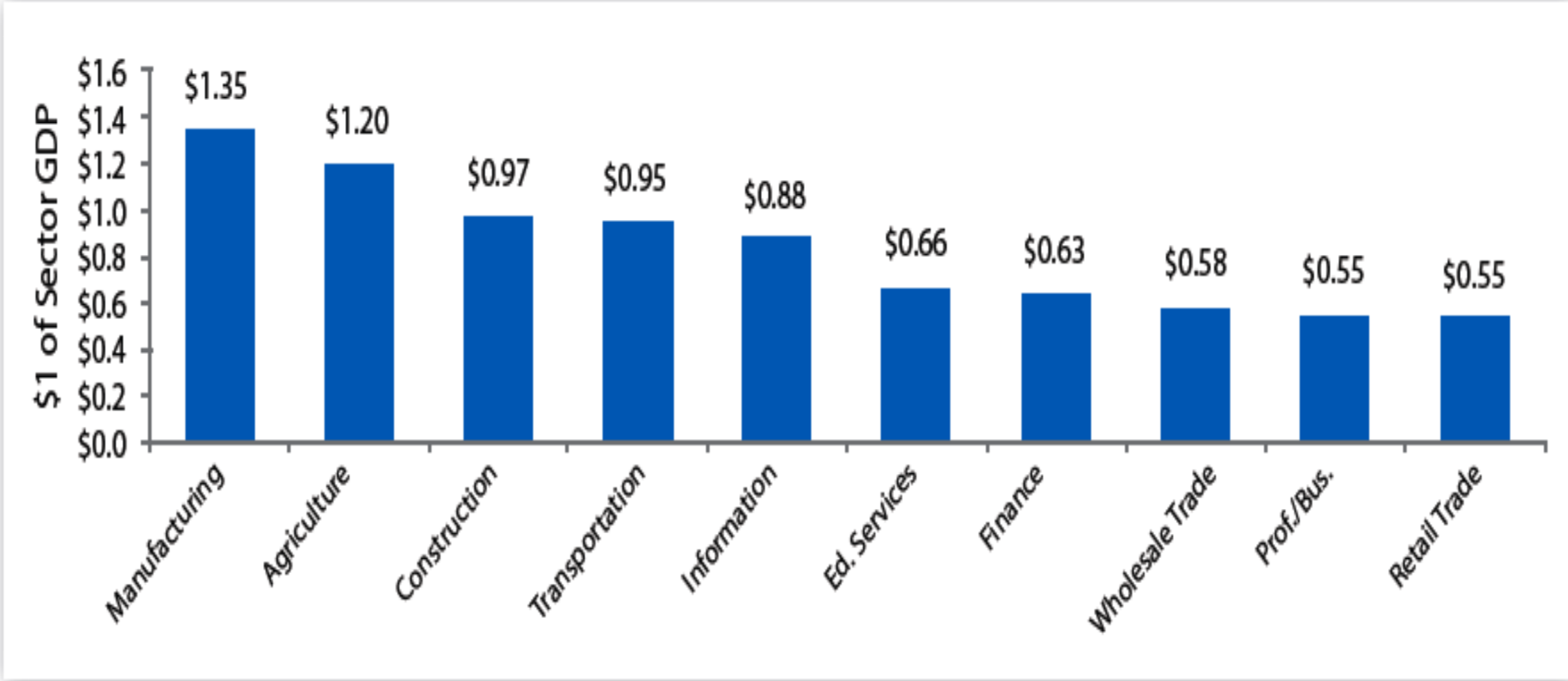
Capturing Domestic Competitive Advantage in Advanced Manufacturing

