

**Spring 2008
Industry Study**

**Final Report
*Manufacturing Industry***



The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-5062

MANUFACTURING 2008

Abstract: America remains the world's leader in manufacturing, both in output and in productivity. In fact, the U.S. accounts for more than a quarter of all global output. That said, there are serious fault lines running through the sector that, if left unaddressed, could erode America's current dominance and harm the nation's long-term economic health. Manufacturing is also critical to our national security, as the relative health of our defense industrial base ensures our military has the right resources to prevail when the need arises. The health of these defense-related firms is intrinsically tied to the continued evolution and success of U.S. manufacturing.

In 2005, the U.S. manufacturing sector, in terms of GDP, was close to \$1.5 trillion. If the U.S. manufacturing sector was a country by itself, it would be the eighth largest economy in the world. Simply put, manufacturing matters – it creates jobs and raises productivity which, in turn, gives us higher standards of living. Manufacturers improve our quality of life, and create a multiplier effect that benefits other economic sectors: for each dollar of final demand in manufacturing, \$1.37 of additional goods and services are needed to support that demand.

The resiliency and robustness of the U.S. manufacturing sector belie the fact that it faces many serious long-term challenges. These challenges to the sector, if left unaddressed, could erode America's ability to maintain our way of life, influence its future and guarantee the national security. The included paper is a proposed letter to the incoming President on what those challenges are and policy recommendations to attend to these issues.

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Mr. Ladislao Carballosa, Department of Justice
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Professor Gerald Abbott, Lead Faculty
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CORPORATE & GOVERNMENTAL INTERACTION

DOMESTIC

Hughes Network Systems, MD
Lockheed-Martin, Crystal City, VA
BAE, Rosslyn, VA
Volvo Powertrain North America, MD
New Concept Technology, York, PA
National Center for Defense Manufacturing and Machining, Latrobe, PA
JWF Industries, Johnstown, PA
Hamill Manufacturing, PA
RLW, PA
APEX Design, PA
Kennametal Inc., Latrobe, PA
Impact Innovative Products, PA
Lockheed Martin Aeroparts Inc., PA
Oberg Industries, PA
Latrobe Specialty Steel, Latrobe, PA
RNDT Inc., Johnstown, PA
Advanced Skills Center, York, PA
New Concept Technology, York, PA
New Standard Company, York, PA
Pennsylvania Dept. of Community & Economic Development, Harrisburg, PA
Advanced Conversion Technology, Harrisburg, PA
Manufacturers' Association of South Central, York, PA
MANTEC, Inc., Harrisburg, PA
PA Manufacturing Ombudsman, Harrisburg, PA
DuPont Spruance Plant, Richmond, VA
North Carolina Department of Commerce, Raleigh, NC
The Research Triangle Park, Raleigh-Durham, NC
GlaxoSmithKline, Raleigh, NC
Caterpillar Inc., Raleigh, NC
Semiconductor Research Corporation, Raleigh, NC
Tompkins Associates, Raleigh, NC

INTERNATIONAL

Dublin Institute of Technology, Dublin, Ireland
US Embassy, Dublin, Ireland
DAON, Dublin, Ireland
FORFAS, Dublin, Ireland
Science Foundation Ireland, Dublin, Ireland
Enterprise Ireland, Dublin, Ireland
Industrial Development Authority, Dublin, Ireland
Leinster House, Dublin, Ireland

IBM Ireland, Dublin, Ireland
Business Enterprise and Regulatory Reform, London, England
Ministry of Defense, London, England
Delegation Generale pour l'Armement, Paris, France
Organisation for Economic Co-operation and Development (OECD), Paris, France

SEMINAR BRIEFS

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23 May 2008

Manufacturing Study Group
Industrial College of the Armed Forces
National Defense University
Fort McNair, DC 20319

President of the United States
The White House
Washington, DC 20001

Dear Mr. President:

Despite public perceptions to the contrary, America remains the world's leader in manufacturing, both in output and in productivity. In fact, the U.S. accounts for more than a quarter of all global output. That said, there are serious fault lines running through the sector that, if left unaddressed, could erode America's current dominance and harm the nation's long-term economic health. Manufacturing is also critical to our national security, as the relative health of our defense industrial base ensures our military has the right resources to prevail when the need arises. The health of these defense-related firms is intrinsically tied to the continued evolution and success of U.S. manufacturing.

Given the challenge of maintaining America's competitive edge, nurturing its innovative spirit, and building a capable workforce, all in an increasingly interconnected global economy, our group has attempted to answer a fundamental question: Is government a help or hindrance to U.S. manufacturing?

Why it matters: Manufacturing has, from the very beginning, served as a vital cog in keeping the American economy strong and growing. As early as 1791, then-Treasury Secretary Alexander Hamilton deemed that manufacturing was critical to the "the independence and security of a country."

The United States is the world's largest producer of manufactured goods and leads the world in innovation. In 2005, the U.S. manufacturing sector, in terms of GDP, was close to \$1.5 trillion. In fact, if U.S. manufacturing was a country by itself, it would be the eighth largest economy in the world. Twenty-one different sectors and another 86 sub-sectors make up the manufacturing sector. Simply put, manufacturing matters – it creates jobs and raises productivity which, in turn, gives us higher standards of living (U. S. Department of Commerce 2004). Not only do manufacturers improve our quality of life, they also create a multiplier effect that benefits other economic sectors -- for each dollar of final demand in manufacturing, \$1.37 of additional goods and services are needed to support that demand.

Manufacturing's share of the economy, measured by GDP, has declined from more than 25 percent in the 1950s to 12 percent in 2005. One reason for this decline is that the economic recessions of the past 50 years have hit the manufacturing sector much harder than the rest of the economy. However, manufacturing still accounted for 15 percent of economic growth—real GDP adjusted for inflation—between 2001 and 2005.

What are the challenges facing U.S. manufacturing? The resiliency and robustness of the U.S manufacturing sector belie the fact that it faces many serious long-term challenges. In speaking with manufacturers and policy-makers, we have identified

five key areas where we believe prompt action is needed if the U.S. is to preserve and sustain its manufacturing dominance:

- **Fostering Innovation through Research and Development (R & D):** U.S. manufacturing relies on its ability to improve productivity through innovation in order to compete in the global marketplace. The government can and should encourage this process through tax incentives and direct assistance.
- **Educating Tomorrow's High-Skilled Workforce:** The U.S. is not training the next generation of engineers and scientists, which could weaken its ability to compete in the high-skilled manufacturing of the future. Investment in education now can help reverse this trend.
- **Sustaining America's Productivity Edge:** America's ability to outproduce its competitors, even while manufacturing jobs are shrinking, must be preserved and reinforced through a mixture of tax, employee benefit, and regulatory reform.
- **Building a More Balanced Trade Policy:** Free trade, while much disparaged, is the grease that sustains the global economic engine. We need a balanced approach to free trade that avoids protectionism and offers access to new markets.
- **Safeguarding Intellectual Property:** Counterfeiting and piracy siphon billions of dollars from the global economy and stymie the innovative process that fuels economic growth. Stronger interagency coordination, patent reform, and augmented enforcement can help ameliorate the impact of IP theft.

In the sections that follow, each of these issues will be discussed in greater detail, along with recommendations on what the government can do to ensure the long-term stability and strength of the U.S. manufacturing sector.

Finally, Mr. President, it is clear that manufacturing suffers from a serious image problem: productivity has never been stronger, yet many Americans buy into the rust belt mantra that manufacturing is drying up. Nanotechnology and other cutting-edge innovation are redefining the industry, yet most Americans still envision 1950's assembly lines and push their children to pursue other vocations. Good, well-paying jobs are readily available, but many manufacturers are still unable to attract employees with the requisite skills to perform. This is an industry that is critical to our economic well-being and our national security. We are convinced that prompt and persuasive leadership by our government can ensure it remains so for future generations of Americans.

