The Global Innovation Imperative

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Current Global Mega-Challenges

- Fostering Economic Growth through Innovation
  - Driving domestic Growth and Employment
- Developing New Sources of Energy
  - Commercializing renewable alternatives to oil
  - Increasing the capacity to fuel growing global demand for electricity
- Addressing Climate Change
  - Growing a Green Economy; A major Growth opportunity
- Delivering Global Health
  - Transforming large investments in research to affordable and personalized treatment and care
- Improving Security
  - Through all of the above
- Addressing these Global Challenges requires Innovation

Other Countries are taking up this Challenge

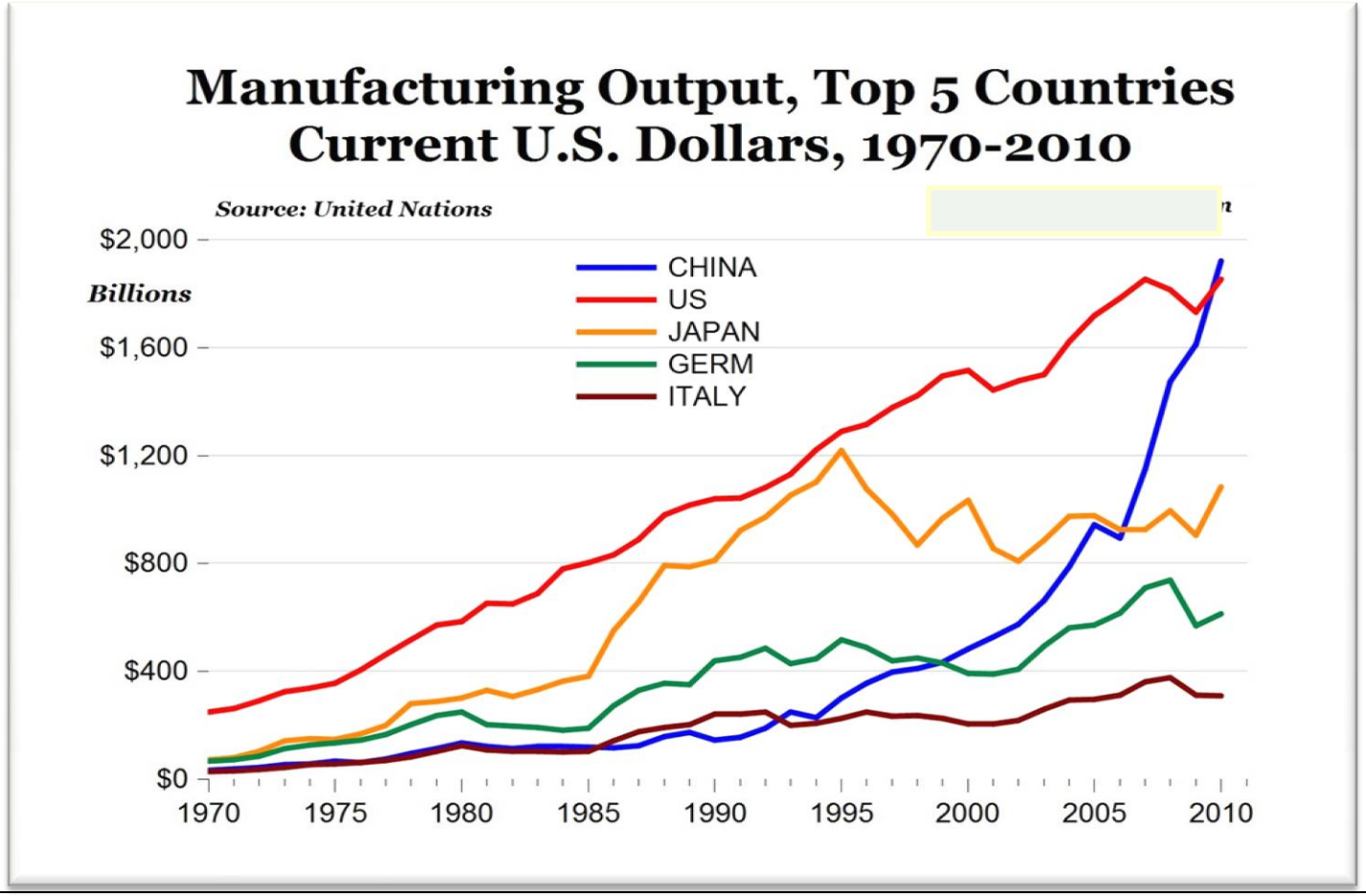
- They are Providing Five Key Areas of Support:
  - High-level Focus on Growth and Strength
  - Sustained Support for Universities
  - Rapidly Growing Funding for Research
  - Support for Innovative Small Businesses
  - Government-Industry Partnerships to bring new products and services to market
- They are investing very substantial resources to create, attract and retain the industries of today and tomorrow.

China's Goal: To Become an "Innovation-Driven Economy" by 2020

- Boosting R&D Investments
  - Expenditure on basic research doubled between 2004 and 2008
  - Tax incentives for enterprises that invest in R&D
- Building first-world R&D Infrastructure and Facilities
- Developing World Class Universities
  - Investing in Higher Education at Record Levels
- Building Innovation Clusters though the development of large S&T Parks
- Acquiring technologies and talent from abroad

