# LIFT Model of the U.S. Economy:

## Long Term Economic Impact of Energy Policies

## The Impact of Port Disruptions

September 13, 2007

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# Introduction

- The Lift Model
- Methodology and results for energy study
- Methodology and results for port study

# Inforum

- Founded by Clopper Almon in 1967, Inforum stands for Interindustry Forecasting at the University of Maryland. Research Center within the Department of Economics.
- Builds and uses structural economic models of U.S. and other economies. We pioneered the construction of dynamic, interindustry, macroeconomic models which portray the economy in a unique "bottom-up" fashion.
- Works with government and private sector organizations to investigate a variety of issues. Recent issues include energy, homeland security, immigration, and health care.
- Economic projections and analysis using Inforum econometric models distinguished by detail at industrial and product level.
- Inforum serves as a training crucible for University of Maryland graduate students. Students receive valuable training in empirical economics and find fertile ground for dissertation research.
- Inforum maintains active ties with a world-wide network of research associates, each of which uses Inforum modeling methods and software.

# Inforum Interindustry-Macroeconomic (IM) Models

- Combine input-output structure with econometric equations in a dynamic and detailed framework.
- Like a CGE: Contains detailed industry structure and *bottom-up* accounting.
- Like an (macro) econometric or VAR model: Parameters estimated from actual data. Portray dynamic evolution of economies over actual time periods.
- Lift (Long-term interindustry forecasting tool) is 97 sector flagship model. Under continuous development and use for over 30 years.
- Iliad - detailed 360 sectors.
- International System: BTM bilateral trade model, IM models for all major trade partners including China.

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# *LIFT*: Inforum's Model of the U.S. Economy

*LIFT* stands for **L**ong-term **I**nterindustry **F**orecasting **T**ool.

*LIFT* is an interindustry-macro (IM) model.

- **Sectoral detail** for production, prices jobs, consumer spending, foreign trade and factor income (wages, profits, depreciation, etc).

- **Macrovariables**. Many, such as GDP, net exports, the unemployment rate, and the aggregate price level are aggregates of the underlying industry forecasts. Other macrovariables such as the savings rate and interest rates, complete the model.

*LIFT* is particularly useful in addressing questions involving interactions between industries, as well as the interplay between industry and macroeconomic relationships.

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# The *LIFT* Philosophy

## Bottom-up

Aggregates are summations of detailed industry results.

## Consistent

The NIPA and IO frameworks ensure consistency. The patterns of expenditures by industry affect employment by industry. Prices reflect unit costs of materials, labor and other factor income (profits, depreciation, indirect taxes, etc.)

## Econometric Relationships

LIFT is based on empirically estimated relationships, using detailed historical data, based on long time-series.

## Dynamic

LIFT models economy year by year. The time path of response is important. Many equations use distributed lags, so effects of shocks build up and decay over time. Input-output coefficients change over time, in response to estimated trends or exogenous assumptions.

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# Recent Studies Using LIFT/ILIAD

**Economic Impact of Energy Policies –** Securing America's Future Energy (SAFE)
**Sustainability of Long-term Projections -** Centers for Medicare and Medicaid Services
**Impact of Port Closures** – Applied Physics Lab, JHU
**Immigration Impacts on U.S. Economy–** U.S. Department of Commerce
**Impact of U.S. Port Closures on U.S. and Asian Economies** – Booz-Allen Hamiliton
**Industrial, Regional & Occupational Impacts of Defense** - Department of Defense
**Impact of High Oil and Natural Gas Prices –** Department of Commerce (ESA)
**Enhanced Medical Insurance Coverage –** MITRE Corporation
**Impact of Container Trade Interruptions** - CBO
**Impact of Currency Fluctuations –** Department of Commerce (ITA)
**Static & Dynamic Effects of Trade Liberalization –** Manufacturers Alliance
**The Digital Economy 2000/2005 -** Department of Commerce (ESA)
**Impact of Asian Crisis on the U.S. Industries -** Manufacturers Alliance
**Local Impacts of Electricity Deregulation** – NRECA
**China in the WTO** - U.S. Government
**Clean Energy and Jobs** - Center for a Sustainable Economy

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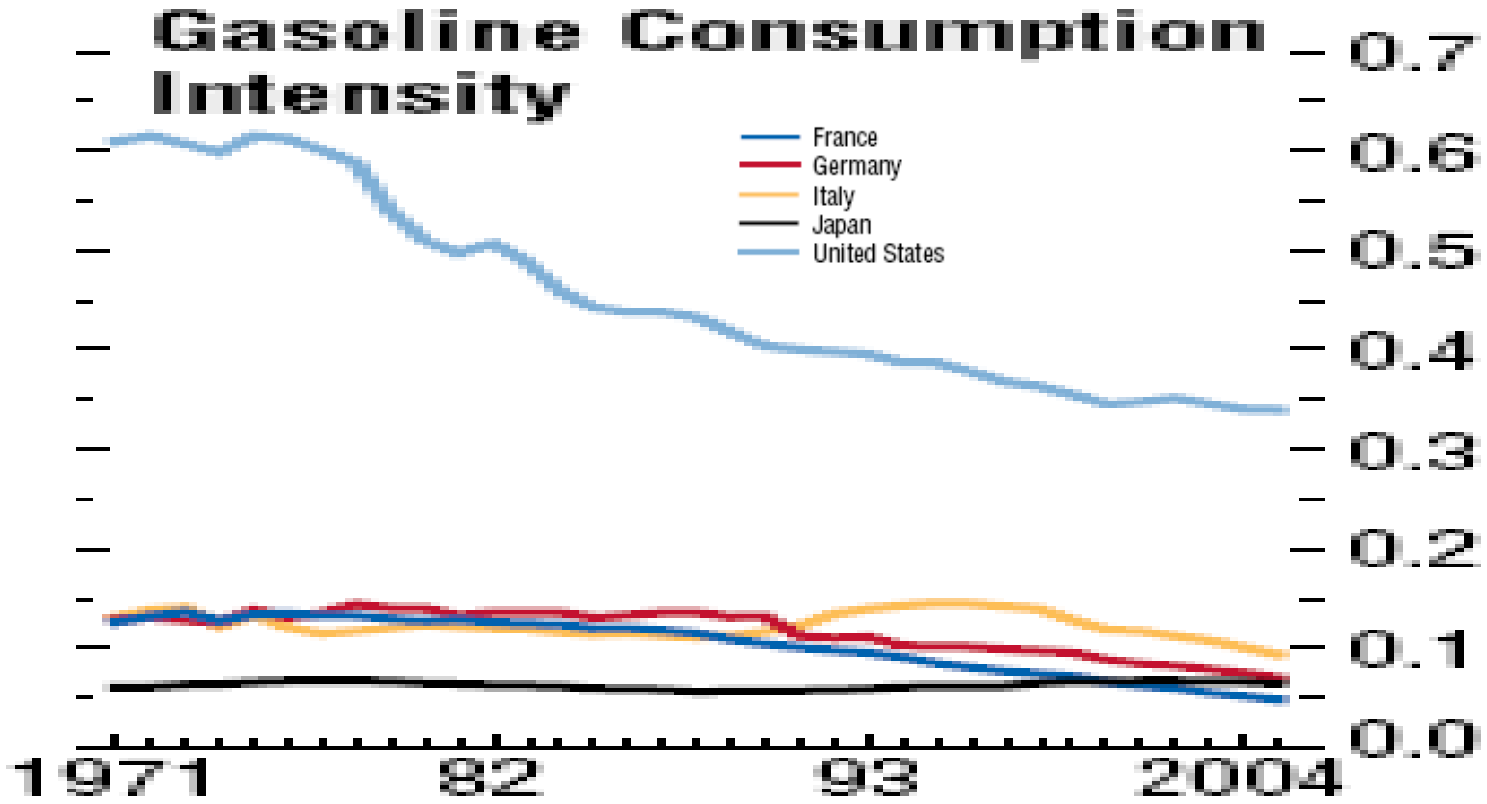
# The Issue

- "The U.S. "addiction" to oil comes largely from gasoline consumption, which as a share of GDP is nearly five times that in other major industrial countries." (IMF, WEO, April 2007)
- Fuel efficiency in the United States is 25 percent lower than the EU average and 50 percent lower than that of Japan (An and Sauer, 2004).



# Conventional "Wisdom"

- American public will never accept tax increases on fuel (no matter what happens to the revenues).
- Besides, gasoline consumption is insensitve to price, even in the long run.
- We are not fighting for oil supply in the Middle East (though actual objective is not clear).
- But, fortunately, the American consumer will do what the Generals, CEOs, and Politicians say.
- *This conventional wisdom is why a rational and effective energy policy is many years away.*

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# Methodology for ESLC/SAFE Policies

- Calibrate LIFT to AEO 2006 baseline, medium variant.
- Alter Transportation A-matrix coefficients to simulate transportation sector conservation measures.
- Produce greater volume of biofuels: incr A-matrix coefficients from agriculture to chemicals & chemicals to petrol products.
- Control crude oil/petroleum product import share to calibrate to assumed domestic production.
- Increase cost of manufacturing motor vehicles by increasing parts content from associated industries.

