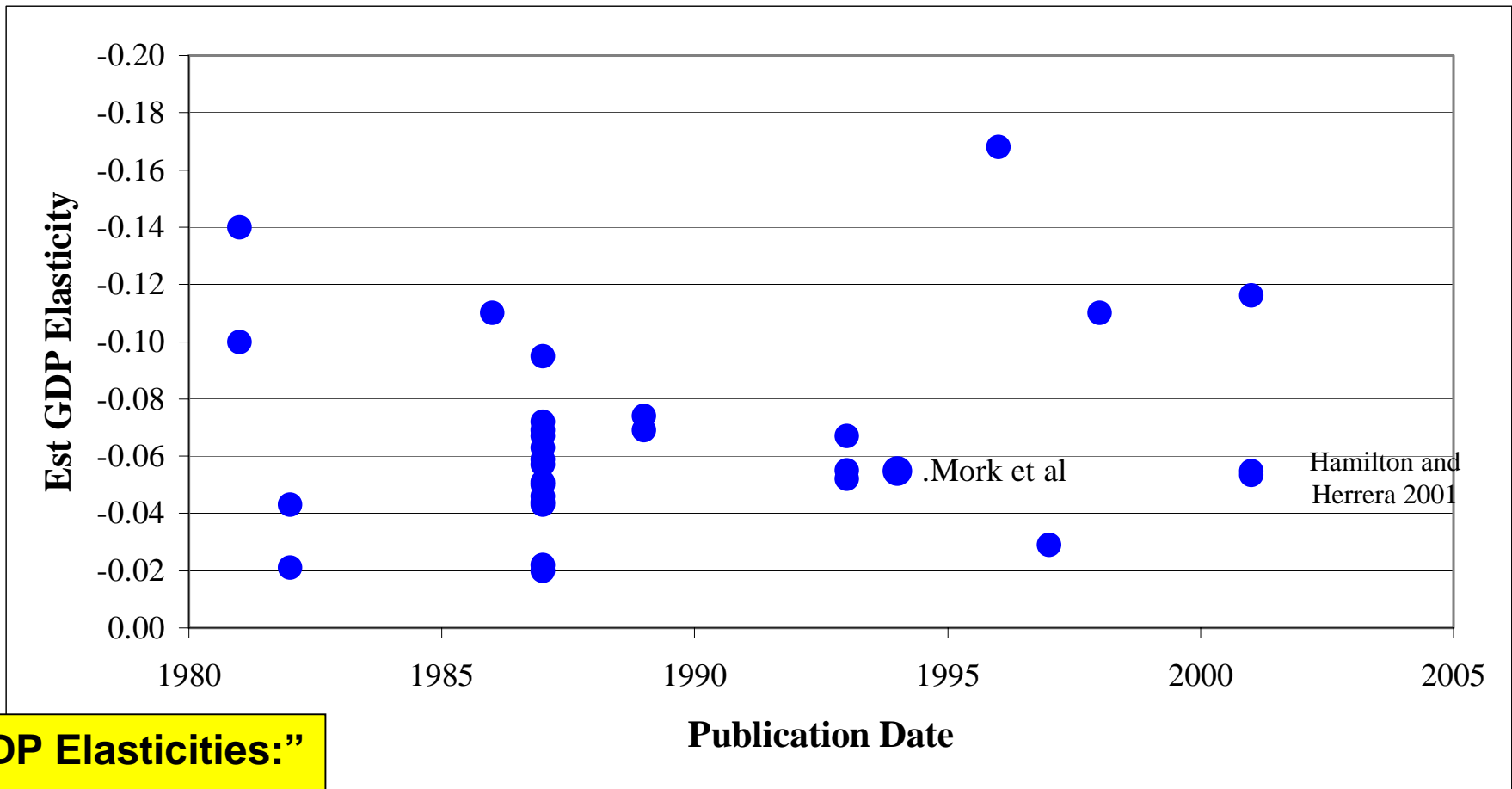


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**As of 2004, 9 of 10 U.S. postwar  
recessions preceded by an oil shock**



# Published Estimates of U.S. GDP Elasticity: Scatter Plot Over Time



**“GDP Elasticities:”**  
**(GDP change for**  
**a price doubling)**

Source: ORNL worksheet (ElasTable4\_GDPElasticities.xls), updated Nov. 2002



# Growing Understanding of Oil-Macro Link: Five Major Issues Addressed in Literature

- ◆ Separate Monetary Policy vs. Oil price Shocks as the Cause of Recessions
- ◆ Identify Mechanism of Effect
- ◆ Explain Asymmetric Effects of Oil Price Shocks
- ◆ Test Stability of Oil Price-GDP Relationship:
  - Has the world changed?
- ◆ Assess Magnitude of Oil Price-GDP Sensitivity (Elasticity)

See: "Oil Price Shocks And The Macroeconomy: What Has Been Learned Since 1996," Donald W. Jones, Paul N. Leiby, and Inja K. Paik, *The Energy Journal* 25(3) 2004.