Martin Schmidt-MIT
Theresa Kotanchek-Dow Chemical

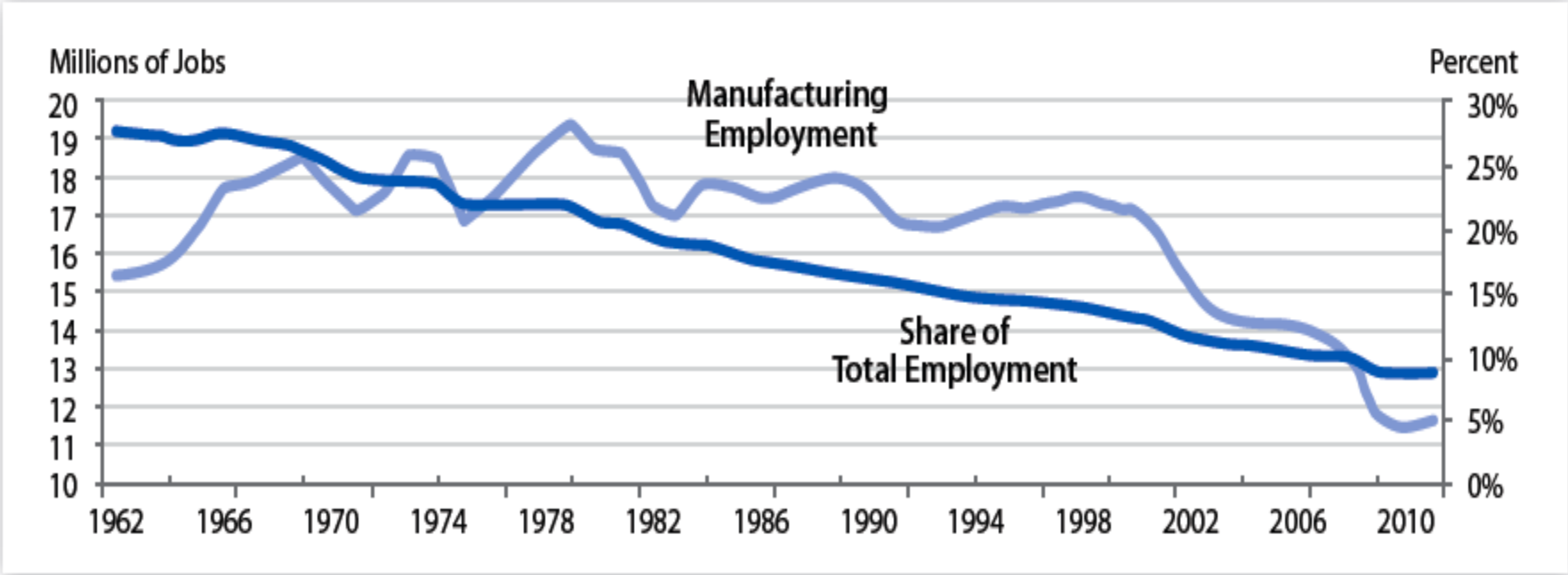
Manufacturing's Multiplier Effect

Economic Activity Generated by $1 of Sector Output



Source: Bureau of Economic Analysis, Input-Output Tables; www.bea.gov/1Table/indes_industry.cfm

Employment Trends



Source: Bureau of Labor Statistics, Current Employment Statistics, 1962-2010; www.bls.gov/ces/tables,htm#ee