# Key Assumptions

- Deficit neutrality on all new federal expenditures.
- Conservation and production measures successful as envisioned. Income enhancements create additional demand for oil.
- Elasticity of global oil price wrt U.S. demand is 1.7 (compared to 2.7-4.7 for EIA). A fall of 6.5% (8 MBD) of world demand leads to a fall in prices of $12/bbl (11.2%).
- No elasticity of domestic supply wrt. price (all new production displace imports bbl for bbl).
- Costs of manufacturing motor vehicles increase by 10% by 2020, 20% by 2030.

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# SAFE Demand Side Measures

| POLICY ELEMENTS | PROJECTED ENERGY SAVINGS BY 2030 |
|---|---|
| Significantly reform and then annualy strengthen fuel efficiency standards for passenger cars and light-duty trucks. | 4.3 MBD |
| Set and then annually strengthen fuel efficiency standards for medium-duty vehicles employing Federal subsidies as suitable. | 0.2 MBD |
| Set and then annually strengthen fuel efficiency standards for heavy-duty vehicles employing Federal subsidies as suitable. | 0.9 MBD |
| Require the Federal Aviation Administratio (FAA) to implement improvements to commercial air traffic routing to increase safety and decrease fuel consumption. | 0.4 MBD |
| Total Demand Savings Proposed<br>Total Savings Realized | 5.8 MBD<br>4.7 MBD |

# SAFE Supply Side Measures

| SUPPLY ENHANCEMENT POLICY ELEMENT | PROJECTED OIL SAVINGS BY 2030 |
|---|---|
| Expand production of ethanol for motor fuels | 1.3 MBD |
| Expand access to outer continental shelf (OCS) | 1.3 MBD |
| Enhanced oil recovery (EOR) | 1.0 MBD |
| Grow the biodiesel market | 0.2 MBD |
| Total projected increase to supply | 3.8 MBD |

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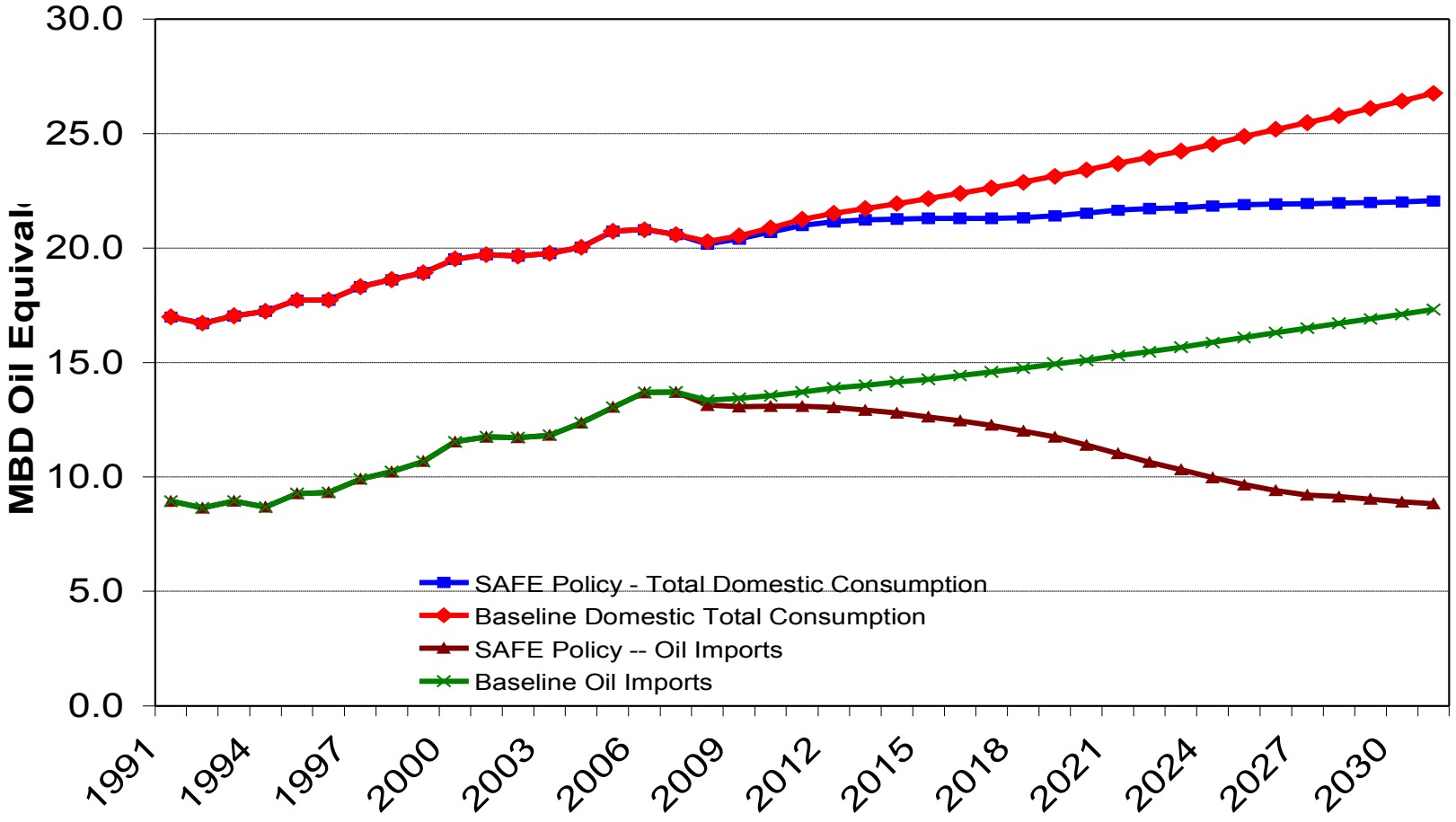
# Demand Savings