Very respectfully,

Manufacturing Study Group

Science, Technology, Engineering and Mathematics (STEM) Education

Introduction

An important concern of the manufacturing sector is skilled employees. The comprehensive 2005 Skills Gap Report by Deloitte Consulting found that 81 percent of manufacturers are experiencing a moderate to severe shortage of qualified skilled labor (Deloitte, 2005). Many potential employees lack the knowledge required to manipulate the high productivity machinery used on the shop floor as their predecessors are beginning to retire in large numbers. Portions of the prospective labor force lack basic algebra, geometry, physics, and chemistry knowledge, limiting their ability to participate in the manufacturing industry. Without skilled laborers, manufacturing firms will be forced to turn away business. As President Bush stated in urging the reauthorization of the No Child Left Behind (NCLB) Act: “If this country wants to remain an economic leader in the world, we’ve got to make sure we have a workforce capable of filling the jobs of the twenty-first century” (Bush, 2007). Simply put, the insufficient skilled employee pool is impacting the output of the nation’s manufacturers.

The education system does not prepare its graduates to participate in the high performance economy of the United States. Some students are moving from elementary school to high school without a sufficient grasp of linear mathematics, physical science and phonics. Graduation criteria from high schools in some states do not require basic algebra. Fifty three percent of manufacturers believe that technical skills and basic employability skills (attendance, timeliness, work ethic, etc) will be needed for their employees over the next three years, followed by 51 percent believing that reading, writing and communication skills will be required (Deloitte, 2005). Even the United States military has taken to educating recruits possessing high school degrees in remedial mathematics and English courses so that they can serve effectively. In order to remain competitive in the global market manufacturers require new product innovation which is directly linked to having a high performance workforce (Deloitte, 2005). This high performance workforce requires production personnel who can innovate processes as well as scientists and engineers to conduct the basic research and develop the technologies that give birth to innovation.

Students in the United States are falling behind their contemporaries in other developed nations with regard to educational performance. The United States ranked 25th of the 30 Organisation [*sic*] for Economic Co-operation and Development (OECD) countries participating in the Programme [*sic*] for International Student Assessment (PISA) evaluation in mathematics and 27th in science (Organisation for Economic Co-operation and Development, 2007). A dearth of engineers and scientists participating in our economy will impede the manufacturing sector from the development and application of new and emerging technologies. The problems of today and the future regarding energy, nanotechnology, robotics, environment and healthcare in part require technical solutions. The current trend could prove dire for the future as losing our relative edge in technology has negative economic and national security implications.

Manufacturing’s image is partly to blame for the lack of development of the future work force. “Research has shown a direct relationship between manufacturing’s

negative image – which is tied to the old stereotype of the assembly line – and the decreasing number of young people pursuing careers in the industry” (Deloitte, 2005). Unless manufacturers can motivate future employees to educate themselves beginning at an early age, the workforce will continue to dwindle. Students will put the effort into the proper education and skills attainment if they believe their future in such an endeavor is bright.

In order to reverse the downward trend of skilled workers three steps must be taken. First, inform the public at large and students and their parents specifically of the benefits of a career in manufacturing. Second, develop a strong educational base with increased emphasis on mathematics and science to draw talent from. Third, enable communities and manufacturers to develop training systems for the development of marketable skills.

Policy Recommendations

Attract Employees – Today’s high school student is not persuaded to participate in the manufacturing sector. Information regarding manufacturing such as pay and benefits, required skills, performance, work conditions and job satisfaction is not getting to perspective employees, their parents, guidance counselors and educators. As manufacturers deem the low availability of qualified employees is at a critical level, they must take the lead in changing the perception of manufacturing and marketing their firms. Manufacturers are attempting to improve their image by efforts such as the National Associations of Manufacturers’ (NAM) “Dream It. Do It” campaign. Local manufacturing trade groups, manufacturing labor unions and their members could blitz their school districts with information, briefings and other forms of exposure. Hosting or judging grade school science fairs, sponsoring scientific or engineering competitions such as Battlebots IQ, giving tours and presentations to a Boy or Girl Scout troop, schools’ sports teams and educational clubs and Parent Teachers Associations are examples of efforts that would ferment support for participation in the manufacturing sector.

The government and private sector are addressing the issue of attracting future employees into the engineering and science programs. The American Competitiveness Initiative (ACI), which has been proposed by President Bush as part of the NCLB reauthorization (Domestic Policy Council, 2006) would increase financial aid for students pursuing math, science and engineering diplomas. Firms such as Exxon-Mobil, IBM and Raytheon have developed programs to incentivize and motivate students into pursuing careers in the sciences and engineering fields. Some private citizens have developed foundations to attend to the issue such as the Carnegie Foundation and the Gates Foundation.

Government should assist in the rejuvenation of science, technical, engineering and mathematics education by highlighting the success of the nation’s scientific, engineering and manufacturing efforts. The decades of the 1940’s through the 1970’s included the national goals to win World War II, develop nuclear power, win the Cold War and put a man on the moon and return him safely; all of which glorified the role of engineering and manufacturing. National efforts exist today, but citizens lack a clear vision of them, be they energy independence, healthcare or expansion into space for example. National, state and local governments should promulgate current needs and illuminate how science, engineering and manufacturing is meeting or could meet them.

Potential employees would be motivated in becoming part of a broader effort to meet the many challenges facing the United States.

Realign Educational Priorities - The education systems in the United States are not producing graduates with the skills required to compete in today's economy much less the skills for upward social mobility. In addition to the low PISA scores in mathematics and science, industrial arts programs are disappearing from high schools. The simplistic means which have been used recently to address the decline in education are not working: namely higher teacher pay, smaller classes and updated infrastructure, which have not led to a reversal in the performance of graduates. At the end of the 2004 through 2005 school year, national K-12 education spending increased by 105 percent since the 1991 through 1992 school year and total taxpayer investment education in the United States for the 2004 through 2005 school year was approximately \$536 billion. Despite a per-pupil funding increase of 20 percent, students continue to demonstrate disappointing performance (U.S. Dept of Education, 2007).

Per the Constitution of the United States, the primary responsibility of education is a role for the state, not the federal government (U.S. Dept of Education, 2007). If manufacturing is to influence the education system it must include a strategy to do so at the local and state levels. Manufacturers, either individually or through trade associations, must inform educational decision makers and stakeholders what they require from graduates to include basic employability skills such as attendance, punctuality and a developed work ethic.

The federal government should influence a shift in educational priorities to the sciences, engineering and mathematic areas through funding. Greater support for research opportunities has the benefit of accelerating innovation and enhancing education. Scholarships, grants and loans should be expanded for college level students wishing to pursue studies in the hard sciences, mathematics and engineering. It costs a university more to graduate an engineer than an accountant so policies should be developed and resources dedicated to schools that encourage engineering retention and graduation of highly qualified students. Government could assist universities with the means to adopt policies that retain students in the engineering fields, such as defraying some costs for extra semesters to gain sufficient credits, internship compensation and graduate and research grants.

Skill Development - While overall manufacturing jobs have declined since their peak in 1978 (Bivens, et al, 2003), high-skilled manufacturing job requirements have increased. Low- and mid- skill level manufacturing jobs are being replaced by capital, which leads to increased productivity. Many firms are turning down manufacturing business because they lack the skilled labor force to conduct the tasks.