# Mechanisms and Nature of Shock Effects

Davis & Haltiwanger (1996 & 2001), Keane & Prasad (1996)

- ◆ **Shocks cause Aggregate & Allocative Effects**
  - *Aggregate Channels*: potential output, income transfer, sticky wage effects - operate *symmetrically*
  - *Allocative Channels*: both oil price increases & decreases cause factor reallocations & losses
    - operate *asymmetrically*
    - surprisingly large
- ◆ **Widespread intersectoral reallocations of resources**
  - Plant-level research shows oil price shocks cause more job destruction than creation
- ◆ **Surprise matters, implying shock threshold effects:**

11/30/2004 “Investment Pause” mechanism given uncertainty

# Summary of Oil-Macro Conclusions from advanced studies, 1994-2001

- ◆ **Asymmetric oil price-GDP response explainable.** *Not* an artifact of monetary policy or spurious relationship
- ◆ The ability to use **monetary policy** to avoid impacts **limited**
  - (Hamilton and Herrera 2001)
- ◆ **Stable oil price-GDP relationship identified** over the entire period 1947:2-1999:4
  - obtained using transformed price series (either Lee-Ni-Ratti or Hamilton 3-year NOPI oil price shock specification)
- ◆ **Current, best *empirical* estimates of the magnitude of the U.S. oil price-GDP elasticity around -5.5%**
  - Large Macro-model-based estimates smaller by  $\sim 1/2$

# Recently Estimated Oil Price-Shock Effects Significantly Negative for Most Consuming Economies

## Oil Importers

Taiwan	-8.4%
Hong Kong	-6.5%
Japan	-5.8%
South Korea	-8.7%
Philippines	-3.6%*
Singapore	-4.2%
Thailand	-8.4%
France	-9.8%
Germany	-8.1%
Greece	-2.4%
U.K.	-3.8%

## Oil Exporters

Indonesia	-4.3%
Malaysia	-5.6%
Norway	+5.1%

**“GDP Elasticities:”**  
**(GDP change for**  
**a price doubling)**

\*Statistically Insignificant.  
Sources: WEFA (1998), Mork  
1994

# Advantages of Emergency Oil Stocks: Direct Economic Benefits

- ◆ Provide high-rate **surge supply** ( $\Delta S$ ) during supply disruption
  - ◆ Stock releases calm markets, **dampen oil price rises** ( $\Delta P$ ).
  - ◆ Lower prices **provide economic benefits**
    - Stock sales revenue ( $\Delta S * P$ )
    - Reduce import costs ( $I * \Delta P$ )
    - Reduce GDP losses ( $GDP * (\Delta P/P)^v$ ), allow time for economies to adjust.
  - ◆ Price-moderation **Benefits shared worldwide** among oil consuming regions, *Provided* trade flows continue
- 11/30/2009 <sup>11</sup> Implies opportunity for expanded cooperation