Figure 1

**ESLC/SAFE Policy Impacts on Oil Consumption and Imports**

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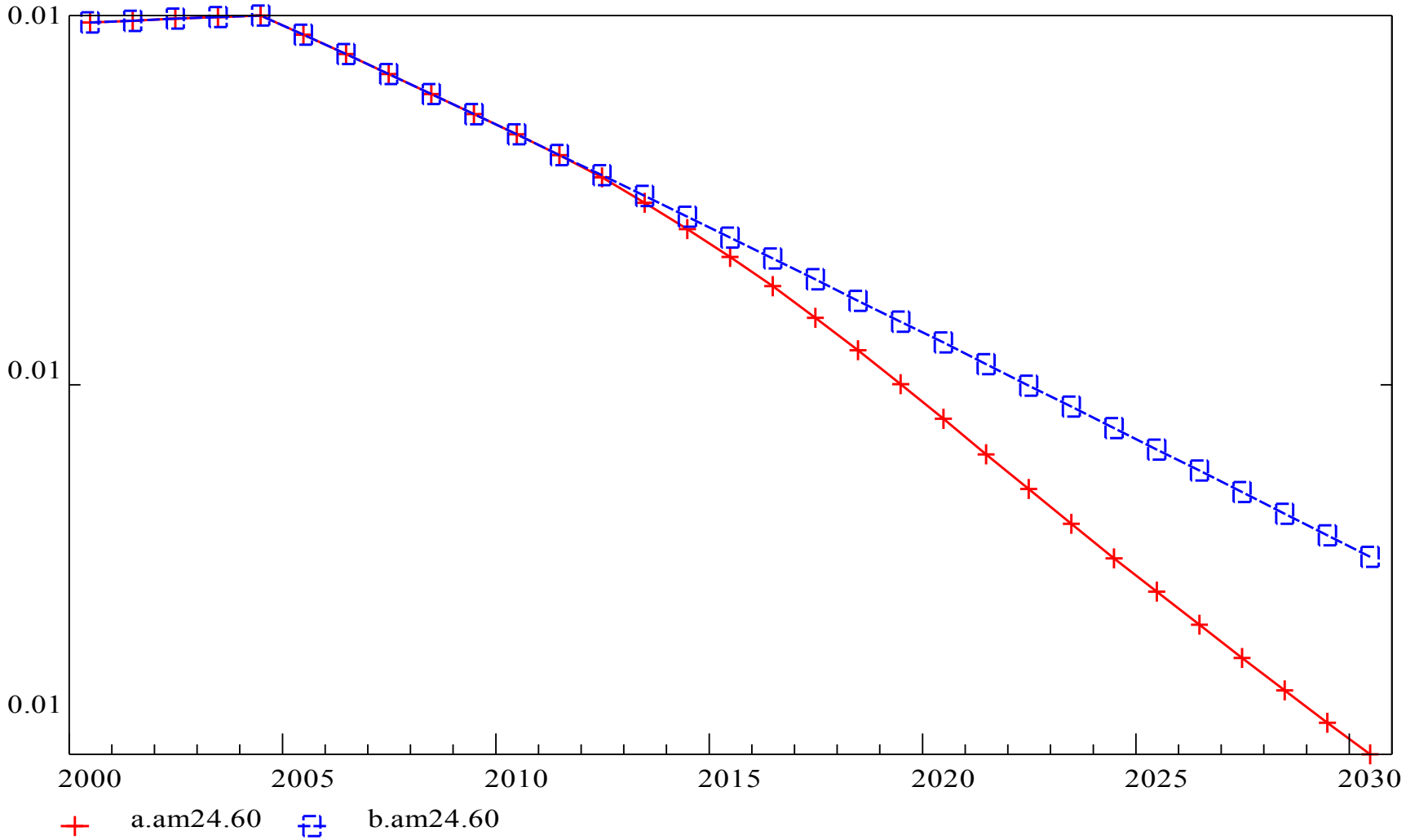
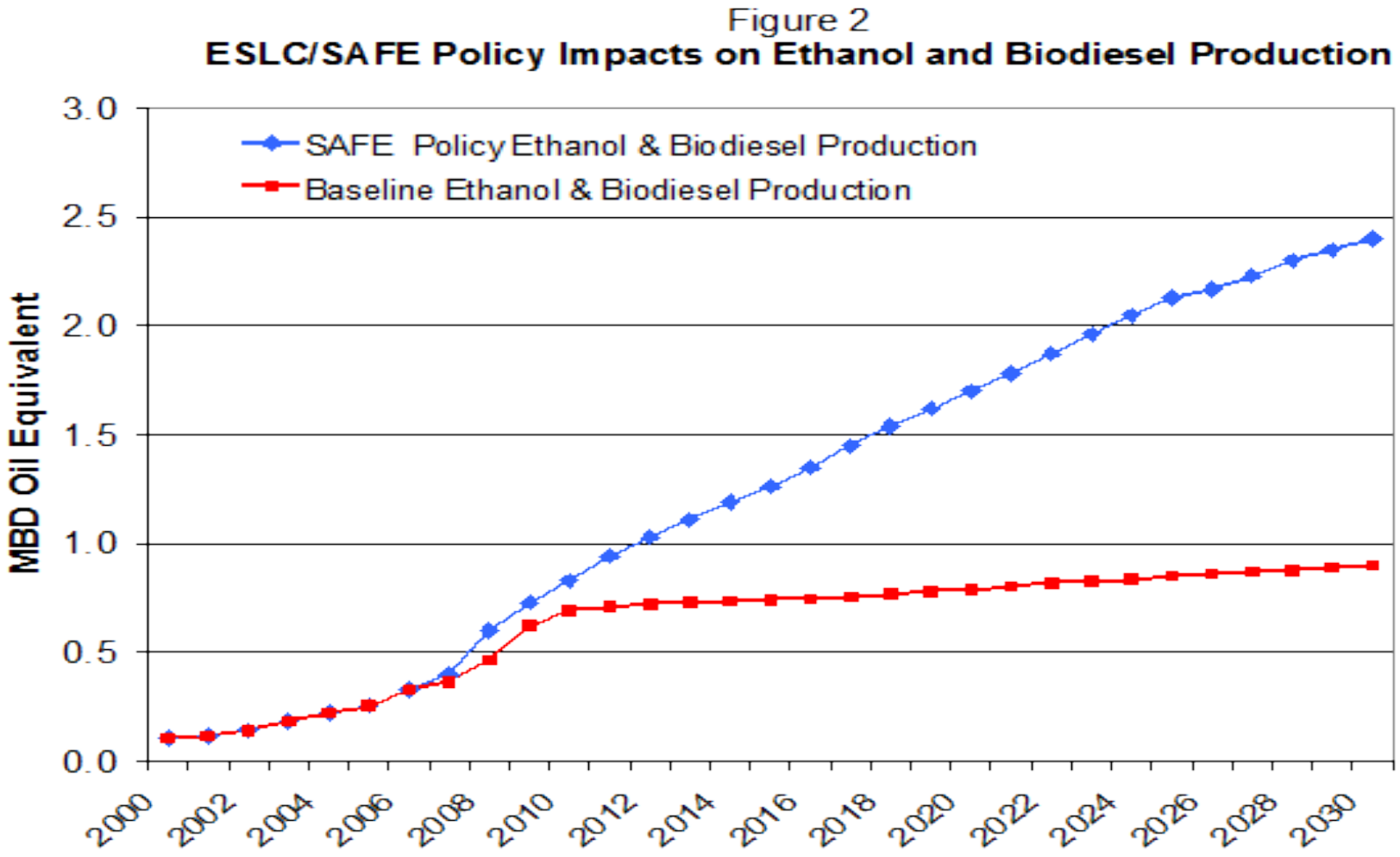
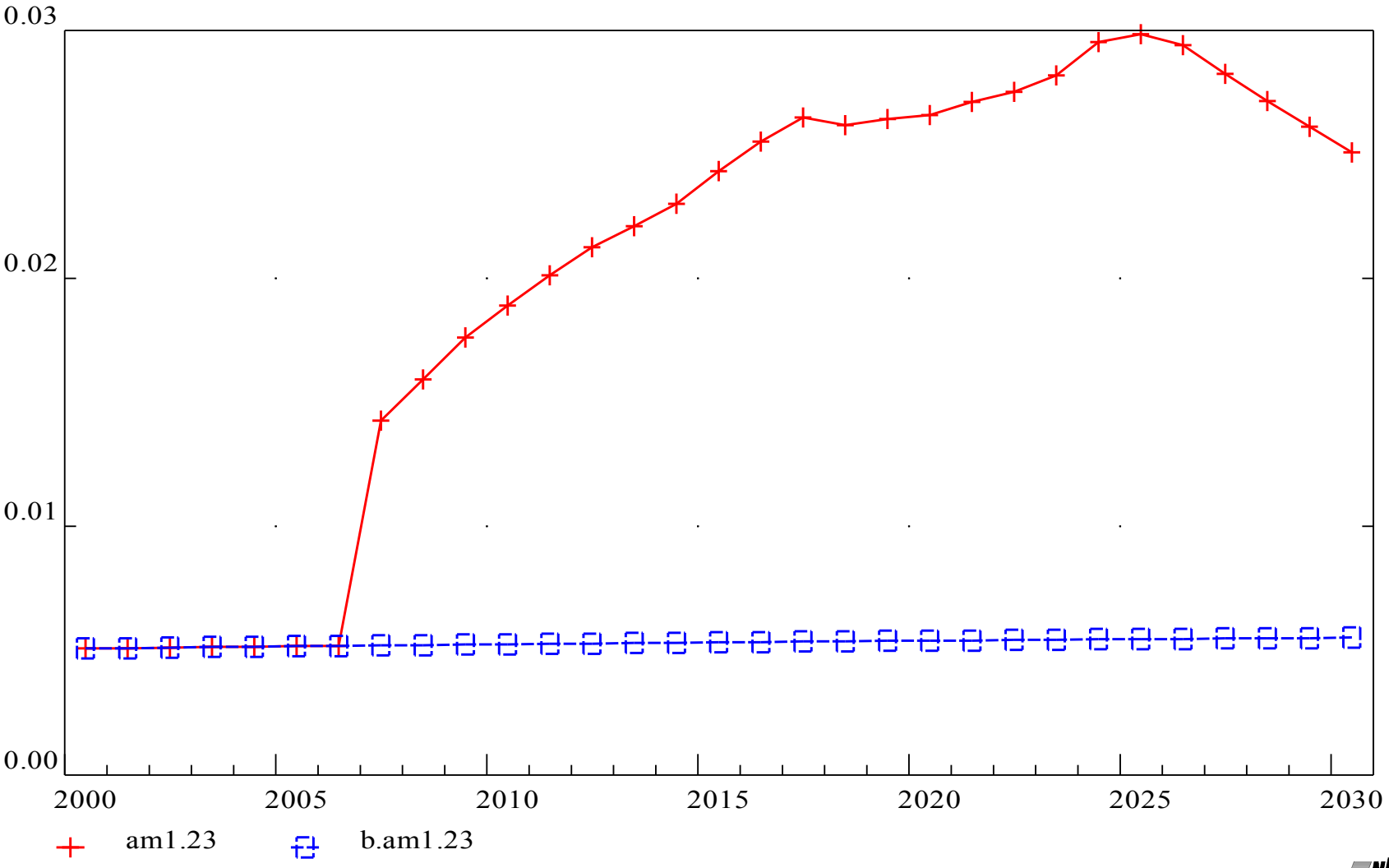
# LIFT “calibration”: am24.60
# Petroleum product to trucking