In addition to addressing education requirements and recruitment issues, the manufacturing sector must develop the means to properly train their employees for the tasks of today and tomorrow. Examples of organizations that are successful in this role include Manufacturing Centers of Excellence such as the National Center for Defense Manufacturing and Machining, which optimizes manufacturing processes, and the Advanced Skills Center such as Pennsylvania's William F. Goodling Center, which trains

students in specific high skilled manufacturing tasks. Such facilities are few in number relative to need.

Government can assist in developing the proper skills by allocating resources to advanced skills facilities and manufacturing centers of excellence. These activities have an excellent business case, as they would provide the training for employees to gain and hold family sustaining jobs and increase the tax base as well as developing innovative manufacturing processes. Additionally, politicians should use their positions in the public light to emphasize the fact that high skilled manufacturing jobs are readily available. By accurately portraying the growth in highly skilled manufacturing jobs in their communities they could benefit their constituency by increasing worker productivity and the overall tax base.

Conclusion

Current educational policies and performance have not kept pace with the requirements to compete in today's global economy. With the impending retirement of the baby boomer generation – the most highly educated generation in U.S. history – coinciding with a decline in educational levels the country will see a drop in the average level of education in the U.S. This “would depress personal income levels for Americans, in turn creating a corresponding decrease in the nation's tax base” (National Center for Public Policy and Higher Education, 2005).

This nation must replace low-skilled labor with capital to remain competitive. Utilizing the capital at maximum productivity requires highly skilled employees while developing the breakthrough technologies that lead to innovation requires scientists and engineers. If the current generation wishes for the next generation the high standard of living that it enjoys it must take part in guiding and counseling today's students.

Research and Development

Introduction

Basic research focuses on the expansion of knowledge. This research and its associated funding is the hardest to quantify in terms of return on investment. The nature of scientific exploration lends itself to not only great opportunities but also to great likelihood of failure. While there is potential for economic spillover and application of discoveries that are positive, the economic return is not always initially clear. For these reasons, basic research does not attract a great deal of commercial investment. Government funding in basic research continues to be essential to academic, research institutes and laboratories and to the American industrial base.

Applied Research aims to link scientific knowledge to some practical purpose. This is an area of interest to both government and industry. The transition of science into commercially viable products can be an expensive endeavor. While the success rate is higher than that of basic research projects, failure remains a concern. Government programs encouraging, funding and/or incentivizing industry to bridge the gulf between research and practicality are in demand and serve national interests. Funding in this

arena could take a greater degree of industry cost share than basic research, but Government support continues to be essential.

Development receives the majority of both federal and industry's Research and Development (R&D) budget as it aims to bring products either to market or fielding. Commercial markets generally provide sufficient incentive for companies to undertake development. Therefore, industry dollars spent on product development are significantly higher than Government spending. However, the need for Government funding for non-commercially viable products will continue.

The demands placed on a limited budget are not surprising. Priorities come in many fashions: geographic, political, and mission-oriented are but a few examples. The Interagency Working Group on Manufacturing R&D (IWG) just released a report articulating Federal priorities. Their report articulates three areas of opportunity:

- Manufacturing R&D for Hydrogen Technologies
- Nanomanufacturing
- Intelligent and Integrated Manufacturing

The IWG believes these interrelated priorities encourage industry to focus resources on future needs. These top priorities, if properly incentivized, would not only focus American research needs, but also create jobs, transform research into competitive products and work to clean the environment.

While the large amount of federal dollars spent on defense related R&D often draws attention, it should remain in perspective. Figure 4 below demonstrates the contraction of the R&D percentage spent on U.S. defense relative (and U.S. overall) compared to the rest of the world.

Composition of Global R&D (based on global R&D estimates and NSF data)

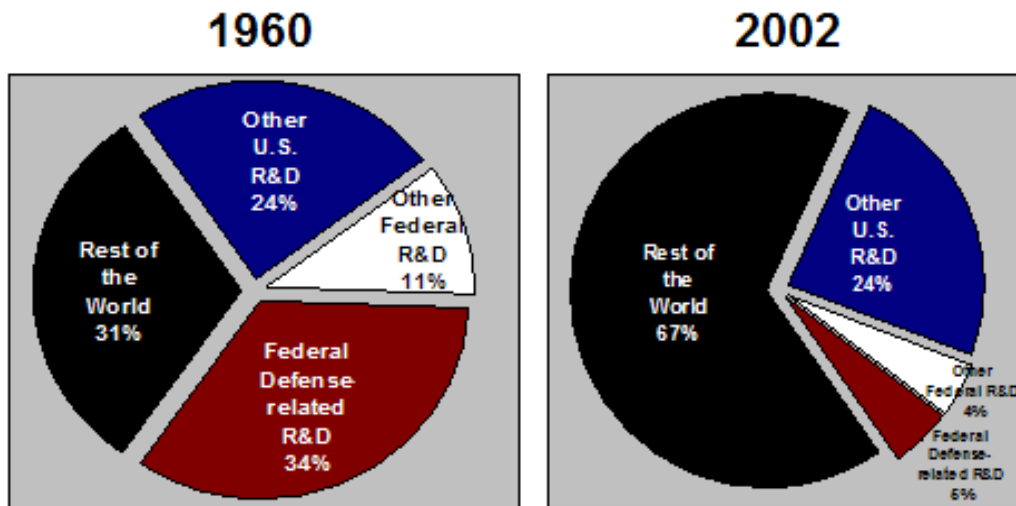


Figure 4: Source CRS

The apparent relative growth of global R&D spending may, or may not, be cause for U.S. concern. An optimist could cite the increased opportunity for the U.S. to take

advantage of the seeds sown elsewhere. The ‘insourcing’ of European technology for Presidential helicopters, Air Force tankers, and composite fuselage structures for the Boeing 787 could be viewed as examples of American harvesting the best value product produced with foreign R&D investments. However, if one takes the view that science and technology talent follows funding, there would be cause for concern, particularly if one believes that America’s technological superiority is the root of its economic and military dominance. The advantages of competition are relative to both the buyers and sellers. It should not be a surprise that the worlds’ largest market (defense or otherwise) attracts competition.

Policy Recommendations

R&D Investment – Government at the federal and state levels must continue direct investment for basic research. The inherent failure rate and inability to schedule invention are natural detractors that discourage commercial investment. Funding of Government labs and universities are essential enablers to American technological growth. Federal and State funding should target specific programs like nanotechnology, integrated information technology, and hydrocarbon, as articulated by the Interagency Working Group on Manufacturing R&D. Funding must however, reach beyond these targeted programs. The nature of exploration must permit multiple avenues, and not be limited to only the known paths.

Budget Authority for the Conduct of R&D, by Agency

Request for FY 2008				
Agency	Basic	Applied	Development	Total
DOD	1,428,138	4,371,428	70,030,173	75,829,739
<i>Military</i>	<i>1,428,138</i>	<i>4,356,656</i>	<i>70,015,400</i>	<i>75,800,194</i>
<i>Civilian</i>	<i>0</i>	<i>14,772</i>	<i>14,773</i>	<i>29,545</i>
HHS	15,614,700	13,533,524	50,560	29,198,784
NASA	2,225,608	1,126,225	6,706,970	10,058,803
DOE	3,408,693	2,869,007	1,892,633	8,170,333
NSF	3,977,418	380,302	0	4,257,720
USDA	759,353	980,139	159,921	1,899,413
DOC	109,229	743,929	89,798	942,956
DHS	15,000	510,000	408,468	933,468
DVA	329,370	444,220	48,410	822,000
DOT	0	542,746	251,451	794,197
DOI	38,867	531,243	63,845	633,955
EPA	91,300	346,700	101,800	539,800
DED	8,000	174,000	135,000	317,000
AID	5,437	156,111	117,142	278,690
DOL	0	4,000	152,000	156,000
SMITH	137,112	0	0	137,112
DOJ	6,000	25,000	65,000	96,000
NRC	0	70,933	0	70,933
USPS	0	0	42,000	42,000
HUD	0	13,895	25,805	39,700
SSA	0	27,000	0	27,000
TVA	0	7,000	15,000	22,000
TOTAL	28,154,225	26,857,402	80,355,976	135,367,603

Table 1: Source NSF

The “top six” agencies dominate Federal R&D spending, as demonstrated in Table 1. There are multiple programs and projects funded with these dollars. The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs are examples of Government methods to bolster the American research base, and to encourage commercialization of research or technology transition to products. Programs like these need to continue. State and local levels of government should expand upon the federal programs.