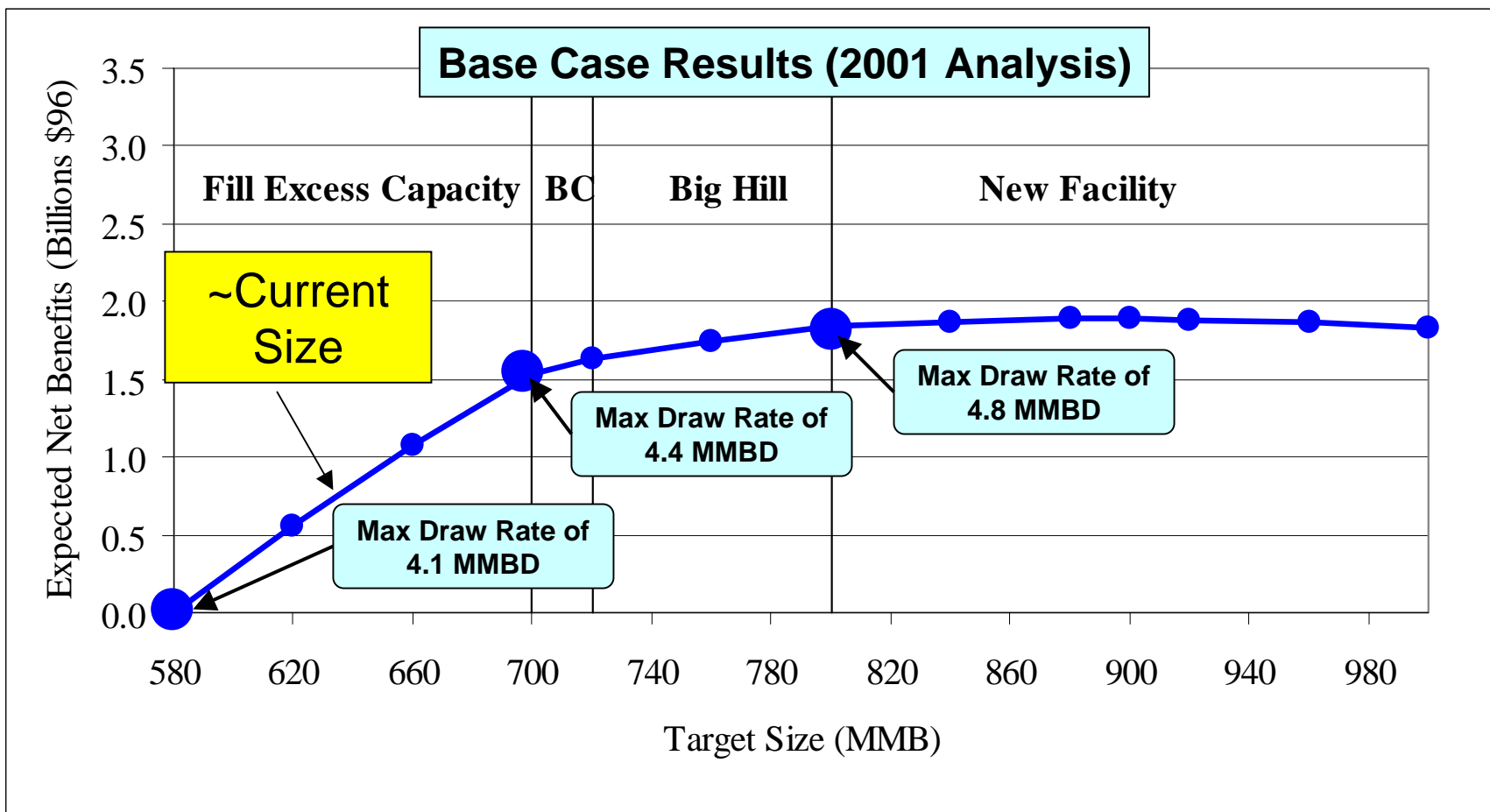
# Advantages of Emergency Oil Stocks: Indirect and Non-economic Benefits

- ◆ **Could deter some supply interruptions** (politically or economically motivated).
- ◆ Diplomatic flexibility
