



# The Case for a National Manufacturing Strategy

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## EXECUTIVE SUMMARY

This paper builds the intellectual case for why the United States needs a serious national manufacturing strategy. The paper focuses on three key questions where to date consensus has been lacking:

1. Does the United States need a healthy manufacturing sector?
2. How healthy is U.S. manufacturing at the moment and for the foreseeable future?
3. Does the United States need a national manufacturing strategy?

Until there is a consensus that manufacturing is important, that it is not healthy, and that a national manufacturing policy is needed, it will be difficult to create a platform for reframing the conversation. Meanwhile, other nations are putting in place manufacturing strategies that include key components such as tax incentives and large investments in research, skills development, infrastructure, and technology transfer and technical assistance. Every day we do nothing we risk falling further behind.

The paper is divided into four major sections:

### 1) Why is Manufacturing Important?

Manufacturing plays a critical role in the U.S. economy for five key reasons:

1. It will be extremely difficult for the United States to balance its trade account without a healthy manufacturing sector.
2. Manufacturing is a key driver of overall job growth and an important source of middle-class jobs for individuals at many skill levels.
3. Manufacturing is vital to U.S. national security.
4. Manufacturing is the principal source of R&D and innovation activity.
5. The manufacturing and services sectors are inseparable and complementary.

### 2) U.S. Manufacturing in Transition and Relative Decline

Many who argue against a national manufacturing strategy do so because they claim that U.S. manufacturing is quite healthy and that any job losses are due to superior productivity performance;<sup>1</sup> or they assert that manufacturing is in decline everywhere, such that relative decline in U.S. manufacturing is not a particularly noteworthy concern. This section rebuts both those mistaken perspectives, arguing that:

1. Output growth in U.S. manufacturing sectors is overstated and, when measured properly, job loss in U.S. manufacturing is a reflection also of output decline, not just of productivity increases.
2. U.S. manufacturing decline is neither “inevitable” nor “normal” as demonstrated by the fact that manufacturing is growing in many nations, including developed nations.

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### 3) Why the United States Needs a National Manufacturing Strategy

Beyond the importance of a robust manufacturing sector to economic health, there are three primary reasons why the United States needs a national manufacturing strategy:

1. Other countries have strategies to support their manufacturers and by lacking similar strategies we are therefore forcing our manufacturers to compete at a disadvantage.
2. Systemic market failures mean that absent manufacturing policies, U.S. manufacturing will underperform in terms of innovation, productivity, job growth, and trade performance.
3. If a country loses complex, high-value-added manufacturing sectors, it's unlikely to get them back, even if the dollar were to decline dramatically.

### 4) What Would a National Manufacturing Strategy Do?

It's important to understand that a considerable part of the loss in U.S. manufacturing jobs has not just been a story of higher productivity leading to fewer jobs—as was the case with the transformation of the U.S. agricultural sector over the last century. It's been more a story of decline in output due to a loss of international competitiveness. This is why the decline of U.S. manufacturing merits a serious policy response.

To call for a U.S. manufacturing strategy is not to call for the same kind of sectoral or occupational composition in manufacturing that the United States had twenty or fifty years ago. It's not to nostalgically wish for the re-creation of all the lost jobs from factories employing low-skill workers and producing commoditized products. Obviously the profile of manufacturing evolves over time, just as the U.S. economy evolves. Rather, it's a call to restore U.S. manufacturing to a competitive position in the global economy, even though the industries and jobs will look very different than they did a generation ago.

Moreover, to call for a national manufacturing strategy is not to call for a de facto, heavy-handed industrial policy that “picks winners and losers” (for example, by picking Duracell to be the nation's lithium-ion battery champion). Rather, we mean a process of designing our nation's tax, regulatory, and innovation policy environments to make the United States the world's most attractive location for advanced manufacturing (including both domestic and foreign direct investment).

### Building a Group of the Willing (and Able)

There is a groundswell emerging for a comprehensive U.S. national manufacturing strategy, with numerous public agencies, policy organizations, corporate leaders, and elected officials calling for, writing about, and speaking of the need for a U.S. manufacturing strategy. Many of these reports and studies present specific recommendations geared toward certain stakeholders, while others offer more general recommendations, some complementary, some competing. ITIF seeks to use this paper to coalesce support around a consensus on core principles for why now is the time for a serious national manufacturing strategy for the United States. We can be a more powerful voice together than any of us can be on our own.

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## INTRODUCTION

There is relatively little agreement in Washington about the importance of manufacturing to the U.S. economy. This lack of agreement can be traced to the inability to reach consensus on three critically important questions:

1. Does the United States need a healthy manufacturing sector?
2. How healthy is U.S. manufacturing at the moment and for the foreseeable future?
3. Does the United States need a national manufacturing strategy?

Until these questions are answered and agreed upon, it will be difficult for Washington to put in place the policies needed to bolster U.S. manufacturing.

In this white paper, we argue that a healthy manufacturing sector (defined as real manufacturing output as a stable or growing share of GDP, with no significant and chronic manufactured products trade deficit) is a key factor in the health of the U.S. economy. Unfortunately, many economic policy analysts hold that it is possible to have a robust economy without a strong manufacturing sector. For example, when asked recently how much manufacturing the United States really needs, the head of a leading Washington, DC think tank answered, “Really? Really we don’t need any.” Such statements are based more on ideology than informed analysis. For while other sectors are important, an economy the size of the United States’ simply cannot thrive without a healthy manufacturing base. Thus, the central goal of this paper is to replace conjecture, opinion, and perception with facts, analysis, and arguments demonstrating the need for both a vibrant U.S. manufacturing sector and a concerted manufacturing strategy supporting it.

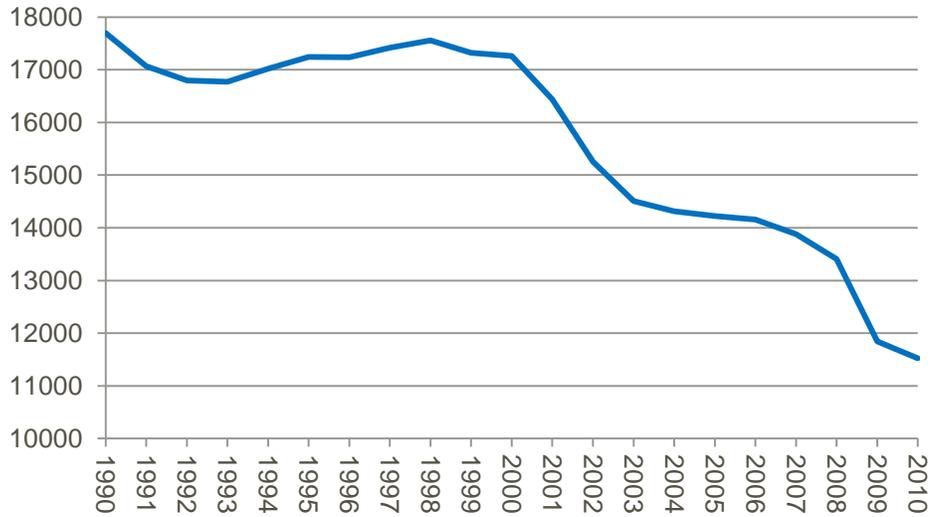
For the reality is that U.S. manufacturing has declined noticeably over the last decade, not just in the number of jobs—as Figure 1 shows, from January 2000 to January 2010, manufacturing jobs fell by 6.17 million, or 34 percent—but also in output. In fact, from 2000 to 2009, fifteen of the nineteen aggregate-level U.S. manufacturing sectors shrank in terms of change in real value-added.<sup>2</sup> Moreover, the government’s official calculation that manufacturing accounts for a 11.2 percent share of U.S. GDP is too high because it vastly overstates output from the computer and electronics industry, as we explain subsequently.<sup>3</sup>

In fact, we postulate that only one other nation in history—the United Kingdom in the 1960s and 1970s—has experienced as precipitous a loss of manufacturing output. However, alarm bells have been largely silent because government statistics significantly overstate the growth of U.S. manufacturing output. This suggests that the conventional wisdom that U.S. manufacturing job loss is simply a result of productivity-driven restructuring (akin to how U.S. agriculture lost jobs but is still healthy) is wrong, or at least not the whole story. Rather, we contend that the loss of U.S. manufacturing jobs is a function of slow growth in output (and in many sectors, actually loss of output), caused in turn by the declining international competitiveness position of U.S. manufacturers.

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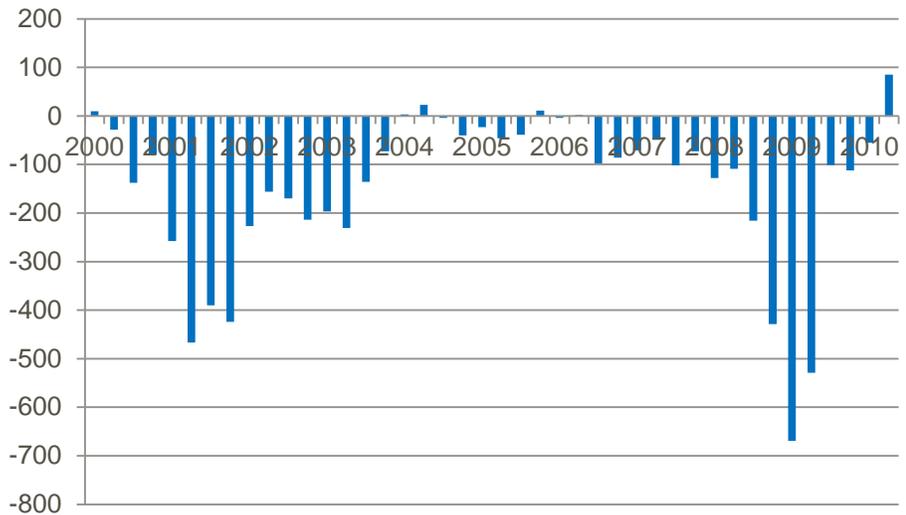
*An economy the size of the United States’ simply cannot thrive without a healthy manufacturing sector.*

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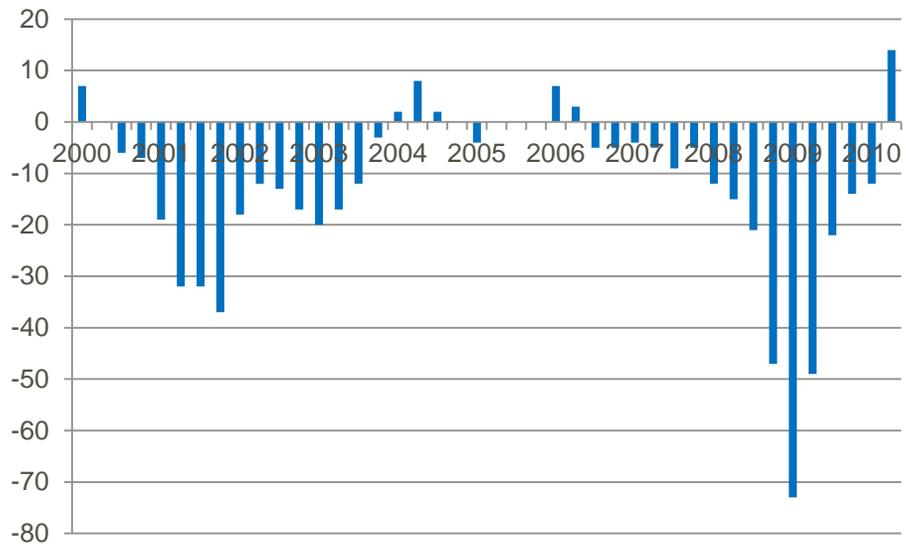


**Figure 1: Decline in U.S. Manufacturing Employment (millions), 1990-2010<sup>4</sup>**

Figure 2 shows gross job gain (from opening and expanding manufacturing establishments) subtracted by gross job loss (from closing and contracting manufacturing establishments) for each quarter since 2000. Figure 3 shows the number of establishments gaining jobs by expansion and creation minus the number losing jobs by contraction and death. What these charts show is substantial losses in manufacturing jobs during recessionary periods, but not very many gains during recovery. If the changes affecting the U.S. manufacturing sector really were just productivity related, then the losses would be more evenly distributed and there would be greater pick up during the recovery periods.