# Increased Ethanol/Biodiesel

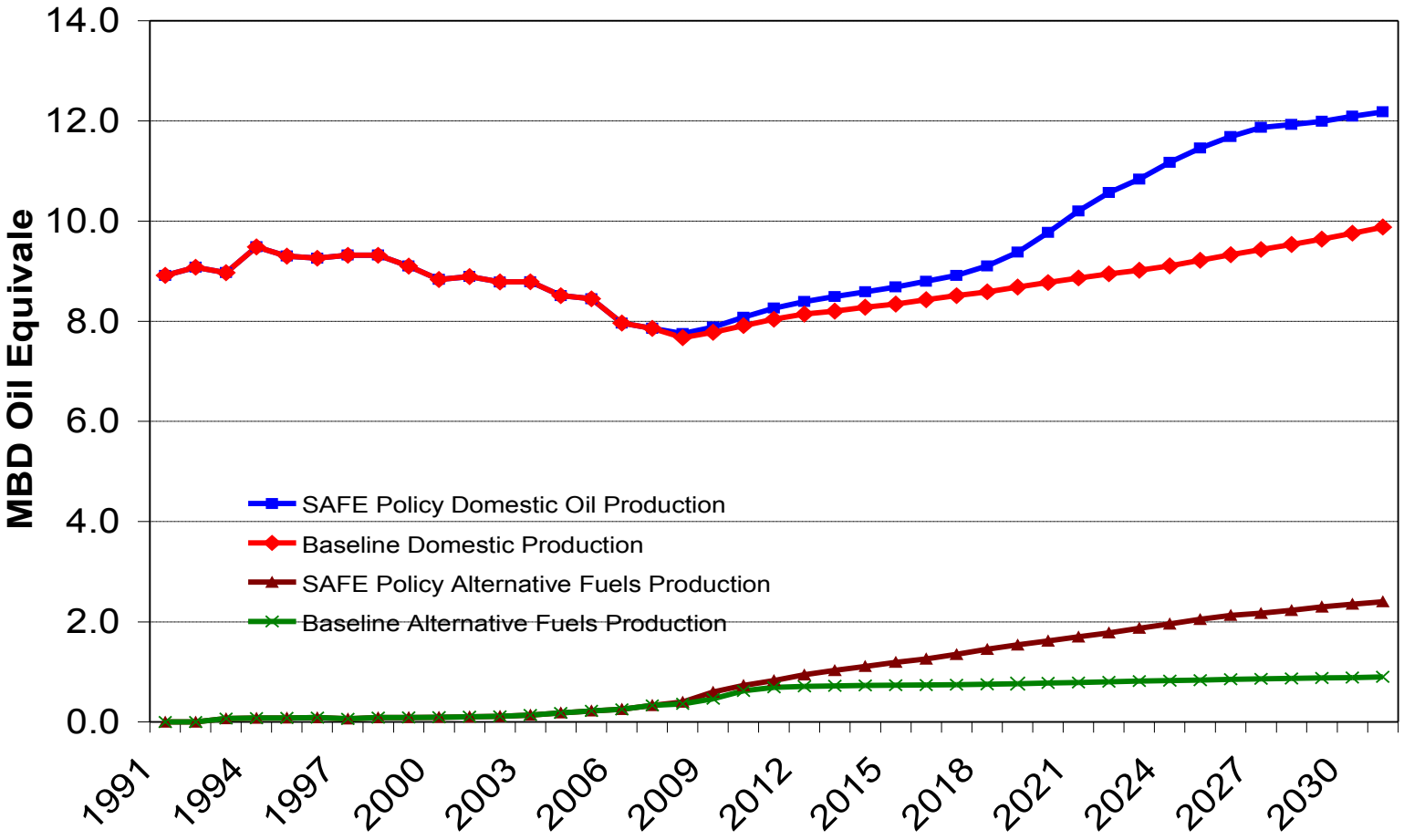


# Produce greater volume of biofuels: incr A-matrix coefficients from agriculture to chemicals & chemicals to petrol products.