  - Provide **negotiating tool** with key suppliers & other stockholders
- ◆ **National security** benefits
  - Disasters, logistic emergencies
  - War



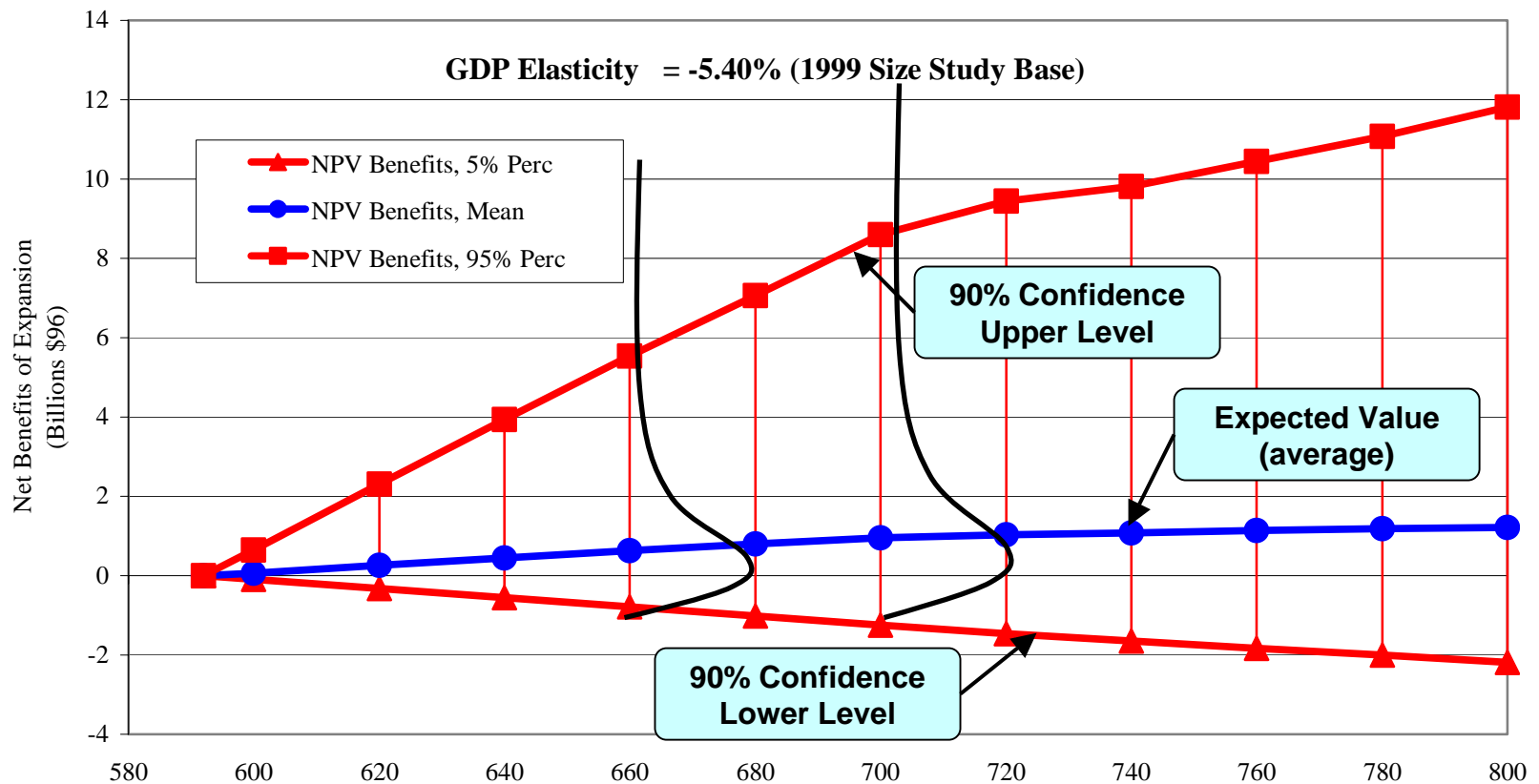
# U.S. Benefits from Expanding its Reserve