**Figure 2: Gross Manufacturing Job Gain Minus Job Loss by Quarter, 2000-2010 (thousands)<sup>5</sup>**



**Figure 3: Number of Manufacturing Establishments Gaining Jobs vs. Losing Jobs, 2000-2010<sup>6</sup>**

Yet even when some economic policy experts acknowledge that manufacturing’s share of output has declined, many comfort themselves with a narrative that such decline is inevitable and a result of market forces. “Manufacturing is in decline everywhere, even in China,” they argue. They would be wise to consult actual data, for if they did they would find that while real manufacturing output has declined as a share of GDP in some nations (notably Italy, Spain, the United Kingdom, and the United States), it is stable or even growing in many others (including Austria, China, Finland, Germany, Japan, Korea, the Netherlands, and Switzerland).<sup>7</sup> Moreover, they would see that the loss of U.S. manufacturing reflects in part a failure of U.S. policies (e.g., underinvestment in manufacturing technology support policies, a corporate tax rate that is uncompetitive, etc.) and in part other nations’ manufacturing policies, and not some natural result of the market’s invisible hand.

Some even go so far as to assert that manufacturing industries are “old economy” and that it is a reflection of failure, not success, if a country has a manufacturing sector with a GDP share that is either stable or growing. Perhaps they are thinking of the kind of factories depicted in old movies, television shows, or news clips: dirty, clunky, mechanical havens filled with low- and moderate-skilled workers producing commodity products. Again, they would be well advised to visit the modern new manufacturing facilities springing up in the United States (and throughout developed nations across the rest of the world), for what they would find are clean, streamlined, IT-driven facilities using advanced technologies and employing moderate- and high-skilled workers to turn out advanced products from jet aircraft, computers, advanced instruments, and vehicles to sophisticated chemicals and biotechnology compounds.

But most U.S. manufacturers, small or large, cannot thrive solely on their own; they need to operate in an environment grounded in smart economic and innovation-supporting policies with regard to taxes, talent, trade, technological development, and physical and

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digital infrastructures. Moreover, U.S. manufacturers—like their competitors in an increasing number of countries—need to be the beneficiaries of effective public-private partnerships that facilitate the transition of emerging technologies from universities and federal laboratories into commercializable products, that promote technological diffusion across the manufacturing base, and that encourage adoption of best-in-class manufacturing and management practices.

Thus, economic policies can play a key role in revitalizing U.S. manufacturing fortunes. Unfortunately, while many other nations—and indeed many U.S. states—are taking steps to boost the competitiveness of their manufacturing industries, the United States lacks a clear, coherent strategy to bolster the competitiveness of manufacturing firms of all sizes and across all sectors, a shortcoming that must be rectified if the United States hopes to “win the future” in manufacturing. Accordingly, this white paper is the first in a series of three that will build the case for and lay out a specific national manufacturing strategy. The three white papers, to be released in the Spring, Summer, and Fall of 2011, respectively, will:

1. Explain why manufacturing is vitally important to the U.S. economy, document how many U.S. manufacturing sectors have struggled recently, and articulate why the United States needs to support its manufacturing base with a national manufacturing strategy.
2. Survey how competing peer countries are supporting their manufacturing sectors through their national manufacturing strategies (and manufacturing-support agencies) and summarize key lessons and insights the United States can use to better support its manufacturers.
3. Formally define a national manufacturing strategy for the United States, including specific recommendations around the “4 T’s” of tax, trade, technology, and talent.

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## WHY IS MANUFACTURING IMPORTANT?

A robust manufacturing sector is indispensable to the health of the U.S. economy. While manufacturing is not the only sector that contributes to a nation's international competitiveness, it is impossible for large economies like the United States' to remain competitive without a viable manufacturing sector. Manufacturing plays a critical role in the U.S. economy for five key reasons:

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*Losses in U.S. manufacturing jobs are not simply a result of productivity gains, but rather also reflect the declining international competitiveness of U.S. manufacturing.*

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- It will be extremely difficult for the United States to balance its trade account without a healthy manufacturing sector.
- Manufacturing is a key driver of employment growth and source of high-paying jobs for individuals at many skill levels.
- Manufacturing is the principal source of R&D and innovation activity.
- Manufacturing and services sectors are inseparable and complementary.
- Manufacturing is vital to U.S. national security.

### **It Will Be Extremely Difficult for the United States to Balance its Trade Account Without a Healthy Manufacturing Sector**

Perhaps the most important reason the United States needs a healthy manufacturing base is because it is the principal way for our nation to stop running chronic trade deficits. Balancing U.S. trade through a revitalized manufacturing sector is crucial because:

- The trade deficit represents a tax on future generations that compromise their economic well-being.
- The United States is running substantial trade deficits across many categories of manufactured products.
- Services and non-manufactured goods won't be enough to close the U.S. trade deficit.

#### **The trade deficit represents a tax on future generation**

The principal reason to be concerned with the health of U.S. manufacturing relates to its key role in determining the U.S. trade balance—and its economic impact not just on the current generation of Americans, but also on the next one. Over the prior decade, manufacturing accounted for approximately 65 percent of U.S. trade, and thus a weak manufacturing sector has contributed substantially to large and chronic trade deficits.<sup>8</sup> If Americans are going to import large volumes of HDTVs, T-shirts, and sports cars, we must have something that other nations want to buy in exchange—that's why it's called "trading" and not "borrowing."

The massive bill we run up every year by buying more imports than selling exports will have to be paid eventually when foreign nations demand payment in real goods and services, not in Treasury Bills. (In fact, the average annual U.S. trade deficit for each year of

the previous decade was \$458 billion, or about \$20,000 per household over the course of the decade.) The implication of the United States' chronic trade deficit is that while America's 310 million consumers can buy their imported DVD players, T-shirts, cars, and oil to drive them cheaply today, the manufacturing base that would produce wealth in the future is being hollowed out. And while some of the effects of a weaker manufacturing base are felt presently by the almost six million manufacturing workers who have lost their jobs over the past decade, those effects will be felt most keenly in the future in the form of relatively lower U.S. productivity and a trade debt that future generations will have to pay off by producing more than they consume and exporting the difference.

It's as simple as this: every DVD player, luxury automobile, and barrel of oil Americans consume now by expanding our trade debt is a DVD player, luxury automobile, and barrel of oil that a future generation will have to pay for in the form of reduced consumption of real goods and services and a future trade surplus. Thus, the trade deficit represents a hidden tax on the next generation of Americans. The reality is that the United States will have to significantly boost its manufacturing exports to balance its trade in order to avoid passing on unsustainable debts to future generations.

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*The trade deficit represents a hidden tax on future generations that compromises their economic well-being.*

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#### The United States is running substantial trade deficits across many categories of manufactured products

As Figure 4 illustrates, over the past two decades the United States has increasingly run sharp trade deficits in both manufactured products (such as vehicles, consumer electronics, and machine tools) and non-manufactured goods (such as agricultural products, oil, and commodity inputs), with the recent mitigation in those trade imbalances caused primarily by the recession. But the U.S. trade deficit in manufactured products is not seen just in low- to mid-technology products like apparel, luggage, or hand tools, but even in advanced technology products (e.g. life sciences, medical devices, optoelectronics, information technology, and aerospace products) as a whole. Even in some advanced technology industries where one might expect that surely the United States runs a trade surplus, such as renewable energy products, the country actually runs a trade deficit. In fact, from 2004 to 2008, the trade deficit in renewable energy products increased by 1,400 percent to nearly \$5.7 billion.<sup>9</sup>

The reality is that—while the United States has comforted itself with the narrative that it could let go of commodity manufacturing industries and seamlessly “migrate up the value-chain” to high-tech, higher-value-added industries in which it could readily lead the world—the United States is increasingly running trade deficits in manufacturing sectors across all levels of technological sophistication. A number of stark facts make the challenge clear:

#### Aggregate U.S. trade deficit:

- During the prior decade, the United States accumulated a \$5.5 trillion trade deficit in goods and services with the rest of the world.<sup>10</sup>
- In no year in the last decade did the United States have a negative trade balance of less than \$360 billion, and in five of those years it had negative trade balances of at least \$600 billion.

### U.S. trade deficit in manufactured products

- The U.S. trade deficit in manufactured products tallied nearly \$4.5 trillion from 2000 to 2010.<sup>11</sup>
- In seven of those ten years, the U.S. manufactured products trade deficit was greater than \$400 billion.