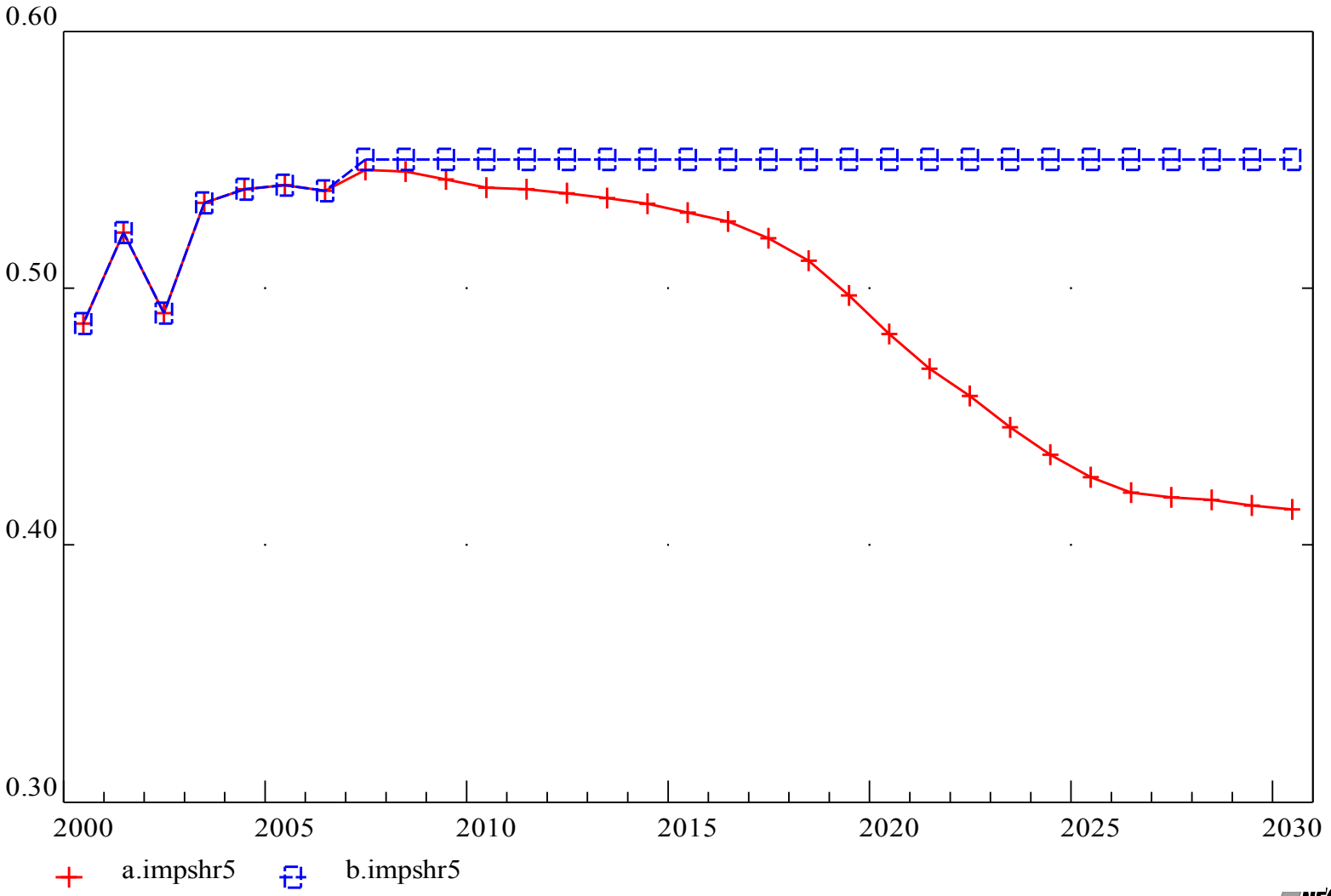


# Domestic Crude Production Enhancement

Figure 3
**ESLC/SAFE Policy Impacts on Domestic Production**

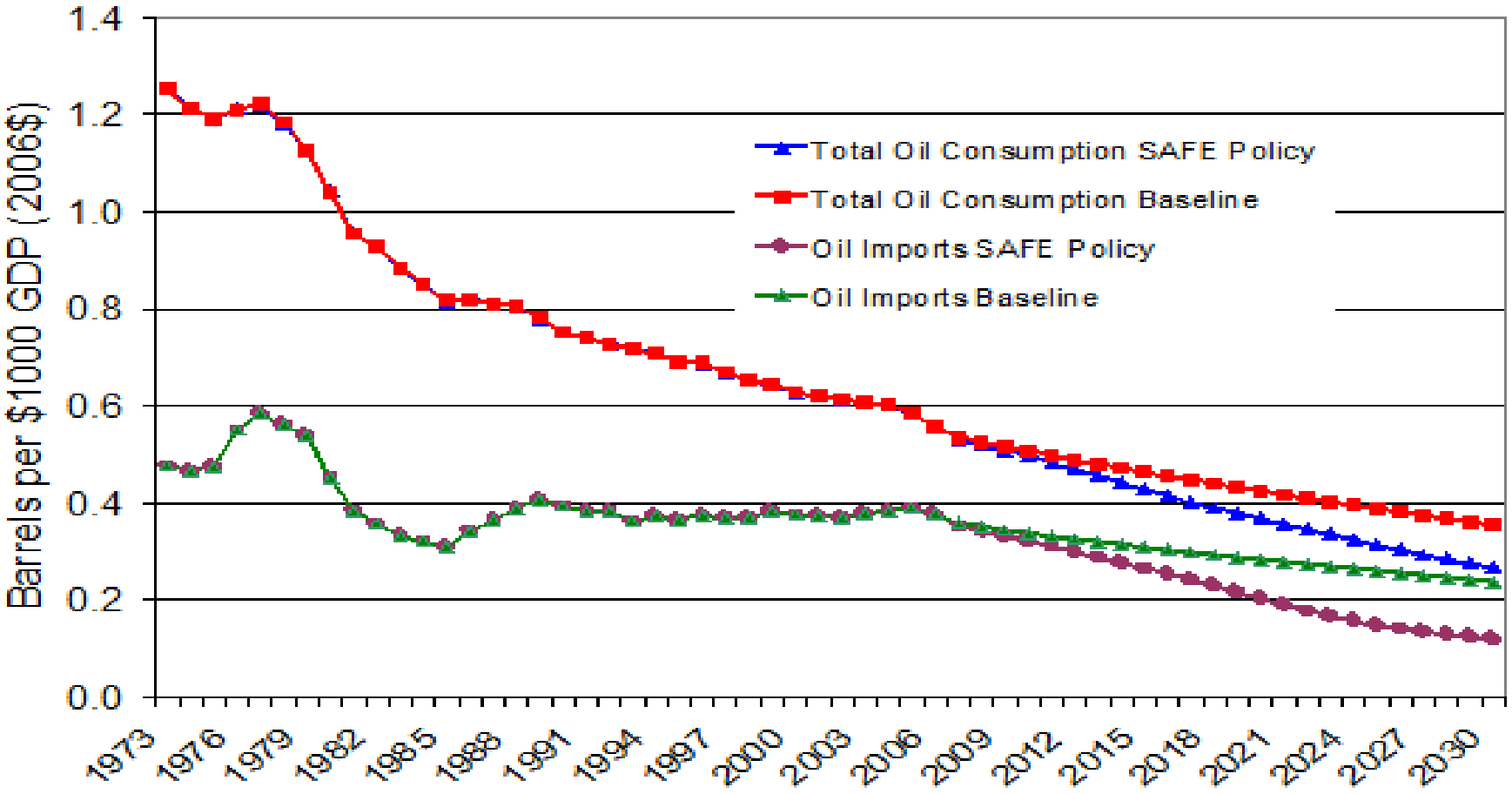


# LIFT “calibration”: impshr5
# Import share of crude petroleum

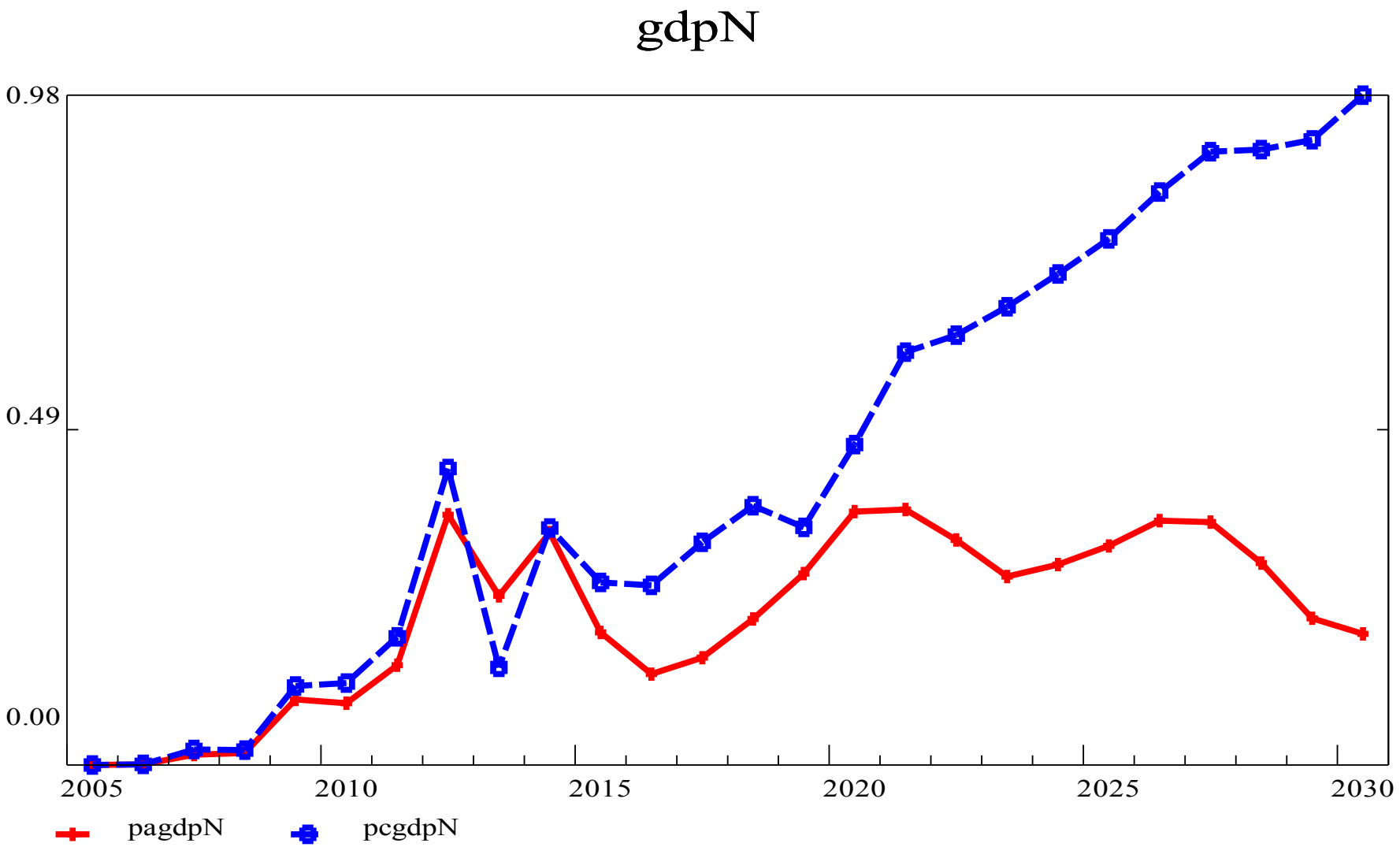


# Increased Energy Efficiency

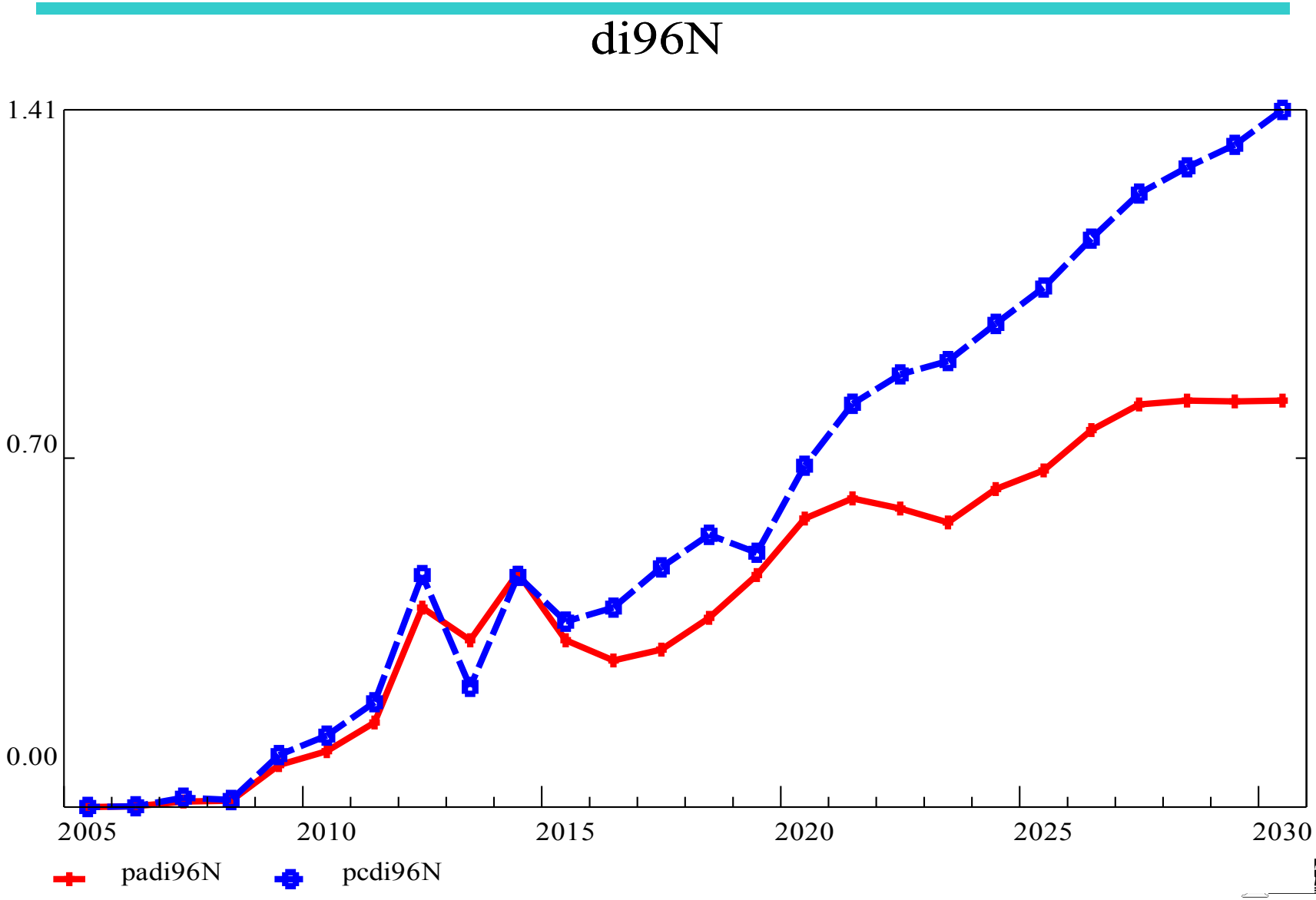
Figure 4
**Oil Consumption and Imports Intensity of GDP**