Source: Mu Roping, 2010 UNESCO Science Report

China's Rapid Rise to No.1 in Manufacturing

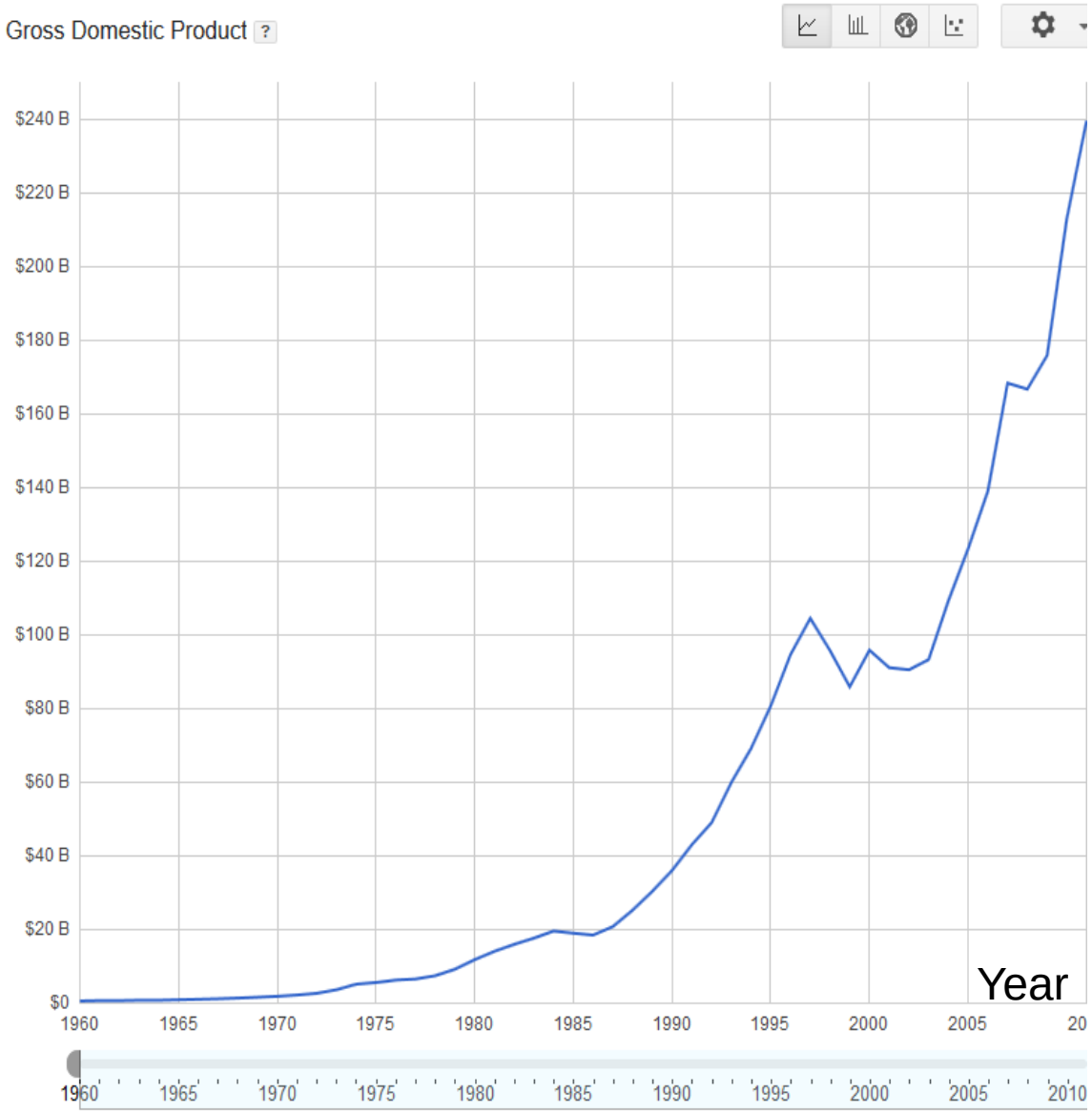


Its not just Size but Focus!
Singapore's Innovation Strategy

- Singapore (population: 4.5 million) goal is to be Asia's preeminent financial and high-tech hub. (GNP is $240 Billion)
- Government investing $12.8 billion under the Research, Innovation and Enterprise 2015 plan
- A*STAR's task, with $5 Billion in funding, is to:
  - Attract a skilled R&D workforce
  - Draw major investments in pharmaceuticals and medical technology production
  - Invest in S&T Parks: Biopolis & Fusionopolis
  - Focus on funding for Early-Stage firms (SBIR)

Singapore's Remarkable GDP Growth:

The Focus Pays off



Germany is Investing for the Future

- Germany's Federal and State Governments to raise spending levels for education and research to 10% of GDP by 2015.
  - Education: 7%
  - Research: 3%
- New High Tech Strategy 2020 seeks to
  - Create lead markets in Germany
  - Intensify cooperation between science and industry
  - Improve the framework conditions for innovations, including the climate for start-ups
- Ongoing focus on manufacturing

Germany's Innovation Strategy focuses on Manufacturing

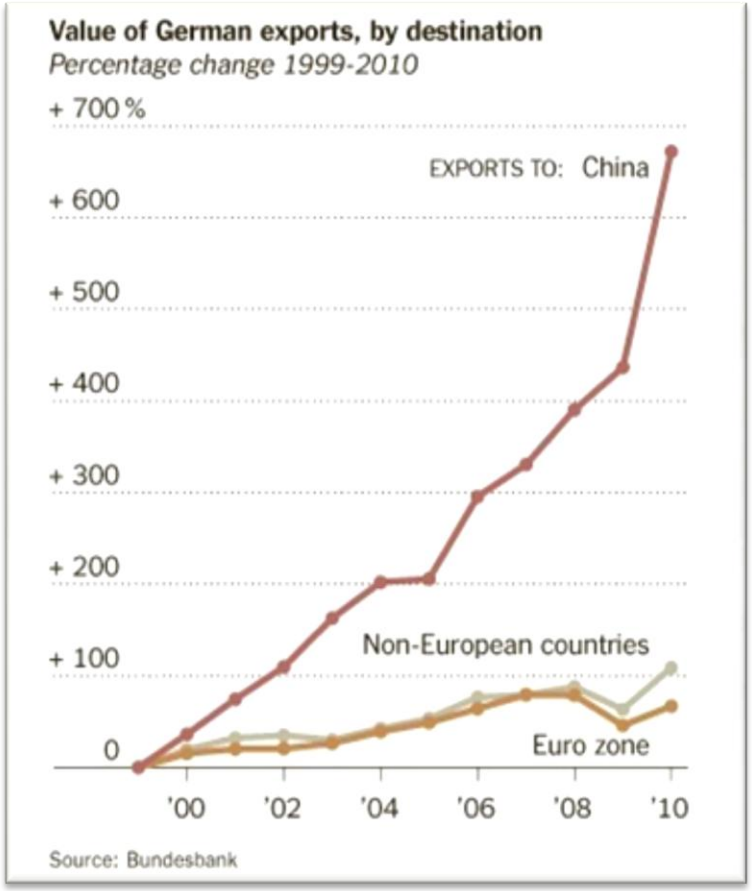
- Germany is a high-wage, highly-regulated, high-tax, unionized developed economy
- Factors behind Germany's manufacturing success*
  - Support for "traditional" industries: Cars, Machines, and Chemicals
  - Focus on niche markets for high value products
  - Continuous vocational training for workers
  - Manufacturing firms enjoy stable access to finance
  - Support for applied research in cooperation with companies
  - Well funded export promotion programs

*Susan Helper et al., "Why does Manufacturing Matter?" Brookings, 2012

The German Fraunhofer Institutes

- Stable and well-organized system of 60 research institutes with 18,000 employees
  - Located next to or on Universities
- Sustained and substantial investment:$2.5 billion/yr
  - State and federal contributions (~80%) plus contributions from industry fees
- Focus on applied research, incremental improvements with market orientation
- Builds a skilled work force closely engaged with industry, with theoretical and practical skills
- Outstanding brand; incremental product innovation