### U.S. trade balance in advanced technology products:

- The United States has recorded a deficit in advanced technology products trade every year since 2002.<sup>12</sup>
- The United States ran a \$81 billion advanced technology products trade deficit in 2010, the largest in its history, and from January 2002 to December 2010, it totaled a \$427 billion deficit in advanced technology products.<sup>13</sup>

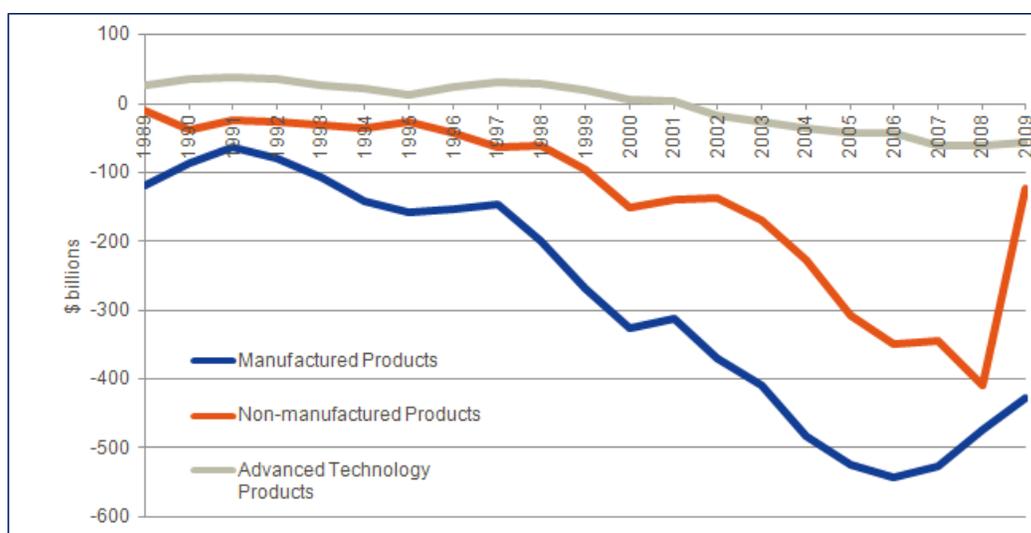


Figure 4: U.S. Trade Balances for Manufactured Products, Non-manufactured Goods, and Advanced Technology Products, 1989-2009<sup>14</sup>

### U.S. share of world exports

- Since 2000, the U.S. share of world exports has declined from 17 percent to 11 percent, even as the European Union's share held steady at 17 percent.<sup>15</sup>
- From 2005 to 2010, the U.S. share of global high-tech exports dropped from 21 percent to 14 percent, while China's share grew from 7 percent to 20 percent, as China replaced the United States as the world's number one high-technology exporter.<sup>16</sup>

### Services and non-manufactured goods exports won't be enough to close the trade deficit

Some have argued that the United States can close its trade deficit solely by boosting exports of services and/or non-manufactured goods (principally agricultural products or energy exports such as natural gas). And while the United States does run a trade surplus in services, that positive balance (\$149 billion in 2010) was dwarfed by a negative balance in goods imports (\$646 billion), for an aggregate U.S. trade deficit of \$499 billion in 2010 (which was \$123 billion, or 25 percent, more than the 2009 deficit of \$375 billion).<sup>17</sup>

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Moreover, with U.S. exports of goods 157 percent greater than exports of services, one of the fastest ways to boost exports will be through expanding manufacturing.

The Brookings Institution's Howard Wial has examined export growth rates for services, non-manufactured goods, and manufactured products (or combinations thereof) that would be required to balance the U.S. trade deficit over the next decade. He finds that to balance the trade deficit through increased services exports alone would require them to grow at an annual compound rate of 13.5 percent over the next decade, whereas their annual growth rate from 2001-2010 was 7.9 percent. To balance trade through increases in non-manufactured goods exports would require them to grow at a 23.7 percent rate over the next decade, whereas they grew at a 11.1 percent rate over the past decade. However, to balance trade by 2019 with only manufacturing exports, they would have to grow at a compound annual growth rate of 9.4 percent, compared to their growth rate of 6 percent over the prior decade. In other words, manufacturing has a "shorter road to hoe" in terms of the increase in exports required of it to balance the trade deficit.<sup>18</sup>

Moreover, even if the U.S.'s services surplus grew 10 percent every year (a highly unlikely scenario) it would take fifteen years before it would equal the amount of the goods trade deficit in 2010, whereas that gap could be closed in just two and a half years if both exports of goods and services increased at a 10 percent annualized rate. Thus increases in services and non-manufactured goods exports will be necessary but not sufficient; to balance its trade the United States must have a robust manufacturing sector.

The reality is that the United States needs robust manufacturing, services, and non-manufactured goods industries; the country must move beyond its "either/or" approach to balancing its trade deficit and to restoring economic growth. In contrast to the contention made in a recent *Economist* article that "calls to boost manufacturing ignore the gains still to be made from services," calls to boost manufacturing simply recognize manufacturing for what it is—a vital component of the U.S. economy, the preponderant source of U.S. exports, and a major source of strong paying middle class jobs (as explained subsequently).<sup>19</sup> Moreover, to make such an argument is not to denigrate the important role services play, but rather to make the argument that the United States cannot succeed without a much stronger manufacturing sector.

Ultimately, without a robust manufacturing sector, it's simply impossible for almost any nation, unless it's endowed with oil or other natural resources, to balance its trade—and the United States is no exception.

### **Manufacturing is a Key Driver of Employment Growth and Source of High-paying Jobs for Individuals at Many Skill Levels**

Manufacturing is vitally important to the U.S. economy because it is a crucial source of:

- Employment growth, particularly through exports.
- Indirect employment in other economic sectors.
- High-paying jobs, for individuals at many skill levels.

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### Manufacturing is a key source of overall U.S. employment growth, particularly through exports

Regional economists have long shown that the employment multiplier from exports is much higher than that from spending within a region. This is why so many states target exporting sectors like manufacturing, software, tourism, and corporate headquarters. For every job supported by exports from a state, usually two or three jobs are supported in the state. National economies are larger than state economies, but the principle is the same: exports have a bigger impact on jobs than domestic spending. Economist Lori Kletzner finds that, within an industry, a 10 percent increase in sales due to exports leads to a 7 percent increase in employment, while a 10 percent increase in domestic demand leads to just a 3.5 percent increase in employment.<sup>20</sup> With manufacturing accounting for 57 percent of U.S. exports, the fastest way to boost exports—and the jobs they support—will be by increasing U.S. manufacturing.

### Manufacturing generates significant employment spillovers in other sectors

Most economists agree that manufacturing has a large multiplier effect, with each job in manufacturing leading to the creation of from two to five additional jobs elsewhere in the economy.<sup>21</sup> The Economic Policy Institute finds that manufacturing jobs have a robust employment multiplier of 2.90, compared to 1.63 in business services or 1.66 in transportation.<sup>22</sup> A more recent June 2009 Milken Institute report, *Manufacturing 2.0*, finds that for every job created in manufacturing, 2.5 jobs are created in other sectors.<sup>23</sup> Hans Zobel, former CEO of Festo, a German manufacturer of electrical automation technology, notes that recent research from Germany finds that a job in a modern, smart manufacturing factory supports 5.2 additional jobs throughout the economy.<sup>24</sup> High-tech manufacturing industries have even greater multipliers. Electronic computer manufacturing has a multiplier effect of 16 jobs, meaning 15 other jobs are dependent on one job created in that industry.<sup>25</sup>

Likewise, manufacturing has a substantial impact in terms of output, with an estimated additional \$1.40 in output from other sectors being generated for every \$1.00 in final sales of manufactured products.<sup>26</sup> The only other industries coming even close to this are information services; agriculture, forestry, fishing, and hunting; and construction, each slightly over \$1.00.

### Manufacturing is a key source of high-paying jobs

A strong manufacturing sector is not just about more jobs; it's about higher wage jobs. U.S. manufacturing jobs, on average, pay 9 percent more in wages and benefits than jobs in the overall economy.<sup>27</sup> Moreover, the average wage in the high-tech sector (which includes a large number of manufacturing jobs) is 86 percent higher than the average private sector wage.<sup>28</sup>

Many manufacturing jobs are found in export-producing traded industries.<sup>29</sup> Thus, one of the reasons jobs in manufacturing pay more is because manufacturing produces more exports, and exports contribute an additional 18 percent to workers' earnings on average in the U.S. manufacturing sector.<sup>30</sup> Moreover, the premium for blue-collar workers is approximately 20 percent greater than the export earnings premium for white-collar workers.<sup>31</sup> Employees in the top third of the most trade-intensive industries (those where

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*Manufacturing is a vital source of employment growth and above-average-wage middle-class jobs.*

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combined exports and imports amount to at least 70 percent of their domestic industrial output) earn an annual compensation package about 47 percent greater than those in the bottom third of trade-intensive manufacturing sectors.<sup>32</sup>

### Manufacturing remains a critical source of middle-class jobs

U.S. manufacturing jobs increasingly require individuals possessing higher skill levels. From 1973 to 2001, the share of production workers with some post-secondary education rose from 8 percent to over 30 percent.<sup>33</sup> Moreover, according to a recent survey of leading manufacturers, 51 percent of the workforce demand in manufacturing is currently for skilled production workers, 46 percent for scientists and engineers, and only 7 percent for unskilled production workers.<sup>34</sup>

Yet, while manufacturing workers are becoming more educated and skilled, still 47 percent of U.S. manufacturing workers have not completed education beyond high school (with about 36 percent of the U.S. manufacturing workforce having high school but no college education and 11 percent not having completed high school).<sup>35</sup> Given the wage data for the industry, this means that manufacturing remains a critical source of good-paying jobs for a broad swath of the U.S. workforce that lacks advanced education. If the United States is to move away from a bifurcated economy of “janitors vs. lawyers” with the consequent substantial wage differentials that entails, these types of moderately skilled jobs will be crucial to providing good-paying employment to large numbers of Americans.

### Manufacturing is the Principal Source of R&D and Innovation Activity

Manufacturing plays a critical role in driving R&D and innovation.

- Manufacturing accounts for the vast majority of U.S. R&D.
- Manufacturing sectors are the most innovative in the economy.

### Manufacturing accounts for the vast majority of U.S. R&D

Manufacturing firms perform approximately 70 percent of U.S. industry R&D, despite the fact that manufacturing accounts for only about 11 percent of the economy. Services industries, despite the fact that they account for over 80 percent of GDP, perform only 30 percent of industry R&D.<sup>36</sup>

### Manufacturing sectors are the most innovative

The National Science Foundation’s *2008 Business R&D and Innovation Survey* found that, on average, only 9 percent of surveyed U.S. businesses were active innovators from 2006 to 2008.<sup>37</sup> However, U.S. “manufacturing industries in aggregate exhibited a considerably higher overall incidence of innovation than did the population of companies as a whole.”<sup>38</sup> In fact, 22 percent of manufacturing companies reported product or process innovations compared to only 8 percent of non-manufacturing companies reporting product or process innovations over that time frame. Moreover, the individual industries with the highest rates of innovation were found almost entirely in manufacturing industries. For example, 45 percent of computer/electronic products firms reported product innovations and 33 percent process innovations; 41 percent of chemical companies reported product

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innovations and 34 percent process innovations; and 37 percent of electrical equipment/appliances/components subsector firms reported product innovations.

### **Manufacturing and Services Sectors are Inseparable and Complementary**

While some economists have tried to draw sharp divisions between manufacturing and services in an attempt to argue that an economy can grow robustly without a manufacturing sector, the reality is that the manufacturing and services sectors are inseparable and complementary. The notion that the United States can give up its manufacturing sectors because it will be able to seamlessly “migrate up the value chain” to higher-value-added knowledge-based service sectors is incorrect.