R&D Incentives for Business – Government funding is not sufficient to address America’s research needs. Policies need to provide incentives for industry to invest in the R&D arena beyond what the market forces drive. R&D tax credits have been a recurring topic with industry leaders throughout our discussions. Although the Government has provided R&D tax credits, it has not been a sure thing. Initiatives like the American Competitiveness Act would make the R&D tax credit permanent—Congress should enact a permanent R&D tax credit. Knowing the credit will be there, will encourage R&D investment.

Clusters of R&D, such as North Carolina’s Research Triangle, are not new and in some cases provide a beneficial culture of innovation and knowledge (table 2). Creating incentivized regions meant to attract funding, produce jobs, and rise productivity can be great for the *gaining* region. However, we should understand the counter effects of the *losing* region, whether they be foreign or domestic.

During 2005, the top 10 states accounted for two-thirds of the industrial R&D performed in the United States. Companies in California, Michigan, Massachusetts, New Jersey, Texas, Washington, Illinois, New York, Pennsylvania, and Connecticut (listed by decreasing level) reported aggregate R&D expenditures of \$152 billion (table 5). California alone accounted for 22% of the U.S. industrial R&D total.

TABLE 5. Funds for industrial R&D performed in the United States, by state, by source of funds: 2005
(Millions of dollars)

State	All R&D	Federal	Company and other	State	All R&D	Federal	Company and other
United States	226,159	21,909	204,250	Montana	77 i	6 i	71 i
Alabama	1,417	719	698	Nebraska	407	7 e	400
Alaska	32 e	2 e	30 e	Nevada	382	17 e	365
Arizona	2,980	269	2,711	New Hampshire	1,435	D	D
Arkansas	271	8 e	262	New Jersey	13,214	311	12,902
California	50,683	5,065 i	45,618	New Mexico	405	128	278
Colorado	4,299	131	4,168	New York	9,474	654	8,819
Connecticut	7,885	1,443	6,442	North Carolina	5,158	107	5,051
Delaware	1,511	21	1,490	North Dakota	104	D	D
District of Columbia	166	73	93 e	Ohio	5,900	455	5,445
Florida	4,164	1,190	2,974	Oklahoma	422	20	401
Georgia	2,282	56 e	2,226	Oregon	3,252	30	3,223
Hawaii	168	46	122	Pennsylvania	8,846	205 e	8,640
Idaho	642	7	635	Rhode Island	1,387 i	D	D
Illinois	9,712	205	9,506	South Carolina	1,402	38 i	1,364
Indiana	4,610 i	283	4,327 i	South Dakota	68	2 e	66
Iowa	1,039	10 e	1,029	Tennessee	1,246	96	1,150
Kansas	1,993 i	D	D	Texas	12,438	858	11,579
Kentucky	660	11 e	650	Utah	1,234	197	1,036
Louisiana	300	22	278	Vermont	360	22	338
Maine	350	20 i	331	Virginia	4,379	1,696 i	2,683
Maryland	3,706	1,254	2,452	Washington	9,736	181	9,555
Massachusetts	13,342	2,554 i	10,788	West Virginia	242	D	D
Michigan	16,752	204	16,548	Wisconsin	2,729	69	2,660
Minnesota	6,340	287	6,053	Wyoming	30	1 e	29
Mississippi	194	47	147	Undistributed funds*	3,731 i	96	3,636 i
Missouri	2,602	79	2,523				

D = data withheld to avoid disclosing operations of individual companies.

e = more than 50% of the cell value is imputed due to raking of state data.

i = more than 50% of the cell value is imputed.

* Includes data reported on Form RD-1 not allocated to a specific state. Data reported on the Form RD-1A, the questionnaire sent to small companies or companies new to the survey, were allocated to the state in the address on the company’s survey form, which is usually the company’s headquarters.

NOTES: Detail may not add to totals because of rounding. Excludes data for federally funded research and development centers.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005.

Table 2: Source NSF

Conclusion

Research and development are the basis for success in the manufacturing sector and government must continue direct investment in R&D while encouraging industry to invest. Government should assist in bridging the transition of basic science into commercial application.

Manufacturing Productivity

Introduction

Since 1950 manufacturing output in America has continued to rise outpacing all other sectors, while employment in the manufacturing sectors has remained relatively constant. This has resulted in a remarkable acceleration in productivity growth (figure one). In 1950 manufacturing employment accounted for 31% of all jobs, or nearly 15 million workers. According to the U. S. Department of Labor, by 2007, the percentage of jobs in the manufacturing sectors had fallen to 10%, or nearly fourteen million workers; while service and non-farm jobs had risen from forty-seven million in 1950 to just under 140 million in 2007 (figure two).