World Manufacturing Output

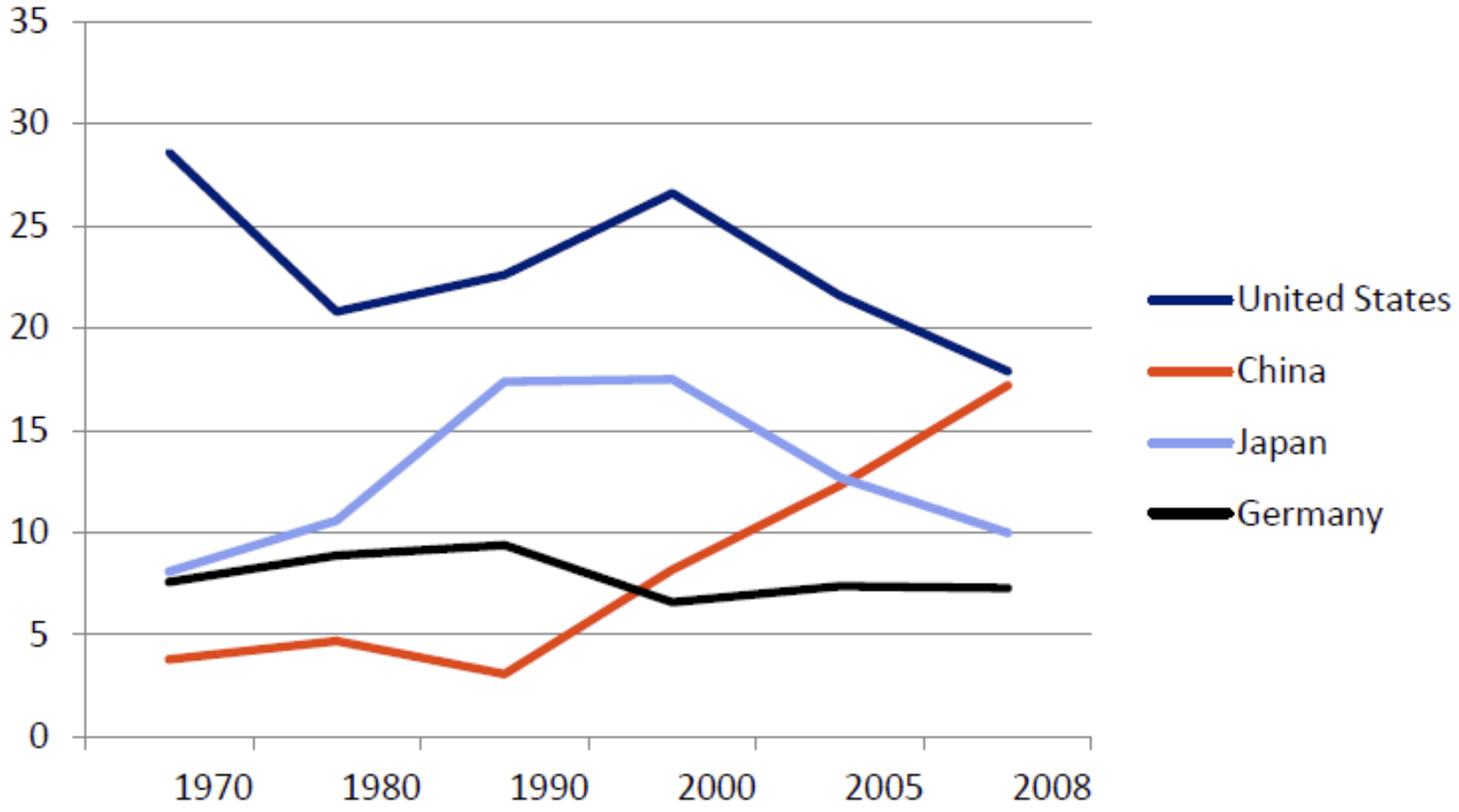
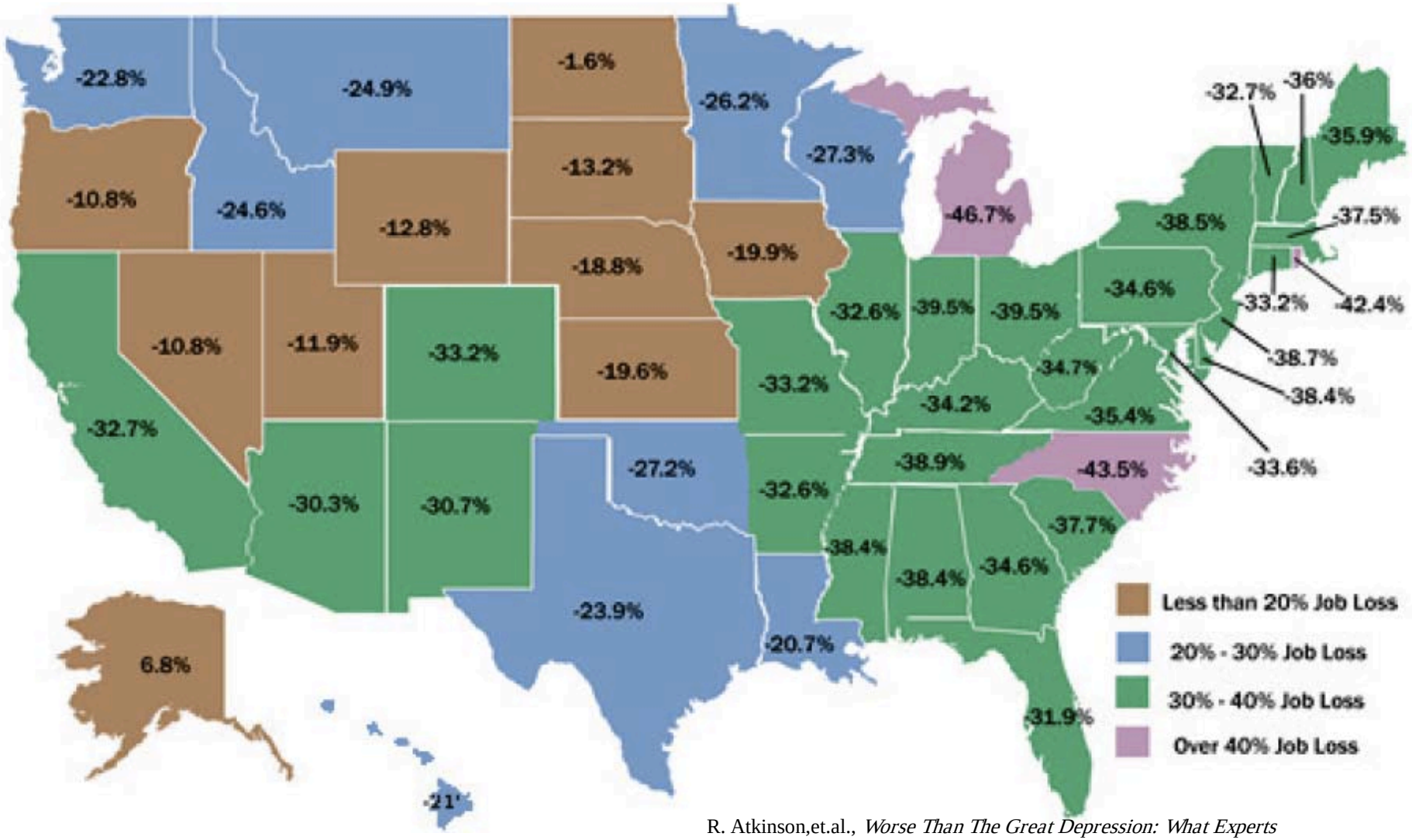


Figure 8: Select Country Share of World Manufacturing Output, 1970-2008[75]