# Real GDP baseline vs. alternatives

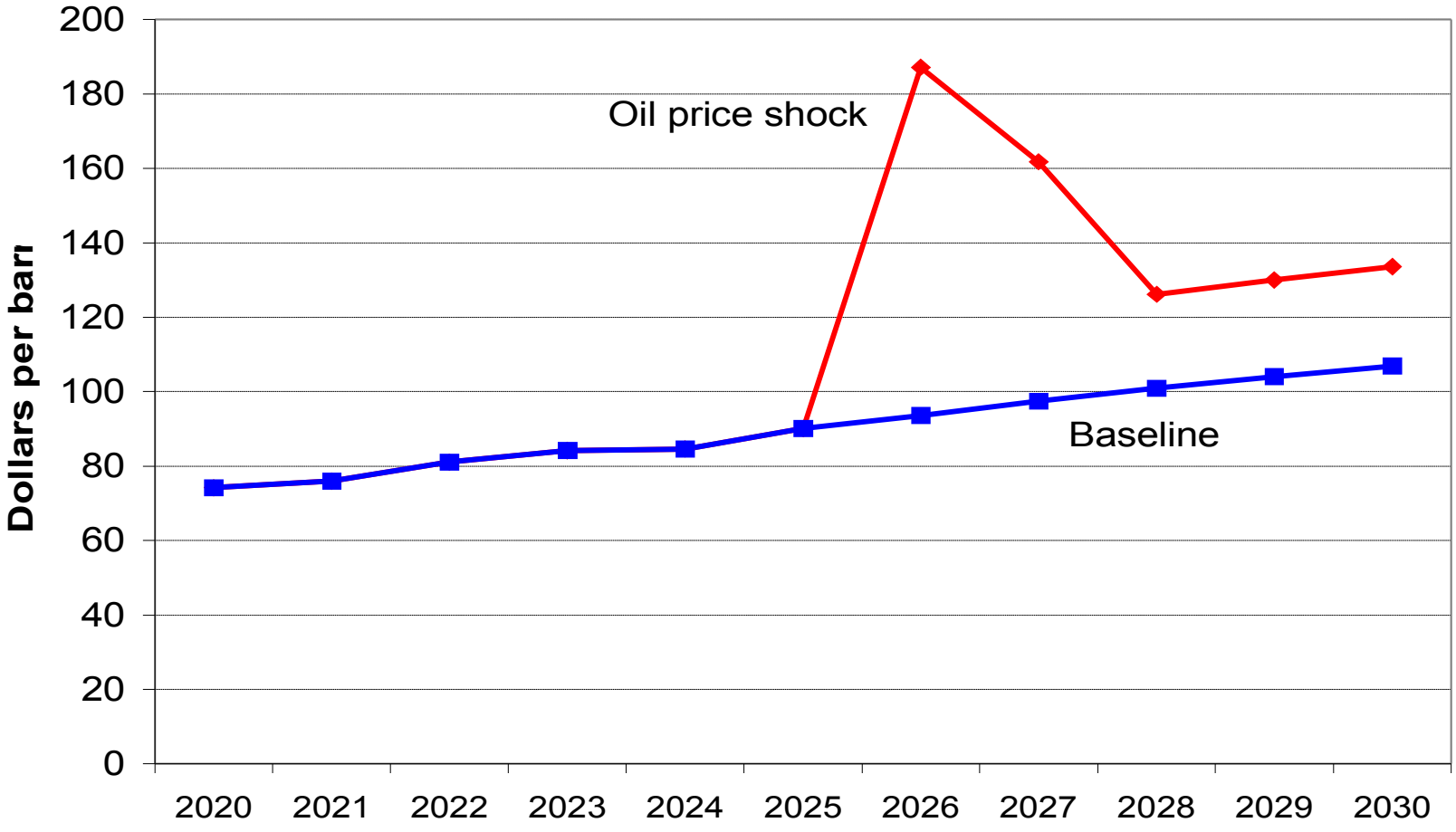


# Real disposable income baseline vs. alternatives



# Economic Resilience to Oil Shocks

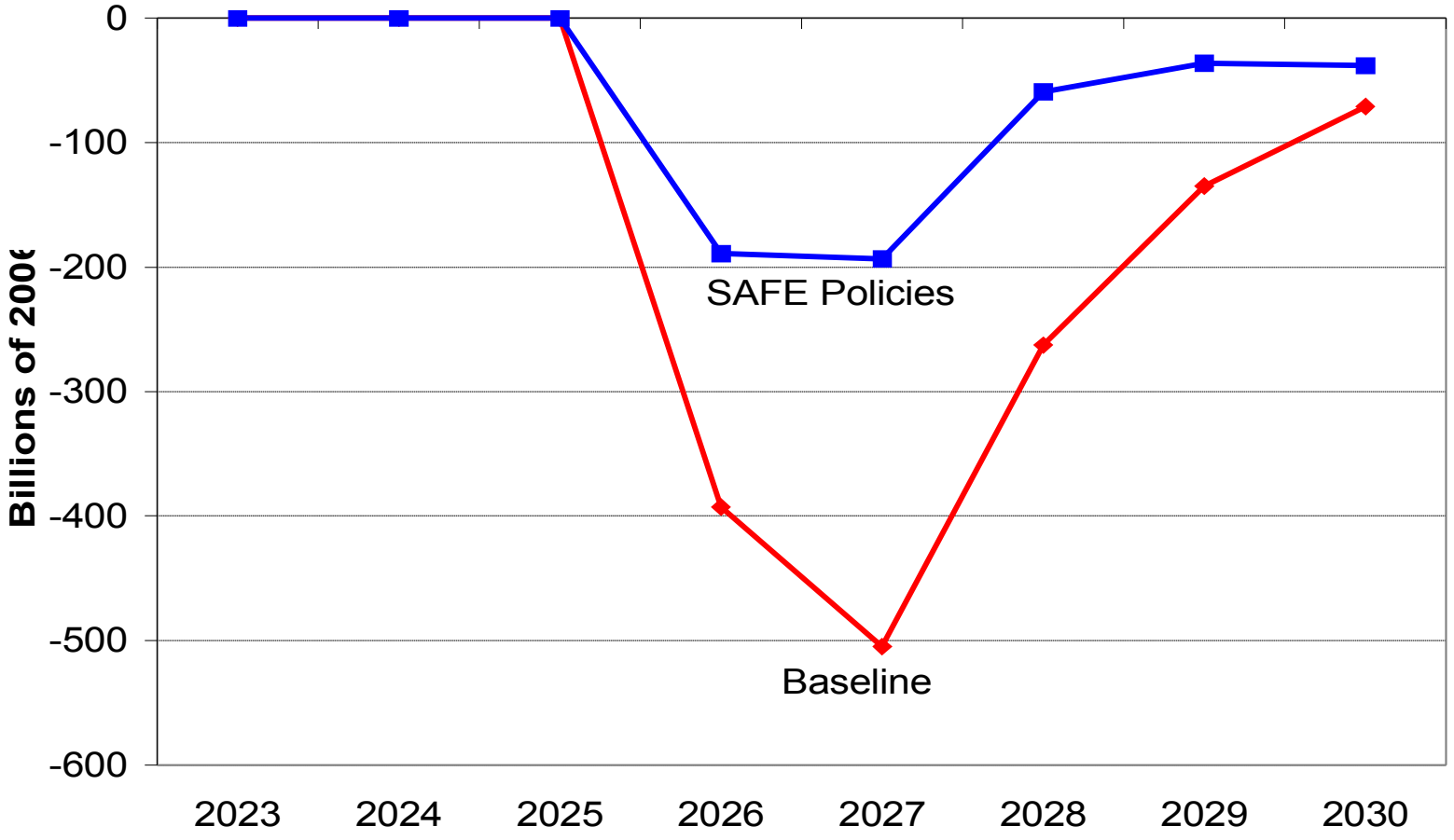
Figure 5
**Oil Price Shock 2026- 2030: Nominal Price per Barrel**