Yet some have argued that the United States should feel safe offshoring all manufacturing, because service-based activities such as R&D, design, financing, marketing, and service maintenance functions will stay here. However, the notion that the design and R&D value-add components can be separated from the manufacturing of a technology-based product is fundamentally flawed, because:

- Manufacturing, R&D, and innovation go hand-in-hand.
- The process of industrial loss becomes additive.
- The health of manufacturing and services sectors depend on one another.

### **Manufacturing, R&D, and innovation go hand-in-hand**

Greg Tassej, Senior Economist at the National Institute of Standards and Technology, excoriates the received wisdom that the United States can outsource manufacturing but keep the higher-value-added service activities at home, observing that this view fundamentally misunderstands the nature of technology development, especially across current and subsequent technology life cycles. As Tassej writes:

When technological advances take place in the foreign industry, manufacturing is frequently located in that country to be near the source of the R&D. The issue of co-location of R&D and manufacturing is especially important because it means the value-added from both R&D and manufacturing will accrue to the innovating economy, at least when the technology is in its formative stages. Thus, an economy that initially controls both R&D and manufacturing can lose the value-added first from manufacturing and then R&D in the current technology life cycle—and then first R&D followed by manufacturing in the subsequent technology life cycle. This is the economics of decline.<sup>39</sup>

Susan Houseman of the Institute for Employment Research agrees: “The big debate is whether we can continue to be competitive in R&D when we are not making the stuff that we innovate. I think not; the two cannot be separated.”<sup>40</sup> Likewise, according to George W. Bush’s President’s Council of Advisors on Science and Technology, “The proximity of research, development, and manufacturing is very important to leading-edge manufacturers.”<sup>41</sup> In other words, the continuing shift of manufacturing offshore is pulling

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*R&D, manufacturing, and innovation go hand-in-hand; and where manufacturing goes, innovation follows.*

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high-end design and R&D capabilities out of the country. In fact, 90 percent of all electronics R&D now takes place in Asia, in part because firms need volume production to be able to afford general R&D.<sup>42</sup> This in part explains why, from 1998 to 2007, investment by U.S. corporations in R&D increased more than 2.65 times as fast overseas as all corporate investment did domestically.<sup>43</sup> Thus, the reality is that R&D, innovation, and manufacturing go hand-in-hand. As Dow Chemical CEO Andy Liveris succinctly states: “Where manufacturing goes, innovation inevitably follows.”<sup>44</sup>

#### The process of innovation and industrial loss becomes additive

Once one technological life cycle is lost to foreign competitors, subsequent technology life cycles are likely to be lost as well. In fact, examples abound of the United States losing technology leadership in one product life cycle with the result that it falls behind in subsequent technology life cycles. For example, the United States lost leadership in rechargeable battery manufacturing technology years ago, largely because most innovation in batteries has been driven by increasing demands in consumer electronics for more and more power in smaller packages.<sup>45</sup> When U.S. companies largely abandoned the “mature” consumer electronics business, the locus of R&D manufacturing—not just for laptops and cell phones but also their advanced batteries—shifted to Asia. And lo and behold, as U.S. and global attention has turned toward developing energy-efficient vehicles using advanced electric batteries, Japan’s and Korea’s strong battery (and auto) industries have given them an advantage over U.S. companies in developing electric and hybrid vehicles. Hence, GM has had to source the advanced battery for its Chevy Volt from a Korean supplier. Likewise, the migration of semiconductor foundries to Asia has caused a sharp decline in silicon-processing and thin-film-deposition capabilities in the United States. But now that thin-film-deposition turns out to be a critical process in manufacturing photovoltaic solar cells, the United States increasingly risks falling behind in the manufacture and development of solar cells. The net effect of these trends is the deepening erosion of the U.S. industrial base, the hollowing out of advanced production supply chains, and the loss, for many U.S. industries, of their “industrial commons”—the R&D know-how, advanced process development, engineering skills, and manufacturing competencies related to a specific technology. As Harvard’s Willy Shih and Gary Pisano conclude, “Decades of outsourcing manufacturing have left U.S. industry without the means to invent the next generation of high-tech products that are crucial to rebuilding its economy.”<sup>46</sup>

#### The health of manufacturing and service sectors are interdependent

There is a deeply symbiotic, interdependent relationship between the health of a nation’s manufacturing and services sectors: the health of one sector greatly shapes the health of the other. In particular, the technology-based services sector depends heavily on manufactured goods. In part, this is because most modern technologies are actually systems, which means interdependencies exist among a set of industries that contribute advanced materials, various components, subsystems, manufacturing systems, and eventually service systems based on sets of manufactured hardware and software.<sup>47</sup>

Since, as noted previously, most U.S. R&D is performed by its manufacturing firms, manufacturing R&D remains the dominant source of services-sector technologies, and thus services companies must take much of their technology from the manufacturing sector.

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*Decades of outsourcing have left U.S. industry without the means to invent the next generation of high-tech products crucial to rebuilding the economy.*

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Therefore, the U.S. economy's ability to remain competitive in services sectors, particularly high-technology ones, requires close interactions with the creators and suppliers of technologically advanced hardware and software. As Greg Tassef observes, "The demise of a substantial high-tech domestic manufacturing sector would greatly diminish the size and efficiency of the overall domestic innovation infrastructure. Under a 'services-sector-only' growth scenario, an economy would miss skilled pools of researchers to be the developers of high-tech services."<sup>48</sup> The message is clear: manufacturing and services are not separable—they are joined at the hip.

Therefore, the United States must discard the notion that it can give up its manufacturing industries but retain a robust set of services sectors capable of propelling the economy forward by themselves.

### **Manufacturing is Vital to U.S. National Security**

A strong manufacturing base is vital to the economic well-being of a nation—and to its national security. Thus, a decline in American manufacturing risks national security. A number of reports have warned about the loss of the U.S. industrial base and its high-tech capabilities, arguing that these trends have the potential to profoundly impact the military.<sup>49</sup> For example, a 2005 Defense Science Board Task Force on High Performance Microchip Supply said the country was losing its high-tech industrial capability and that "urgent action is recommended." It warned that America's most strategic industries were not in a position to change the competitive dynamics that had emerged globally to shift the balance of production and markets away from the United States. As the National Defense Industrial Association sums up the situation, "If we lose our preeminence in manufacturing technology, then we lose our national security."<sup>50</sup> This is because:

- As the U.S. industrial base moves offshore, so does the defense industrial base.
- Reliance on foreign manufacturers increases vulnerability to counterfeit goods.

**As the U.S. industrial base increasingly moves offshore, so does the defense industrial base, creating multiple vulnerabilities**

As Joel Yudken explains in *Manufacturing Insecurity*, "Continued migration of manufacturing offshore is both undercutting U.S. technology leadership while enabling foreign countries to catch-up, if not leap-frog, U.S. capabilities in critical technologies important to national security."<sup>51</sup>

If the U.S. defense industrial base is to retain its ability to develop the most technologically sophisticated defense platforms, the United States will need to be at the forefront of advanced technology manufacturing capabilities in many areas, such as nanotechnology, advanced batteries, semiconductors, sensors, etc. Unfortunately, U.S. vulnerabilities in advanced technology manufacturing capability span a number of technologies. The mission of the Defense Production Act Title III is to target and bolster areas of high-tech manufacturing where the United States has diminishing or no capability. Title III currently has active projects in lithium-ion (Li-ion) battery production, yttrium barium copper oxide high-temperature superconductors, and photovoltaic solar cell encapsulants, among others. Lithium-ion battery production is particularly troubling. According to Title III there is "at

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present no domestic production capability for extremely long life Li-ion cells.”<sup>52</sup> As Title III makes clear in the defense context, “dependence on foreign manufacturers...is not an option in some cases.”<sup>53</sup>

Additional examples of defense-critical technologies where domestic sourcing is endangered include propellant chemicals, space-qualified electronics, power sources for space and military applications (especially batteries and photovoltaics), specialty metals, hard disk drives, and flat panel displays (LCDs).<sup>54</sup> In fact, Michael Webber, an engineering professor at the University of Texas, has studied the economic health of sixteen industrial sectors within the manufacturing support base of the U.S. defense industrial system that “have a direct bearing on innovation and production of novel mechanical products and systems,” and finds that, since 2001, thirteen of those sixteen industries have shown “significant signs of erosion.”<sup>55</sup>

### Reliance on foreign manufacturers increases U.S. vulnerability to receiving counterfeit goods

According to a study conducted by the Bureau of Industry and Security (BIS), in 2008 there were 9,356 incidents of counterfeit foreign products making their way into the Department of Defense supply line, a 142 percent increase over 2005.<sup>56</sup> Counterfeit materials can and have hampered the military’s ability to maintain weapon systems in combat operations—a major vulnerability. Moreover, many distributors surveyed in the BIS study cited insufficient steps taken by foreign governments to disrupt counterfeiting operations within their own borders.<sup>57</sup>

Ultimately, as Yudken concludes, “Only a comprehensive strategy aimed at reversing the erosion of the nation’s overall manufacturing base will be sufficient for preserving and revitalizing the nation’s defense industrial base in the coming decades.”<sup>58</sup>

## U.S. MANUFACTURING IN TRANSITION AND RELATIVE DECLINE

On one hand, U.S. manufacturing is on an evolutionary path, as it increasingly transitions from more labor-intensive manufacturing to more knowledge-intensive, higher-value-added sectors. This is a major reason why the United States retains strengths in a number of particularly knowledge-intensive manufacturing sectors—notably aviation, medical devices, pharmaceuticals and life sciences, computers and electronic products, and chemicals, among others. On the other hand, a broad look at data from the past decade shows that the United States has seen absolute declines in output across a number of manufacturing sectors. Moreover, there is reason to believe that official government statistics may be overstating manufacturing output growth.

### Output Growth in U.S. Manufacturing Sectors is Overstated

A principal reason why the United States has not had a manufacturing strategy is because many argue that U.S. manufacturing is healthy. Indeed, the largely consensus view is that U.S. manufacturing output growth remains strong. For example, those arguing that U.S. manufacturing remains fundamentally healthy point to one key statistic: over the last two decades or so, the inflation-adjusted value-added output of U.S. manufacturing has largely been stable at around 11.5 to 12 percent of GDP. But such an analysis overlooks the fact

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that manufacturing has lagged overall economic growth, that the majority of U.S. manufacturing sectors have seen absolute declines in real output over the past decade, and that the apparent growth in manufacturing output stems from overinflated estimates of output from two industries—the computer and electronics industry and the petroleum industry.