German Exports to China Soar



"Germany's economic fortunes have become linked to China's; exports to the country were worth €65 billion last year, more than double the 2007 level." --Financial Times, April 20, 2012

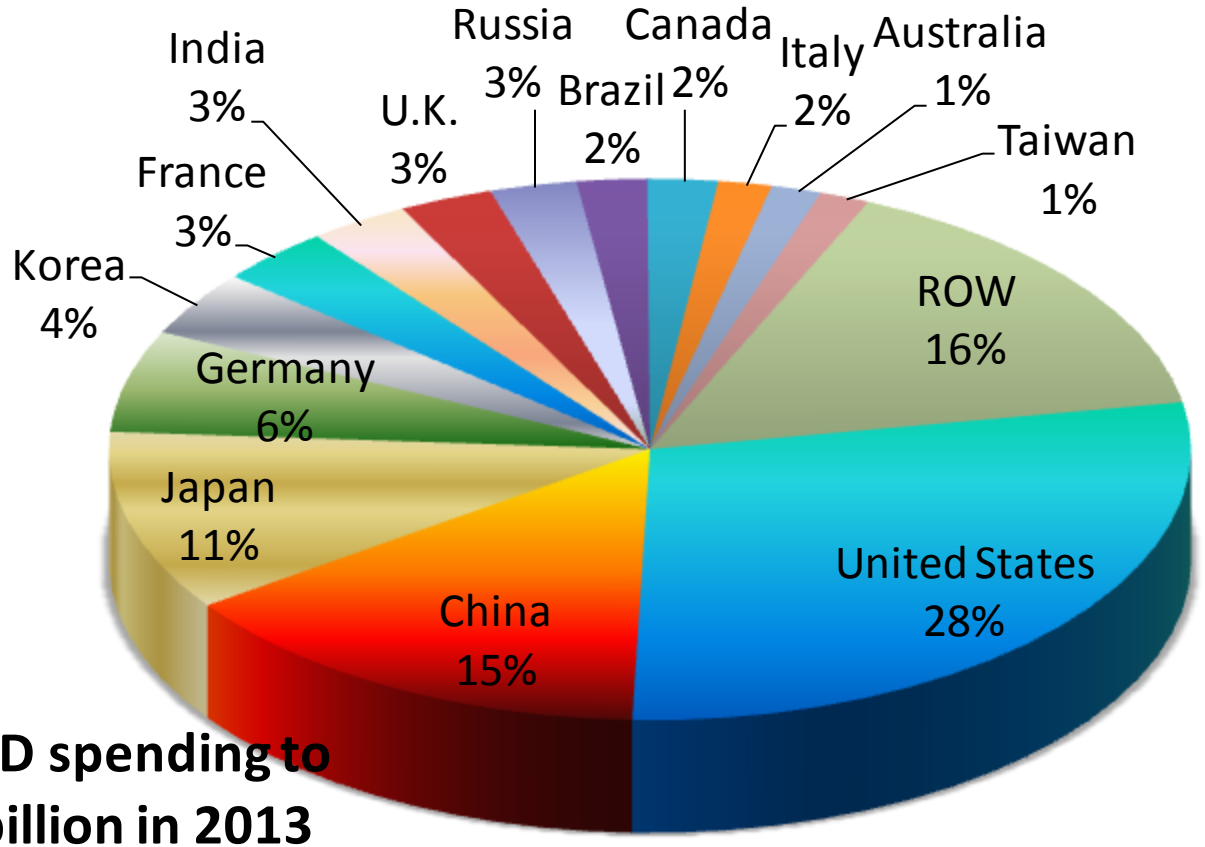
Innovation in the United States

Strengths and Challenges

Traditional Pillars of the U.S. Innovation System

- Research Universities: some with a culture of innovation and commercialization
- Strong Private Sector R&D
- Federal Support for Basic Research: Sustained and Substantial
- Public-Private Partnerships for the Development of New Technologies
- Small Business Entrepreneurship and laws that nurture it
- Top-flight Talent: from the U.S. and from around the world: importing talent is a key U.S. advantage

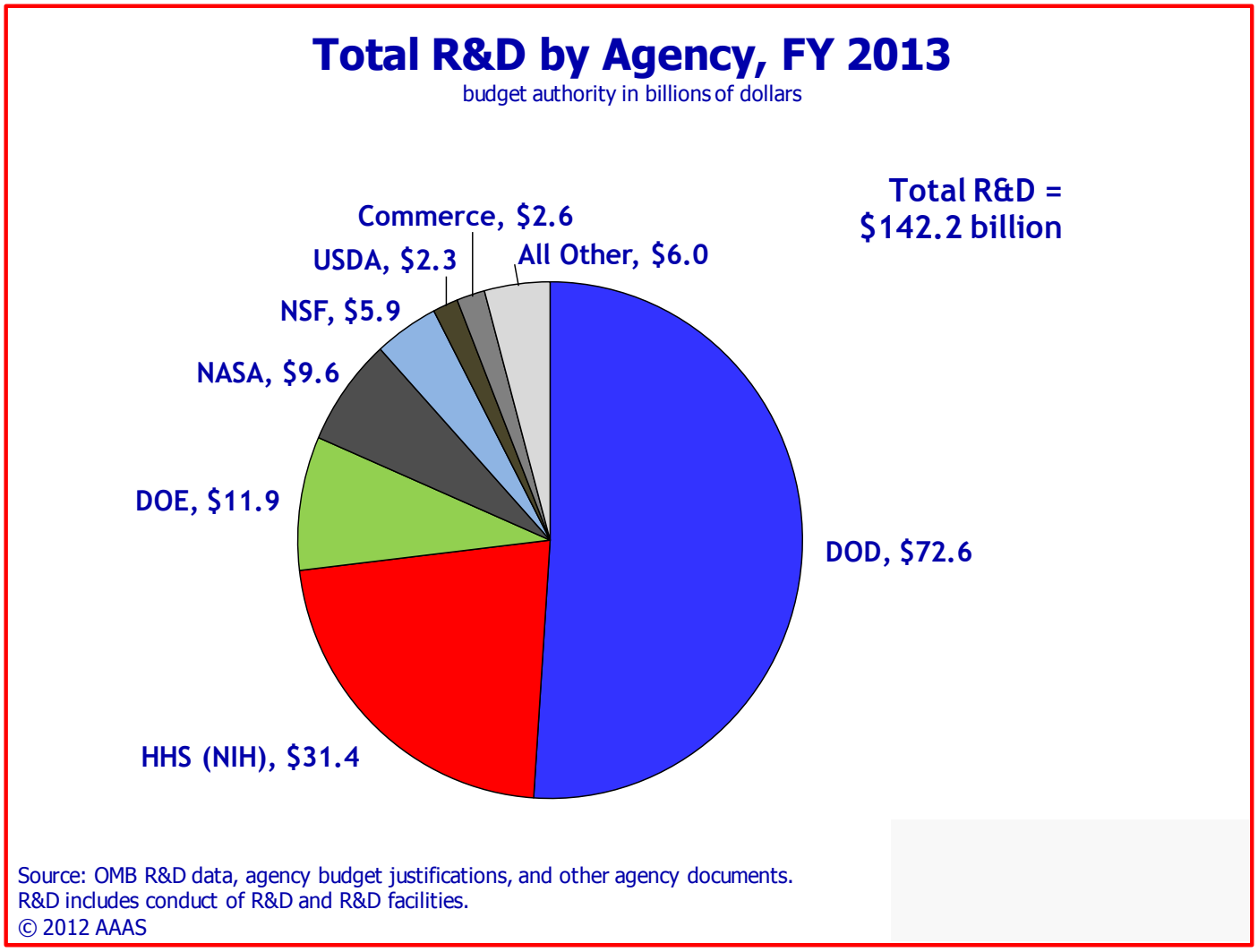
The U.S. has a Large Share of Global R&D