# Economic Resilience to Oil Shocks

Figure 6

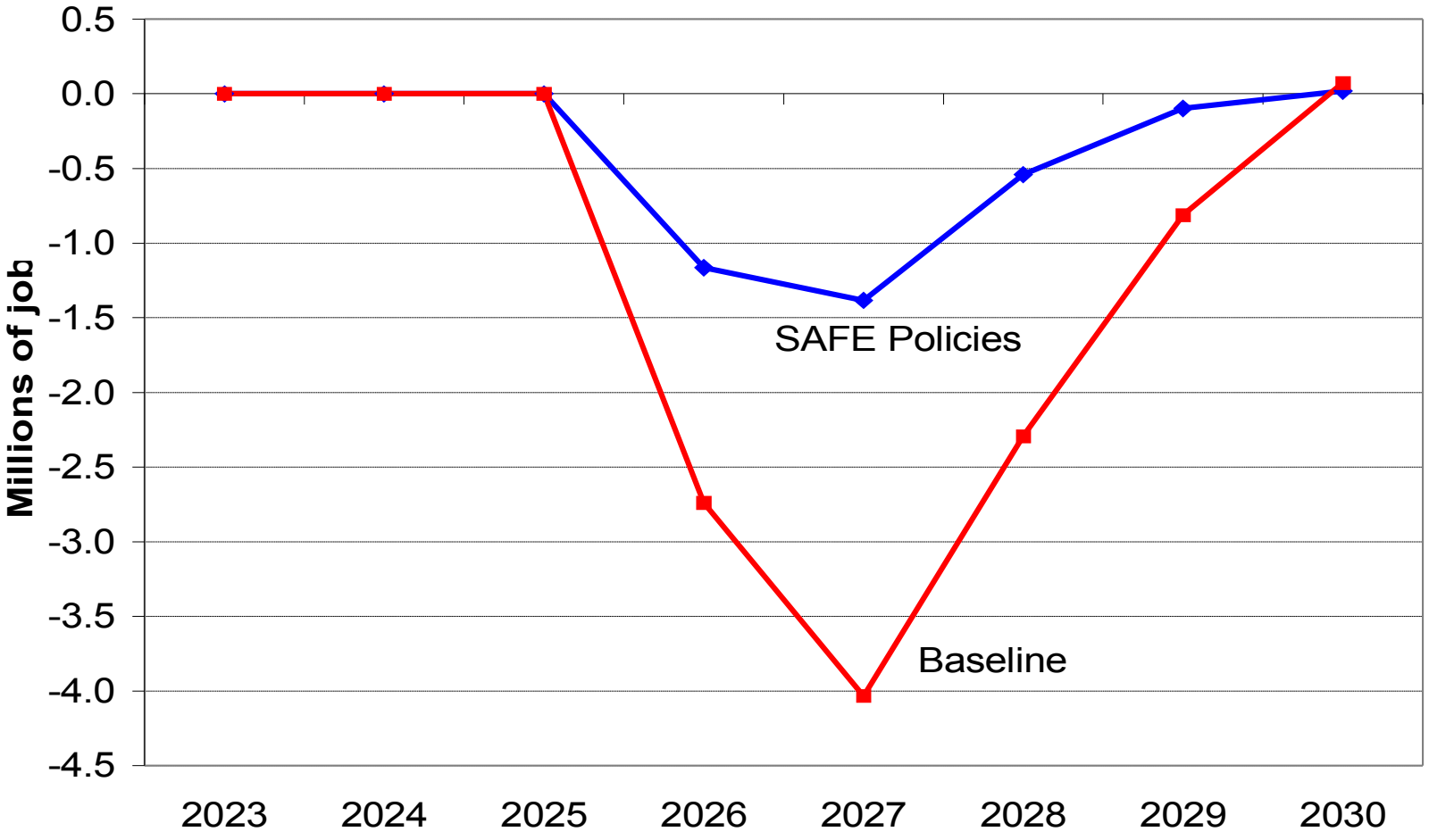
**Oil Price Shock: Difference in Real Disposable Income**



# Economic Resilience to Oil Shocks

Figure 7

**Oil Price Shock: Difference in Aggregate Employment**



# The Impact of Port Disruptions on the U.S. Economy

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# Introduction

- Application of interindustry macroeconomic model to investigate the impacts of a disruption of U.S. seaports.
- Import disruptions modeled as a "supply shock" that impacts import prices and import availability.
- Export disruptions modeled as a "demand shock."
- Scenarios are particularly sensitive to the duration of events and the assumptions concerning backlog after events.
- Scenarios have to be carefully constructed to account for items such as diversion to other ports, domestic production substitutes, etc.
- The model estimates the macroeconomic loss of trade disruptions on GDP, jobs, real incomes, etc.
- It also distributes costs of trade disruptions across industries, consumers, business, etc.

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# Economics of Disasters

**Natural and man-made disasters can have three broad types of economic impacts**

2. Loss of property or wealth (capital stock.) For example, property loss from Hurricane Katrina came was close to $100 billion. (Not included in GDP.)

3. Disruption of production, employment and income flows will reduce GDP during and immediately following the disaster.

   - Paradox: Demand & Production (the two sides of GDP) are reduced initially from the disruption of any given disaster. However, production accelerates over the medium term as postponed activity is regained and destroyed capital is rebuilt.

4. Cost-Push Inflation: energy, construction materials, and downstream price pressures. Usually associated with severe "supply-side" shocks.

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# Everyone loses in disasters

| | Income disruption | Wealth destruction |
|---|---|---|
| Local/Regional | direct employment and income loss | direct property loss |
| National/Global | indirect thru energy & commodity prices, income subsidies/ donations | indirect thru insurance premiums, federal building subsidies/ donations |

# Loss of property productive capital stock.

- In national accounts, capital loss shows up in "consumption of fixed capital" (i.e., depreciation).
- Therefore, the wealth loss it is not a reduction in "Gross" Domestic Product (GDP)
- It shows up as a hit to "Net" National Income (NNI). The main difference between GDP and NNI is capital consumption.
- This type of damage is relatively easy to measure.

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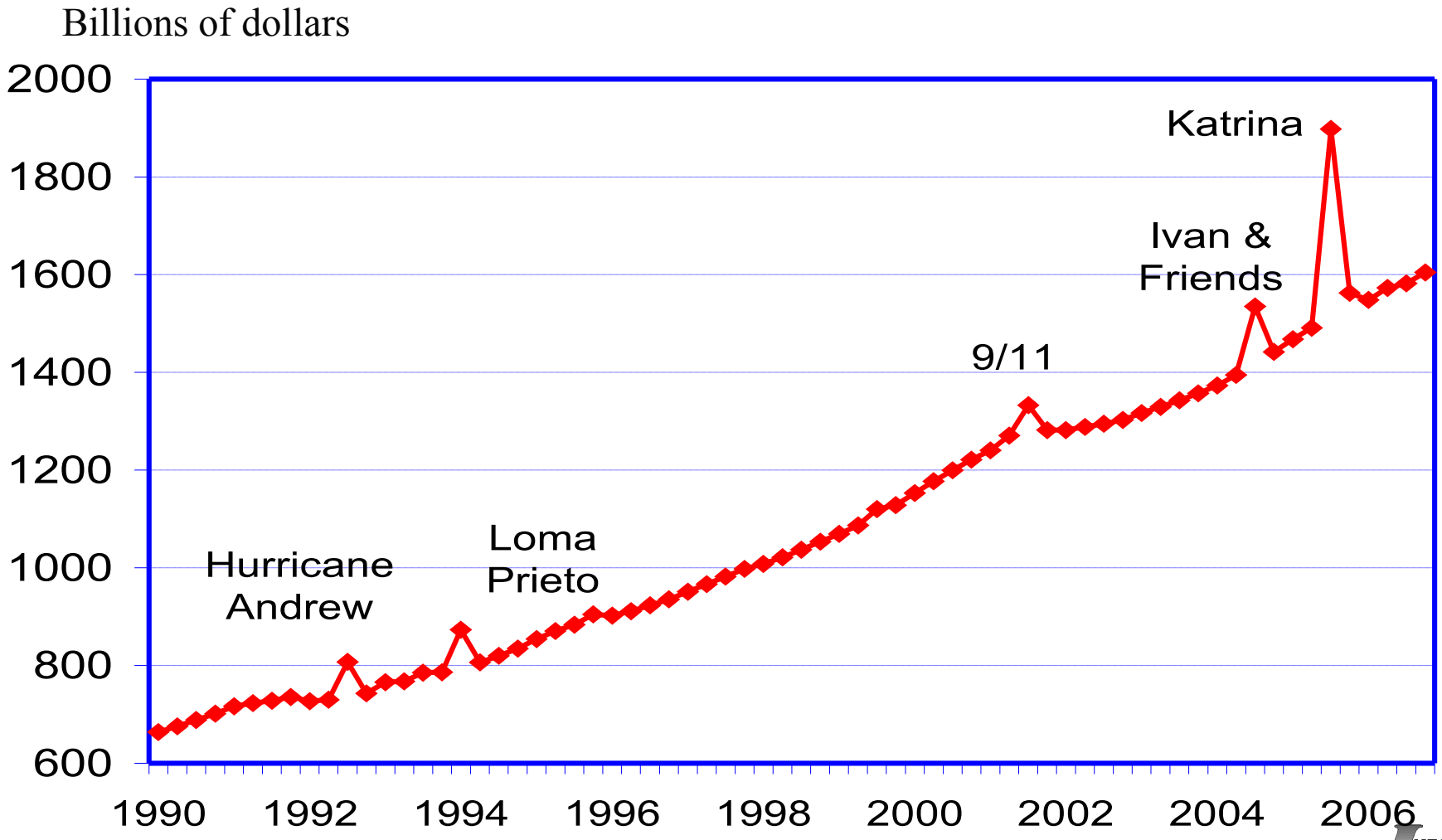
# Consumption of Fixed Capital