### Manufacturing has lagged overall U.S. economic growth

Manufacturing has lagged and is no longer keeping up with overall U.S. economic growth. From 2000 to 2009, total manufacturing realized a 5 percent increase in real-value-added, even as overall U.S. GDP increased 15 percent.<sup>59</sup> This means that manufacturing is not keeping up with the growth in the rest of the economy.

### Most manufacturing sectors actually shrank in terms of real value-added from 2000 to 2009

In fact, from 2000 to 2009, fifteen of nineteen U.S. manufacturing sectors saw absolute declines in output; they were producing less in 2009 than they were at the start of the decade.<sup>60</sup> There were declines of:

- Food, beverage, and tobacco products—0.2 percent
- Electrical equipment—2 percent
- Chemicals—3 percent
- Machinery—14 percent
- Printing—15 percent
- Wood products—16 percent
- Motor vehicles—18 percent
- Fabricated metals—27 percent
- Nonmetallic minerals and primary metals— 28 percent
- Paper— 28 percent
- Plastics—31 percent
- Apparel— 40 percent
- Furniture— 43 percent
- Textiles—43 percent

In other words, fifteen manufacturing sectors that made up 79 percent of U.S. manufacturing output all produced less in 2009 than in 2000, all at a time when overall GDP grew 15 percent.

How is it, then, that just four sectors, which collectively accounted for just 21 percent of U.S. manufacturing output, can offset the declines in these other fifteen sectors to produce the apparent 5 percent growth in U.S. manufacturing output?

Official government figures overstate output from the computer and electronics and petroleum industries, thereby inflating estimates of overall manufacturing output growth. In reality, the data suggesting an overall 5 percent increase in manufacturing output is significantly overstated. It rests on a misreading of national output data that overstates output of NAICS 334, the computers and electronics industry,<sup>61</sup> and NAICS 324, the petroleum and coal products industry. This over-estimation of the output growth from the computer and electronic products sector is masking declines across the majority of U.S.

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*From 2000 to 2009, fifteen of nineteen U.S. manufacturing sectors shrank in terms of percentage change in real value-added.*

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manufacturing sectors and inflating output growth from the manufacturing sector as a whole. In fact, if the official government figures had been counted correctly, the United States probably would have experienced an absolute decline in manufacturing output over the past decade.<sup>62</sup>

To see how, understand that the federal government classifies manufacturing into two groups, durable goods (industries like automobiles, machines, and computers) and non-durables (industries like food, chemicals, apparel, and petroleum products). From 1987 to 2009, increases in the output of non-durables added just 2.55 percent to overall GDP growth.<sup>63</sup> This is well under half of the approximately 6 percent they should have added to GDP had they contributed their “fair share” to U.S. GDP growth, (e.g. the level needed to not shrink as a share of the economy.)

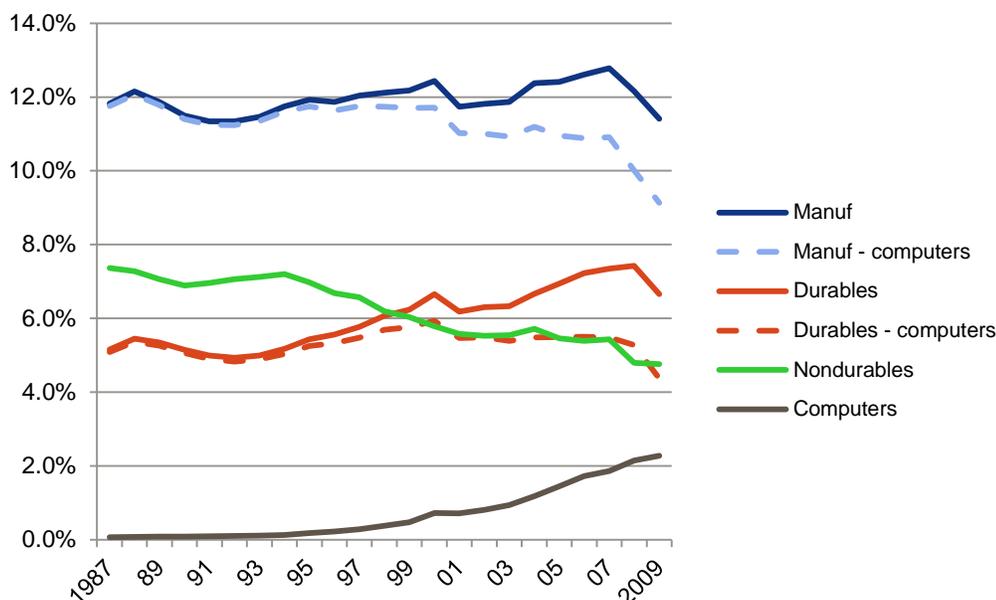
In fact, the vast majority of output growth in non-durables came from just one sector—petroleum and coal products—which experienced reported output growth of 73 percent. Yet this figure is likely overstated and suspect, because official statistics attribute as output increases some of what are more likely simply increases in oil prices and other inputs. The Bureau of Economic Analysis (BEA) reports that change in output in current dollars was actually 175 percent. But according to the Energy Information Agency, U.S. coal production was unchanged between 2000 and 2010, while natural gas production was down slightly.<sup>64</sup> And U.S. new refinery production of petroleum and petroleum related products was up just 3 percent.<sup>65</sup>

Durables, on the other hand, added 39 percent more than their fair share to U.S. GDP, suggesting that they grew faster than overall GDP. In particular, one durable goods industry—computer and electronic products—experienced whopping growth of 260.5 percent according to official statistics.<sup>66</sup> In other words, this one sector which accounts for just 9 percent of overall U.S. manufacturing output accounted for 80 percent of U.S. manufacturing output growth from 2000 to 2008, even though the number of workers in the industry declined from 1.78 million to 1.09 million. (In fact, close to 12 percent of total U.S. GDP growth supposedly came from this one sector, which accounted for less than half a percent of GDP.) Moreover, according to the BEA, output of computer and electronics parts grew by just 20 percent in current dollars.

Figure 5 illustrates how the inflated estimate of output from the computer and electronic products industry is overstating the health of U.S. manufacturing. The solid blue line shows that U.S. manufacturing as a share of GDP (in real, inflation-adjusted numbers) has been roughly constant at about 12 percent from 1987 to 2009. However, over that time period, the share of non-durables manufacturing (green line) has declined noticeably, yet been offset by an apparent increase in durables (red line). However, this increase in durables is almost entirely a result of the (incorrectly calculated) increased output from the computers and electronic products industry (gray line at bottom). Thus, when one backs out NAICS 334 from durables (the red dotted line), it’s apparent that output from both durables and non-durables are on the same decline trajectory. Likewise, when one backs out computers and electronic products from total manufacturing (the light blue dotted line), it becomes quite apparent that all other manufacturing has experienced significant

*Over the last decade, many nations—including ones with higher manufacturing wages than the United States—have seen either stable or increasing manufacturing output as a share of GDP.*

declines (especially since 2000) and that apparent output growth from the computer and electronic products sector is by itself bolstering the appearance that manufacturing has maintained a stable share of GDP since 1987.



**Figure 5: Share of U.S. GDP Attributable to Total Manufacturing, Total Manufacturing without Computers, Durables, Durables without Computers, Non-Durables, and Computers, 1987-2009**

In summary, an assessment of manufacturing trends since 2000 shows that the picture is much worse—one not just of slow growth and contracting share, but actual decline across almost all sectors. Another way to see this is that between 2001 and 2009 the sum of yearly GDP changes was 18.2 percent (e.g. if GDP increased 3 percent in one year and two percent the next, the sum would be five percent). On average, manufacturing accounted for about 12 percent of the U.S. economy over this time period. Had manufacturing contributed its share to GDP growth, it would have added a sum of changes of 2.2 percent (18.2 percent times 12 percent). But in fact, manufacturing contributed just 0.76 percent, a third of what it should have. And when one takes out computers, the expected growth was 1.9 percent, but manufacturing minus computers actually subtracted 0.6 percent from GDP. This is because during the last decade, manufacturing minus computers actually lost 11 percent of value-added. And if one assumes that petroleum and coal experienced no change in real value-added and computers and electronics increased by 50 percent, real manufacturing output declined by 9 percent.

Other economists, including Dan Luria and Joel Rogers as well as Susan Houseman and her colleagues, have reached similar conclusions.<sup>67</sup> In “Offshoring and the State of American Manufacturing,” Houseman et al. report similar findings, estimating that overall manufacturing output grew 1.18 percent per year from 1997 to 2007, but just 0.46 percent per year once computers are removed.<sup>68</sup> Thus, those who would point to the apparently stable GDP share of U.S. manufacturing output over the past decade as an

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indicator of strength in U.S. manufacturing industries are mistaken; those figures are being inflated by overstating output in the computers and electronics sectors.

**Manufacturing capital investment in the United States has been decreasing, both relative to historical levels and relative to peer countries**

From 2000 to 2008, manufacturing investment as a proportion of GDP was on average lower in the United States than in most competitor countries. And from 2000 to 2009, capital investment within the United States by U.S. manufacturers declined over 7 percent. The declines were steep in many industries. Paper declined by 29 percent, motor vehicles by 42 percent, furniture by 50 percent, and apparel by 73 percent. Even sectors that the United States is supposed to lead in saw declines, with computers and electronic products down 4 percent and chemicals down 13 percent.<sup>69</sup> In contrast, from 2000 to 2009, capital investment abroad by U.S. manufacturing firms and majority-U.S.-owned affiliates was on average 16 percent higher than manufacturing investment at home.<sup>70</sup>

**Many U.S. manufacturing industries now have less capital stock**

This is a reflection of decreasing amounts invested every year in new plant and equipment. That amount has to exceed the amount of depreciation that occurs every year to prevent overall capital stock (the total value of plant and equipment) from declining. For most of American history, at least since World War II when the Department of Commerce started tracking these numbers, manufacturing capital stock increased at a robust pace. But in the last decade a different picture has emerged. Appendix A shows the year in which the overall capital stock in various U.S. industries peaked, and the change from that peak year to 2009, revealing that dramatic decreases in capital stock have occurred in a number of U.S. manufacturing industries. For example, the capital stock of the primary metals industry (that is, the steel and aluminum industries) peaked three decades ago, in 1981, and has fallen by 27 percent since. Other industries peaked later, but in some cases saw a similarly steep fall in capital stock. For example, in just eight years, the value of buildings, machines, and equipment in the apparel industry fell by 21 percent. Capital stock in the motor vehicles industry peaked in 2003 and has fallen 7 percent since. Most U.S. manufacturing industries now have less machinery and equipment than they did a decade ago, though a few, like machinery and petroleum products, have remained stable. In contrast, other industries, such as the securities and health care industries, have more capital stock now than ever in their history.

