

**Why clean transportation alternatives are still
needed to promote world-wide economic growth
(the “Oil Problem” is not going away)**

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**The views and data provided in this presentation are those of Carmine Difiglio
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Price & Income Elasticity of Oil Demand

$$e(P) = \frac{\frac{dQ}{Q}}{\frac{dP}{P}}$$

$$e(I) = \frac{\frac{dQ}{Q}}{\frac{dI}{I}}$$

Components of the Price Elasticity of Oil Demand

- **Substitution Effect**
 - In principle, the industrial or private consumer could substitute other forms of energy for petroleum fuels, and
 - the consumer could substitute other goods or services for the services enabled by the consumption of refined petroleum products.
- **Income Effect (statistically inseparable)**
 - An increase in the price of refined petroleum products will decrease household purchasing power leading to a decrease of demand for refined petroleum products.

Income Elasticity of Oil Demand (Exogenous)

- **An exogenous change in income affects the demand for oil.**
- **Focusing on national income (GDP), higher GDP causes industry and consumers to demand more oil to enable more industrial production, consumption in service industries, personal travel and automobile consumption.**

Measured Short-Term Elasticities of Oil Demand

- $e(I) = 0.3$ to 0.6 (higher in later studies)
- $e(P)$ has significantly declined:
 - 0.1 to -0.3 in the 1970s/1980s
 - 0.01 to -0.06 since 2000
- This decline is caused by:
 - Decreased use of oil in the power sector and industry for process heat
 - Decreased use of oil for space heating
 - The price of oil depends on the price of gasoline, distillate and jet fuel. No other products are important.
 - There are extremely limited short-term opportunities to reduce the consumption of these fuels in the face of a price increase without curtailing transportation services.
 - Increased motor-vehicle fuel efficiency has also reduced price elasticity of demand.

Short Term Elasticity of Oil Supply

- **Response of oil supply to oil price changes:**
 - Higher or lower oil prices can cause backwardation or contango in the forward curve that would motivate stock draws or builds.
 - Higher prices can cause Saudi Arabia and a few other countries to move some of its reserve production into production or, with lower prices, to move some of its production into reserve.
 - Outside Saudi Arabia, etc., oil producers cannot increase short term production in response to higher oil prices as they are already going flat out.
 - Oil producers respond to price changes by increasing or decreasing E&P investment (E&P resources directly affected) but this does not affect short-term production.

Dynamics of Brittle Oil

Supply & Demand – Part 1

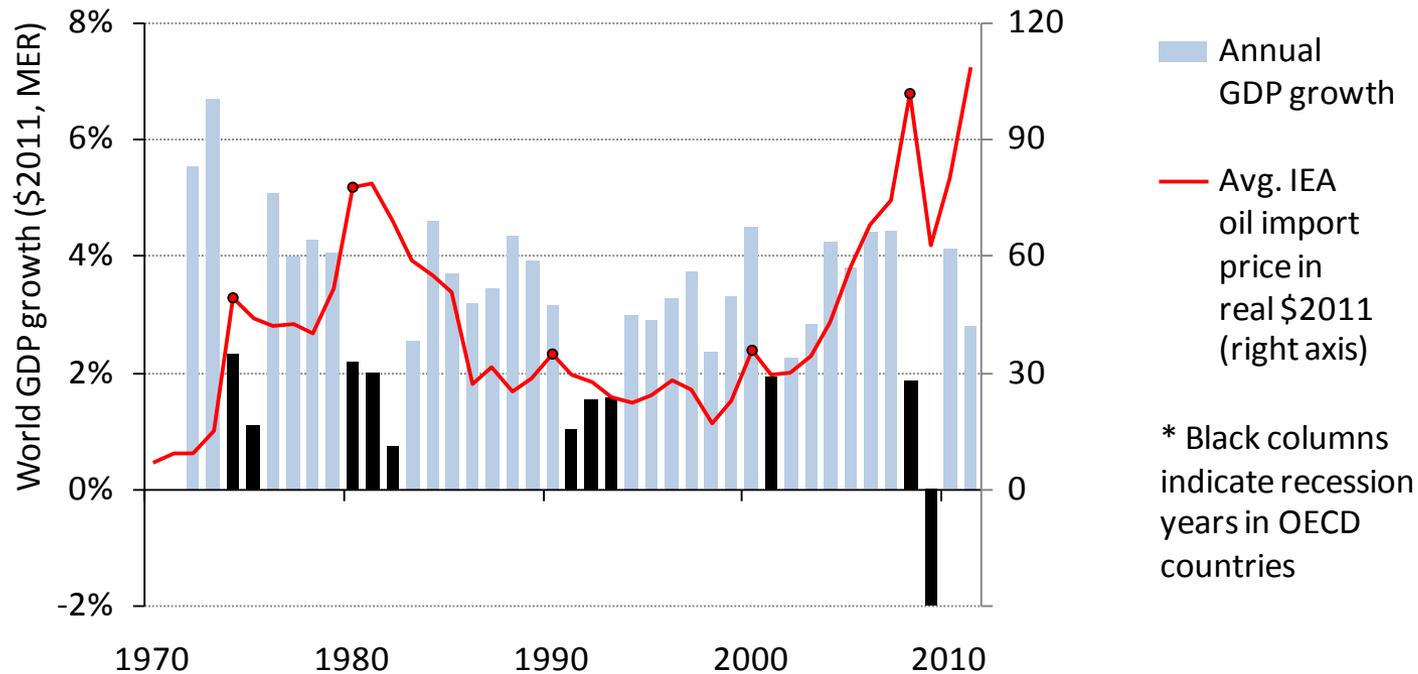
- **High GDP growth causes high oil prices since high income elasticity for oil increases oil demand;**
- **Low price elasticities require high oil prices to balance supply and demand; and then**
- **The resulting high share of GDP spent on oil reverses GDP growth;**