Percentage Loss in Manufacturing Jobs: 2000-2010

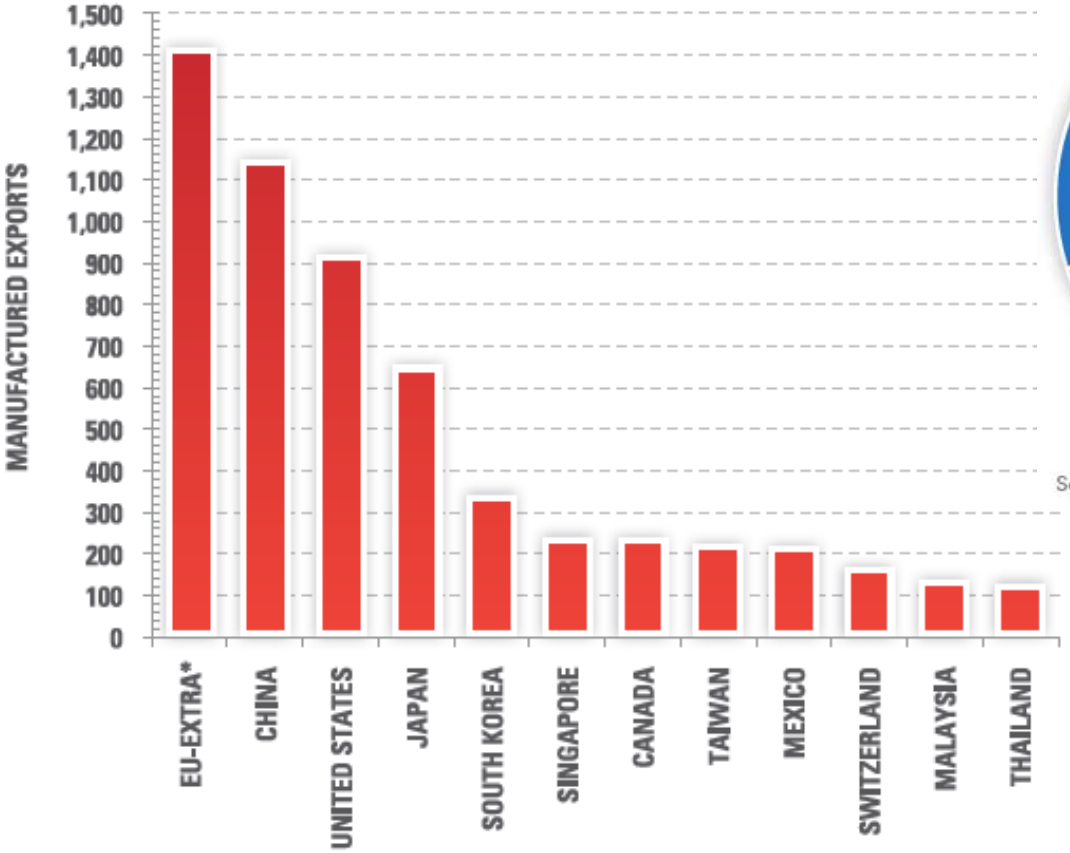


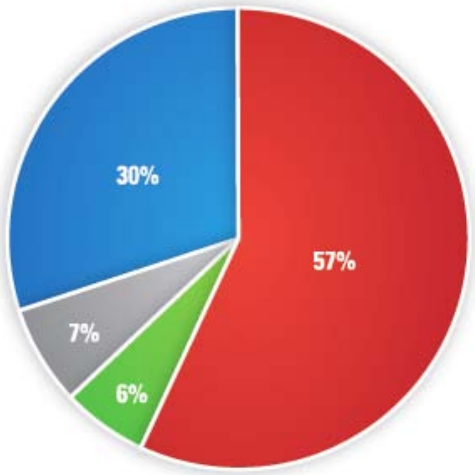
R. Atkinson,et.al., *Worse Than The Great Depression: What Experts Are Missing About American Manufacturing Decline*, ITIF, March 2012

US #3 Manufacturing Exporter
Manufacturing Dominates US Exports

FIGURE 15.

(2007, $BILLIONS)





Source: U.S. Bureau of the Census, 2008

Year	US/China Export Ratio
2000	300%
2012	72%

*"Extra" means exports to nonmembers.

Total EU exports, including to other members, was $4,249 billion.