Another way to view this is to look at the rate of change of fixed assets by industry and by decade, as Figure 6 does. In the 1960s and 1970s, the percent increase in manufacturing assets generally kept up with the robust rate of increase in fixed assets in the overall private sector (though running about 10 percent behind). In the 1980s, in part due to the severe recession at the start of the decade and the emergence of tough international competition, growth in manufacturing assets fell by half of the 1970s' level, but picked up to almost 40 percent in the 1990s. But over the last decade manufacturing assets grew by just 6 percent, about one-sixth the rate of increase in total private fixed assets, again reflecting weakened growth in the manufacturing sector compared to the rest of the U.S. economy.

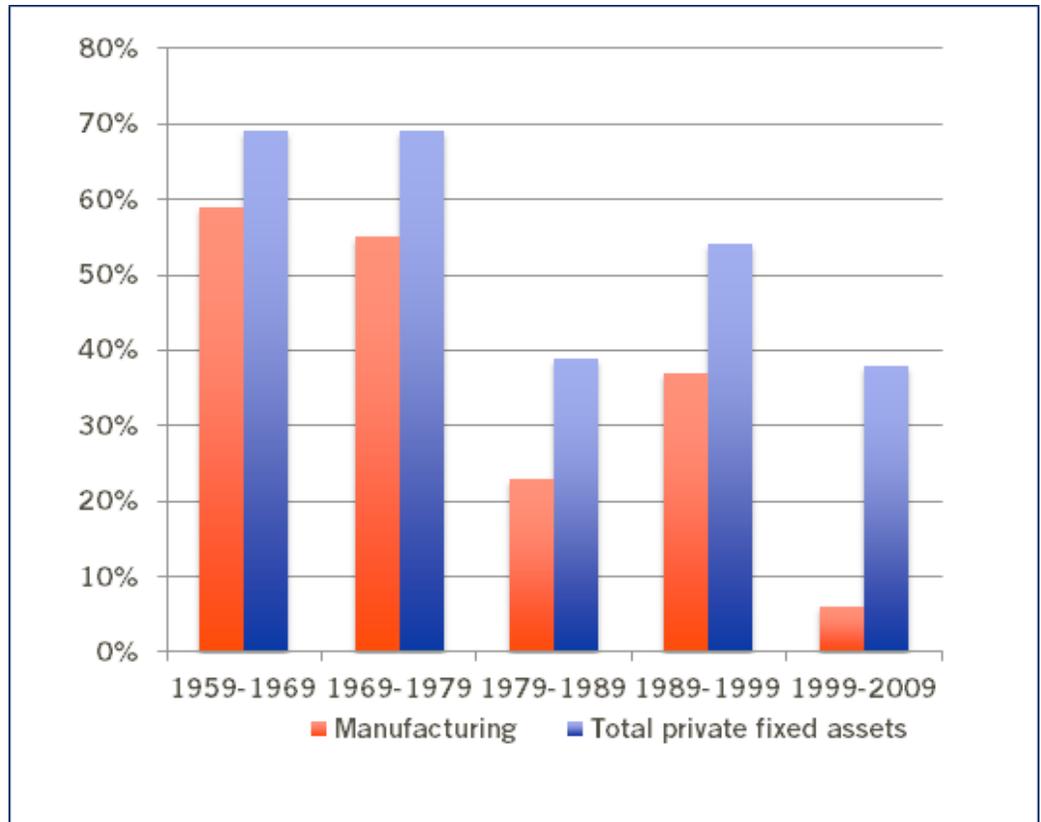
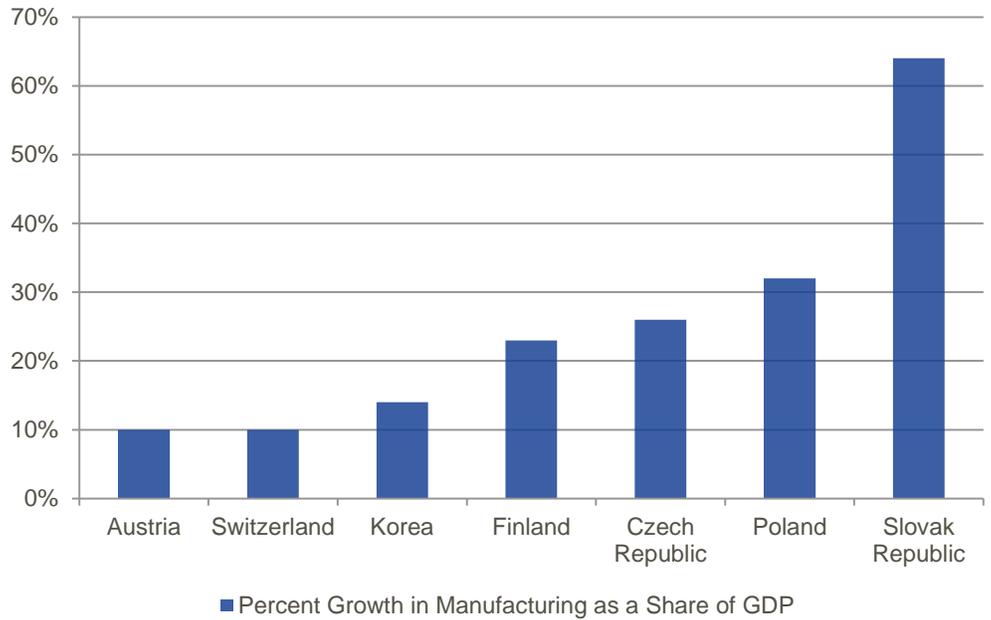


Figure 6: Percentage Change in Manufacturing and Total Private Fixed Assets, by Decade<sup>71</sup>

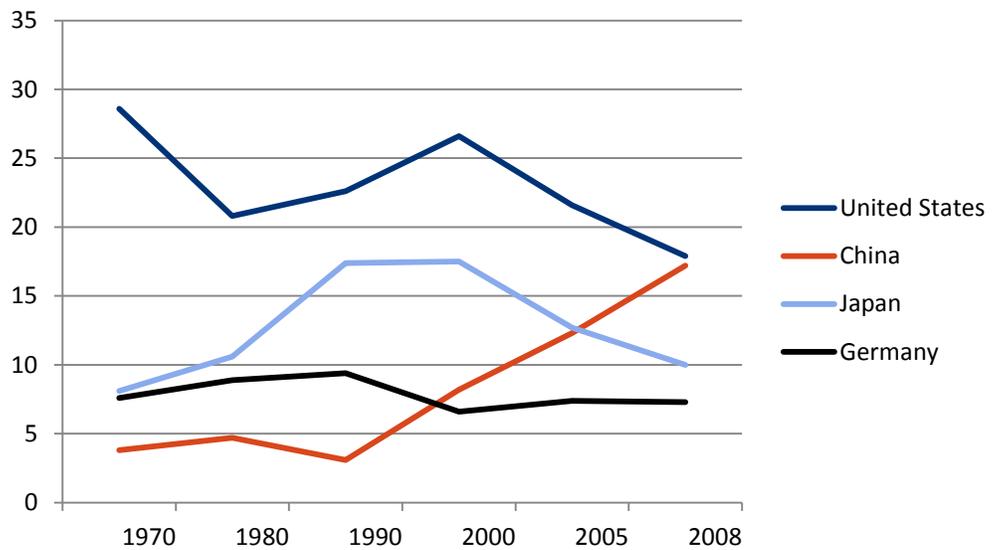
### U.S. Manufacturing Decline is Neither “Inevitable” nor “Normal”

The decline of U.S. manufacturing is often cited as “normal” and in line with what is happening in other countries. In this “post-industrial” view, the more advanced nations are transitioning from factories to services. But the reality is that over the last decade, many nations, including ones with higher manufacturing wages than the United States, have seen either stable or increasing manufacturing output as a share of GDP. For example, over the last decade, Germany, the Netherlands, and Norway have all seen stable manufacturing shares. As Figure 7 shows, many nations have actually seen their manufacturing sectors grow as a share of their economy, by 10 percent in Austria and Switzerland, 14 percent in Korea, 23 percent in Finland, 26 percent in the Czech Republic, 32 percent in Poland, and 64 percent in the Slovak Republic.<sup>72</sup> Additional countries in which manufacturing as a share of GDP (on a real, inflation-adjusted basis) increased from 2000 to 2008 include Estonia, Hungary, Poland, Slovenia, and Sweden. While some have argued that even China’s manufacturing economy has peaked or has begun to decline, China’s manufacturing employment actually rose by an astounding 11 million workers between 2002 and 2006, as the country created as many manufacturing jobs in four short years as exist in the United States.<sup>73</sup>



**Figure 7: Countries with Manufacturing as a Growing Share of GDP, 2000-2008<sup>74</sup>**

More broadly, Figure 8 shows that, from 1970 to 2008, German and Japanese shares of world manufacturing output held stable, while China’s share saw steep increases and the United States’ share experienced a sharp decline.



**Figure 8: Select Country Share of World Manufacturing Output, 1970-2008<sup>75</sup>**

That Japan and Germany have maintained their global manufacturing share (despite ups and downs) over this period, avoiding the precipitous decline the United States has experienced, shows that U.S. manufacturing decline was not inevitable. Indeed, deindustrialization of high-wage economies is not pre-ordained. The United States’ loss of manufacturing is not “normal” and is certainly not progressive.

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This highlights a key point that many miss. There is a major difference between restructuring and decline in a nation's manufacturing sector. Manufacturing restructuring is required (higher productivity and a shift from lower-wage sectors to higher-wage ones) for economic success. But decline is just decline. Germany restructured. It shed jobs in lower-wage manufacturing sectors and lower-skill jobs in all manufacturing sectors. But it made up for those losses with gains in higher-value-added sectors and jobs. In contrast, the United States restructured and declined.

As we demonstrated above, the loss of U.S. manufacturing output and jobs has not just been a story of high productivity leading to fewer jobs—as was the case with U.S. agriculture over the last century. It's been a story also of decline in output and competitiveness. This is why the decline of U.S. manufacturing merits a policy response. To call for a U.S. manufacturing strategy is not to call for the same kind of sectoral or occupational composition in manufacturing that the United States had twenty years ago. Obviously a nation's manufacturing sector evolves, just as the U.S. economy evolves. Rather, it's a call to restore the U.S. manufacturing sector to a competitive position in the global economy.

## **WHY THE UNITED STATES NEEDS A MANUFACTURING STRATEGY**

Beyond the vital importance of a robust manufacturing sector to a nation's economic health, there are three primary reasons why countries need a national manufacturing strategy:

- Other countries have strategies to support their manufacturing industries.
- Systemic market failures and externalities affect manufacturing activity.
- If a country loses key manufacturing sectors, it's unlikely to get them back.

### **Other Countries Have Strategies to Support Their Manufacturing Industries**

The United States must recognize that a significant reason for the erosion of its manufacturing sectors has been the result of strategies—whether fair or unfair under international trade law—on the part of foreign countries to shift U.S. manufacturing activity to their shores or grow their own in competition with ours.

