The Manufacturing and Energy Challenges

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MANUFACTURING: Hollowing Out?

- Manufacturing Employment:
  - Down almost 1/3 in a decade

- Investment:
  - Manufacturing fixed capital investment declined (accounting for costs) in the 2000s for the first time since the data has been collected

- Output:
  - Adjusting gov’t data (for foreign component origin and inflationary assumptions in IT and energy sectors), U.S. manufacturing output value declined in the 2000s
  - Decline in 16 of 19 manufacturing sectors

- Productivity:
  - If output lower than assumed, productivity is lower
Sharp Decline in Mfg. Employment, 2000-2010 -- drop so steep that productivity gain can’t explain

Exhibit 16
US manufacturing employment has been shrinking since 1980, but the pace dramatically accelerated after 2000
Manufacturing employment, 1942–2010, 5-year moving average
Millions of jobs

Manufacturing Jobs by Sector (Chart 2-20)

Data from BLS: [http://www.bls.gov/iag/tgs/iag31-33.htm](http://www.bls.gov/iag/tgs/iag31-33.htm)
Manufacturing Jobs as a % of the Civilian Workforce (Chart 2-19)

Data from BLS
We have been assuming we have been losing manufacturing jobs because of productivity gains

- But analysis shows **lower output**

- Historically - most recently, tech boom of the 90’s - **productivity gains**, although disruptive initially, **grow more jobs**

- Lower output means “The Great Recession” in manufacturing is **structural, not business cycle**

- The Keynesian macro-economic **stimulus tools we have been applying won’t work well with structural problems.**

- **Requires a Structural strategy not only a macro-economic strategy**

- **Means innovation capability is key**
Manufacturing Remains a Major Sector

- Manufacturing = $1.7 Trillion of $15T U.S. economy
- Employs 12 million in workforce of 140m
- **Mfg. dominates the U.S. innovation system** – 70% of industrial R&D, 80% of patents, employs 64% of scientists and engineers
- The **currency of international trade is complex high value goods** –
  - 80% of U.S. exports are high value goods (capital goods, industrial supplies, transport goods, medicines)
  - 2012 - $600B deficit in goods
  - Services surplus ($160B) growing gradually but will not offset manufacturing deficit in foreseeable future
  - Services don’t scale; don’t get economies of scale
U.S. Trade Balances for
High-Tech vs. All Manufactured Products, 1988-2008

$ billions

Source: Census Bureau, Foreign Trade Division
High-tech Trade Balance – U.S., Asia, China, & Japan (Chart 2-17)

High-tech trade balance: billions of dollars

Data from NSF Figure O-34
Declining U.S. Share of High-Tech Exports
(Chart 2-18)

Data from NSF Figure O-30
Underlying Issue: Our “Innovate here/Produce Here” Assumption

- Since WWII - **U.S. economy organized around leading the world in technology advance.**
- US led all but one of the innovation waves of the 20th century -
  - growth economics: technological & related innovation = 60%+ of growth
  - Led - aviation, electronics, nuclear power, computing, the internet, biotech
  - If your organize your economy on leading technology advances, missing an innovation wave is serious

- **Our operating assumption** - WE would innovate here and WE would translate those innovations into products
  - Would realize the full range of economic gains from innovation at all stages
  - It worked – world’s richest economy
“Innovate here/Produce here” Bonds Breaking?

- With global economy, assumption of “innovate here/produce here” no longer holds.
  - In some industrial sectors, can now sever R&D and design from production
  - **RISK -> innovate Here/Produce There**

- Last 25 years -
  - **Distributed Manufacturing** – with IT based specs - in some sectors
  - But **other sectors** still require deep connection between R&D and production
Risk -> “Innovate There/Produce There”

- IT goods can sever R&D/design & production
  - Electro-mechanical-aero-pharma-capital goods– tie R&D/production– variables too complex

RISK → “Innovate There/Produce There”

Underlying all this: Competing with low cost/wage high tech competitors: must have production productivity gains

That means new innovation req’d: new technology and processes

That means an advanced mfg. R&D agenda
Behind it all: Understanding the Hourglass --

<---- Resources, Suppliers, Components, Innovation

<---- Production (12m jobs)

<---- Distribution, Sales, Life Cycle
An Energy Innovation Wave? -
-Underlying ISSUE

- The scale of technology investment …
US Public and Private Trends in Energy R&D

U.S. Energy R&D Spending vs. Price of Crude Oil

US Energy Budget vs. the Price of Crude Oil

Chart 3-5

Federal investment in energy R&D and other non-defense R&D

 Millions of dollars


Energy R&D

Other non-defense R&D

“Energy” includes Energy (270) plus DOE portion of General Science (251) budget functions. Actual dollars, not adjusted for inflation.
US Private Energy Sector R&D Investment Compared to that in Sectors with Significant Innovation:

**Innovating industries** -
- The biotech industry invests 39% of annual revenue,
- pharmaceuticals invest 18%,
- semiconductors invest 16%.

**Established industries:**
- electronics industry invests 8% of sales
- auto industry invests 3.3%.
- all U.S. industry average: 2.6%
- **Energy Sector** – below 1% (‘88-’03 – Nemet & Kammen ‘07)
Chart 3-6
Top ten nations in terms of clean energy investment (2010)

- **China**: $54.4 billion
- **Germany**: $41.2 billion
- **United States**: $34.0 billion
- **Italy**: $13.9 billion
- **Rest of EU-27**: $13.4 billion
- **Brazil**: $7.6 billion
- **Canada**: $5.6 billion
- **Spain**: $4.9 billion
- **France**: $4.0 billion
- **India**: $4.0 billion

Energy as an Innovation Wave:

- Energy –
- If it is the next innovation wave, are we making the investments we need to make to lead it?