Source: WTO, International Trade Statistics

US Trade Balance

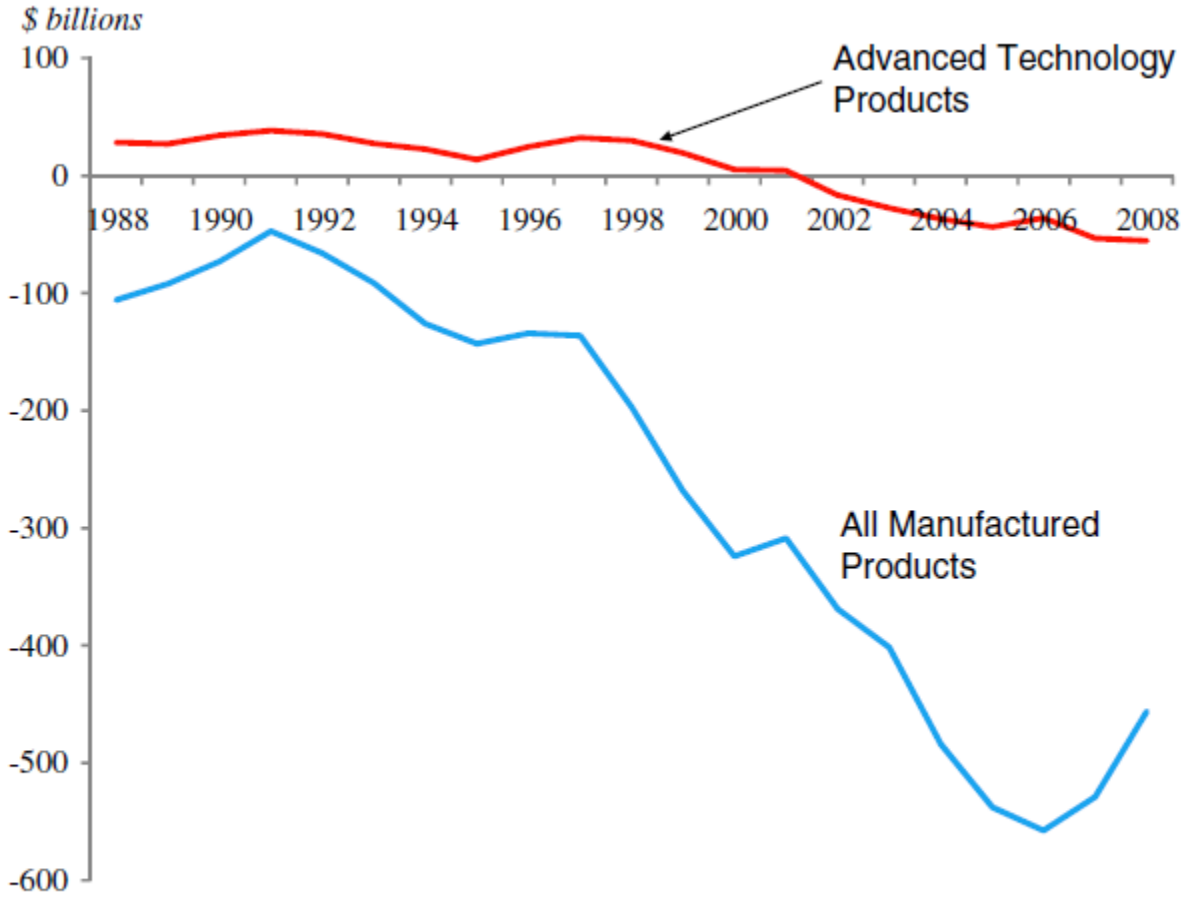


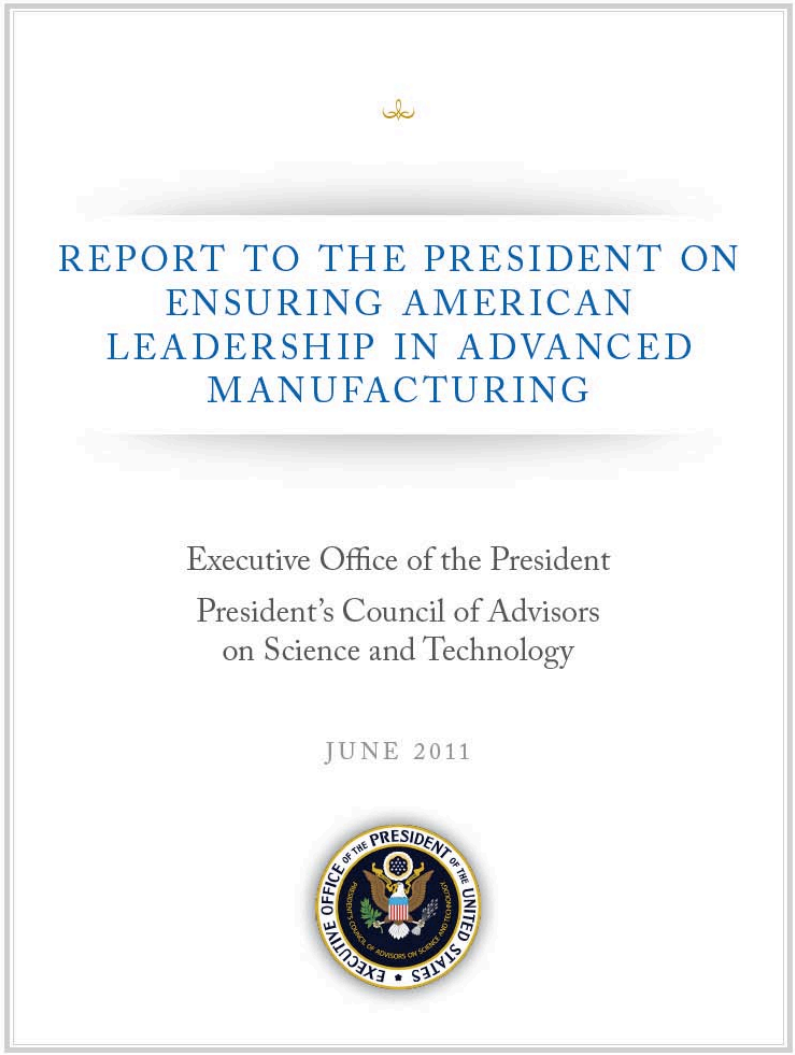
Fig. 1 US trade balances for high-tech and all manufactured products. *Source*: Census Bureau, Foreign Trade Division

Relationship Between R&D Intensity and Output Growth

Industry (NAICS code)	Average R&D intensity, 1999–2006	Percent change in real output, 2001–2006
R&D intensive		
Pharmaceuticals (3254)	10.3	38.3
Semiconductors (3344)	9.8	19.7
Medical equipment (3391)	8.1	39.2
Computers (3341)	6.3	83.9
Group Ave	8.6	46.6
Non-R&D intensive		
Machinery (333)	3.8	12.3
Electrical equipment (335)	2.5	-6.3
Plastics & rubber (326)	2.3	4.6
Fabricated metals (332)	1.4	7.8
Group Ave	2.5	4.6

G. Tassey, J. Technol Transf (2010) 35:283-333

Why Should We Care?