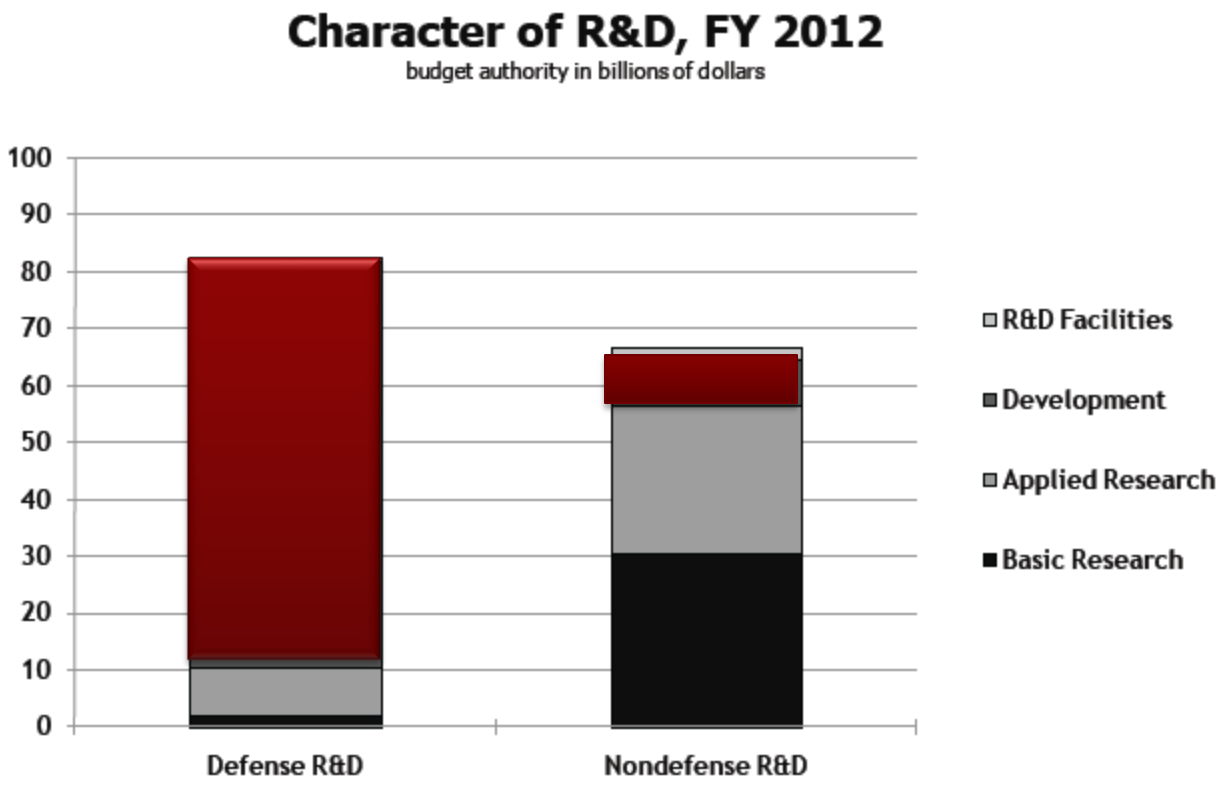
Total global R&D spending to reach $1,496 billion in 2013

SOURCE: Battelle and R&D Magazine, *2013 Global R&D Funding Forecast* (December 2012).

DoD R&D Budget is ~50%



But ~90% of Defense R&D Spending is for Weapons Systems Development



Source: OMB R&D data, agency budget justifications, and agency budget documents.
Defense R&D = DOD + DOE defense.