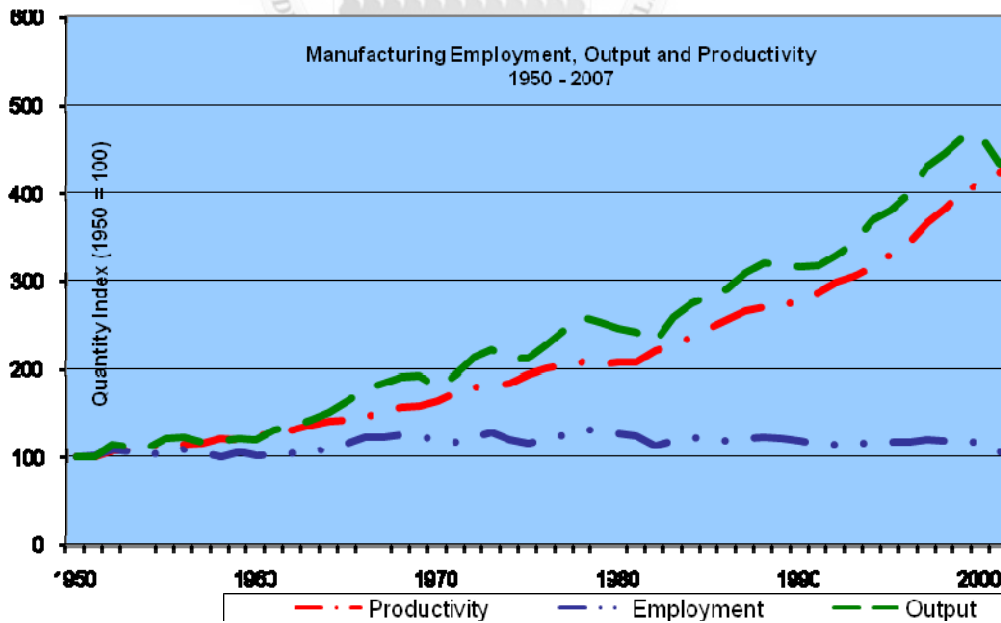


Figure 1 - Source: U. S. Department of Labor

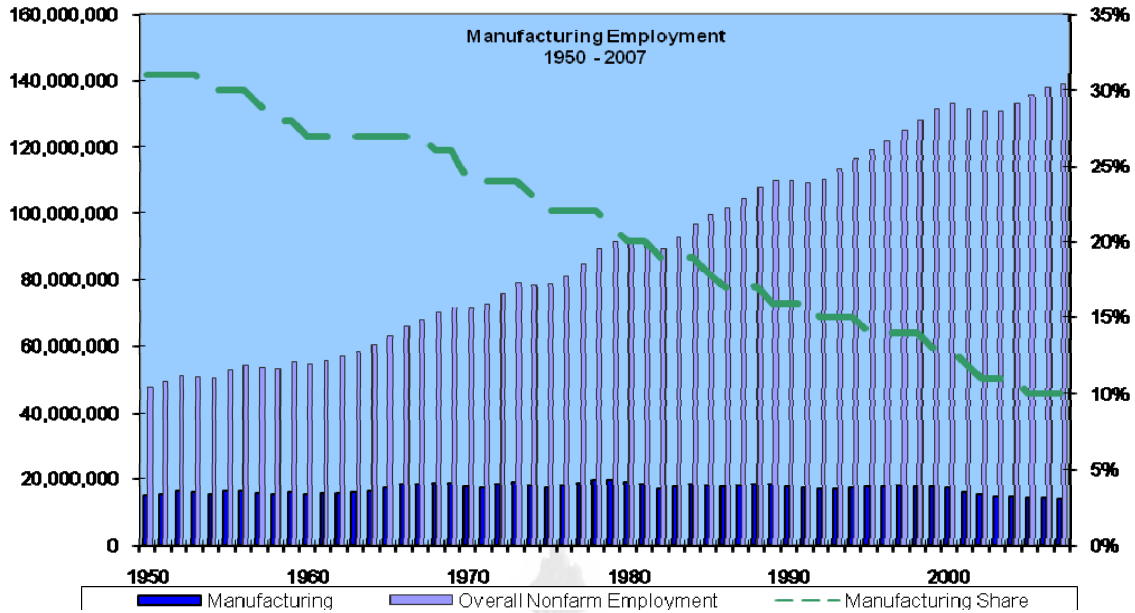


Figure 2 - Source: U. S. Department of Labor

Productivity is a measure of economic efficiency which shows how effectively economic inputs, usually labor, are converted into output. Annual labor productivity growth has increased from 1.4% for the period 1974 to 1995, then to 2.5% from 1996 through 2001 and finally 4.2% from 2002 to the present. However productivity growth does not affect all manufacturing industries equally (Labonte 2004). Information released by the Bureau of Labor Statics (BLS) in March indicated that for the period 1987 through 2006 labor productivity increased in all but one of the 86 manufacturing industries (Bureau of Labor Statics, 2008).

There is a popular perception that recent sluggishness in employment growth is caused by the acceleration in productivity growth. Analysts often point to the “jobless recovery” from the 2001 recession as proof that increases in productivity cause unemployment. Economic theory suggests that productivity growth should not reduce employment because it expands the overall purchasing power of the economy, thereby creating new employment opportunities in the economy. The casual observer does not appreciate that productivity growth, like any change brought on by market forces, will not necessarily lead to new jobs in the same industry or local economy where old jobs were lost (Labonte, 2004).

The populist points to the loss of 2.69 million jobs in manufacturing following the 2001 recession as proof of manufacturing weakness. Again, productivity gains are achieved when fewer inputs such as labor are used to produce the same or more goods. This was the case in the recovery from the 2001 recession where manufacturing output continued to increase while manufacturing input decreased (figure one). The job creation that did occur came in the nonmanufacturing and government sectors, while jobs in the durable goods sector of manufacturing declined by 1.88 million, or 17.3% (Ellis, 2003).

The truth of the matter is somewhere in between the theoretical economist and the populist view of the overall health of the manufacturing sector. Productivity gains have been achieved by replacing labor with capital enabled by technological advances, but

there have been other pressures such as low cost labor availability in foreign markets. The addition of several billion new workers in the global supply of labor (an estimated 50% increase), combined with the diminution of time and distance the information technology revolution has created has made the world a more competitive environment for U.S. manufacturing (Ahearn, 2007).

Manufacturing has demonstrated an ability to overcome pure wage differentials of cheap overseas labor costs through innovation and capital investment which leads to productivity increases. An important question for policymakers is how long the surge in manufacturing productivity will continue. Manufacturers are faced with other structural challenges which will make it difficult to sustain high productivity increases in the face of global competition.

As discussed in the previous section a shortage of high skilled laborers, engineers and scientists is negatively affecting manufacturing productivity and the innovation that drives future increases in productivity. Compounding this skills gap, those baby boomers in the work force who possess the skills which has fueled our productivity surge are beginning to retire and will be almost entirely out of the labor force within 10 to 15 years. As a result, there is projected to be a need for 10 million additional skilled workers by 2020. Currently, one of the only new sources of skilled workers for manufacturers is through immigration.

Several structural issues such as taxes, regulatory policies and benefits, also affect manufacturing productivity. Although the U.S. has a reputation for lower taxation compared to its trading partners, the U.S. actually taxes corporate income higher and more than once (figure 3). This places a drag on competitiveness for three reasons: it constrains after-tax cash flow; discourages establishment of foreign manufacturing facilities in the U.S.; and encourages the migration of U.S. manufacturing facilities to lower-tax jurisdictions (Leonard, 2003).

The Small Business Administration (SBA) sponsored a study in 2001 which estimated the cost of regulatory compliance among U.S. Manufacturers at \$147 billion, an average per-employee cost of \$7,904. The largest of these costs are imposed by environmental regulations, which account for almost 50% of the costs reported (Crain and Hopkins, 2001).

The United States differs from many of its major trading partners in that businesses are responsible for financing a larger share of healthcare and retiree benefits. In other countries these benefits are funded in large part for governments via a general income tax. A study released in 2001 shows that benefits made up about 21% of total compensation compared to only 8% of compensation in China (Manufacturers Alliance, 2003).

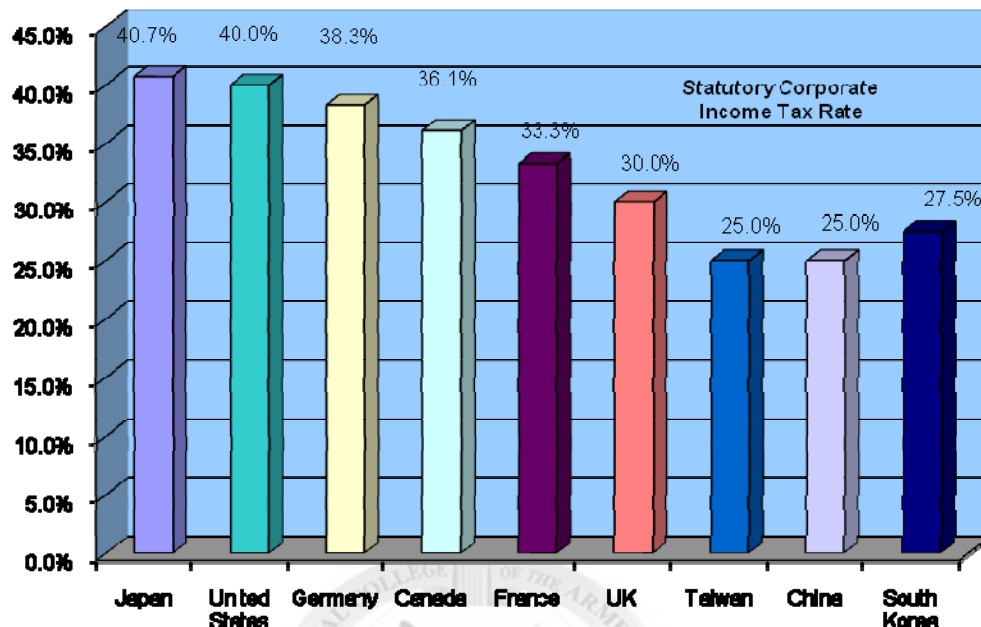


Figure 3: Source OECD

Policy Recommendations

While policymakers have some direct or indirect influence over many economic variables, productivity growth may be among those that remain relatively removed from the influence of deliberate economic policy (Cashell, 2007). Productivity gains are projected to increase for the foreseeable future despite shifts in workforce skills and demographics, globalization and other structural challenges.