U.S. should strive to revitalize advanced manufacturing because:

- **Jobs**: Manufacturing provides high-quality, good-paying jobs for American workers.
- **Innovation**: By keeping manufacturing local, design, engineering, scale-up, and production processes feed back on the conception and innovation sectors to generate new ideas and novel second- and third-generation products.
- ***Security****: Domestic manufacturing capabilities using advanced technologies and techniques are vital to maintaining national security and critical resources.*

Advanced Manufacturing

AMP Mission Statement

The Advanced Manufacturing Partnership identifies collaborative opportunities between industry, academia and government that will catalyze development and investment in emerging technologies, policies, and partnerships with the potential to transform and reinvigorate advanced manufacturing in the U.S.

AMP Outcomes

1. Develop a permanent model for evaluating, prioritizing, and recommending federal investments in advanced manufacturing technologies
2. Recommend a set of 'partnership projects', focused on advancing high-impact technologies and creating models for collaboration that encompass technology development, innovation infrastructure, and workforce development
3. Provide recommendations to the Administration on the actions required to support investment in advanced manufacturing in the U.S.

Advanced Manufacturing: What is it?

Advanced Manufacturing involves the manufacture of conventional or novel products through processes that depend on the coordination of information, automation, computation, software, sensing, and networking, and/or make use of cutting edge materials and emerging scientific capabilities.

– **From PCAST REPORT**

AMP Steering Team

Industry	University	Government
Allegheny Technologies	University of California, Berkeley	OSTP
Caterpillar	Carnegie Mellon	Department of Commerce
Corning Glass	Georgia Tech	Department of Defense
Dow Chemical	MIT	Department of Education
Ford	University of Michigan	Department of Energy
Honeywell	Stanford	Department of Labor
Intel		National Economic Council
Johnson & Johnson		National Science Foundation
Northrop Grumman		
P&G		
Stryker		
United Technologies		

Advanced Manufacturing Work Stream Objectives

Work Stream	Objectives
Technology Development	• Determine a permanent mechanism to be used for identifying and developing key manufacturing technologies • Determine a set of top technology areas that would ensure U.S. manufacturing competitiveness
Shared Infrastructure & Facilities	• Assess opportunities to de-risk, scale-up and lower the cost of accelerating technology from research to production through unique capabilities and facilities that serve all U.S. based manufacturers, in particular small and medium sized manufacturers
Education & Workforce Development	• Identify tangible actions that AMP can implement to support a robust supply of talented individuals to provide human capital to companies interested in investing in advanced manufacturing activities in the U.S.
Policy	• Make recommendations to the Administration on economic and innovation policies that can directly impact the overall climate and the ability to improve research collaboration and the pathway to commercialization in support of U.S. based manufacturing and jobs
Outreach	• Conduct stakeholder outreach and reviews • Conduct & consolidate findings of regional meetings

AMP in Action

- **Four Regional Meetings**

  ~ 1200 attendees

- **Work Stream Outreach**
  - Surveys through NAM, NCMS, MAPI and APLU
  - Interviews with leaders at Department of Labor, SBA, Veterans Associations, Community Colleges, Manufacturing Institutes, and Technical, Education, Labor & Policy Subject Matter Experts
- **Targeted Outreach**
  - Trade Groups: NAM, Sematech, US Chamber of Commerce, NCMS
  - Capitol Hill: Ryan & Manzullo of House Manufacturing Caucus, House & Senate Committee Staffs
  - Agencies: DOE, DOD, NSF, DOL

AMP 'Top Line' Recommendations

http://www.whitehouse.gov/administration/eop/ostp/pcast

- **Enabling Innovation**
  - Establish a National Advanced Manufacturing Strategy
  - Increase R&D Funding in Top Cross-Cutting Technologies
  - Establish a National Network of Manufacturing Innovation Institutes
  - Enhance Industry/University Collaboration in Advanced Manufacturing Research
  - Foster a Robust Environment for Commercialization of Advanced Manufacturing Technologies
  - Establish a National Advanced Manufacturing Portal
- **Securing the Talent Pipeline**
  - Correct Public Misconceptions about Manufacturing
  - Tap the Talent Pool of Returning Veterans
  - Invest in Community College Level Education
  - Develop Partnerships to Provide Skills Certifications and Accreditation
  - Enhance Advanced Manufacturing University Programs
  - Launch Advanced Manufacturing Leadership Fellowships & Internships
- **Improving the Business Climate**
  - Enact Tax Reform, Streamline Regulatory Policy, Improve Trade Policy; Energy Strategy

Enabling Innovation:
National Advanced Manufacturing Strategy

Need:

- Establish US as a global advanced manufacturing leader

Recommendation:

- Establish 5 year National Advanced Manufacturing Strategic Plan
- Utilize to prioritize technologies, programs & public-private partnership investments

Who:

- Advanced Manufacturing National Program Office coordinates and aligns interagency programs
- Industry+University+Government Agencies partner to develop, manage & execute the plan

Permanent Mechanism: The Technology Lifecycle Process

Create National Strategy & Objectives

- Prioritized list of strategic needs and required technologies

Create Technology Roadmaps

- Technology roadmaps for each of the prioritized technologies

Create and Manage Programs

- Technology programs established & executed

Review Progress and Correct Course

- Periodic review of program portfolio by key stakeholders

Framework for Identifying, Prioritizing, and Developing US Advanced Manufacturing Technologies

Recommended Criteria for Assessing & Prioritizing

- National Strategic Needs
  - Defense Security
  - Energy Security
  - Food Security
  - Health Security
  - Homeland Security
  - Economic Security
- Global Market Demand
- US Industry Competitiveness
- Technology Readiness

The significance of national need, size of global market opportunity & state of technology readiness determines the scale & role of Industry-Academia-Government partnerships

Enabling Innovation:
Top Cross-Cutting Technologies

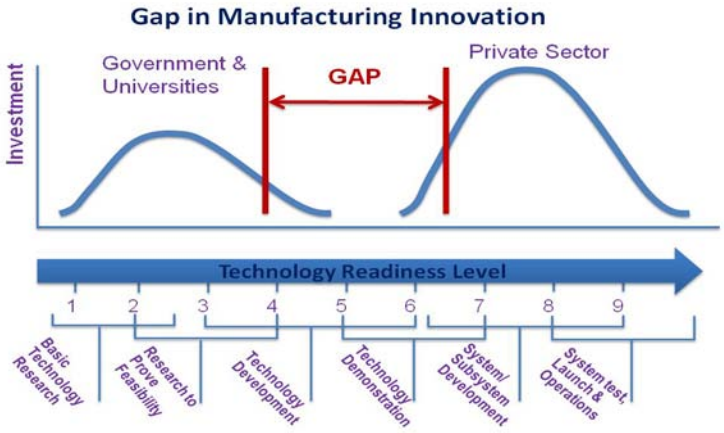
Establish partnerships in top cross-cutting technologies:

- Additive Manufacturing
- Advanced Forming and Joining Technologies
- Advanced Materials Design, Synthesis and Processing
- Advanced Sensing, Measurement, & Process Control
- Visualization, Informatics and Digital Manufacturing Technologies
- Sustainable Manufacturing
- Nano-Manufacturing
- Flexible Electronics Manufacturing
- Bio Manufacturing and Bioinformatics
- Advanced Manufacturing & Testing Equipment
- Industrial Robotics

Enabling Innovation
Manufacturing Innovation Institutes

Need:

- Expedite filling existing technology and workforce development gaps through network of shared facilities



Recommendation:

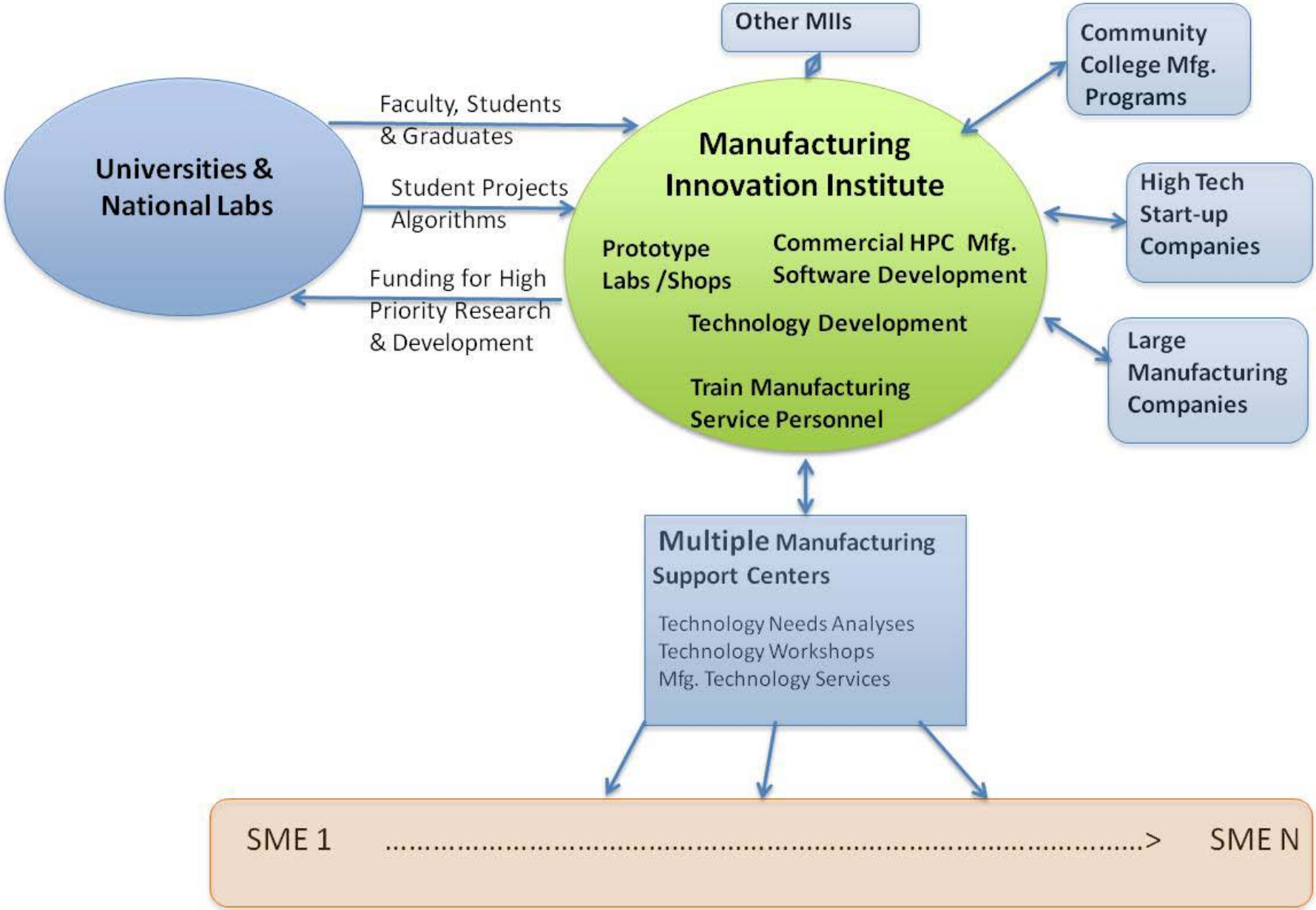
- Establish a network of Manufacturing Innovation Institutes