Source: Bureau of Economic Analysis, National Income and Product Accounts

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# GDP, Income, and Inflationary Effects

- Immediate negative GDP impact will be offset later by positive stimulus.
- Price pressure associated with disaster can impede growth as Federal Reserve raises interest rates to quell inflation.
- Magnitude of GDP and inter-related price impacts are much more difficult to measure.
- Need to compare acutal macroeconomic performance during and after disaster with a hypothetical "counterfactual" case with no disaster.
- GDP is not the best measure of economic impact.
- Real income includes both changes in income flows from production and the changes in consumer prices. It is the best proxy for the economic impact of disaster.

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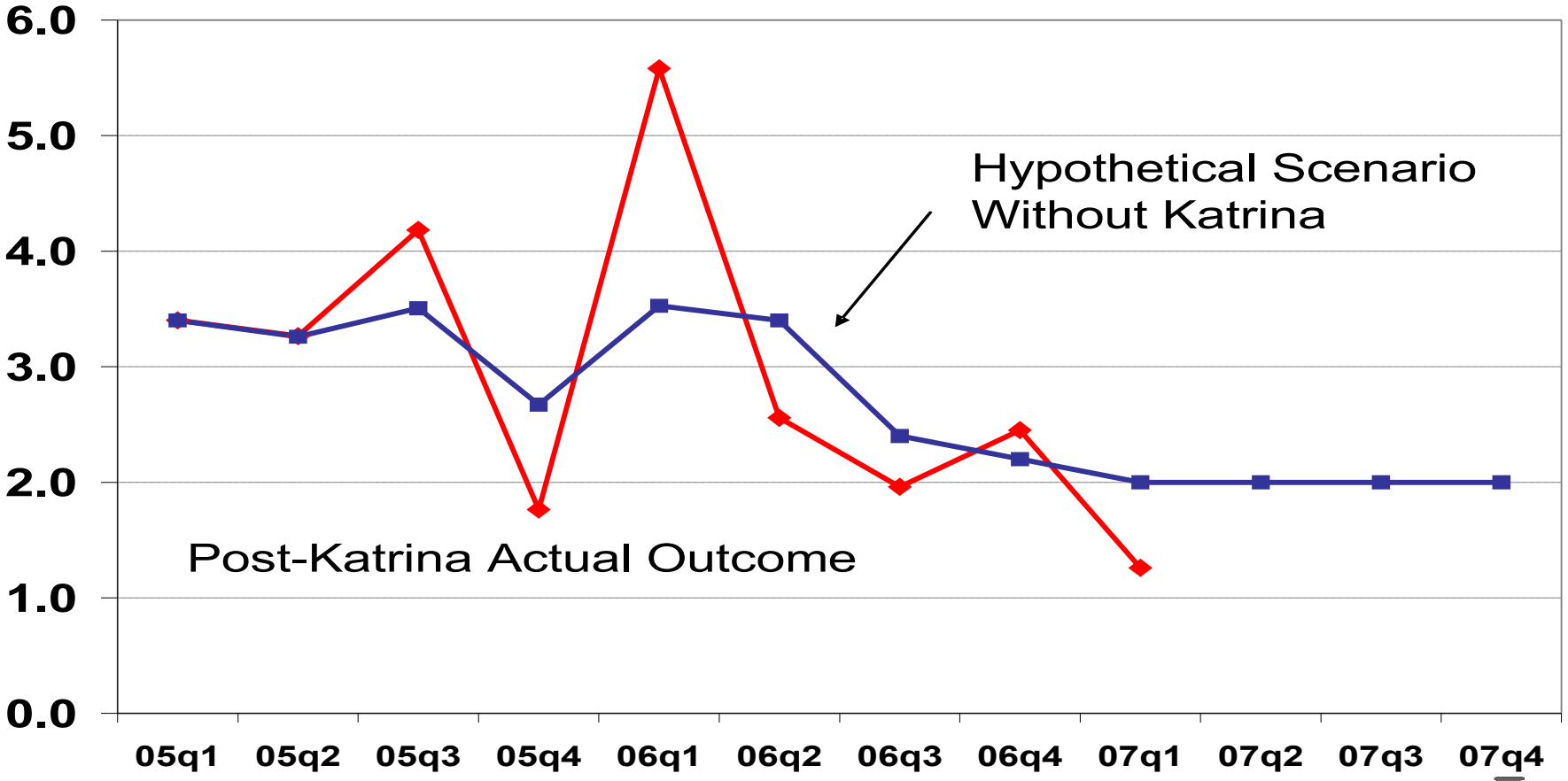
# Difficult to separate the GDP impact of any given event.

U.S. GDP growth with and without Katrina



# Economic Impact of Recent Disasters

All figures in billions of 2005 dollars

| Event | Region | Date | Wealth Destruction | Production Disruption | Total Loss |
|---|---|---|---|---|---|
| Katrina | GOM | Sep-05 | $90-120 | $40-60 | $130-180 |
| Ivan | GOM | Sep-04 | 7.2 | 6.5 | 13.7 |
| 9/11 | Nat'l | Sep-01 | 25.7 | 61.8 | 87.5 |
| Northridge EQ | LA | Jan-94 | 23.6 | 12.5 | 36.1 |
| Midwest Floods | MN to MO | Sum 93 | 6.1 | 9.4 | 15.5 |
| Andrew | So. FL. | Aug-92 | 36.7 | 11.6 | 48.3 |
| Loma Prieta EQ | Bay Area | Oct-89 | 10.6 | 5.4 | 16.0 |
| Hugo | SC | Sep-89 | 14.5 | 4.7 | 19.2 |

Sources: Swiss Re, RMS, Insurance Information Institute, Inforum estimates

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# Port Disruption Methodology

- Basic methodology drawn from CBO study.
- Key assumptions:
  - Which ports? How long?
  - What is potential for diversion to other modes or ports?
  - What industries could face acute/ severe supply chain problems?
  - Petroleum imports significantly disrupted?
  - What other strategic items could be treated specially?
  - How quickly can ports be brought on line and backlogs relieved?
- Estimate import and export volume disruption for proportion of seaborne trade for each commodity. Example: Motor vehicle trade, 30 day disruption (1/12).
  - Seaborne import proportion: 0.55
  - Port disruption proportion: 0.05
  - Target import disruption 0.55 x .050 x 1/12 = 0.0225 or 2.3%
  - Actual outcome is generally different because of income/demand interaction, alternative sourcing (Canada and Mexico)

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# Port Disruption Methodology

- Supply Shock:  Adjust international trade prices (i.e., simulate prohibitive shipping costs during event) to reduce import volumes to target levels.
- Demand Shock: Exports reduced by inability to move them outside the country.
- For several key commodities (fuel, food, strategic intermediate goods) impose supply bottlenecks (no supply available at any price).
- Revenue impacts of shipping cost increases split between U.S. (75%) and foreigners (25%).
- U.S. result:  Lower imports, exports for 2007-2009, lower GDP for 2007 – 2008.  Inflation spike 2007.

# Key Assumptions for Port Disruption Scenarios

- No significant property losses (capital stock destruction). All damage comes through production and income interruption that is not subsequently regained.
- General Equilibrium Model: Market forces ration goods and services relatively efficiently and quickly.
- Government reaction limited and benign (no price controls or other command and control measures).
- No pre-planning for resiliency by governments and firms (apart from the SPR and normal inventory behavoir).
- Model accounts for problems in supply chains in general terms (mostly through pricing). It does not consider specific bottlenecks that have substantial production impacts (e.g., lack of a $10 part shutting down an auto assembly line).

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