*(Expected or average benefit)*

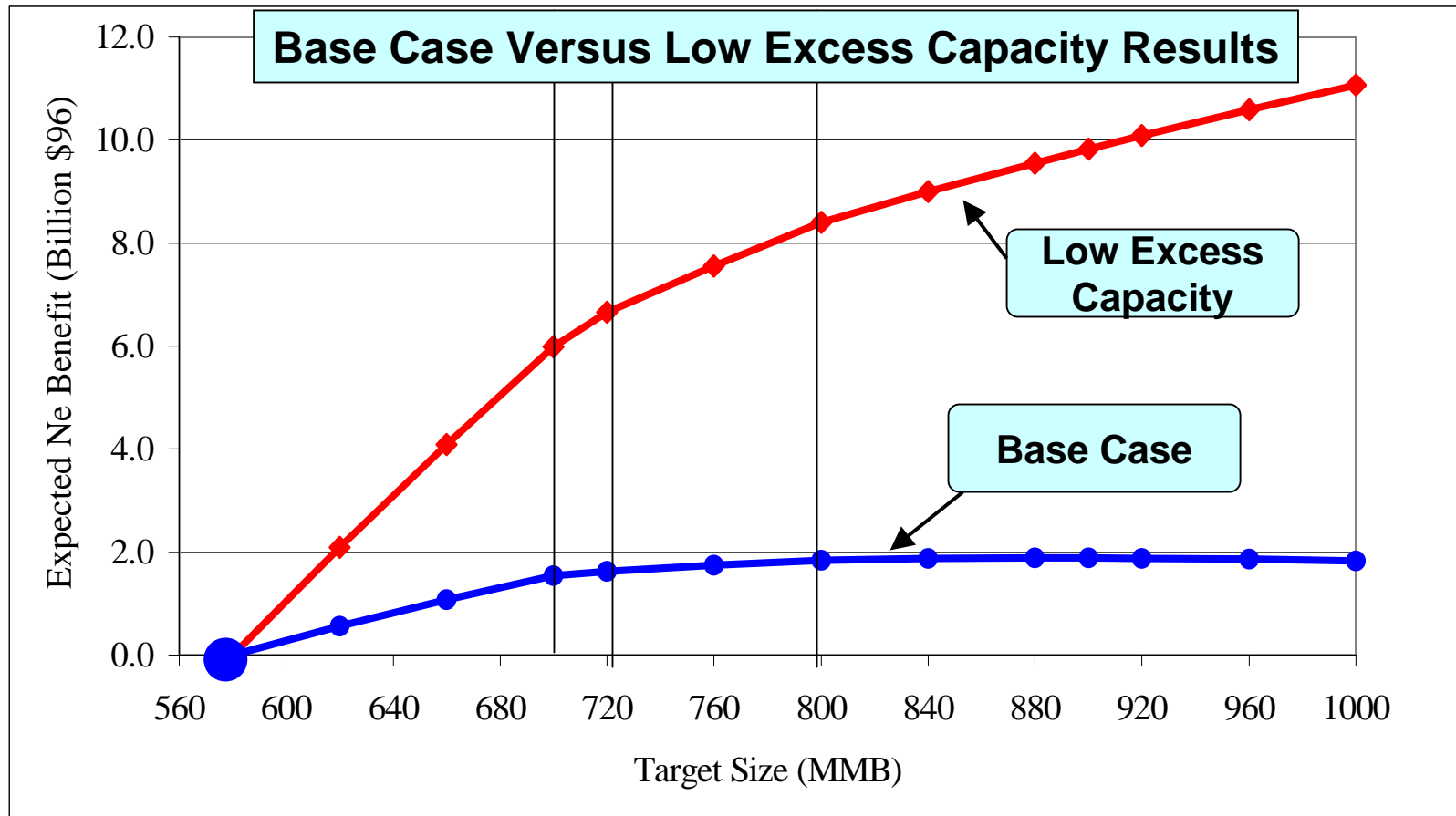


# Like Any Insurance, Payoffs Asymmetric, 10% Likelihood Payoff *Much* Greater Than Mean

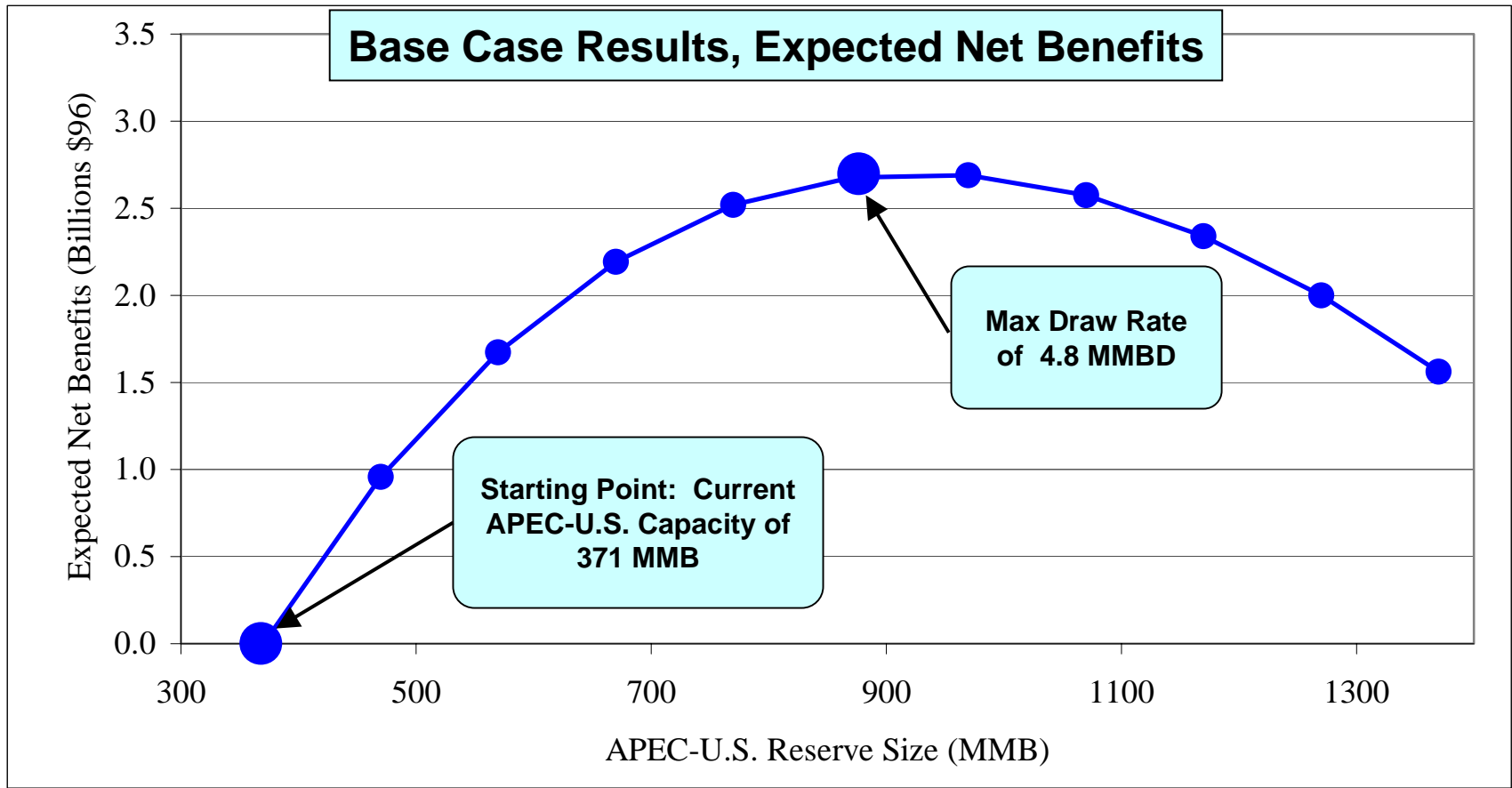
**Expected Net Benefits of SPR Expansion, and 90% Confidence Interval,  
Results from Dis-Risk Model, 10/23/2001**