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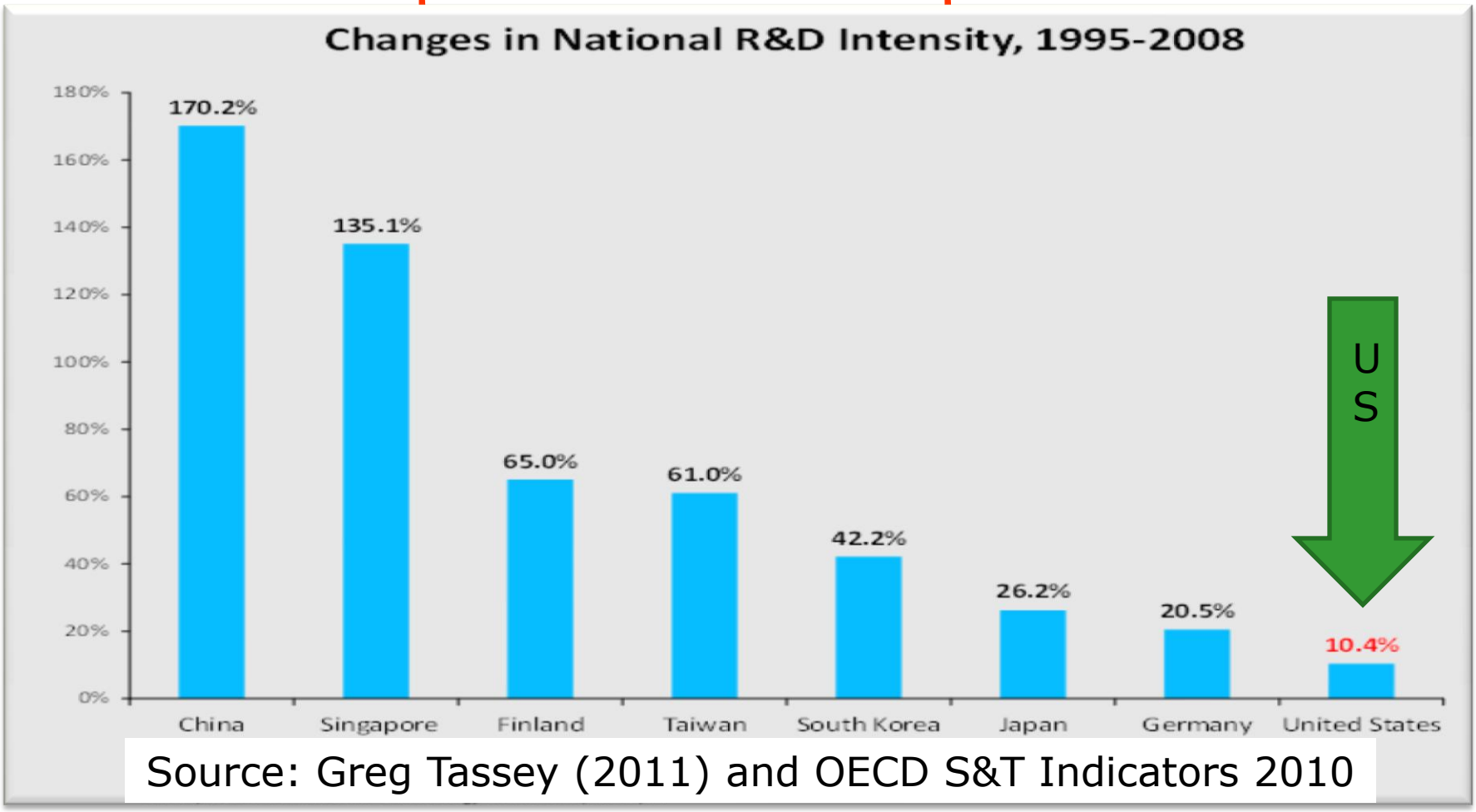
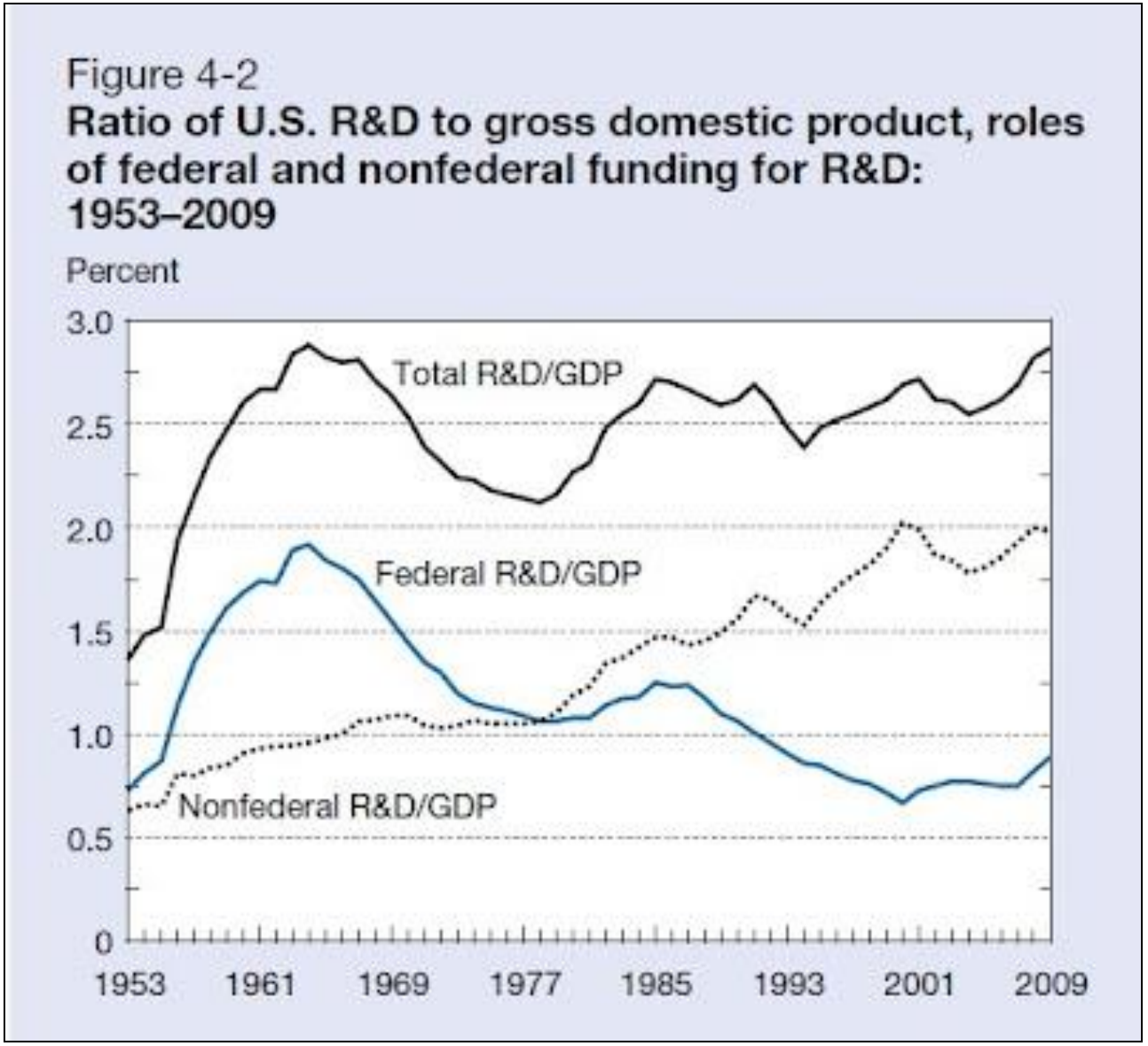
Low Growth for U.S. R&D Compared to Competitors



Source: Greg Tassey (2011) and OECD S&T Indicators 2010



Federal R&D Spending: A Declining Share of GDP

Source: NSF S&E Indicators 2012

The Major Risks to the U.S.