Immigration Policy – Current U.S. Immigration policy restricts immigration of professional specialties. In 1998 the Congress recognized a shortage of Information Technology professionals in the workforce and temporarily raised the ceiling on skilled professional immigrants from 65,000 to 195,000 over five years, then the cap on skilled immigrant (H1B Visas) was allowed to revert to 65,000 in 2003 (Levine and Naughton, 2007). This cap on skilled employee immigration is a protectionist policy which exacerbates the shortage of highly skilled employees and should be lifted.

Tax Policy Reform - The current tax system penalizes work, investment and entrepreneurial activity. In the short run, tax law changes will spur capital investment, reduce tax burden faced by companies in business-cycle downturns and make U.S. manufacturers more competitive in the global market place (Leonard, 2003). Some recommendations include:

- Reduce statutory corporate tax rates, as most of our international trading partners have throughout the 1990s.
- Repeal the corporate alternative minimum tax, which hits manufacturers hardest when profitability is weak.

- Lower the cost of innovating and investing by making the R&D tax credit permanent (Coleman, 2006).

Regulatory Reform – The regulatory compliance burden on U.S. Manufacturers is the equivalent of a 12 percent excise tax (Leonard, 2003). Often regulations are developed and implemented without an objective cost-benefit analysis. Some recommendations for regulatory reform include:

- Commission third-party cost-benefit reviews for all proposed regulations.
- Conduct third-party cost-benefit reviews for existing regulations pertaining to environmental and workplace safety regulation, and repeal those that are not justified on a cost-benefit basis.

Employee Benefit Reform – It is well known that the U.S. spends more on healthcare than any other country, and costs have outpaced inflation for the last two decades. A debate on healthcare reform is beyond the scope of this paper, but it is important to focus on the disproportionate share of healthcare costs borne by U.S. manufacturers compared to our trading partners. Any consideration for reform should include:

- Encourage greater individual responsibility for coverage costs and health status.
- Improve affordability of health coverage for individuals and companies through individual tax credits and tax-favored savings accounts
- Reform medical liability laws to discourage “defensive” diagnostics and treatments and cost shifting from lawsuits.

Conclusion

Globalization has changed the competitive environment by shortening supply chains, putting a billion new workers in the global labor force, lowering the barriers to entry for other countries. American manufacturers have been able to compete with low-cost labor through productivity improvements. Although productivity is expected to continue to increase in the short term, American manufacturers are encumbered by structural impediments not found among our competitors in the global economy. American business has long preferred a *laissez faire* approach which did not impede domestic competition, however in the global economy American business and will need to help of government in order to compete in the global market.

Intellectual Property

Introduction

In 2006, the United States produced nearly two-and-a-half times more output than China’s “vaunted factories” (Ikenson, 2007). The manufacturing dominance that America enjoys depends in large part on its ability to increase productivity through constant innovation. Innovation – whether through new processes and techniques or improved technology – is the lifeblood of modern manufacturing, ensuring that the U.S. maintains its competitive edge in the global marketplace by out-producing and out-pacing its competitors, even those in Asia and elsewhere with access to cheap pools of labor. As Microsoft Chairman Bill Gates told Congress in March 2008, “Innovation is the

engine of job growth; if we discourage innovation here at home, economic growth will decline, resulting in fewer jobs for American workers” (Murphy, 2008).

Intellectual Property (IP) is a significant factor behind the continuous process of innovation. IP is defined as any creation of the human mind, but for our purposes encompasses the creative capacity for U.S. manufacturing to make things people want to buy and make more of them faster and better than anyone else. We live in a technological age. Slimmer, faster computers, I-Pods with audio and video, and cell phones that can browse the internet are just some of the more tangible signs of this phenomenon. All of these high-tech gadgets are products of the creative process, and all are examples of IP. Many Americans, however, tend to dismiss the importance of IP – for example, many young people think nothing of downloading music illegally from the internet or buying a counterfeit DVD of the latest movie – but it is among the most critical catalysts driving U.S. manufacturing and, by extension, our economy. For example, 30-40 percent of all gains in productivity and growth in the U.S. over the 20th century can be traced to innovation (Murphy, 2008). Manufacturing generates nearly 60 percent of private-sector research and development (Epstein, 2006). The U.S. also spends nearly twice as much -- \$200 billion – than the next highest spender, the European Union. Patents are often used as a way to quantify innovation, and they paint a similar picture: The U.S. generates more utility patents per million of population than any other country on the globe (National Association of Manufacturers, 2007).

Policy Recommendations

When it comes to protecting IP, most U.S. manufacturers face a thorny dilemma. In order to thrive, they must expand into - and offshore to - a variety of global markets, which in turn exposes them to unscrupulous business practices, including counterfeiting, piracy, and reverse engineering. Legal protections do exist, but enforcement is limited beyond U.S. borders, and many firms lack the financial and legal wherewithal to pursue counterfeiters internationally. While the U.S. government diligently pursues IP protection both domestically and internationally through a variety of means, its efforts are often inconsistent and incapable of staunching the economic hemorrhage caused by IP theft – which amounts to an estimated \$200-250 billion annually in lost revenue (Wayne, 2004). The U.S. Chamber of Commerce puts the number of U.S. manufacturing jobs lost to piracy at 750,000 (U.S. Chamber of Commerce, 2007).

Interviews with numerous manufacturers revealed a complex and often contradictory approach to safeguarding IP. Pharmaceutical companies, for example, rely more heavily on patent protection to safeguard a product until they can recoup their research and development costs (estimated to be approximately \$800 million dollars per product). Increasingly, companies appear to rely on internal controls, including compartmentalizing the manufacturing process among several overseas companies or camouflaging the name and make of the equipment used to manufacture a specific product. One businessman confided that his company deliberately chose not to patent its trade secrets to avoid making them public and, therefore, accessible to his competitors in China and elsewhere via the internet. The apparent incongruity of his company’s actions

– avoiding the very legal device designed to protect IP – highlights some of the unique challenges of protecting IP in the 21st century.

Current government efforts also appear to be insufficient to counter the surge of piracy, counterfeiting, and reverse engineering occurring beyond U.S. borders, which siphons an estimated \$650 billion from the world economy each year and puts millions at risk from counterfeit medicines and engine parts (U.S. Chamber of Commerce, 2007). There are, however, several areas where IP protection could be made more responsive and effective:

Streamline the patent process - The current process is time-consuming and overly bureaucratic, which impedes the economic benefits of patent protection (Epstein, 2007).

Strengthen domestic enforcement – Stronger and consistent enforcement of laws against piracy and counterfeiting are required. The recent passage of the *Stop Counterfeiting in Manufactured Goods Act* is an example of the type of legislation needed to counter IP theft more effectively, as it expands “the set of criminal remedies available in counterfeiting cases, such as criminalizing the export of counterfeit goods and allowing government seizure of machine tools along with inventory” (Epstein, 2007).