Dynamics of Brittle Oil Supply & Demand – Part 2

- **With lower GDP growth, high income elasticity reduces oil demand;**
- **With lower oil demand, low oil price elasticities sharply lower oil prices; and**
- **Low oil prices help GDP growth recovery but reduce oil production investments.**

Oil Price Shocks & Global GDP Growth

International crude oil prices and global GDP growth



Why Oil Price Shocks Reduce Growth

- **Reduced income available for other goods and services cause dislocations in these industries.**
- **The automobile industry is particularly affected by oil price shocks.**
- **The multiplier effects of these dislocations cause the economy to operate below its potential output until a new equilibrium can be established.**
- **These dislocations are only caused by large oil price increases (e.g., if they set a new high for the previous 3 years).**

Looking Forward

- **Supply outages are now chronic events.**
- **Previously, oil supply outages averaged less than 1 mmb/d; since 2011, they have averaged ~ 3 mmb/d.**
- **Citing the International Energy Agency**
 - **Relatively stable oil prices should not conceal an abundance of risk as much of the Middle East and North Africa remains in turmoil.**
 - **The political situation in the MENA region reflects a precarious balance that does not bode well for clear, stable and predictable oil policies, let alone supplies.**
- **The marginal cost of oil production is increasing (see paper for evidence).**

Will North American Tight Oil be Replicated Elsewhere?

- **Russia**
- **United States**
- **China**
- **Argentina**
- **Libya**
- **Australia**
- **Venezuela**
- **Mexico**
- **Pakistan**
- **Canada**
- Countries with tight oil resources (ARI 2013)
- These plays have unique geological characteristics. Few, if any, may be similar to the best plays in the United States.
- Consequently there is high uncertainty as to whether oil production in these countries would be economically feasible.
- **Countries in red are oil exporters.**

Additional Risks

- **Aboveground factors such as mineral rights, government support, E&P services, transportation infrastructure & political stability are all necessary.**
- **One or more of these factors are lacking in almost all of the countries that might have promising resources.**
- **In addition, some of the countries with tight oil resources are oil exporters that can more easily tap conventional resources.**

Long-Term Strategy: Increase the Price Elasticity of Oil Demand with Plug-In Vehicles

- Beginning in the late 1990's, electric-hybrid passenger automobiles are now available from most major manufacturers in most market segments. While initially expensive, costs have come down.
- Plug-in electric-hybrid vehicles are now entering the market.
- They can travel up to 40 miles on a single electric charge: Compare to less than 50 miles/day average daily travel.
- Climate policies in the United States and other countries will motivate the sales of plug-in hybrids.
- With battery cost reductions, it may be feasible for government policies and consumer preferences to grow the percentage of plug-in vehicles in the world auto fleet (see IEA ETP 2012).
- If so, $e(P)$ could significantly increase as plug-in owners could increase their share of travel on electricity during oil-price shocks.
- Other types of fuel-flexible vehicles could also increase $e(P)$.

Near-Term Strategy: Use Strategic Oil Stocks to Prevent Economy-Damaging Oil Price Spikes

- **The U.S. President has decided to use the Strategic Petroleum Reserve 3 times:**
 - 1991 (1990 Gulf War)
 - 2005 (Hurricanes Katrina & Rita)
 - 2011 (Libyan supply outage)
- **These releases demonstrated the effectiveness of the SPR, however;**
- **The 1991 and 2011 releases (those made response to a disruption of the international oil market) were made well after oil prices had spiked in response to the respective supply disruptions.**

Conclusions and Recommendations

- Oil price shocks sharply reduce world economic growth & throw OECD countries into recession.
- The “main-culprits” of the oil-economy problem are the tiny short-term price elasticities of oil demand and supply.
- Significantly increased or cheaper oil supplies are not likely: oil supply disruptions are more likely than ever.
- Long term: Increasing $e(P)$ would improve the oil-economy problem. Plug-in vehicles offer the best chance to increase $e(P)$.
- Near term: Effective use of strategic oil stocks provides the best protection, especially if the international release of stocks stems the rise in oil prices *before* they reach levels that damage the world economy.

Thank you.

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