- Complacency about our competitive position
- Focus on current consumption rather than investment for the future
  - A lack of investment in R&D on the scale of our fathers and our competitors
- Limited attention to the composition of the economy, including trade and investment policy

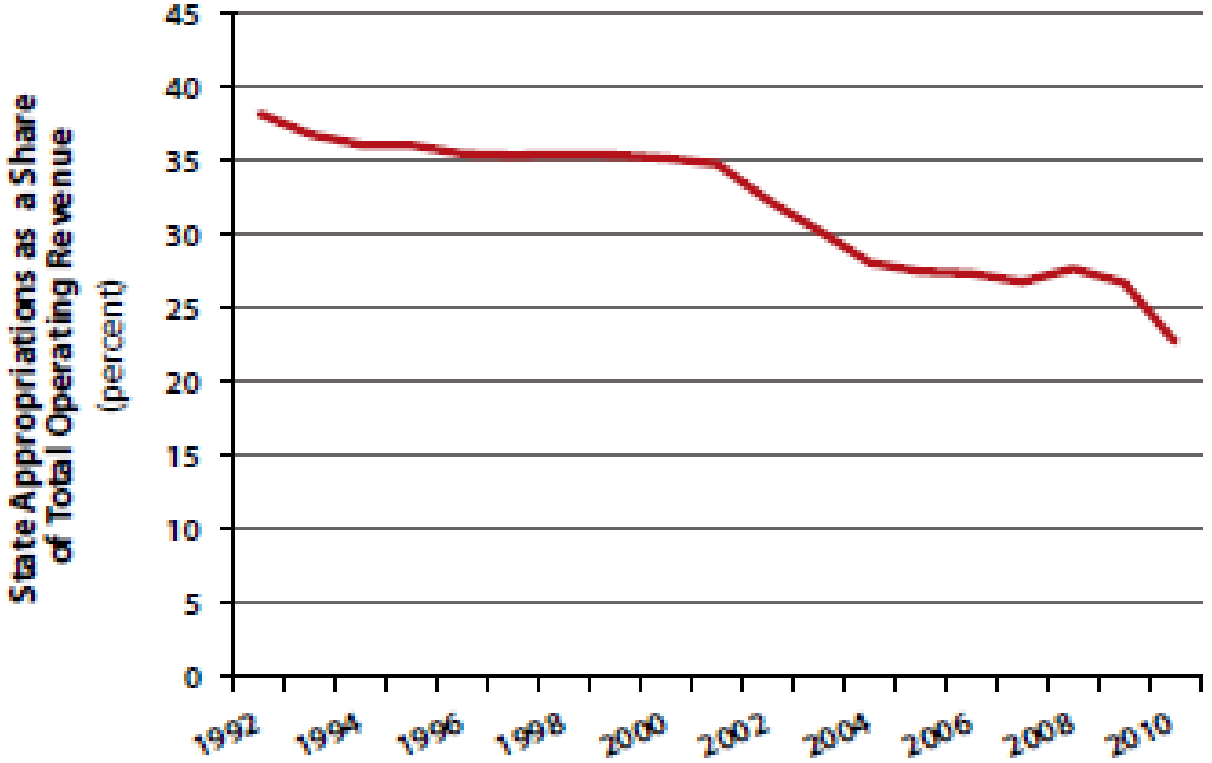
We are investing less in the front end

Falling Support for U.S. Universities

Falling Support for U.S. Universities: Less Funding and More Regulations

- Per-student funding for major public research universities has dropped by 20 percent during the past decade (NSB,2012)
- At the same time, U.S. Research Universities face a growing regulatory burden.
  - Source: NRC, *Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security,*2012.
- These developments are undercutting a principal pillar of the U.S. innovation system.

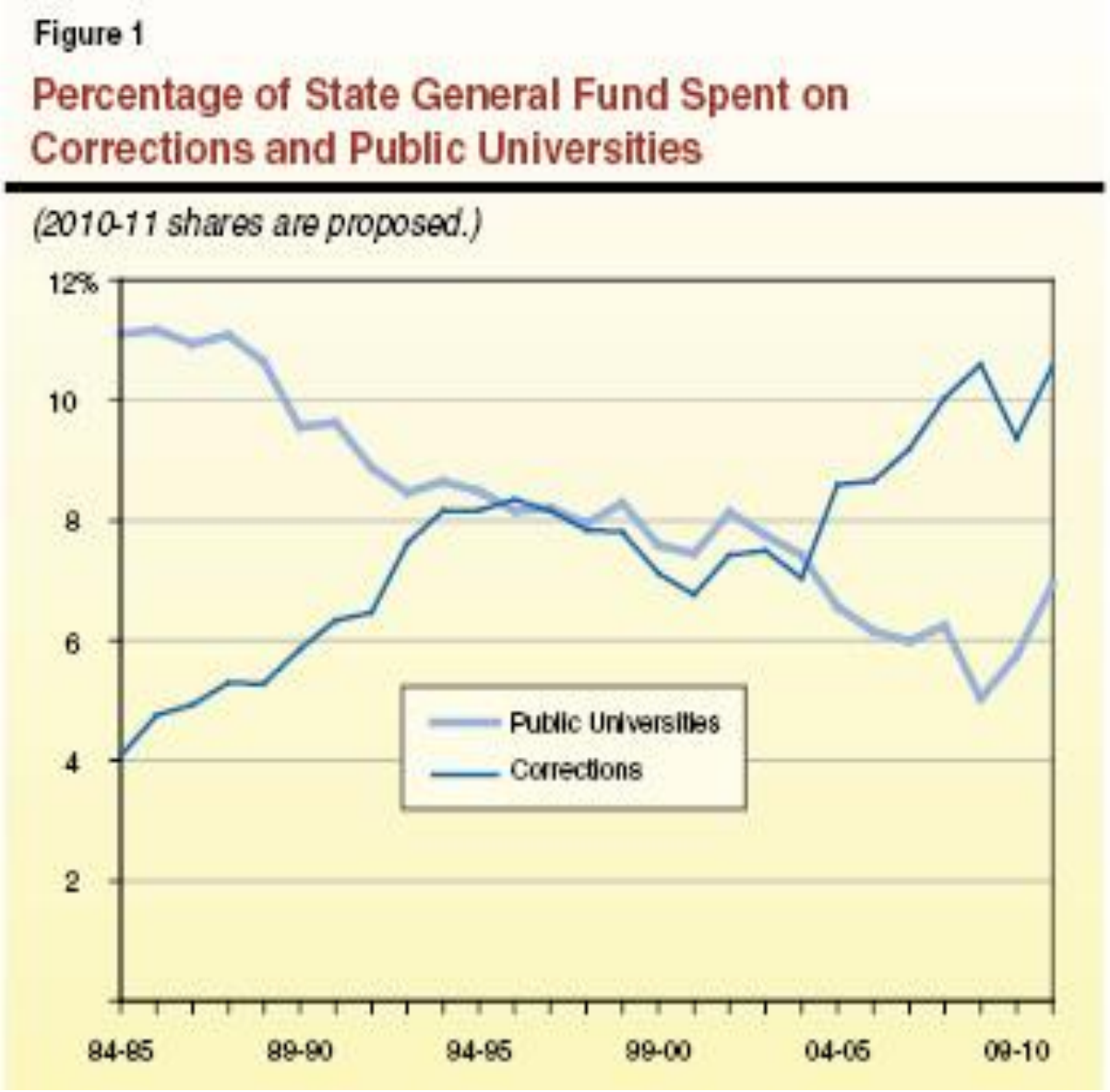
Impact of Cuts in State Funding for Public Research Universities



State Appropriations as a Percentage of Public Research Universities Total Operating Revenue, 1992 to 2010
Source: Trends and Challenges for Public Research Universities, NSF, 2012

What are California's Priorities?