# A Low Excess Capacity Future Implies Much *Higher* Stock Benefits

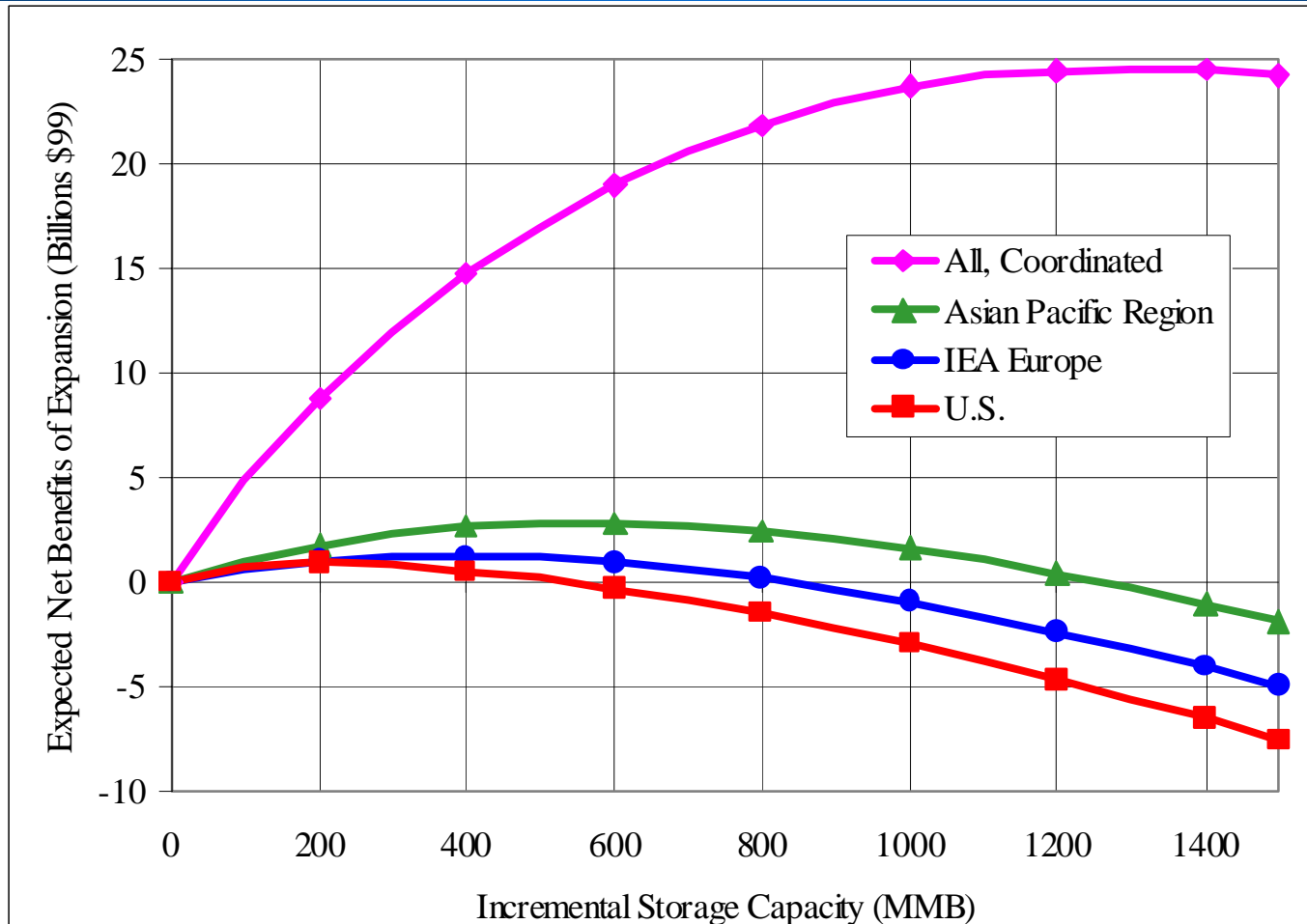


# Asian-Pacific (APEC excluding U.S.) Study Shows Sharply Increasing Benefits



# Public Good Aspect of Stock Expansion

## Cooperation Benefits Much Greater than Independent Action



# Stockpile Benefits Spillover, But “Public Good” Analogy is Inadequate

- ◆ Spillover means **some “Global Public Good” properties**
  - But many benefits, e.g. import cost savings and particularly non-economic and indirect benefits, flow to stock owners
- ◆ Use care, **Some game-theory analogies poor**
  - E.g. “Common property” and “Prisoners Dilemma”
  - “Access” (stock use) not guaranteed
    - Cooperating means sharing in drawdown decision
  - “Free-riding” (non-cooperation) not a good strategy:
- ◆ Can show:
  - **Gains of Free Ride much less than Losses if No Ride is provided**

# Summary: Insights from Single-country and Cooperative Stock Analyses

- ◆ Oil Market is Unstable, and Oil Shocks Matter
  - True for essentially all world consuming regions
- ◆ Economic value to stock expansion for many large regions
- ◆ Benefit-payoff structure supports (in some cases, requires) collaborative stockpiling initiatives.
  - Collective groups of countries sharing a reserve prefer larger size and
  - achieve greater benefits than the sum of individual countries acting alone
- ◆ Longer run demand reduction and flexibility worthwhile
- ◆ *Diplomatic actions and relations are critical*