Improve interagency coordination on IP protection - Current IP enforcement is stretched too thinly across a broad array of different agencies which dilutes its effectiveness. “The Intellectual Property Rights Enforcement Act” seeks to improve “the management, coordination, and effectiveness” of current enforcement efforts by creating, *inter alia*, an Intellectual Property Enforcement Network (IPEN) to formulate policy and coordinate a comprehensive enforcement of IP, both domestically and internationally.

Reform the global patent and trademark system - The National Association of Manufacturers (NAM) and the U.S. Chamber of Commerce advocate global changes to IP protection, calling for the “reform and harmonization of the global patent and trademark system in a way that improves global IP protection, ensures robust enforcement of IP rules, educates developing nations on the importance of enforcing IP rules, and reduces costs and increases efficiencies in establishing global IP protections in all nations” (National Association of Manufacturers, 2007).

Conclusion

The importance of IP protection to U.S. manufacturing is considerable, and the deleterious effects of piracy and counterfeiting on the U.S. economy are real. The dilemma faced by many American companies – both small and large – is how to engage in the global market without losing their competitive edge to IP theft and reverse engineering. While acknowledging the extent of the problem, both the federal government and manufacturers seem to lack a comprehensive and cohesive approach that would strengthen IP protection domestically and internationally. Within the government, enforcement and protection of IP is stretched across a wide array of different agencies and entities – including Congress; the Departments of State, Justice, and Commerce; the U.S. Trade Representative; and U.S. Customs and Border Patrol – which dilutes their

ability to dismantle a problem of global proportions. Manufacturers also adopt a scatter-shot approach to IP protection, with some avoiding patents and others employing tactics to conceal and camouflage their manufacturing process from their plants in China and elsewhere. A more coordinated and comprehensive approach – such as the IPEN suggested by the “Intellectual Property Enforcement Act” – might be able to focus law enforcement and trade policy to counter more effectively the effects of IP theft. The real onus, however, is on U.S. manufacturers to make IP protection a greater priority and put the necessary pressure on Congress to take concrete action to address the problem.

Trade Policy

Introduction

The consensus among economists is wholeheartedly in favor of free trade, though uncertainty and argument among the American public and politicians continue. However, the fluid premises that define the complex conditions of trade’s logic problem can give us no other result than flux. Globalized trade involves hundreds of countries all in various stages of economic growth and development, clashing despite and alongside our continued development and economic prosperity. Our leaders must continually walk a tightrope that spans the chasm between free trade and protectionism.

Free trade is a policy by which a government does not discriminate against import or export; however it does not necessarily stipulate that a country abandon all tariffs and duties. Free trade, a term in economics and government, includes:

- Trade of goods without taxes (including tariffs) or other trade barriers (e.g., quotas on imports or subsidies for producers)
- Trade in services without taxes or other trade barriers
- The absence of trade-distorting policies (such as taxes, subsidies, regulations or laws) that give some firms, households or factors of production an advantage over others
- Free access to markets
- Free access to market information
- Inability of firms to distort markets through government-imposed monopoly or oligopoly power
- The free movement of labor between and within countries
- The free movement of capital between and within countries (Tupy, 2003).

The groups that perceive themselves as gaining the most from protectionist policies comprise a smaller, yet very influential, slice of the populace; traditionally they are special interest groups like unions and farmers’ groups who desire higher wages than they might receive given a free marketplace. Protectionism does in some respects “protect” as the name implies, but it creates problems in five key areas:

1) International Tension: Protectionism ultimately leads down a road of international commercial tensions. If the government of one country erects excessive trade barriers

against another, the obvious reaction would be a corresponding retaliatory measure. The effect of these barriers has the potential to result in a downward spiral of restrictions known as a “Trade War.” In 1930, President Hoover signed the Smoot-Hawley Act which raised many tariffs to the 100% level. Over 25 governments responded by passing similar restrictions. Though perhaps not the sole driving factor, “world trade came to a grinding halt, and the entire world was plunged into the ‘Great Depression’ for the rest of the decade”(Miller and Elwood, 2008).

2) Higher Prices: Japanese consumers pay five times the world price for rice because of import restrictions protecting Japanese farmers and Americans shoulder similar burdens, paying six times the world price for sugar. The benefits of tariffs are minor compared with the total cost Americans pay for this protection. “Economists at the Institute for International Economics estimate that consumers would save \$70 billion if the United States eliminated all tariffs and quantitative restrictions on imports--or about \$750 per American household.” (Froning, 2000).

3) Unfair Trading Practices: A number of countries subsidize the export of goods to America. The prices are often below their actual cost of production, thereby making non-subsidized American products un-competitive on the open market. A resulting second order effect is that this lower price is a bargain to the consumer and a burden to the foreign taxpayer as they pay the bill for the original government subsidy.

4) The Debt Crisis: Because Western banks are owed hundreds of billions of dollars by Eastern European and Third World countries, the trade restrictions put in place by Western governments make it difficult for them to earn the currency to repay their loans.

5) Minimizes Competitive Improvement: Alan Greenspan, former chair of the American Federal Reserve, has criticized protectionist proposals as leading "to an atrophy of our competitive ability. If the protectionist route is followed, newer, more efficient industries will have less scope to expand, and overall output and economic welfare will suffer" (Tupy, 2003).

Policy Recommendations

Though Free Trade creates significant numbers of both winners and losers, the broad consensus among economics professionals in the U.S. is that free trade is a net gain for society as a whole. In a 2006 survey of American economists (83 respondents), "87.5% agree that the U.S. should eliminate remaining tariffs and other barriers to trade" and "90.1% disagree with the suggestion that the U.S. should restrict employers from outsourcing work to foreign countries" (Miller and Elwood, 2008). Free Trade does not, however, necessarily mean allowing market forces to reign absolutely free and unhindered. Below are several recommendations that include reducing tariffs, promoting regional and bilateral free trade agreements, and working with the International Monetary Fund (IMF), World Bank, and World Trade Organization (WTO) to endorse the economic freedom that helps not only the U.S., but all nations.

Seek a balance of trade - A primary issue during the last several years has been the fact that America buys more abroad than it sells, resulting in a trade deficit which possibly jeopardizes the economic stability of the United States. Additionally, several of the Asian economies, but primarily China, have pursued an “export-led growth strategy” and have fixed their currency value to that of the US dollar (Dodge, 2006). This corresponding and disproportionate foreign exchange reserve has only made the global imbalance worse. Several rounds of meetings between central bankers and finance ministers in Boca Raton in 2004 revealed the primary method of balancing the overall trade balance sheet are “flexible exchange rates that reflect economic fundamentals and promote smooth adjustments” (Dodge, 2006).

Encourage reform in the International Monetary Order (IMF /WTO) - Resolving global imbalances can only begin to be achieved if we also reform the financial institutions that oversee the world economy. Over 60 years ago, the Bretton Woods conference shaped an international monetary order hoping to mend the damage of the Great Depression and the Second World War. This system of rules, procedures, and institutions include the International Bank for Reconstruction and Development (IBRD) (now one of five institutions in the World Bank Group) and the International Monetary Fund (IMF) (Tupy, 2003). The WTO, often hailed as one of the crowning achievements of post-WWII diplomacy, was later added to open up markets, promote international trade and act as an arbiter in trade disputes. Today, we must further this progress by constructing an updated, 21st-century international monetary order that navigates the divide between open financial systems and those very important emerging economies such as China and India. David Dodge, a Canadian economist and Governor of the Bank of Canada from 2001 to 2008 aptly summarized an appropriate direction to pursue:

“A renewed IMF could use its surveillance to be more forthright in terms of the policy outcomes that are implied by different regimes. It could and should be the umpire for the world economic order, unafraid to call out countries that aren't playing by the rules. It could provide the support for the market to work at peak efficiency, monitor risks, provide necessary early warnings, and help to correct vulnerabilities before they become crises. In short, a renewed IMF could help us move towards a well-functioning, market-based international financial system in which markets would provide incentives that would lead to an orderly resolution of global imbalances” (Dodge, 2006).