#### **Many countries have put in place fair strategies to strengthen the competitiveness of their manufacturing sectors**

A number of countries—including Brazil, Canada, China, Germany, India, Singapore, South Africa, Russia, and the United Kingdom, among others—have articulated national manufacturing strategies, and the United States needs one as well if it wants to stay competitive with these countries.<sup>76</sup> Among other elements, countries' manufacturing strategies include measures such as:

- offering competitive tax environments including generous R&D tax credits;
- providing incentive packages, including tax breaks and credits, to attract internationally mobile capital investment;

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*Scores of countries are increasingly using measures—both fair and unfair—designed to promote the competitiveness of their manufacturing industries.*

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- increasing government R&D funding;
- supporting programs designed to enhance the productive and innovative capabilities of their small to medium enterprise (SME) and large manufacturers;
- facilitating technology transfer between university and industry;
- producing a highly educated, highly skilled workforce, including by investing directly in workforce manufacturing skills; and
- investing in physical and digital infrastructure such as wired and wireless broadband networks, smart electric grids, and intelligent transportation systems.

These types of policies and incentives all represent tough, fair, legitimate competition between nations to win advantage in key manufacturing industries.

#### Foreign competitors increasingly back their companies in international competition

It's important to understand that U.S. manufacturers aren't just competing against foreign manufacturers; they are increasingly competing against foreign manufacturers backed by the technology, economic, and political systems of their nations. As Greg Tassej explains, a key "underlying problem is that U.S. manufacturing firms are attempting to compete largely as independent entities against a growing number of national economies in Europe and Asia in which government, industry, and a broad infrastructure (technical, education, economic, and information) are evolving into increasingly effective technology-based ecosystems."<sup>77</sup> Or, as Wayne Johnson, Hewlett Packard's Director of Worldwide Strategic University Customer Relations, puts it, "We in the United States find ourselves in competition not only with individuals, companies, and private institutions, but also with governments and mixed government-private collaborations."<sup>78</sup>

As an example, consider advanced battery manufacturing. The Japanese government has identified advanced battery technology as a key driving force behind its competitiveness and views battery technology as an issue of "national survival."<sup>79</sup> As a result, it committed over ¥25 billion (\$275 million) in funding for lithium-ion battery research over the six-year period from 2007 to 2012 and has committed to a twenty-year advanced battery research program. Germany's government is providing a total of €1.1 billion (\$1.4 billion) over ten years to applied research on automotive electronics, Li-ion batteries, lightweight construction, and other automotive applications.<sup>80</sup> China's Innovation 2020 strategy intends to invest \$1.5 trillion over the next decade in seven areas that it considers to be strategic, including alternative fuel-based vehicles. Moreover, China has set a goal of becoming the world's largest manufacturer of Li-ion batteries sometime between 2015 and 2020.<sup>81</sup>

When China's, Germany's, Japan's, and Korea's governments are directly supporting their automotive sectors (and other strategic manufacturing industries) with hundreds of

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millions in research funding for the development of cutting-edge technologies like advanced batteries, it's increasingly difficult for American firms, not receiving such coordinated support, to simply "go out in the market" by themselves and compete against foreign rivals. Going forward, American manufacturing firms operating as independent entities will increasingly find themselves at a disadvantage in international markets against firms from countries backed by effective public-private partnerships.

Many foreign countries increasingly compete through unfair mercantilist practices. Unfortunately, a number of countries are supporting their manufacturers through unfair, mercantilist strategies that manipulate or violate the mutually established rules of international trade. In contrast to the fair practices described above, these countries' goals are not to increase the global supply of jobs and innovative activity, but rather to induce their shift from one nation to another. These countries accomplish this goal by using a broad range of unfair mercantilist practices, including:

- Currency manipulation;
- Standards manipulation;
- Intellectual property theft;
- Illegal mandates including the forced transfer of intellectual property or location of manufacturing production as a condition of receiving market access;
- Government procurement practices that exclude foreign competitors; and
- Abuse of regulatory, anti-trust, or competition policies to the disadvantage of foreign competitors.<sup>82</sup>

These countries' mercantilist practices can be quite damaging to manufacturers in the United States. For example, trade analysts at the Peterson Institute for International Economics find that a wide range of countries, including China, Hong Kong, Malaysia, Singapore, Taiwan, South Korea, and even Switzerland, among others, intervene in currency markets and substantially undervalue their currencies against the dollar and other currencies.<sup>83</sup> Currency manipulation disadvantages manufacturing in the United States by making American products more expensive in foreign markets while making those countries' products cheaper in the United States.

Intellectual property theft is particularly damaging to U.S. manufacturing (and services) firms. According to the U.S. Commerce Department, theft of U.S. intellectual property is estimated to top \$250 billion annually and cost the United States approximately 750,000 jobs.<sup>84</sup> Gerwin and Kim find corruption to be a significant barrier to trade generally and to government procurement contracts in at least twenty-five of the top fifty-eight U.S. export markets.<sup>85</sup> And foreign countries' standards manipulation hurts U.S. firms because the cost of complying with country-specific technical standards can add as much as 10 percent to the cost of a product for manufacturers and in some cases keeps U.S. firms out of markets altogether.<sup>86</sup>

Foreign countries' mercantilist practices account to a significant degree for the decline in many U.S. manufacturing sectors, costing American jobs and having a damaging impact on American's standard of living. To stop the continued erosion of America's technology

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leadership, the federal government must make fighting countries' mercantilist practices a top priority, and this would be one objective of a national manufacturing strategy.

### **Systemic Market Failures and Externalities Affect Manufacturing Activity**

Another reason there's a role for public policy to support U.S. manufacturing is because there are a number of market failures and externalities surrounding manufacturing activity. One reason the high rates of product and process innovation in U.S. manufacturing sectors, as documented previously, are so important is that they generate spillover effects that benefit the entire economy. The knowledge needed to create new products, processes, and organizational forms cannot be contained completely within an individual firm. It inevitably spills over to other firms and individuals, who can use it without paying the costs of creating it. These types of spillovers are rampant in innovation, arising from product R&D, process R&D, technology adoption (particularly IT adoption), and the development of new business and organizational models.

#### **Companies underinvest in R&D and capital equipment to societally optimal levels because they can't capture all the benefits of their investments**

A plethora of studies have found that the rate of return to society from corporate R&D is at least twice the estimated returns that the company itself receives.<sup>87</sup> For example, Tewksbury et al. examined the rate of return from twenty prominent innovations and found a median private rate of return of 27 percent but a median social rate of return of a whopping 99 percent, almost four times higher.<sup>88</sup> And these spillovers are not confined to breakthrough products. There are also significant spillovers from process R&D (that is, the R&D conducted to help organizations produce things better). Ornaghi finds "statistically significant knowledge spillover associations for process and product innovation."<sup>89</sup> She finds that these "knowledge spillovers play an important role in improving the quality of products, and to a lesser extent, in increasing the productivity of the firm."<sup>90</sup> And at least one study finds that firms invest more in product R&D when they invest more in process R&D, meaning that spurring process R&D also spurs product R&D.<sup>91</sup>

Likewise, studies at the industry and firm levels have also found compelling evidence of capital equipment spillovers, particularly in information technology. Van Ark finds that the spillovers from investment in new capital equipment are larger than the size of the benefits accrued by the investing firm.<sup>92</sup>

But firms' inability to capture all the benefits of their own investments in R&D and new capital equipment means that, left on their own, they will produce much less innovation and productivity than is optimal for society. This is the key rationale for policies such as the R&D tax credit and accelerated depreciation of new equipment investments.<sup>93</sup>

#### **Market failures also plague the diffusion and adoption of cutting-edge technologies and best practices**

This is especially true for small to medium-sized enterprise (SME) manufacturers, because small firms simply lack the bandwidth that large ones have to stay abreast of the universe of emerging technologies and processes being constantly innovated around the globe.<sup>94</sup> This is why many countries, including Argentina, Canada, Germany, Japan, Spain, Sweden,

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*As a share of GDP, Japan invests 54 times more in its principal agency supporting the competitiveness of its small to medium-sized enterprise manufacturers.*

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Turkey, the United Kingdom, and the United States, among others, have agencies whose principal mission is to assist small firms in the adoption of proven technologies.

These types of investments can generate considerable societal returns, as federal and state investments in the U.S. Hollings Manufacturing Extension Partnership (MEP) program have shown. In fact, every \$1 of federal investment in MEP generates \$32 of return in economic growth, a total of \$3.6 billion in new sales nationally.<sup>95</sup> Moreover, client surveys indicate that MEP centers create or retain one manufacturing job for every \$1,570 of federal investment, one of the highest job growth returns of all federal funds.<sup>96</sup> At the same time, MEP centers are responsive to the needs of state, local, and commercial partners, as they must match federal investment two to one. However, despite the considerable societal returns MEP generates, it is underfunded compared to peer programs in other countries, many of which are putting significant resources into supporting the competitiveness of their SME manufacturers. For example, Japan invests \$2 billion annually in its Kohsetsuhsi Centers, which have the same remit as the MEP, meaning that Japan's government funds the Kohsetsuhsi Centers fifty-four times more as a percent of GDP than the United States funds MEP. Likewise, the U.K.'s Technology Strategy Board, Britain's counterpart to MEP, is funded at \$389.6 million annually, which is twenty times more than MEP funding as a percent of GDP.

### **If a Country Loses Key Manufacturing Sectors, It's Unlikely to Get Them Back**

A central reason why countries need a manufacturing strategy is that if they lose key industrial sectors of an economy, those sectors are likely to be gone for good. For example, if a country loses its aerospace or computer chip industries to foreign competitors, that value similarly disappears as the industry's supply chains, knowledge base, and industrial commons are hollowed out; the neoclassical economics assumption that residual assets will get redeployed to high-value-added sectors is not necessarily the case.