Thank you very much!  
For More Information:

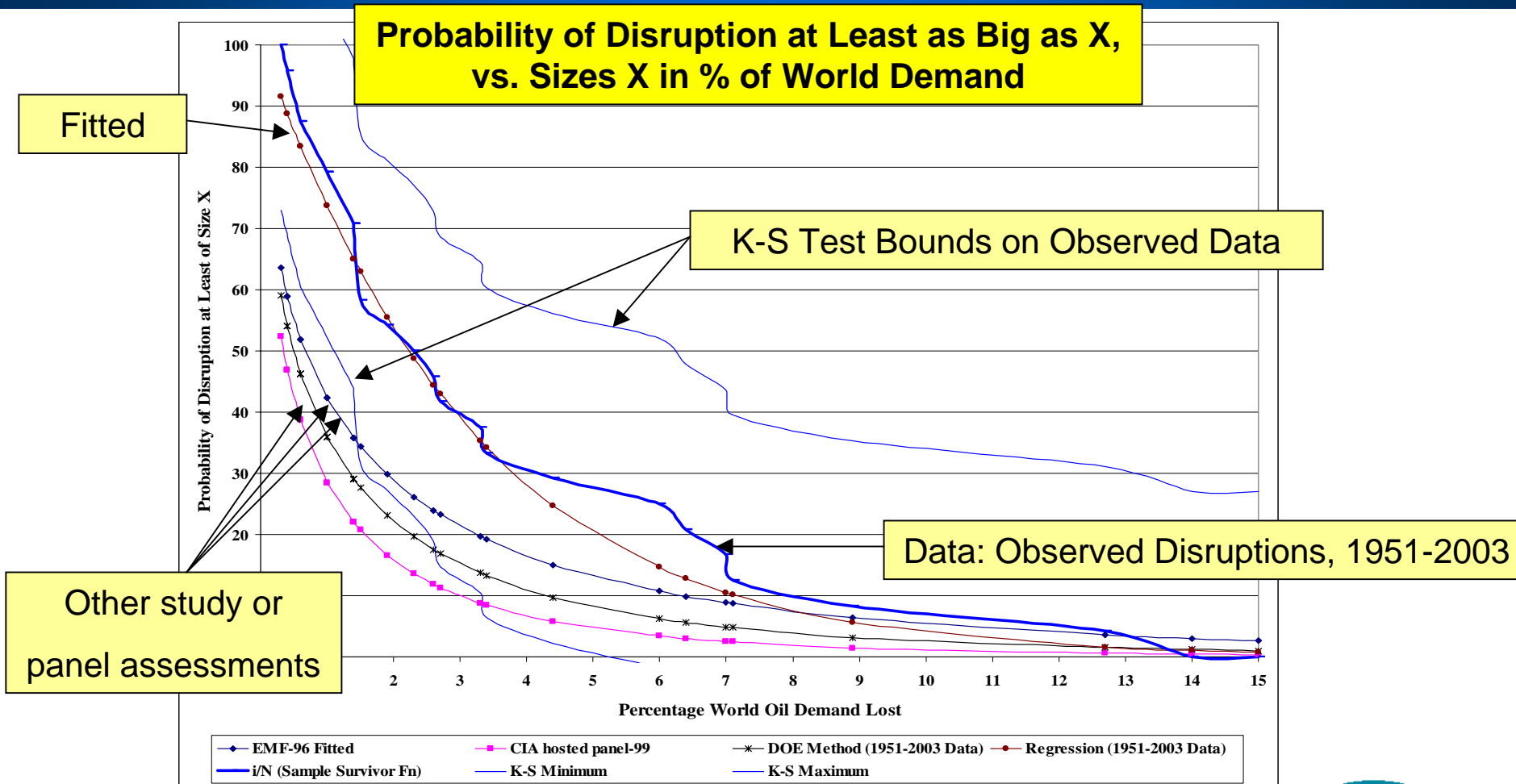
See our website on  
“Energy Security, Oil Shocks and the Strategic  
Petroleum Reserve (SPR)”:

[pzl1.ornl.gov/energysecurity.htm](http://pzl1.ornl.gov/energysecurity.htm)

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# Assessing Disruption Likelihood: Empirical Analysis of Historical Record