More for Prisons, Less for Universities



Impact of the Sequester on R&D

- First Year Impacts: $12.1 billion reduction in federal FY 2013 R&D funding (AAAS Estimate)
  - NIH expects $1.6 billion to be cut from an annual budget of about $31 billion.
  - NSF expects to make 1,000 fewer grants this year than the 11,000 it typically makes.
  - Universities are admitting fewer graduate students this year because of the fiscal uncertainty.
    - Source: Washington Post, March 17, 2013, "Sequester cuts university research funds"
- Primary concerns are long-term resetting of federal funding at a lower baseline, with negative impact on the future of U.S. competiveness.

We are also capturing less of the value of our investments in research

A Shrinking Manufacturing Sector Poses Major Risks for U.S. Innovation

Why does Manufacturing Matter?

- An important Source of Employment
  - Manufacturing supports an estimated 18.6 million jobs in the U.S.—about one in six private sector jobs
- Manufacturing dominates the U.S. Innovation System
  - 70% of industrial R&D, 80% of patents, employs 64% of scientists and engineers
- An essential element in U.S. National Security: Having on-shore production capacity matters

Source: National Association of Manufacturers, 2009

A Robust Manufacturing Sector Promotes Growth, Competitiveness and Trade

- Fosters Economic Growth
  - U.S. manufacturing produces $1.7 trillion of value each year
- Improves Competitiveness and Expands Trade
  - It provides goods for export, and the currency earnings that come with exports to maintain national economic independence

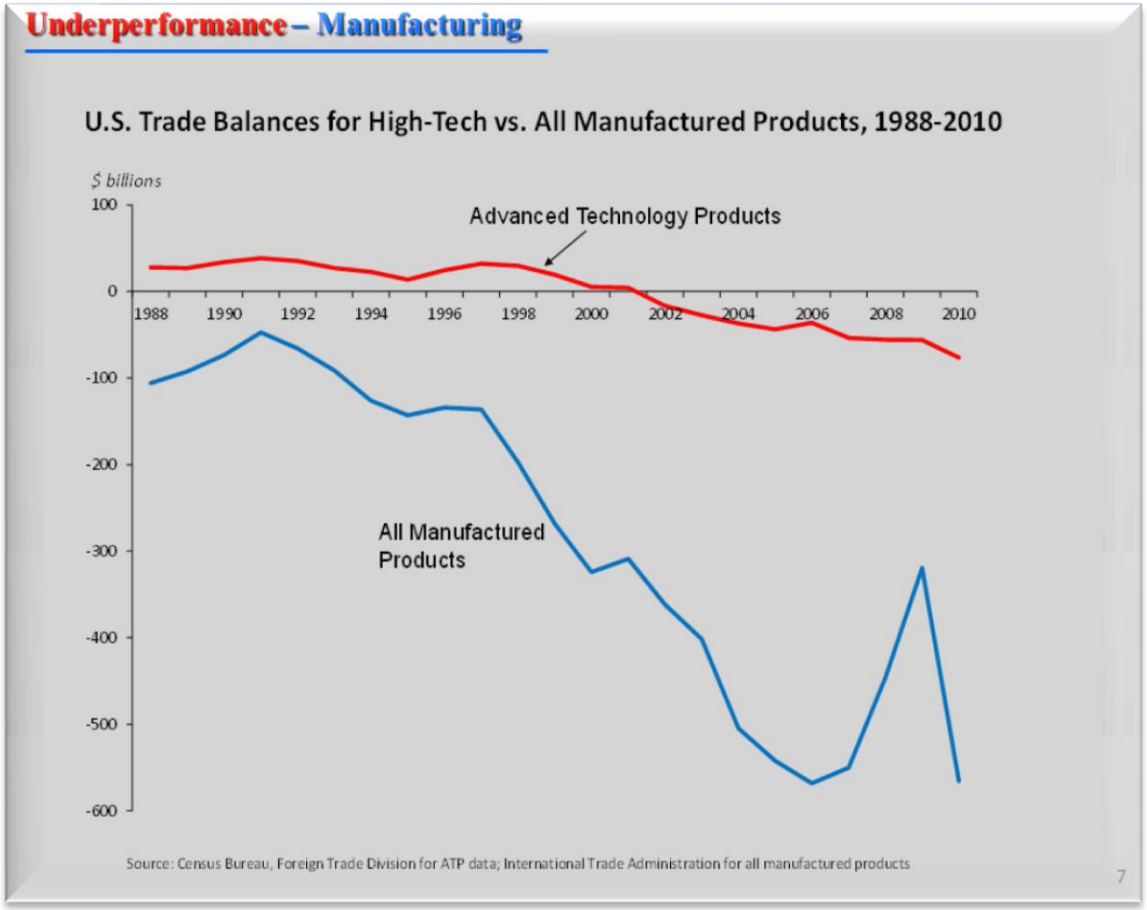
Sources of the Flight of Manufacturing

- Decline of vertically integrated industries*
  - The great new American companies of the past 30 years like Dell, Cisco, Apple, and Qualcomm have little or no manufacturing in-house.
- Focus on "Core Competence"*
  - Higher stock market valuations of leaner, "asset-light" companies led firms to move outsource and offshore manufacturing.
- The NAS: Growth in Capabilities Overseas**
  - Rapid Growth of Skills, R&D, and Government Support have Created Substantial Manufacturing Capabilities Overseas.

* Suzanne Berger et al., Production in the Innovation Economy, MIT, 2013

** NRC, Rising to the Challenge; U.S. Innovation Policy for the Global Economy, 2012

Result: Declines in U.S. Trade Balance for Manufactured Products



Erosion of America's high-tech manufacturing base can undermine U.S. leadership in next-generation technologies.