Promote National Asset Industries to reduce time-of-war vulnerabilities - With rare exceptions all nations, including the United States, impose tariffs that add to the cost of selling products in their respective countries. While the US average rate is extremely low by world standards (3.5%), the United States does not apply its tariff rate evenly. Tariff rates vary according to the types of goods, with some of the highest rates going to textiles (7.7%), clothing (11.4%), sugar (20.4%) and dairy products (25%) (WTO, ITC and UNCTAD, 2006). While all industries are arguably essential, of this list, only dairy products rise to the level of national importance. The question to ask is what product or industry is vital to our national security in the event external sources of supply are cut or

severely reduced. Marian Tupy, policy analyst with the Center for Global Liberty and Prosperity, has opined, "In the history of the world, no country has ever suffered military defeat, or capitulated to sanctions, due to the inability to produce a domestically producible product" (Tupy, 2003). However, Britain's inability to feed herself without U.S. assistance during WWI and WWII and her dependence on Germany for manufacturing goods prior to the latter were avoidable vulnerabilities. One of the National Asset Industries where the U.S. has clearly lost production capability is steel production. The market U.S. producers face is one that is massively subsidized, allowing foreign competitors to sell below cost for and thus drive domestic companies into bankruptcy. Even natural market downturns have very little effect on these protected mills. As the U.S. is the only major industrial country that is a net steel importer, care must be established not to lose this cornerstone of our industrial base (Rockefeller, 1989). The same principles that underlie free trade and globalization open our own economy and infrastructure to malicious foreign government investments. Our leaders have addressed and need to continually revisit this inevitability.

The difficult part is to make a candid, non-politically biased link between an eroded or lost manufacturing capability and whether it can actually impact national security, instead of whether it can impact a congressional district or a firm's growth or the bottom line of shareholders. For example, we as a nation must distinguish between the criticality of apparel and nanotechnology or between electronics and textiles. We need an independent, bipartisan appointed commission to outline which manufacturing capabilities are of strategic importance to national security, grouping them into categories such as critical, vital, valuable, etc. U.S. leaders can then implement policies based on our manufacturing capacity by sector or the anticipated erosion of capacity in new sectors as Chinese growth continues. The objective grouping of our manufacturing capabilities will provide the starting point to "protect" those that are most critical, whether through US incentives or foreign disincentives.

Promote programs for displaced workers and an improved education system - Joseph Schumpeter labeled last year's annual loss of seven million American jobs as "creative destruction," for many more than that were created. Since 1994 there has been a net creation of about 23 million jobs (Gordon, 2008). This encouraging statistic, however, does not lift one's spirit if he is one of the seven million. Free trade may extol a net profit to society, but it does not value the benefits that come from the self-assurance and optimism that each worker may possess in his belief of a secure future. Free trade creates conditions that require unsought relocation and likely career field changes, perhaps many times in one's lifetime. Within the last century, farmers faced the movement of their children to the cities seeking lifetime employment in the mining or manufacturing sector. Now their grandchildren face a new phenomenon: multiple required (as opposed to optional) job transitions in a lifetime. The pace of change will soon show itself to have a huge emotional toll, especially for those workers who are in their 50's face hiring barriers due to age discrimination.

The U.S. offers displaced manufacturing workers assistance via the Trade Adjustment Assistance Program, established by the Trade Act of 1974. People who lose their manufacturing jobs as a result of foreign imports may apply for welfare benefits and receive job training and job search and relocation assistance. Initial results have shown

the unemployed are able to find a new job in a median of 6.4 weeks (Froning, 2000). Authorities at every level need to promote additional programs that ease the movement of workers between sectors and minimize the emotional toll of labor transience.

Seek new trade agreements and openly acknowledge they work for America - Since 2001, the Congress has approved free trade agreements (FTAs) with twelve countries. The United States ran a \$12 billion goods surplus with four FTA partners in 2005, with total goods exports of \$42.3 billion, compared to total imports of \$30.4 billion (Office of U.S. Trade Representative, 2006).

The North American Free Trade Agreement (NAFTA) became effective on January 1, 1994, and has not materialized into the job destruction mechanism once feared. As reported by the United States Trade Representative, NAFTA has significantly expanded trade and investment between the U.S., Mexico, and Canada, as well as created American jobs and helped America's manufacturing base. Some published NAFTA facts include:

- From 1993 to 2007, trade among the NAFTA nations more than tripled, from \$297 billion to \$930 billion. Business investment in the United States has risen by 117 percent since 1993, compared to a 45 percent increase between 1979 and 1993.
- National employment rose from 110.8 million people in 1993 to 137.6 million in 2007, an increase of 24 percent. The average unemployment rate was 5.1 percent in the period 1994-2007, compared to 7.1 percent during the period 1980-1993.
- U.S. manufacturing output rose by 58 percent between 1993 and 2006, as compared to 42 percent between 1980 and 1993. Manufacturing exports in 2007 reached an all time high with a value of \$982 billion.

Conclusion

We cannot ignore the reality of a 21st century global economy where a failure to resolve disparities will affect every country. "Domestically, policy-makers need to promote well-functioning markets for goods, services, capital, and labor. Internationally, policy-makers need to develop a framework that allows an orderly, market-based unwinding of global imbalances" (Dodge, 2006).

Policy makers also need to monitor the changing nature of Chinese manufacturing capacity. The focus must be not on whether China is succeeding in high technology manufacturing but on whether that success directly results in lost U.S. capability. Again, it is not necessarily a zero sum game that equates lost US opportunities with lost U.S. capabilities.

American also needs to reform its economic relationship with China. Given China's impressive industrial growth, the U.S. must engage China with bilateral agreements and mediate differences via the World Trade Organization. Necessary reform, including human rights violations, use of child labor, emission standards, polluting water reserves, etc..., can only be achieved given active engagement, not hostile political posturing. "As the world's second-largest economy, third-largest exporter, largest destination for

FDI and second-largest holder of foreign currency reserves,” consideration should be given to inviting China to join the G-8, instead of having them attend as a guest (Gresser, et al, 2005).

Lastly, the public perception is that free trade is bad for America. Forty-six percent of people polled in March 2007 by NBC News and the Wall Street Journal said the U.S. is being harmed by Free Trade Agreements, while only twenty-eight percent said the nation is benefiting (Fletcher, 2007). Therefore, the President and Congress have two battlefronts: perception and reality. Every opportunity should be taken by the next administration to express the benefits of free trade, lower existing trade barriers, sign new regional and bilateral trade agreements, and support trade forums. We face an extremely difficult challenge. Regardless of undervalued currencies, government subsidies, product dumping, and the many other claims of unfair trade, the competition is indeed better and America needs to rise to the challenge.

Summary

Since America’s early industrialization the manufacturing sector, fueled by near limitless factors of land, labor and capital, has provided unprecedented wealth, prosperity and opportunity for citizens and attracted immigrant labor from around the world. Today, the manufacturing sector in the United States is at an all time high with regards to productivity and remains far and away the number one manufacturing nation in the world. Yet challenges to the sector, if left unaddressed, could erode America’s ability to maintain our way of life, influence its future and guarantee the national security. A strong and flexible manufacturing sector is necessary to ensure the nation’s defense and the recommendations set out in this paper also benefit the defense industrial base.

The American people have always answered challenges when informed and motivated by sound leadership. The time has come for all levels of government to understand that manufacturing is vital to the health and welfare of our nation and lead the people accordingly.

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