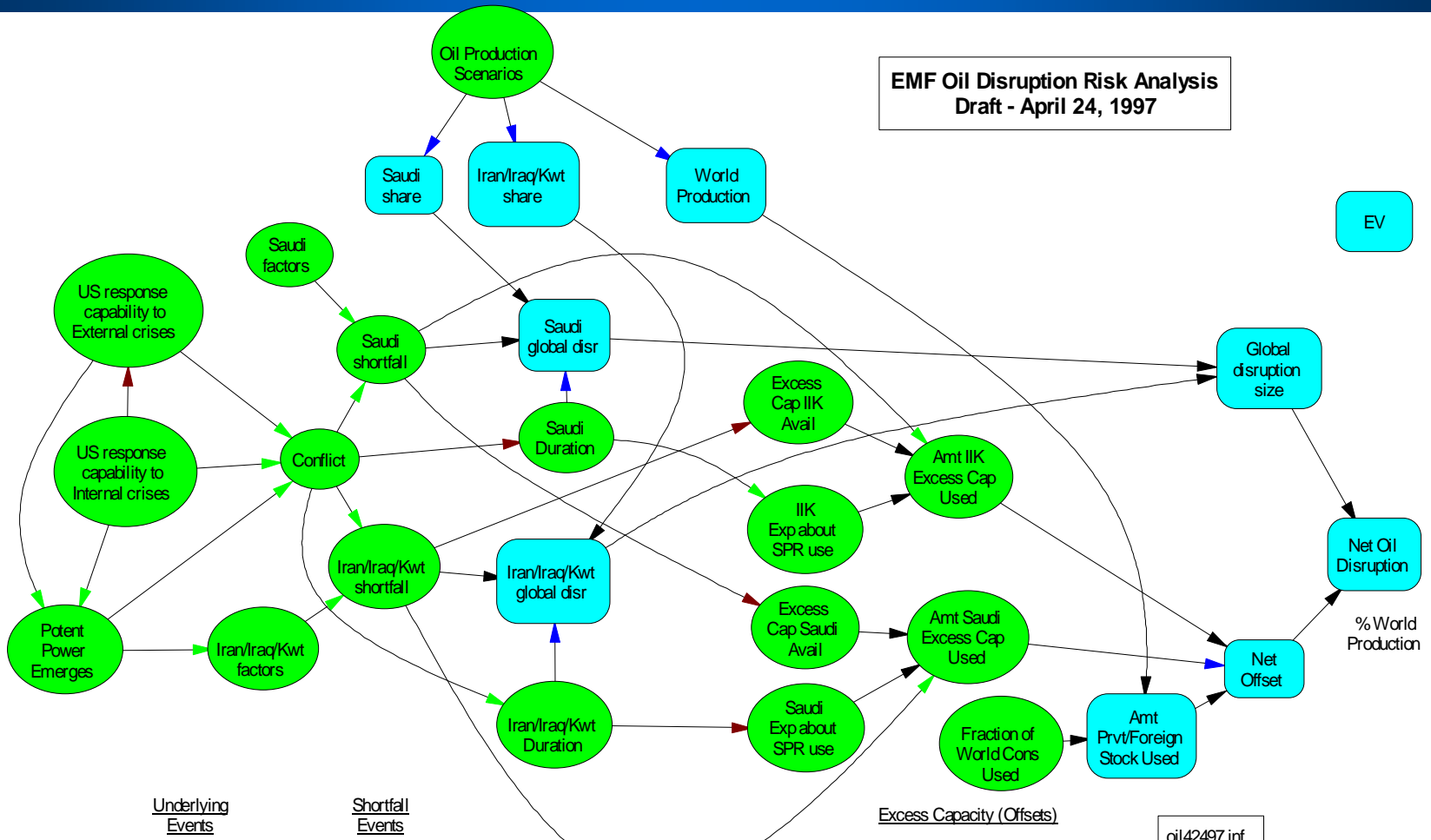
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Source: Oladosu, Leiby and Bowman, 2004 (Draft)

# Assessing Disruption Likelihood by Expert Analysis of Event Tree (EMF Study 1996)



oil42497.inf



# Disruption Probabilities

## Annual Probability of Gross Disruption, As % of World Supply

Study	Disruption of 10% or more of World Supply	Disruption of 15% or more of World Supply
EMF 1996	5.3%	2.5%
DOE 1990 High Risk	3.1%	1.4%
<b>DOE 1990 Midcase</b>	<b>2.4%</b>	<b>1.0%</b>
DOE 1990 Low Risk	1.5%	0.5%
CIA-hosted panel 1999	1.1%	0.4%

# Triggering Considerations

- ◆ Can private agents be expected to provide effective trigger? Two problems:
  - Incentive mismatch: over-use, under-storage
  - Not all price shocks alike, in terms of social costs
- ◆ Reflect economic considerations
  - execution price conditions should reflect price “innovation”/surprise

$$\Delta P_t \geq n\sigma(P) \quad \text{or} \quad P_t \geq \max_{L=1\dots 12} (P_{t-L})$$

- consider futures spread (mkt info)
- ◆ Assure oil’s prompt return to SPR: no regrets

# Trigger Must Account for “News” (World Conditions) as Well as Market Status

- ◆ “Given that the heart of the oil price macroeconomy relation appears to be driven by these five big shocks, it **remains a distinct possibility that it is events associated with the military conflicts themselves, rather than the specific changes in oil prices, that leads the economy into recession.** The wars may lead to anxiety about future energy prices and availability or have other psychological effects whose consequences ... are as important or more important than the movements in oil prices themselves.”

**Hamilton 2003:395**