N.Y. based Manufacturing is Closely Linked to U.S. based Innovation

- Anchoring more production onshore gives:
  - More high paying, quality jobs
  - Applied Research geared to Industrial Needs
  - Local Production and Local Learning
  - A Healthy and Reliable Supply Chain
  - Synergies for further innovation
- Research, Training, Expertise, Supply Chain, and Tax Revenues are all Linked to a Dynamic Manufacturing Base

The View from MIT:

"The loss of companies that can make things will end up in the loss of research that can invent them."

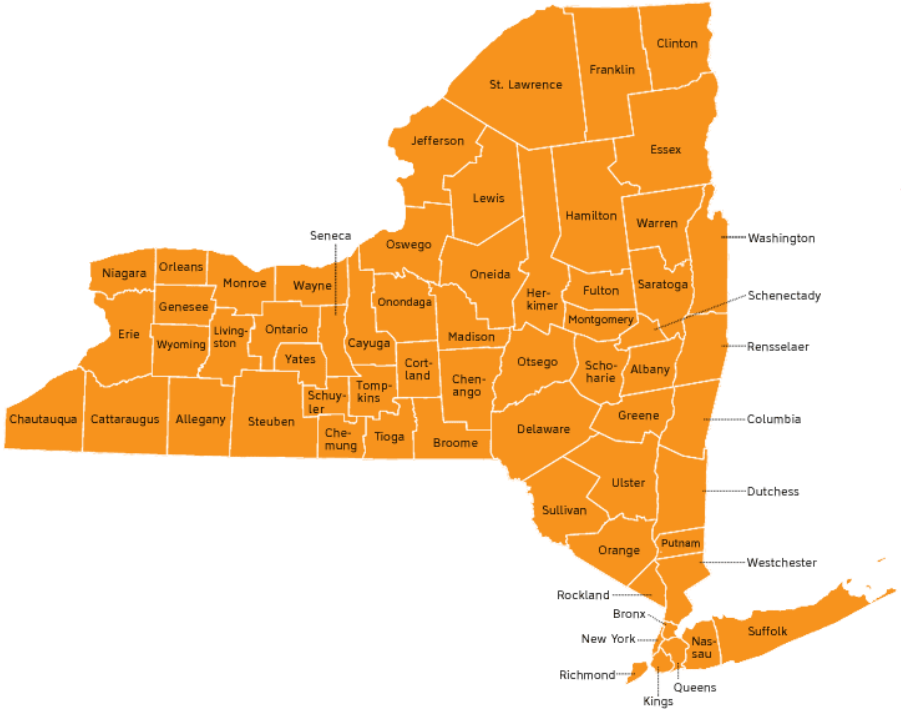
Suzanne Berger et al.,

Production in the Innovation Economy

Preview of MIT's major new report on Manufacturing Released, February 22, 2013, at the National Academies

The U.S. needs to be an Attractive Location for R&D and Manufacturing

- The Results of Research are Mobile: They can be—and are being—exploited around the world.
- Attracting Private R&D: Governments around the world are employing a host of measures (e.g., market access, quality research) to attract Corporate R&D Centers.
- Tax and Regulatory Policy Matter: Many governments have active programs to attract and retain manufacturing, and the jobs, growth, and security they bring.



How is New York Addressing the Innovation Imperative?

Population: 19.6 Million
Gross State Product: $1.156 Trillion

New York's Nanotechnology Initiative

- Substantial and sustained state investments are fostering research, investment, manufacturing, and jobs focused on nanotechnology and semiconductor manufacturing
  - Public-private research programs
  - New Institutions, Academic programs, and new Workforce
  - State-of-the-art research laboratories

Characteristics of the Albany Model

- Inspired Leadership, at Multiple Levels:
  - Initiative was launched by Governor Pataki, but has subsequently been strongly supported by Governor Andrew Cuomo.
  - IBM, CNSE, GlobalFoundries
- Shared Investments in Facilities:
  - Joint investment by the state and IBM of the world's only university-based 300-millimeter semiconductor wafer fabrication facilities and clean room attracted other microelectronics firms to Albany
- Training a new Workforce
  - In 2004, SUNY at Albany launched the College of Nanoscale Sciences and Engineering (NanoCollege) to train a specialized nanotechnology work force

Best Practice Features of the NY Nano Cluster

- Bipartisan Support → Sustained, Substantial Funding
- New Institutions focused on cutting edge technologies
- Enlightened, Entrepreneurial Leadership
- Public-Private Partnerships –the initial effort, later Sematech – Shared Equipment
- Inward Investments for the Supply Chain
- Major Manufacturing Investment: Global Foundries

Payoffs for New York

- Establishment of a globally recognized center in a key enabling industry
- Billions in investment have been drawn into the state
  - Companies such as IBM, AMD, Applied Materials, and Tokyo Electron are making significant investments in the region.
- Economic Activity and High Value Jobs are moving to New York State
  - 2500 jobs were created at SUNY at Albany alone
  - New economic activity is driving the revitalization of downtown Schenectady, Albany, and Troy.

How must the United States Respond to the Innovation Challenge?

A New National Academies Report,

"Rising to the Challenge"

identifies key goals for the U.S.

Support the Pillars of Innovation

- R&D Investment as a share of global R&D is shrinking
  - Federal spending on basic research as a percentage of GDP is stagnant, falling in real terms
  - Raise and sustain federal support for R&D
- University Funding
  - U.S. universities face severe cutbacks by state governments
  - China, India, Germany, Singapore, and Taiwan are among those spending billions to expand and upgrade their university systems.
  - Sustain support for university research
    - Provide support for basic and applied research
    - Connect universities to industry, and vice-versa, such as through the Focus Programs

Support Public-Private Collaboration

- We need to capture greater value from public investments in research through partnerships and more applied research
  - Strengthen university links to industry
  - Develop public private partnerships to facilitate learning, cooperation, and competitive clusters
  - Expand support for innovations in manufacturing that overcome low wage competition

Improve the Competitiveness of Tax and Regulatory Environment

- Ensure that the tax and regulatory frameworks support corporate investment, maximizing competitive advantage.
  - Regularly benchmark tax policies and regulatory costs against those of other nations.
  - Make the tax credit for research & experimentation larger and permanent.
  - Reduce corporate taxes where appropriate and review greater reliance on consumption taxes.
- Public investment needs support as well

Monitor and Learn from what the Rest of the World is Doing

- Benchmark best practices to adopt and adapt new programs and practices
- Engage and cooperate abroad, e.g., health policy
- Actively counter the negative impacts of mercantilist policies
- Respond and adapt at home with sustained investment and policy focus

The Innovation Imperative: What are the Stakes?

- Jobs: Jobs for our graduates, and faster growth and greater prosperity for our children and grandchildren.
- Security: Our continued leadership in science, technology, and innovation is the foundation of our national security .

Thank You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