#### **Losing international competitions in knowledge-based industries means losing much more than just the firms and their output**

It means losing much of the value from these dispersed pieces of value now represented by unemployed workers and underutilized suppliers. Thus, for many parts of the U.S. economy exposed to international competition, if you lose it, you can't easily reuse it. In these cases, foreign high-value imports may end up substituting for the defunct domestic product. As Greg Tassej argues, "The central failure of current economic growth models is the assumption that shifts in relative prices will automatically elicit a Schumpeterian-type efficient reaction from domestic private markets—namely an adjustment involving development/assimilations of new technologies to replace offshored ones."<sup>97</sup>

Take the example of advanced aviation. If America were to lose a company like Boeing due to massive subsidies of Airbus by Europe and mercantilist Chinese policies, in all likelihood it could not rely on market forces, or even a dramatic drop in the dollar, to later recreate a domestic civilian aviation industry. To do so would require not only creating a new aircraft firm from scratch, but also the complex web of suppliers, professional associations, university programs in aviation engineering, and other knowledge-sharing organizations. With fewer aviation jobs, fewer students would become aeronautical engineers, making it

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difficult to rebuild capacity. If a country loses the intangible knowledge about how to build an airplane, it cannot easily reconstitute it without massive government subsidies.<sup>98</sup>

An increasing share of a nation's capital resides in intangible, knowledge-based capital, which does not get reallocated easily

According to the neoclassical economic model, if skilled workers lose their jobs, they are readily able to go out and secure ones of roughly equivalent pay. To take the Boeing example, the assumption is that anyone smart enough to be an aeronautical engineer is smart enough to find another high-skill, high-wage job. But the value-added per worker in the aviation industry is among the highest of any U.S. industry, at \$133,000 per year. In contrast, the value-added by the average U.S. job is \$103,000 per year. Imagine the introduction: "I'd like to apply for the hedge fund trading position. I'm an aeronautical engineer specializing in carbon-fiber wing design." In reality, the newly unemployed Boeing engineer would more likely apply for a retail clerk position, and make less than half of what she made before. So even if every Boeing worker and every worker at its suppliers obtain a new job, most of them would see a big cut in their wages and standard of living and the nation as a whole would be poorer. A national manufacturing strategy would help U.S. manufacturing industries stay on the cutting-edge of emerging technologies, help bolster their international competitiveness, and thereby help prevent these types of outcomes.

## WHAT WOULD A NATIONAL MANUFACTURING STRATEGY DO?

The goal of a national manufacturing strategy would be to create the most competitive environment for U.S. manufacturing firms, of all sizes, to flourish. It's critical to note that a national manufacturing strategy would not "pick winners and losers." A national manufacturing strategy would not constitute a de facto, heavy-handed industrial policy that for example picks Duracell to be the nation's advanced lithium-ion battery champion. Rather, it means designing the nation's business, regulatory, and innovation policy environments to make the United States the world's most attractive location for R&D and business investment in manufacturing (including foreign direct investment).

It would include a coherent set of policies based on the four T's: technology, tax, trade, and talent. It would seek to make the United States the most tax-friendly environment for business investment in the world by reducing effective corporate tax rates, including by increasing R&D tax credit generosity and reducing the effective tax rate on investments in new capital equipment. With regard to trade, it would ensure that the rights of U.S. manufacturing firms are protected in international markets and in international trade agreements while forging market opening to give U.S. manufacturers access to new markets. It would contemplate the skills needs of U.S. manufacturing firms and coordinate with educational providers to ensure that the U.S. workforce has the requisite skills to support world-leading manufacturing industries.

With regard to technology, a national manufacturing strategy would increase public investment in R&D in general and industrially relevant R&D in particular, supporting the programs designed to enhance the innovativeness and competitiveness of small and large U.S. manufacturers alike, including facilitating technology transfer from universities to

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*The goal of a national manufacturing strategy would be to create the most competitive environment for U.S. manufacturing firms, of all sizes, to flourish.*

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industry. And it means upgrading both physical infrastructure such as bridges, roads, rails, airports, pipelines, water systems, and energy storage facilities as well as digital infrastructure such as smart electric grids, intelligent transportation systems, and fixed and mobile broadband communications networks. In short, a national manufacturing strategy would support the infrastructure necessary for U.S. manufacturing firms to remain globally competitive.

An explicit goal of a U.S. national manufacturing strategy would be to support public-private partnerships designed to help strengthen the connection between research and commercialization and to help firms “bridge the gap” between transforming technologies developed in universities and federal laboratories into commercializable products. Transitioning these technologies from universities or federal laboratories can be quite difficult, especially for smaller firms with limited resources, which often need assistance with developing early-stage prototypes and designing products for scaled manufacturing. The strategy would also help ensure that emerging technologies and best operational practices are diffused and widely adopted by SME manufacturers throughout the United States.

Furthermore, a U.S. national manufacturing strategy would play an important role in aligning federal programs designed to assist U.S. manufacturers. A national manufacturing strategy would also coordinate state, local, and federal programs to maximize their combined impact. State and local governments and regional organizations are usually more closely tied to production processes and have long track records of working more closely and flexibly with firms, particularly small- and mid-sized manufacturing businesses.<sup>99</sup> In fact, since the 1980s, when the United States first began to face global competitiveness challenges, all states and many local governments and metropolitan business alliances have established technology-based economic development (TBED) programs and now invest about \$2 to \$3 billion per year on these activities. A more supportive federal engagement could help states coordinate their TBED activities across state lines, give them information on successful and unsuccessful practices, and encourage them to implement smart region-specific innovation strategies. The federal government could also engage directly with regional industry clusters, supporting their manufacturing firms, educational institutions, business alliances, and other regional institutions in providing the training, technological modernization, and other forms of assistance that cluster firms need if they are to innovate. For example, the Manufacturing Extension Partnership can play a role in this effort given its mission and its presence and partnerships in each state.

Export assistance would also be a primary goal of a U.S. national manufacturing strategy, building upon the Obama Administration’s National Export Initiative, which seeks to double U.S. exports to \$3.14 trillion by 2015.<sup>100</sup> The initiative identifies SMEs that can begin or expand exporting, prepares SMEs to export successfully by increasing training opportunities for both SMEs and SME counselors, connects SMEs to export opportunities by expanding access to programs and events that can unite U.S. sellers and foreign buyers, and improves SME awareness of export finance programs. Since its launch in 2009, the National Export Initiative has already delivered palpable results. For example, exports in

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the first six months of 2010 were 18 percent higher than over the comparable period in 2009.

Thus, another focus of a national manufacturing strategy would be to increase export support for U.S. manufacturers. To be sure, the United States has made some steps in the right direction, with the U.S. Export-Import Bank increasing its loan approvals by nearly 20 percent in FY 2010 compared to FY 2009. However, there is more work to be done, as the United States trails many competitors, including China, India, Brazil, Italy, France, Canada, and Germany in new medium- and long-term official export credit volumes as a share of GDP. In fact, China's Export-Import Bank provides seventeen times more financing to its exporters than the U.S. Ex-Im Bank does.<sup>101</sup>

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## CONCLUSION

Despite those who would dismiss it, the fact is that a vibrant manufacturing sector is vital to the health and competitiveness of the U.S. economy. Moreover, the conventional wisdom—which holds that U.S. manufacturing establishment and job losses simply reflect productivity-driven restructuring—is wrong. So are the fallacies that “manufacturing is in decline everywhere,” that “the United States has only lost low-wage, labor-intensive technology sectors and its high-tech, advanced technology product sectors aren’t at risk,” and that “a services-sector-only approach is sustainable because large economies no longer need strong manufacturing sectors.” The United States needs much more sophisticated thinking about the importance of manufacturing than simply to say, “we’ll be fine without it.” To restore the competitiveness of the U.S. manufacturing sector, a concerted national manufacturing strategy will be needed.

This will require a new understanding of the importance of U.S. manufacturing on the part of economists and policymakers alike. For economists, it will require a deeper understanding of the forces affecting U.S. manufacturing industries. However, before one can advocate to most economists for even the most modest government action to spur innovation, one first has to prove “market failure.” If someone has the temerity to argue that U.S. manufacturing has declined, the immediate response from most neoclassical economists is “the market produced this result, so it is beneficial.” If someone then proposes a solution—like a national manufacturing renewal strategy—economists reply, “show us the market failure!”

This is because, for most economists, unless there is evidence of monopoly or government barriers, market outcomes are by definition the right outcomes. Thus, any outcome is, by definition, the right outcome. The fact that the number of U.S. manufacturing jobs has declined by 34 percent over the last decade and that manufacturing’s share of GDP has declined means not that there is a crisis in need of action, but rather that market forces are working. Like Voltaire’s Dr. Pangloss, who proclaimed, “Tis demonstrated...the things cannot be otherwise; for, since everything is made for an end, everything is necessarily for the best end,” the United States’ Panglossian economists agree, virtually everything that happens in the market is for the best, even when there is ample evidence that what happens in markets is increasingly the result of foreign government’s actions—both fair and unfair—to influence global markets to their economies’ benefit.

For policymakers, current discussion in Washington is fixated on reducing budget deficits. While reducing budget deficits and putting government expenditures on a stable and sustainable footing is important, it is not the most urgent action policymakers should be taking at this moment to restore U.S. economic health. Rather, restoring the competitiveness, innovation, and productivity engine of the U.S. economy—in part by enacting a national manufacturing renewal strategy that includes the initiatives enumerated above—is the most important issue policymakers should be focused on. For only by restoring U.S. economic competitiveness can historic trade imbalances and high unemployment levels be expeditiously reduced and economic growth expanded to generate sufficient tax revenues to help ultimately balance the budget deficit.

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Finally, it's worth concluding by noting that survey research indicates that the vast majority of Americans believe the United States has lost its position as the world's strongest economy, in part by allowing its manufacturing base to whither and shift offshore. They want the federal government to help revitalize U.S. manufacturing, in part by "creating a national manufacturing strategy that leads to more jobs and a rebirth of manufacturing."<sup>102</sup> The Alliance for American Manufacturing commissioned a bi-partisan survey of 1,000 likely voters before the 2010 elections and found that 78 percent favor "a national manufacturing strategy aimed at getting economic, tax, labor, and trade policies working together," and 90 percent want some action to revitalize manufacturing. Fifty-seven percent of respondents judged manufacturing the "most important" ingredient of U.S. economic strength and 66 percent rejected the view that other sectors like services can entirely replace manufacturing.<sup>103</sup>

The American public gets it; it's time that economists and policymakers do so as well. It's time for Congress to craft, pass, and fully fund, and for the President to sign and implement, a comprehensive national manufacturing renewal strategy for the United States.

**APPENDIX A: YEAR OF PEAK CAPITAL STOCK BY MANUFACTURING INDUSTRY AND LEVEL OF DECLINE TO 2009<sup>104</sup>**

INDUSTRY	YEAR OF PEAK CAPITAL STOCK	DECLINE TO 2009
Primary metals	1981	-27%
Paper products	1996	-19%
Textile mills and textile product mills	1997	-29%
Wood products	2000	-6%
Food, beverage, and tobacco products	2000	-2%
Apparel and leather and allied products	2001	-21%
Computer and electronic products	2001	-1%
Electrical equipment, appliances, and components	2002	-5%
Plastics and rubber products	2002	-3%
Motor vehicles, bodies and trailers, and parts	2003	-7%
Furniture and related products	2007	-4%
Nonmetallic mineral products	2007	-2%
Printing and related support activities	2007	-2%
Wholesale trade	2008	-3%
Retail trade	2008	-1%
Miscellaneous manufacturing	2008	-1%

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