Who:

- Federal, State and Regional Agencies Sponsor
- Industry-University- Community Colleges Manage & Lead
- Advanced Manufacturing National Program Office coordinates

Enabling Innovation

Manufacturing Innovation Institutes



Additive Manufacturing Innovation Institute

Energy Department's Assistant Secretary David Danielson announcing the selection of the National Institute for Additive Manufacturing in Youngstown, Ohio. *Photo credit:* Advanced Manufacturing National Program Office (AMNPO)

$30 MM Federal + $40 MM Partners

- 40 Companies
- 9 Universities
- 5 Community Colleges
- 11 Non-Profits

Enabling Innovation

- **Enhance Industry/University Collaboration in Advanced Manufacturing Research**
  - Create Waiver or Exception to Revenue Procedure 2007-47 To modify tax policies which prohibit greater industry investment & partnership with nations top universities
- **Foster a Robust Environment for Commercialization of Advanced Manufacturing Technologies**
  - Create new section of SBA Small Business Innovation Research Program to support early stage funding activities
  - Extend nation-wide work of NSF created 501(c)3 Innovation Accelerator to support startups emerging from federal advanced manufacturing programs
  - Clear pathway from startup to pilot scale production by greater interagency coordination & procurement
  - Incorporate manufacturing impact measures into annual performance reports issued by Association of University Technical Managers
- **Establish a National Advanced Manufacturing On-Line Portal**

Securing the Talent Pipeline

- **Image of Manufacturing: Ad Council Campaign**
  - A national campaign with local flavor to correct public's misconceptions from "Dull, Dirty & Dangerous" to "Exciting, Engaging, Essential & Environmentally Sustainable"
- **Tap the Talent Pool of Returning Veterans**
  - Use the TAP program to educate veterans about the career possibilities
- **Invest in Community College Level Education**
  - Standardized national curricula with project-based learning, internships and apprenticeships. Use partnerships with industry to achieve maximum results
- **Adopt Stackable Credentials**
  - Adapted to life-long learning, these credentials give employers a sense of the candidates' competencies & are recognized nationally.
- **Improve University Programs**
  - Engage ABET & Universities to add manufacturing content to engineering programs and create new degrees at BS, MS, and PhD levels
- **National Manufacturing Fellowships & Interns**
  - Establish coordinated interagency fellowship program

Improving the Business Climate

- **Tax Reform**
  - Strengthen & Make Permanent R&D Tax Credits
  - Lower corporate tax rate to bring it line with other advanced economies
  - Create an internationally competitive corporate tax system
- **Smarter Regulations**
  - Early Engagement & Better Cost-Benefit Analyses using Best Available Science & International Best Practice
- **Trade Policy**
  - Focus on non-tariff barriers and export control standardization
- **Energy Policy**
  - Focus on energy efficiency & conservation
  - Increase and diversify domestic supplies
  - Speed the development of cost competitive, renewable sources of energy
  - Transition to low carbon economy

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Advanced Manufacturing Summary

- AMP recommendations aim to re-invent manufacturing in a way that ensures our global competitiveness, feeds our innovation economy & grows a robust domestic manufacturing base.

- The recommendations focus on our future & the opportunity to lead the world in new disruptive advanced manufacturing technologies which are changing the face of manufacturing and in which the inherent strengths of US's innovation economy can be brought to bear to create new opportunities for making things in America.

- We—industry, academia, communities and Federal, State & Local governments—must unite to ignite our ingenuity to make it in America.